AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY, PAIYANOOR

&

VINAYAKA MISSION'S KIRUPANANDA VARIYAR ENGINEERING COLLEGE, SALEM

(Constituent Colleges of Vinayaka Mission's Research Foundation Deemed to be University)

AICTE APPROVED & NAAC Accredited

VINAYAKA MISSION'S RESEARCH FOUNDATION

(Deemed to be University under section 3 of the UGC Act 1956)

Faculty of Engineering and Technology

Department of Mechanical Engineering

Programme : B.E/B.Tech - Mechanical Engineering

Full Time (4 Years)

STRUCTURED CHOICE BASED CREDIT SYSTEM (SCBCS)

Curriculum & Syllabus

(Semester I to VIII)

Regulations 2017

AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY, PAIYANOOR, CHENNAI

&

VINAYAKA MISSION'S KIRUPANANDA VARIYAR ENGINEERING COLLEGE, SALEM

Department of Mechanical Engineering

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO.1. Design, analyze & fabricate, maintain and improve mechanical engineering systems that are technically sound, economically feasible and socially acceptable to enhance quality of life.

PEO.2. Apply modern computational, analytical, simulation tools and techniques to address the challenges faced in mechanical and allied engineering streams.

PEO.3. Communicate effectively using innovative tools and demonstrate leadership & entrepreneurial skills.

PEO.4. Exhibit professionalism, ethical attitude, team spirit and pursue lifelong learning to achieve career and organizational goals.

PROGRAM SPECIFIC OUTCOMES (PSOs)

To achieve the mission of the program, Mechanical Engineering graduates will be able:

PSO1. To work independently as well as in team to formulate, design, execute solutions for engineering problems and also analyze, synthesize technical data for application to product, process, system design & development

PSO2. To understand & contribute towards social, environmental issues, following professional ethics and codes of conduct and embrace lifelong learning for continuous improvement

PSO3. To develop expertise towards use of modern engineering tools, careers in industries and research and demonstrate entrepreneurial skill

PROGRAM OUTCOMES (POs) OR GRADUATE ATTRIBUTES

On completion of program of engineering, graduates will be able to:

Sl. No.	Outcome	Level of Outcome	Description
PO 1	**Engineering knowledge**	Apply	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**	Apply	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions**	Apply	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems**	Apply	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage**	Create	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO 6	**The engineer and society**	Evaluate	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability**	Analyze	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics**	Evaluate	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work**	Analyze	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10	**Communication**	Evaluate	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance**	Create	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**	Create	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Credit Requirement for Course Categories

Sl. No.	Category of Courses	Credits
01	**A. Foundation Courses (FC)**	**54 - 63**
	i. Humanities and Sciences (English and Management Subjects)	12 – 21
	ii. Basic Sciences (Maths, Physics and Chemistry Subjects)	24 – 33
	iii. Engineering Sciences (Basic Engineering Courses)	18 - 27
02	**B. Core courses (CC) relevant to the chosen programme of study.**	**81**
03	**C. Elective Courses (EC)**	**18 - 27**
	i. Programme Specific (Class Room or Online)	12 – 15
	ii. Open (Class Room or Online)	6 - 9
04	**D. Project + Internship + Industry Electives (P + I + I)**	**18**
	i. Project	9
	ii. Internship / Industry Supported Courses	9
05	**E. Employability Enhancement Courses + Co - Curricular Courses + Extra Curricular Courses (EEC)****	**9 - 18**
	Minimum Credits to be earned	**180**

**** - Mandatory, Credits would be mentioned in Mark sheets but not included for CGPA Calculations.**

B.E/B.TECH. – MECHANICAL ENGINEERING - SEMESTER I TO VIII									
CATEGORY A – FOUNDATION COURSES - HSS, BS AND ES COURSES - CREDITS (54-63)									
(i) HUMANITIES AND SCIENCES (ENGLISH AND MANAGEMENT SUBJECTS) - CREDITS (12 - 21)									
S.No	**CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1	17EGHS01	TECHNICAL ENGLISH	ENGLISH	FC (HSS)	3	0	0	3	NIL
2	17EGHS02	BUSINESS ENGLISH	ENGLISH	FC (HSS)	3	0	0	3	NIL
3	17YMHS82	YOGA AND MEDITATION	PHYSICAL EDUCATION	FC (HSS)	0	0	4	2	NIL
4	17EGHS81	ENGLISH LANGUAGE LAB	ENGLISH	FC (HSS)	0	0	4	2	NIL
5	17MBHS04	TOTAL QUALITY MANAGEMENT	MANAGEMENT	FC (HSS)	3	0	0	3	NIL
6	17MBHS01	ENGINEERING STARTUPS AND ENTREPRENEURIAL MANAGEMENT	MANAGEMENT	FC (HSS)	3	0	0	3	NIL
7	17MBHS07	PROFESSIONAL ETHICS AND HUMAN VALUES	MANAGEMENT	FC (HSS)	3	0	0	3	NIL
8	17MBHS08	PROJECT MANAGEMENT FOR ENGINEERING BUSINESS AND TECHNOLOGY	MANAGEMENT	FC (HSS)	3	0	0	3	NIL
9	17MBHS09	INTELLECTUAL PROPERTY RIGHTS & ALTERNATE DISPUTES RESOLUTIONS	MANAGEMENT	FC (HSS)	3	0	0	3	NIL
(ii) BASIC SCIENCES (MATHS, PHYSICS AND CHEMISTRY SUBJECTS) - CREDITS (24 - 33)									
S.No	**CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1	17MABS01	ENGINEERING MATHEMATICS	MATHEMATICS	FC (BS)	2	2	0	3	NIL
2	17PCBS02	PHYSICAL SCIENCES	PHYSICS/CHEMISTRY	FC (BS)	4	0	0	4	NIL
3	17PHBS05	SMART MATERIALS	PHYSICS	FC (BS)	3	0	0	3	NIL

4	17CHBS01	ENVIRONMENTAL SCIENCE AND ENGINEERING	CHEMISTRY	FC (BS)	3	0	0	3	NIL
5	17PCBS81	PHYSICAL SCIENCES LAB	PHYSICS/CHEMISTRY	FC (BS)	0	0	4	2	NIL
6	17CHBS04	INDUSTRIAL MATERIALS	CHEMISTRY	FC (BS)	3	0	0	3	NIL
7	17MABS04	MATHEMATICS FOR MECHANICAL SCIENCES	MATHEMATICS	FC (BS)	2	2	0	3	ENGINEERING MATHEMATICS
8	17MABS11	NUMERICAL METHODS FOR MECHANICAL SCIENCES	MATHEMATICS	FC (BS)	3	2	0	3	MATHEMATICS FOR MECHANICAL SCIENCES
9	17MABS21	RESOURCE MANAGEMENT TECHNIQUE	MATHEMATICS	FC (BS)	2	2	0	3	NIL
10	17MABS20	PROBABILITY AND STATISTICS	MATHEMATICS	FC (BS)	2	2	0	3	NIL
11	17PHBS06	ENERGY PHYSICS	PHYSICS	FC (BS)	3	0	0	3	NIL
12	17PHBS07	SPACE SCIENCE	PHYSICS	FC (BS)	3	0	0	3	NIL
13	17PHBS08	FUNDAMENTALS OF NANO SCIENCE	PHYSICS	FC (BS)	3	0	0	3	NIL

(iii) ENGINEERING SCIENCES - CREDITS (18 - 27)

S.No	CODE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1	17CSES01	ESSENTIALS OF COMPUTING	CSE	FC(ES)	2	0	2	3	NIL
2	17CMES02	BASICS OF CIVIL AND MECHANICAL ENGINEERING	CIVIL/MECHANICAL	FC(ES)	4	0	0	4	NIL
3	17CSES05	PROGRAMMING IN PYTHON	CSE	FC(ES)	3	0	0	3	NIL
4	17EEES03	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	EEE/ECE	FC(ES)	4	0	0	4	NIL
5	17CMES81	ENGINEERING SKILLS PRACTICES LAB A-BASIC CIVIL ENGINEERING B-BASIC MECHANICAL ENGINEERING	MECHANICAL	FC(ES)	0	0	4	2	NIL
6	17CSES83	PROGRAMMING IN PYTHON LAB	CSE	FC(ES)	0	0	4	2	NIL

7	17EEES82	ENGINEERING SKILLS PRACTICES LAB A-BASIC ELECTRICAL ENGINEERING B-BASIC ELECTRONICS ENGINEERING	EEE/ECE	FC(ES)	0	0	4	2	NIL
8	17MEES84	ENGINEERING GRAPHICS (THEORY & PRACTICE)	MECHANICAL	FC(ES)	1	0	4	3	NIL

B.E/B.TECH. – MECHANICAL ENGINEERING - SEMESTER I TO VIII									
CATEGORY B – CORE COURSES RELEVANT TO THE PROGRAMME - CREDITS (81)									
S.No	CODE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1	17MECC01	BASIC MANUFACTURING PROCESS	MECH	CC	3	0	0	3	NIL
2	17MECC02	ENGINEERING THERMODYNAMICS	MECH	CC	2	1	0	3	NIL
3	17MECC03	ENGINEERING MECHANICS	MECH	CC	2	1	0	3	NIL
4	17CVCC34	FLUID MECHANICS AND MACHINERY	CIVIL	CC	3	0	0	3	NIL
5	17CVCC33	STRENGTH OF MATERIALS	CIVIL	CC	3	0	0	3	ENGINEERING MECHANICS
6	17MECC04	MANUFACTURING TECHNOLOGY	MECH	CC	3	0	0	3	NIL
7	17MECC05	MECHANICAL BEHAVIOUR OF MATERIALS AND METALLURGY	MECH	CC	3	0	0	3	NIL
8	17MECC06	KINEMATICS OF MACHINES	MECH	CC	3	0	0	3	ENGINEERING MECHANICS
9	17MECC07	THERMAL ENGINEERING	MECH	CC	2	1	0	3	ENGINEERING THERMODYNAMICS
10	17MECC08	DYNAMICS OF MACHINES	MECH	CC	2	1	0	3	KINEMATICS OF MACHINES
11	17MECC09	DESIGN OF MACHINE ELEMENTS	MECH	CC	2	1	0	3	STRENGTH OF MATERIALS
12	17MECC10	ENGINEERING METROLOGY AND MEASUREMENTS	MECH	CC	3	0	0	3	NIL
13	17MECC11	GAS DYNAMICS AND JET PROPULSION	MECH	CC	2	1	0	3	ENGINEERING THERMODYNAMICS
14	17MECC12	COMPUTER INTEGRATED MANUFACTURING	MECH	CC	3	0	0	3	NIL
15	17MECC13	DESIGN OF TRANSMISSION SYSTEMS	MECH	CC	2	1	0	3	DESIGN OF MACHINE ELEMENTS
16	17MECC14	HEAT AND MASS TRANSFER	MECH	CC	2	1	0	3	ENGINEERING THERMODYNAMICS

17	17MECC15	FINITE ELEMENT ANALYSIS	MECH	CC	2	1	0	3	STRENGTH OF MATERIALS
18	17MECC16	INDUSTRIAL AUTOMATION	MECH	CC	3	0	0	3	NIL
19	17MECC17	AUTOMOTIVE ENGINEERING	MECH	CC	3	0	0	3	NIL
20	17MECC81	MANUFACTURING PROCESS LAB	MECH	CC	0	0	4	2	NIL
21	17MECC82	MACHINE DRAWING LAB	MECH	CC	1	0	4	2	NIL
22	17MECC83	MANUFACTURING TECHNOLOGY LAB	MECH	CC	0	0	4	2	NIL
23	17MECC84	METALLURGY LAB	MECH	CC	0	0	4	2	NIL
24	17MECC85	ENGINE TESTING LAB	MECH	CC	0	0	4	2	NIL
25	17CVCC93	HYDRAULICS AND STRENGTH OF MATERIALS LAB	CIVIL	CC	0	0	4	2	NIL
26	17MECC86	DYNAMICS & METROLOGY LAB	MECH	CC	0	0	4	2	NIL
27	17MECC87	AUTOMOBILE ENGINEERING LAB	MECH	CC	0	0	4	2	NIL
28	17MECC88	COMPUTER INTEGRATED MANUFACTURING LAB	MECH	CC	0	0	4	2	NIL
29	17MECC89	HEAT TRANSFER LAB	MECH	CC	0	0	4	2	NIL
30	17MECC90	FINITE ELEMENT ANALYSIS LAB	MECH	CC	0	0	4	2	NIL
31	17MECC91	INDUSTRIAL AUTOMATION LAB	MECH	CC	0	0	4	2	NIL
32	17MECC18	MANUFACTURING ENGINEERING	MECH	CC	3	0	0	3	NIL
33	17MECC19	MACHANICS OF MACHINES	MECH	CC	3	0	0	3	NIL
34	17MECC92	DYNAMICS LAB	MECH	CC	0	0	4	2	NIL
35	17MECC93	HYDRAULICS AND PNEUMATIC SYSTEMS LAB	MECH	CC	0	0	4	2	NIL
36	17MECC94	MANUFACTURING ENGINEERING LAB	MECH	CC	0	0	4	2	NIL

B.E/B.TECH. – MECHANICAL ENGINEERING - SEMESTER I TO VIII
DETAILS OF ELECTIVE COURSES FOR DEGREE WITH SPECIALISATION

CATEGORY C – ELECTIVE COURSES - CREDITS (18 - 27)

(i) PROGRAMME SPECIFIC (CLASS ROOM OR ONLINE) - CREDITS (12 - 15)

S.No	CODE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
SPECIALISATION – AERONAUTICAL ENGINEERING									
1	17ARSE43	AERODYNAMICS	AERO	EC - SE	3	0	0	3	NIL
2	17ARSE44	AEROSPACE PROPULSION	AERO	EC - SE	3	0	0	3	NIL
3	17ARSE45	AIRCRAFT STRUCTURES	AERO	EC - SE	3	0	0	3	NIL
4	17ARCC09	AIRCRAFT PERFORMANCE STABILITY AND CONTROL	AERO	EC - SE	3	0	0	3	NIL
5	17ARCC10	AIRCRAFT MATERIALS AND PROCESSES	AERO	EC - SE	3	0	0	3	NIL
6	17ARSE34	AIRCRAFT GENERAL ENGINEERING AND MAINTENANCE PRACTICES	AERO	EC - SE	3	0	0	3	NIL
7	17ARSE41	AIRCRAFT STRUCTURES LAB	AERO	EC - SE	0	0	4	2	NIL
8	17ARSE42	AERO ENGINE LAB	AERO	EC - SE	0	0	4	2	NIL
9	17ARCC83	AERO SPACE PROPLUSION LAB	AERO	EC - SE	0	0	4	2	NIL
10	17ARCC84	AERODYNAMICS LAB	AERO	EC - SE	0	0	4	2	NIL
SPECIALISATION – AUTOMOTIVE ENGINEERING									
11	17ATCC03	AUTOMOTIVE CHASSIS	AUTO	EC - SE	3	0	0	3	NIL
12	17ATEC15	VEHICLE TRANSPORT MANAGEMENT	AUTO	EC - SE	3	0	0	3	NIL
13	17ATCC13	ENGINE AND VEHICLE MANAGEMENT SYSTEM	AUTO	EC - SE	3	0	0	3	NIL

14	17ATCC14	VEHICLE MAINTENANCE	AUTO	EC - SE	3	0	0	3	NIL
15	17ATCC04	AUTOMOTIVE ELECTRICAL AND ELECTRONIC SYSTEMS	AUTO	EC - SE	3	0	0	3	NIL
16	17ATEC04	SPECIAL TYPES OF VEHICLES	AUTO	EC - SE	3	0	0	3	NIL
17	17ATCC08	AUTOMOTIVE POLLUTION CONTROL	AUTO	EC - SE	3	0	0	3	NIL
18	17ATCC17	TWO AND THREE WHEELER TECHNOLOGY	AUTO	EC - SE	3	0	0	3	NIL
19	17ATCC82	AUTOMOTIVE CHASSIS LAB	AUTO	EC - SE	0	0	4	2	NIL
20	17ATCC89	VEHICLE MAINTENANCE AND SERVICING LAB	AUTO	EC - SE	0	0	4	2	NIL
21	17ATCC88	TWO AND THREE WHEELER LAB	AUTO	EC - SE	0	0	4	2	NIL
22	17ATCC83	AUTOMOTIVE ELECTRICAL AND ELECTRONICS LAB	AUTO	EC - SE	0	0	4	2	NIL
SPECIALISATION – ENERGY ENGINEERING									
23	17MESE01	ENERGY CONSERVATION IN THERMAL SYSTEMS	MECHANICAL	EC - SE	3	0	0	3	NIL
24	17MESE02	ENERGY CONSERVATION AND MANAGEMENT	MECHANICAL	EC - SE	3	0	0	3	NIL
25	17MESE03	HYDROGEN AND FUEL CELL TECHNOLOGY	MECHANICAL	EC - SE	3	0	0	3	NIL
26	17MESE04	RENEWABLE SOURCES OF ENERGY	MECHANICAL	EC - SE	3	0	0	3	NIL
27	17MESE05	WASTE ENERGY CONVERSION TECHNOLOGIES	MECHANICAL	EC - SE	3	0	0	3	NIL
28	17MESE06	BIO ENERGY TECHNOLOGY	MECHANICAL	EC - SE	3	0	0	3	NIL
29	17MESE07	NUCLEAR POWER ENGINEERING	MECHANICAL	EC - SE	3	0	0	3	NIL
30	17MESE81	ENERGY LAB	MECHANICAL	EC - SE	0	0	4	2	NIL

31	17MESE82	ALTERNATE FUEL TESTING LAB	MECHANICAL	EC - SE	0	0	4	2	NIL
SPECIALIZATION – PRODUCT LIFE CYCLE									
32	17MESE08	PRODUCT DESIGN AND DEVELOPMENT	MECHANICAL	EC - PS	3	0	0	3	NIL
33	17MESE09	NEW PRODUCT DEVELOPMENT	MECHANICAL	EC - PS	3	0	0	3	NIL
34	17MESE10	DESIGN FOR MANUFACTURING AND ASSEMBLY	MECHANICAL	EC - PS	3	0	0	3	NIL
35	17MESE11	FAILURE MODE AND EFFECTS ANALYSIS	MECHANICAL	EC - PS	3	0	0	3	NIL
36	17MESE12	PRODUCT LIFE CYCLE MANAGEMENT	MECHANICAL	EC - PS	3	0	0	3	NIL
37	17MESE13	GEOMETRIC MODELING	MECHANICAL	EC - PS	3	0	0	3	NIL
38	17MESE14	REVERSE ENGINEERING	MECHANICAL	EC - PS	3	0	0	3	NIL
39	17MESE15	SUPPLY CHAIN MANAGEMENT	MECHANICAL	EC - PS	3	0	0	3	NIL
SPECIALIZATION – MANUFACTURING ENGINEERING									
40	17MESE16	INDUSTRIAL TRIBOLOGY	MECHANICAL	EC - PS	3	0	0	3	NIL
41	17MESE17	MODERN MANUFACTURING METHODS	MECHANICAL	EC - PS	3	0	0	3	NIL
42	17MESE18	METAL FORMING AND JOINING PROCESS	MECHANICAL	EC - PS	3	0	0	3	NIL
43	17MESE19	PROCESS PLANNING AND COST ESTIMATION	MECHANICAL	EC - PS	3	0	0	3	NIL
44	17MESE20	RAPID PROTOTYPING AND TOOLING	MECHANICAL	EC - PS	3	0	0	3	NIL
45	17MESE21	IRON AND STEEL MAKING	MECHANICAL	EC - PS	3	0	0	3	NIL
46	17MESE22	AUTOMOTIVE INFOTRONICS	MECHANICAL	EC - PS	3	0	0	3	NIL
47	17MESE23	MICRO AND NANO MACHINING	MECHANICAL	EC - PS	3	0	0	3	NIL

SPECIALIZATION – THERMAL ENGINEERING									
48	17MESE24	COMBUSTION ENGINEERING	MECHANICAL	EC - PS	3	0	0	3	ENGINEERING THERMODYNAMICS
49	17MESE25	COMPUTATIONAL FLUID DYNAMICS	MECHANICAL	EC - PS	3	0	0	3	ENGINEERING THERMODYNAMICS FLUID MECHANICS AND MACHINERY
50	17MESE26	CRYOGENIC ENGINEERING	MECHANICAL	EC - PS	3	0	0	3	ENGINEERING THERMODYNAMICS
51	17MESE27	POWER PLANT ENGINEERING	MECHANICAL	EC - PS	3	0	0	3	THERMAL ENGINEERING
52	17MESE28	REFRIGERATION AND AIR-CONDITIONING	MECHANICAL	EC - PS	3	0	0	3	NIL
53	17MESE29	TURBOMACHINERY	MECHANICAL	EC - PS	3	0	0	3	ENGINEERING THERMODYNAMICS FLUID MECHANICS AND MACHINERY
54	17MESE30	DESIGN OF THERMAL POWER EQUIPMENTS	MECHANICAL	EC - PS	3	0	0	3	NIL
55	17MESE31	ADVANCED CERAMIC TECHNOLOGY	MECHANICAL	EC - PS	3	0	0	3	NIL
SPECIALIZATION – MATERIALS ENGINEERING									
56	17MESE32	COMPOSITE MATERIALS	MECHANICAL	EC - PS	3	0	0	3	NIL
57	17MESE33	EMERGING MATERIALS	MECHANICAL	EC - PS	3	0	0	3	NIL
58	17MESE34	FAILURE ANALYSIS OF MATERIALS	MECHANICAL	EC - PS	3	0	0	3	NIL
59	17MESE35	NANOSTRUCTURED MATERIALS AND APPLICATIONS	MECHANICAL	EC - PS	3	0	0	3	NIL
60	17MESE36	STRUCTURAL PROPERTY OF ENGINEERING MATERIALS	MECHANICAL	EC - PS	3	0	0	3	NIL
61	17MESE37	THEORIES OF ELASTICITY	MECHANICAL	EC - PS	3	0	0	3	NIL
SPECIALIZATION – INDUSTRIAL ENGINEERING									

62	17MESE38	INDUSTRIAL ENGINEERING	MECHANICAL	EC - PS	3	0	0	3	NIL
63	17MESE39	LEAN MANUFACTURING SYSTEMS	MECHANICAL	EC - PS	3	0	0	3	NIL
64	17MESE40	INSPECTION AND STATISTICAL QUALITY CONTROL	MECHANICAL	EC - PS	3	0	0	3	NIL
65	17MESE41	MAINTENANCE MANAGEMENT	MECHANICAL	EC - PS	3	0	0	3	NIL
66	17MESE42	DESIGN FOR QUALITY	MECHANICAL	EC - PS	3	0	0	3	NIL
67	17MESE43	MANAGEMENT FOR ENGINEERS	MECHANICAL	EC - PS	3	0	0	3	NIL
68	17MESE44	SIX SIGMA QUALITY MANAGEMENT	MECHANICAL	EC - PS	3	0	0	3	NIL
69	17MESE45	STRATEGIC QUALITY MANAGEMENT	MECHANICAL	EC - PS	3	0	0	3	NIL
70	17MESE46	WORK DESIGN AND ERGONOMICS	MECHANICAL	EC - PS	3	0	0	3	NIL
GENERAL ELECTIVES									
71	17MEEC01	HYDRAULICS AND PNEUMATIC SYSTEMS	MECHANICAL	EC - PS	3	0	0	3	NIL
72	17MEEC02	FUNDAMENTALS OF PIPING ENGINEERING	MECHANICAL	EC - PS	3	0	0	3	NIL
73	17MEEC03	PETROLEUM PRODUCTION ENGINEERING	MECHANICAL	EC - PS	3	0	0	3	NIL
74	17MEEC04	AGRICULTURAL ENGINEERING EQUIPMENTS	MECHANICAL	EC - PS	3	0	0	3	NIL
75	17MEEC05	BIOMECHANICS	MECHANICAL	EC - PS	3	0	0	3	NIL
76	17MEEC06	MEMS & NEMS	MECHANICAL	EC - PS	3	0	0	3	NIL
77	17MEEC07	NAVAL ARCHITECTURE	MECHANICAL	EC - PS	3	0	0	3	NIL
78	17MEEC08	SHIP BUILDING	MECHANICAL	EC - PS	3	0	0	3	NIL
79	17MEEC09	MARINE AUXILIARY MACHINERY	MECHANICAL	EC - PS	3	0	0	3	NIL

80	17MEEC10	MARINE REFRIGERATION & AIR-CONDITIONING	MECHANICAL	EC - PS	3	0	0	3	NIL
81	17MEEC11	INDUSTRIAL ROBOTICS	MECHANICAL	EC - PS	3	0	0	3	NIL
82	17MEEC12	DESIGN OF EXPERIMENTS	MECHANICAL	EC - PS	3	0	0	3	NIL
83	17MEEC13	INDUSTRIAL SAFETY	MECHANICAL	EC - PS	3	0	0	3	NIL
84	17MEEC14	COMPUTATIONAL FLUID DYNAMICS	MECHANICAL	EC - PS	3	0	0	3	NIL
85	17MEEC15	CONCURRENT ENGINEERING	MECHANICAL	EC - PS	3	0	0	3	NIL
86	17MEEC16	FLUID POWER SYSTEMS	MECHANICAL	EC - PS	3	0	0	3	NIL
87	17MEEC17	ENGINEERING PRODUCT DESIGN	MECHANICAL	EC - PS	3	0	0	3	NIL
88	17MEEC18	ADVANCED IC ENGINES	MECHANICAL	EC - PS	3	0	0	3	ENGINEERING THERMODYNAMICS
89	17MEEC19	AUTOMOTIVE INFOTRONICS	MECHANICAL	EC - PS	3	0	0	3	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

B.E/B.TECH. – MECHANICAL ENGINEERING - SEMESTER I TO VIII DETAILS OF ELECTIVE COURSES FOR DEGREE WITH SPECIALISATION									
CATEGORY C – ELECTIVE COURSES - CREDITS (18 - 27)									
(ii) OPEN ELECTIVE (CLASS ROOM OR ONLINE) - CREDITS (6 - 9)									
S.No	CODE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1	17ATEC13	COMPUTER SIMULATION OF IC ENGINE PROCESSOR	AUTO	EC - OE	3	0	0	3	NIL
2	17ATEC14	COMPUTER CONTROLLED VEHICLE SYSTEMS	AUTO	EC - OE	3	0	0	3	NIL
3	17ATEC12	FUEL CELL TECHNOLOGY	AUTO	EC - OE	3	0	0	3	NIL
4	17ATEC03	MODERN AUTOMOBILE ACCESSORIES	AUTO	EC - OE	3	0	0	3	NIL
5	17ATEC02	NEW GENERATION AND HYBRID VEHICLES	AUTO	EC - OE	3	0	0	3	NIL
6	17ATEC05	POLYMER COMPONENTS AND RUBBER MATERIALS IN AUTOMOTIVE APPLICATIONS	AUTO	EC - OE	3	0	0	3	NIL
7	17ATEC17	VEHICLE AIR-CONDITIONING	AUTO	EC-PS	3	0	0	3	NIL
8	17AREC02	UNMANNED AIRCRAFT SYSTEMS	AERO	EC - OE	3	0	0	3	NIL
9	17ARSE21	ROCKETS AND MISSILES	AERO	EC - OE	3	0	0	3	NIL
10	17ARSE35	ADVANCED MATERIALS AND NDT FOR AEROSPACE APPLICATIONS	AERO	EC - OE	3	0	0	3	NIL
11	17ARSE36	AIRCRAFT MAINTENANCE AND REPAIR	AERO	EC - OE	3	0	0	3	NIL
12	17BTEC13	FOOD PROCESSING TECHNOLOGY	BIOTECH	EC - OE	3	0	0	3	NIL
13	17BTEC30	BIOFERTILIZER TECHNOLOGY	BIOTECH	EC - OE	3	0	0	3	NIL
14	17BTEC25	BIOLOGY FOR NON BIOLIGISTS	BIOTECH	EC - OE	3	0	0	3	NIL

15	17BTEC30	NATURAL RESOURCE MANAGEMENT	BIOTECH	EC - OE	3	0	0	3	NIL
16	17BTEC31	APPLICATION OF ENZYME IN WASTE MANAGEMENT	BIOTECH	EC - OE	3	0	0	3	NIL
17	17CVSE35	QUALITY CONTROL ASSURANCE IN REAL ESTATE	CIVIL	EC - OE	3	0	0	3	NIL
18	17CVSE42	GREEN AND ENERGY EFFICIENT BUILDING	CIVIL	EC - OE	3	0	0	3	NIL
19	17CVSE41	INFRASTRUCTURE PROJECT DEVELOPMENT	CIVIL	EC - OE	3	0	0	3	NIL
20	17CVSE28	URBAN TRANSPORTATION INFRASTRUCTURE-PLANNING AND DESIGN	CIVIL	EC - OE	3	0	0	3	NIL
21	17EECC14	ELECTRICAL MACHINES AND DRIVES	EEE	EC - OE	3	0	0	3	NIL
22	17EECC04	MEASUREMENTS AND INSTRUMENTATION	EEE	EC - OE	3	0	0	3	NIL
23	17EECC16	POWER ELECTRONICS AND DRIVES	EEE	EC - OE	3	0	0	3	NIL
24	17ECCC07	MICROCONTROLLER AND ITS APPLICATIONS	ECE	EC - OE	3	0	0	3	NIL
25	17ECCC18	INTERNET OF THINGS FOR ELECTRONICS	ECE	EC - OE	3	0	0	3	NIL
26	17ECPE06	MEMS AND SENSORS	ECE	EC - OE	3	0	0	3	NIL
27	17BMSE11	BIOMECHANICS	BME	EC - OE	3	0	0	3	NIL
28	17BMSE13	BIOMATERIALS AND ARTIFICIAL ORGANS	BME	EC - OE	3	0	0	3	NIL
29	17BMSE16	ROBOTICS AND AUTOMATION IN MEDICINE	BME	EC - OE	3	0	0	3	NIL
30	17BMSE18	CRITICAL CARE INSTRUMENTS AND THERAPEUTIC EQUIPMENT	BME	EC - OE	3	0	0	3	NIL
31	17CSEC09	ETHICAL HACKING	CSE	EC - OE	3	0	0	3	NIL
32	17CSEC11	GREEN COMPUTING	CSE	EC - OE	3	0	0	3	NIL

33	17CSEC24	OPEN SOURCE SYSTEMS	CSE	EC - OE	3	0	0	3	NIL
34	17CSEC32	VIRTUAL REALITY	CSE	EC - OE	3	0	0	3	NIL
35	17CSEC30	UNIX INTERNALS	CSE	EC - OE	3	0	0	3	NIL

B.E/B.TECH. – MECHANICAL ENGINEERING - SEMESTER I TO VIII									
CATEGORY D – PROJECT + INTERNSHIP + INDUSTRY ELECTIVES (P + I + I)- CREDITS (18)									
(i) PROJECT - CREDITS (9)									
(i) INTERNSHIP + INDUSTRY ELECTIVES - CREDITS (9)									
S.No	**CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1	17MEPI01	PROJECT WORK	MECHANICAL	PI	0	0	18	9	NIL
2	17MEPI02	INTERNSHIP	MECHANICAL	PI				3	NIL
3	17MEPI03	NOISE VIBRATION AND HARSHNESS	MECHANICAL	PI	2	1	0	3	NIL
4	17MEPI04	NON DESTRUCTIVE TESTING	MECHANICAL	PI	3	0	0	3	NIL
5	17MEPI05	COAL MINING ND MECHANIZATION	MECHANICAL	PI	3	0	0	3	NIL
6	17ARIE03	INTRODUCTION TO AIRCRAFT INDUSTRY AND AIRCRAFT SYSTEMS	AERO	PI	3	0	0	3	NIL
7	17ARIE04	DESIGN OF AIRCRAFT STRUCTURES	AERO	PI	3	0	0	3	NIL

B.E/B.TECH. – MECHANICAL ENGINEERING - SEMESTER I TO VIII									
CATEGORY E – EMPLOYABILITY ENHANCEMENT COURSES, CO - CURRICULAR COURSES AND EXTRA CURRICULAR COURSES (EEC)** - CREDITS (9 - 18) (** - MANDATORY, CREDITS WOULD BE MENTIONED IN MARK SHEETS BUT NOT INCLUDED FOR CGPA CALCULATIONS.)									
S.No	**CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
EMPLOYABILITY ENHANCEMENT COURSES (EEC)									
1	17MEEE01	CNC PROGRAMMING (HANDS ON TRAINING)	MECHANICAL	EEC	0	0	4	2	NIL
2	17MEEE02	DESIGN AND FABRICATION OF FIBRE REINFORCED COMPOSITES (HANDS ON TRAINING)	MECHANICAL	EEC	0	0	4	2	NIL
3	17MEEE03	STRUCTURAL AND THERMAL ANALYSIS – ANSYS (HANDS ON TRAINING)	MECHANICAL	EEC	0	0	4	2	NIL
4	17ATEE02	TWO AND FOUR WHEELER SERVICING (HANDS ON TRAINING)	MECHANICAL	EEC	0	0	4	2	NIL
CO - CURRICULAR COURSES									
1	17NCEE01	NCC	NCC	HSS	0	0	4	2	NIL
2	17NSEE01	NSS	NSS	HSS	0	0	4	2	NIL
3	17PEEE01	PHYSICAL EDUCATION	PHYSICAL EDUCATION	HSS	0	0	4	2	NIL
EXTRA CURRICULAR COURSES									
1		MOOC – ONLINE COURSES							
2		SOFT SKILLS TRAINING							

AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY, CHENNAI
&
VINAYAKA MISSION'S KIRUPANANDA VARIYAR ENGINEERING COLLEGE, SALEM

FACULTY OF ENGINEERING AND TECHNOLOGY

STRUCTURED CHOICE BASED CREDIT SYSTEM

BOARD : MECHANICAL ENGINEERING
REGULATION : 2017
PROGRAM : B.E/B.Tech., – MECHANICAL ENGINEERING (FULL TIME-REGULAR)

CURRICULUM AND SYLLABUS

SEMESTER – I								
S.NO	**COURSE CODE**	**COURSE TITLE**	**OFFERING DEPARTMENT**	**CATEGORY**	**L**	**T**	**P**	**C**
THEORY								
1	17EGHS01	TECHNICAL ENGLISH	ENGLISH	FC(HSS)	3	0	0	**3**
2	17MABS01	ENGINEERING MATHEMATICS	MATHEMATICS	FC(BS)	2	2	0	**3**
3	17PCBS02	PHYSICAL SCIENCES	PHYSICS / CHEMISTRY	FC(BS)	4	0	0	**4**
4	17CSES01	ESSENTIALS OF COMPUTING	CSE	FC(ES)	2	0	2	**3**
5	17CMES02	BASICS OF CIVIL AND MECHANICAL ENGINEERING	CIVIL / MECHANICAL	FC(ES)	4	0	0	**4**
PRACTICAL								
6	17EGHS81	ENGLISH LANGUAGE LAB	ENGLISH	FC(HSS)	0	0	4	**2**
7	17PCBS81	PHYSICAL SCIENCES LAB	PHYSICS / CHEMISTRY	FC(BS)	0	0	4	**2**
8	17CMES81	ENGINEERING SKILLS PRACTICE LAB BASIC CIVIL ENGINEERING BASIC MECHANICAL ENGINEERING	CIVIL / MECHANICAL	FC(ES)	0	0	4	**2**
9	17YMHS82	YOGA & MEDITATION	PHYSICAL EDUCATION	FC(HSS)	0	0	4	**2**
TOTAL					**15**	**2**	**18**	**25**
L –LECTURE HOUR		T –TUTORIAL HOUR	P – PRACTICAL HOUR		C –CREDIT			

HSS	HUMANITIES AND SOCIAL SCIENCES	CC	CORE COURSES
BS	BASIC SCIENCES	EC	ELECTIVE COURSES
ES	ENGINEERING SCIENCES	EEC	EMPLOYABILITY ENHANCEMENT COURSES + EXTRA CURRICULAR COURSES + CO - CURRICULAR COURSES
PII	PROJECT + INTERNSHIP + INDUSTRY ELECTIVES		

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FACULTY OF ENGINEERING AND TECHNOLOGY

STRUCTURE CHOICE BASED CREDIT SYSTEM

BOARD : MECHANICAL ENGINEERING
REGULATION : 2017
PROGRAM : B.Tech., – MECHANICAL ENGINEERING (FULL TIME-REGULAR)

CURRICULUM AND SYLLABUS

SEMESTER – II								
S.NO	**COURSE CODE**	**COURSE TITLE**	**OFFERING DEPARTMENT**	**CATEGORY**	**L**	**T**	**P**	**C**
		THEORY						
1	17MABS04	MATHEMATICS FOR MECHANICAL SCIENCES	MATHEMATICS	FC(BS)	2	2	0	**3**
2	17CSES05	PROGRAMMING IN PYTHON	CSE	FC(ES)	3	0	0	**3**
3	17MECC01	BASIC MANUFACTURING PROCESS	MECHANICAL	CC	3	0	0	**3**
4	17PHBS05	SMART MATERIALS	PHYSICS	FC(BS)	3	0	0	**3**
5	17EEES03	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	EEE & ECE	FC(ES)	4	0	0	**4**
		PRACTICAL						
6	17CSES83	PROGRAMMING IN PYTHON LAB	CSE	FC(ES)	0	0	4	**2**
7	17MEES84	ENGINEERING GRAPHICS (Theory + Practice)	MECHANICAL	FC(ES)	1	0	4	**3**
8	17MECC81	MANUFACTURING PROCESS LAB	MECHANICAL	CC	0	0	4	**2**
9	17EEES82	ENGINEERING SKILLS PRACTICE LAB BASIC ELECTRICAL ENGINEERING BASIC ELECTRONICS ENGINEERING	EEE & ECE	FC(ES)	0	0	4	**2**
		TOTAL			**16**	**2**	**16**	**25**
L – LECTURE HOUR		T – TUTORIAL HOUR	P – PRACTICAL HOUR		C – CREDIT			

HSS	HUMANITIES AND SOCIAL SCIENCES	CC	CORE COURSES
BS	BASIC SCIENCES	EC	ELECTIVE COURSES
ES	ENGINEERING SCIENCES	EEC	EMPLOYABILITY ENHANCEMENT COURSES + EXTRA CURRICULAR COURSES + CO - CURRICULAR COURSES
PII	PROJECT + INTERNSHIP + INDUSTRY ELECTIVES		

FOUNDATION COURSES

HUMANITIES AND SCIENCES AND MANAGEMENT

17EGHS01	TECHNICAL ENGLISH	Category	L	T	P	Credit
		FC(HS)	3	0	0	3

Technical English is a life skill course necessary for all students of Engineering and Technology. It aims at developing communication skills in English, essential for understanding and expressing the ideas of different professional context. The outcome of the course is to help the students acquire the language skills of Listening, Speaking, Reading and Writing competency in English language and thereby making the students competent and employable in the globalised scenario.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To enable students to develop LSRW skills in English. (Listening, Speaking, Reading, and Writing.)
2	To make them to become effective communicators
3	To ensure that learners use Electronic media materials for developing language
4	To aid the students with employability skills.
5	To motivate students continuously to use English language
6	To develop the students communication skills in formal and informal situations

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Listen, understand and respond to others in different scenario	Understand
CO2. Speak fluently and correctly with correct pronunciation in different situation.	Apply
CO3. To make the students experts in professional writing	Apply
CO4. To make the students recognize the role of technical writing in their careers in business, technical and scientific field	Apply
CO5. To make the students good communicators at the work place and to be theoretically strong.	Apply
CO6. To make the students in proficient technical communicator	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	-	-	-	M	M	M	L	S	S	S	M	L	-	-

CO 2	S	-	L	M	S	S	M	L	M	S	M	S	L	-	-
CO 3	L	L	-	L	S	M	-	L	M	S	-	L	L	-	-
CO 4	L	M	-	-	M	M	S	M	M	M	S	S	L	-	-
CO 5	S	M	L	-	L	-	S	M	S	S	L	M	L	-	-
CO 6	M	-	-	-	M	-	-	-	M	S	-	S	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT – I: Self introduction - Simulations using E Materials - Whatsapp, Face book, Hiker, Twitter- Effective Communication with Minimum Words - Interpretation of Images and Films - Identify the different Parts of Speech- Word formation with Prefixes and suffixes -Common Errors in English - Scientific Vocabulary (definition and meaning) - Listening Skills- Passive and Active listening, Listening to Native Speakers - Characteristics of a good listener.

UNIT – II: Articles - Phonetics (Vowels, Consonants and Diphthongs) - Pronunciation Guidelines -Listening to Indian speakers from different regions, intrusion of mother tongue - Homophones – Homonyms - Note taking and Note making - Difference between Spoken and Written English- Use of appropriate language - Listening and Responding to Video Lectures (Green India, environment, social talks) - Extempore.

UNIT – III Tense forms- Verbal and Non verbal Communication - Describing objects - Process Description- Speaking Practice - Paragraph Writing on any given topic (My favourite place, games / Hobbies / School life, etc.) -Types of paragraphs - Telephone Etiquettes - Telephonic conversation with dialogue.

UNIT – IV Impersonal Passive Voice - Conditional Sentences - Technical and Non technical Report Writing (Attend a technical seminar and submit a report) - News Letters and Editing - Skimming- Scanning - How to Improve Reading Speed - Designing Invitations and Poster Preparation.

UNIT – V Sentence Pattern (SVOCA) - Statement of Comparison - Transcoding (Flow Chart, Bar Chart and Pie Chart) - Informal letters - Resume Writing- Difference between Bio data, Resume and Curriculum Vitae.

TEXTBOOK

1. English for Engineers- Faculty of English – VMKVEngineeringCollege, Salem and AVIT, Chennai

REFERENCES

1. English for Effective Communication, Department of English, VMKV & AVIT, SCM Publishers, 2009.
2. Practical English Usage- Michael Swan (III edition), Oxford University Press
3. Grammar Builder- I, II, III, and CambridgeUniversity Press.
4. Pickett and Laster. Technical English: Writing, Reading and Speaking, New York: Harper and Row Publications, 2002.

Course Designers:

S.No	Name of the Faculty	Designation	Department / Name of the College	Mail ID
1	Dr.P.Saradha	Professor	English / VMKVEC	saradhap@vmkvec.edu.in

17EGHS02	BUSINESS ENGLISH	Category	L	T	P	C
		HSS	3	0	0	3

Preamble

Language is one of the most valued possessions of men. It acts as a repository of wisdom. Among all other languages English, the international language plays a vital role as a propeller for the advancement of knowledge in different fields and as a telescope to view the dream of the future

Prerequisite

Nil

Course Objectives

1	To impart and enhance corporate communication.
2	To enable learners to develop presentation skills.
3	To build confidence in learners to use English in Business context.
4	To make them experts in professional writing
5	To assist students understand the role of thinking in all forms of communication
6	To equip students with employability and job searching skills

Course Outcomes:

After Successful completion of this course, the students will be able to:

CO1.	Communicate with a range of formal and informal context	Understand
CO2.	Students will undergo in activities, demonstrating interaction skills and consider how own communication is adjusted in different scenario	Apply
CO3.	Strengthening of oral and written skills in the business context	Apply
CO4.	Create interest among the students about a topic by exploring thoughts and ideas	Understand
CO5.	Make the students to start with pleasing note and make them to give different ideas	Apply
CO6.	Make them in better performance in the art of communication	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**L**	**M**	**M**	**-**	**M**	**L**	**M**	**M**	**M**	**S**	**-**	**M**	**-**	**-**	**-**
CO2	**L**	**-**	**-**	**L**	**-**	**M**	**-**	**-**	**-**	**S**	**M**	**L**	**-**	**-**	**-**
CO3	**-**	**L**	**M**	**-**	**-**	**-**	**L**	**-**	**M**	**S**	**-**	**-**	**-**	**-**	**-**
CO4	**M**	**M**	**-**	**-**	**L**	**S**	**-**	**M**	**S**	**S**	**-**	**L**	**-**	**-**	**-**
CO5	**M**	**-**	**-**	**-**	**-**	**M**	**-**	**M**	**M**	**S**	**-**	**-**	**-**	**-**	**-**
CO6	**S**	**M**	**M**	**-**	**-**	**S**	**M**	**-**	**-**	**S**	**-**	**-**	**-**	**-**	**-**

S- Strong; M-Medium; L-Low

Syllabus

SUBJECT -VERB AGREEMENT

Subject and Verb Agreement (concord) - Preposition and Relative Pronoun - Cause and effect - Phrasal Verbs-Idioms and phrases-Listening Comprehension -Listening to Audio Files and Answering Questions-Framing Questions-Negotiation Skills-Presentation Skills and Debating Skills.

STRESS

Stress (Word Stress and Sentence Stress) Intonation- Difference between British and American English Vocabulary-Indianism-Compound Words (including Technical Terminology).

READING SKILLS

Reading Skills-Understanding Ideas and making Inferences-Group Discussion-Types of Interviews – FAQs – E - Mail Netiquette - Sample E – mails - Watching Documentary Films and Responding to Questions.

CORPORATE COMMUNICATION

Corporate Communication -Recommendation-Instruction-Check List- Circulars-Inter Office Memo- Minutes of Meeting and Writing Agenda - Discourse Markers - Rearranging Jumbled Sentences - Technical Articles - Project Proposals-Making Presentations on given Topics -Preparing Power Point Presentations.

CRITICAL READING

Critical Reading-Book Review-Finding Key Information and Shifting Facts from Opinions-Business Letters (Calling for Quotation, Placing Orders and Complaint Letters) - Expansion of an Idea-Creative Writing.

TEXT BOOK:

1. English for Effective Communication - Faculty of English – VMKV Engineering College, Salem and AVIT, Chennai

REFERENCES:

1. Grammar Builder – I, II, III – Cambridge University Press.
2. Technical English – Writing, Reading and Speaking – Pickett and Lester, Harper and Row

Course Designers:

S.No	Name of the Faculty	Designation	Department/College	Mail ID
1	Dr. P. Saradha	Associate Professor	English / VMKVEC	saradhap@vmkvec.edu.in
2				
3				
4				

17EGHS81	ENGLISH LANGUAGE LAB	Category	L	T	P	Credit
		FC(HS)	**0**	**0**	**4**	**2**

English Language Laboratory provides technological support to students. It acts as a platform for learning, practicing and producing language skills through interactive lessons and communicative mode of teaching.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To understand communication nuisances in the corporate sector.
2	To understand the role of mother tongue in second language learning and to avoid interference of mother tongue.
3	To communicate effectively through different activities
4	To understand and apply the telephone etiquette
5	Case study to understand the practical aspects of communication
6	To improve the oral skills of the students

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Give best performance in group discussion and interview	Understand
CO2. Best performance in the art of conversation and public speaking.	Apply
CO3. Give better job opportunities in corporate companies	Apply
CO4. Better understanding of nuances of English language through audio-visual experience and group activities	Apply
CO5. Speaking skills with clarity and confidence which in turn enhances their employability skills	Understand
CO6. Acquire strategic competence to use both spoken and written language in a wide range of communication strategies	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	S	M	S	-	L	-	-	S	S	M	-	L	-	-
CO2	M	-	-	-	-	-	-	-	M	S	-	M	L	-	-
CO3	M	-	-	-	-	-	-	-	-	S	-	M	L	-	
CO4	M	-	-	-	-	-	-	-	-	M	-	-	L	-	-
CO5	M	-	-	S	-	-	-	-	-	M	-	-	L	-	-
CO6	-	M	M	-	-	-	-	-	-	M	-	-	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS
UNIT – I: Ice Breaker, Grouping, Listening- (Hearing and listening)- Active Listening- Passive Listening – Listening to a song and understanding- (fill in the blanks) Telephone Conversation **UNIT – II:** Influence of mother tongue, videos, understanding nuances of English language (video) puzzle to solve, Activity. **UNIT – III** Why is English important, Communication skills, TED (video) Communication in different scenario – a case study, ingredients of success, Activity – chart, speak the design, feedback on progress, Group wise, Individual. **UNIT IV**. Telephone Etiquette, Dining Etiquette, Meeting Etiquette. **UNIT V.** Case study of Etiquette in different scenario.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department / Name of the College	Email id
1.	Dr. P.Saradha	Professor	English / VMKVEC	saradhap@vmkvec.edu.in
2.	Dr. Jennifer G Joseph	Professor	English / AVIT	Jennifer@avit.ac.in

VINAYAKA MISSION RESEARCH FOUNDATION

AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY , PAIYANOOR

YOGA AND MEDITATION

SYLLABUS- 2018-19

UNIT – I SURYA NAMASKAR AND ASANAS

SuryaNamaskar, Padmasana, Vajrasana, Navasana, Bhujangasana, Dhanurasana, TriKonasana, Uttakatasana, Eka pada pranamasana, Pirai Asana, Padha Hasthasana, Savasana.

T – II PRANAYAMA

Surya pranayama, Chandra Pranayama, Anulom Vilom, Sheetali, Brahmari Pranayama.

UNIT – III MUDRA

Chin mudra, Rughi mudra, Yoga mudra, Maha mudra, Shanmukhi mudra.

UNIT – IV KRIYA

Kapalabathi, Bhastrika.

UNIT – V MEDITATION

Simple, Vibrational, Mantra, Yoga Nitra

References:

1. Dr.V.Krishnamoorthy, *Simple Yoga for Health*, Sri Mathi Nilayam, 2012.
2. Dr.Ananda Balayogi Bhavenani, *A Primer of Yoga Theory*, Dhivyananda Creations,2008.
3. Dr.S.Hema, Easy *Yoga for Beginners*, Tara yoga Publications,2008.
4. Dr.Asana Andiappan, *Ashtanga Yoga*, Asana Publications, 2009.
5. Yogacharya Sundaram, *Sundra Yoga Therapy*, Asana Publications, 2009
6. Dr.John B.Nayagam, *Mudumaikku Mutrupulli Vaikkum Muthiraigal*, Saaru Prabha

17MBHS04	TOTAL QUALITY MANAGEMENT	Category	L	T	P	Credit
		HSS	3	0	0	3

PREAMBLE:

Total Quality Management (**TQM**) is a management approach describes to long–term success through customer satisfaction and, is an integrative philosophy of management for continuously improving the quality of products and processes.

PREREQUISITE: Not Required

COURSE OBJECTIVES:

1. To understand the introduction about Quality and Total Quality Management.
2. To understand the TQM principles.
3. To understand the statistical process control
4. To impart the various TQM tools
5. To understand the quality systems.

COURSE OUTCOMES:

After successful completion of the course, students will be able to

CO1: Understand the importance of quality and TQM at managerial level.	Understand
CO2: Explain the required tools to implement TQM.	Apply
CO3: Analyse various TQM parameters with help of statistical tools.	Analysing
CO4: Evaluating various TQM Techniques	Evaluate
CO5: Propose the Quality Management Systems in a different organization environment	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	L	L	L	L	L	L	L	L	M	L	L		
CO2	S	S	M	L	M	L	L	M	M	L	L	L		
CO3	S	S	S	M	S	M	L	M	M	L	L	M		
CO4	M	S	S	L	M	L	L	M	M	L	L	M		
CO5	S	S	S	L	M	M	S	M	M	S	M	S		

S- Strong; M-Medium; L-Low

SYLLABUS:

INTRODUCTION

Quality: Definition - Dimensions - Planning- costs – Analysis Techniques for Quality Costs- Basic concepts of Total Quality Management- Historical Review- Principles - Leadership – Concepts- Role of Top Management- Quality Council – Quality Statements- Strategic Planning- Deming Philosophy- TQM Implementation – Barriers.

TQM PRINCIPLES

Customer satisfaction – Perception of Quality- Complaints- Service Quality- Customer Retention- Employee Involvement – Motivation- Empowerment - Teams- Recognition and Reward- Performance Appraisal- Benefits- Continuous Process Improvement – Juran's Trilogy- PDSA Cycle- 5S – Kaizen - Basic Concepts.

STATISTICAL PROCESS CONTROL (SPC)

The Seven tools of Quality- Statistical Fundamentals – Measures of central Tendency & Dispersion- Population and Sample- Normal Curve- Control Charts for variables and attributes- Process capability- Concept of six sigma- New seven Management tools.

TQM TOOLS

Benchmarking – Reasons - Process- Quality Function Deployment (QFD) – House of Quality- QFD Process- Benefits- Taguchi Quality Loss Function- Total Productive Maintenance (TPM) – Concept- Improvement Needs- FMEA – Stages of FMEA.

QUALITY SYSTEMS

Need for ISO 9000 and Other Quality Systems- ISO 9000:2000 Quality System – Elements- Implementation of Quality System- Documentation- Quality Auditing- QS 9000- ISO 14000 – Concept- Requirements and Benefits.

TEXT BOOKS:

1. Dale H.Besterfiled- et at. - Total Quality Management- PHI-1999. (Indian reprint 2002).
2. Feigenbaum.A.V. "Total Quality Management- McGraw-Hill- 1991.

REFERENCES:

1. James R.Evans & William M.Lidsay - The Management and Control of Quality- (5^{th} Edition) - South-Western (Thomson Learning) - 2002 (ISBN 0-324-06680-5).
2. Oakland.J.S. "Total Quality Management Butterworth – Hcinemann Ltd - Oxford. 1989.
3. Narayana V and Sreenivasan - N.S. Quality Management – Concepts and Tasks- New Age International 1996.

COURSE DESIGNERS:

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17MBHS07	PROFESSIONAL ETHICSAND HUMAN VALUES	Category	L	T	P	Credit
		HSS	3	0	0	3

PREAMBLE: PV & HV

'Professional ethics and Human values' is a very relevant subject of today's environment of conflicts and stress in the profession, with obligations to be met by one person in many directions. A formal study will certainly improve one's ability and judgment and refine one's behaviour, decisions, and actions in performing the duty to the family, organization, and to the society. Academicians even feel that this subject should be introduced in high school level, in place of the moral instructions.

PREREQUISITE: Not Required

COURSE OBJECTIVES:

1. To understand the basic concept of Human Values and Ethics.
2. To understand and practice the engineering professionals to follow work placeethics.
3. To explore various code of ethics and experiments of Engineering.
4. To understand apply the rights, legal, ethical issues and their responsibilities.
5. To Motivate and practice ethical responsibilities of a professional engineer.

COURSE OUTCOMES:

After successful completion of the course, students will be able to

CO1: Understanding the moral values that ought to guide engineering profession or practice	Understand
CO2: Understand the role of ethics in the field of engineering.	Understand
CO3: Imparting the code of ethics and Industrial standards	Apply
CO4: Assessing and evaluating the Safety, Quality Management and Risk analysis	Analyse
CO5: Gaining and applying the skills and knowledgeto solve the contemporary issues.	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	L	L	L	L	S	S	M	M	M	L	M		
CO2	S	M	M	L	L	S	L	S	S	M	L	L		
CO3	S	S	M	L	L	M	L	M	S	L	M	M		
CO4	M	M	S	M	L	L	L	M	L	L	L	M		
CO5	S	S	M	L	L	M	S	S	L	M	M	S		

S- Strong; M-Medium; L-Low

SYLLABUS:

Introduction to HUMAN VALUES

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy –Self-Confidence–Discrimination -Character – Challenges in the work place -Spirituality –and stress management.

Overview of Engineering Ethics

Senses of 'Engineering Ethics' – Variety of moral issues – Moral Dilemmas- moral autonomy - Kohlberg'stheory-Gilligan'stheory-consensusandcontroversy-Profession – Types of Profession- Models of professional roles – Theories about right action – Self- Respect- Self-interest – Customs and Religion – Uses of Ethical Theories–Religion - Case study: Choice of the theory

Engineering as Social Experimentation

Engineering as Experimentation – Engineering Projects VS. Standard Experiments - Engineers as responsible Experimenters – Codes of Ethics – anticorruption-A Balanced Outlook on Law.

SAFETY, RESPONSIBILITIES AND RIGHTS

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination

GLOBAL ISSUES

Transnational and MNC corporations-Environmentalethics-Computerethics-Weaponsdevelopment and Ethical -stand for Engineers in creation-Engineers as managers-Consulting engineers-Engineers as expertwitnessesandadvisorsEthical Responsibilities of a Professional Engineer as an Expert Witness -Moral Leadership –Code of Conduct – Corporate Social Responsibility **Case Studies**

TEXT BOOK:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.
3. R.S. Nagarajan, A Text Book on Professional Ethics and Human Values, New Age International (P) Limited, Publishers,2006

REFERENCES:

1. CharlesD.Fleddermann,"EngineeringEthics",PearsonEducation/PrenticeHall,NewJersey, 2004
2. CharlesEHarris,MichaelS.ProtchardandMichaelJRabins,"EngineeringEthics–Concepts and Cases",WadsworthThompson Leatning, United States,2000
3. John R Boatright, "Ethicsandthe ConductofBusiness", PearsonEducation,NewDelhi,2003.
4. EdmundGSeebauerandRobertLBarry,"FundamentalsofEthics forScientistsandEngineers", Oxford Press, 2000
5. R.Subramanian,"Professional Ethics",Oxford University Press ,Reprint ,2015.

COURSE DESIGNERS:

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17MBHS08	PROJECT MANAGEMENT FOR ENGINEERING BUSINESS AND TECHNOLOGY	Category	L	T	P	Credit
		HSS	3	0	0	3

PREAMBLE:

Project Management for Engineering Business and Technology is a management approach describes to long–term success of project through expertise in project objectives and project Evaluation Techniques, is an integrative of Business and Technology for enjoying advanced concepts and results.

PREREQUISITE: Not Required

COURSE OBJECTIVES:

1. To understand the Project Management basics.
2. To understand the different managerial activities of Project Management
3. To understand the Engineering Technology.
4. To impart the various Risks involved in project management.
5. To understand the importance of various quality for Project Manager

COURSE OUTCOMES:

After successful completion of the course, students will be able to

CO1: Explain the concept of projects, its process, objectives and functions of project management	Understand
CO2: Analyze and Manage time in projects through Gantt charts, CPM and PERT techniques	Apply
CO3: Balance resource requirements of projects so as to avoid idling of resources	Apply
CO4: Update projects and determine revised schedule of activities and critical path if any	Apply
CO5: Crash projects to determine its optimum time- minimum cost relationships	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	-	-	-	-	M	S	S	-	M	-	-		
CO2	S	S	S	M	M	M	-	-	-	-	-	-		
CO3	S	S	S	M	M	M	-	-	-	-	-	-		
CO4	S	S	S	M	M	M	-	-	-	-	-	-		
CO5	S	S	S	M	M	M	-	-	-	-	-	-		

S- Strong; M-Medium; L-Low

SYLLABUS:

Project and its process- Define project and process, boundaries of project, Objectives and functions of Project management, characteristics and types of projects, organization structure / styles, roles of project management group, project management office and its role, project knowledge area, project integration- process group interaction. Project flow, project life cycle- influencing factors.

Project Time Management: Project Scope Management - Work break down structure- Activity/ Task- Events - Project planning tools- Rolling wave planning. Gantt Charts, Milestone chart, Program Progress chart- Creating milestone plan. Project Network- Fulkerson's rules – A-O-A and A-O-N networks. Analyze project time- Critical path method (deterministic approach- activity oriented network analysis- 80-20 rule- Case study, type of time estimates & Square network diagram. Project updating and monitoring- Case study. Estimate time- Program Evaluation & Review Technique (Probabilistic Approach)- Event oriented network analysis- Optimistic, Pessimistic and Most likely time, Degree of variability in average time, Probabilistic estimate, % utilization of resources.

Resource Management: Types of resource- Time, Men, Material, Machinery, Money, Space. Balancing of resource- Resource Smoothing technique- Time constraint. Resource levelling technique- Resource constraint.

Resource optimization: Types of cost – Direct, Indirect and Total Cost. Variation of Cost with time. Schedule Compression Techniques- Crashing, Fast Tracking & Re-estimation- Crash time and crash cost. Optimize project cost for time and resource. CPM Cost model. Life cycle assessment- impacts and economical assessment, Life cycle cost- maintenance and operation, life cycle forecasting – concept and applications.

Emerging trends in project management: Agile Project management and Project Management using latest tools.

Text Book:

1. Samuel J.Mantel JR., Jack R.Meredith, Project Management, Wiley India, Edition 2006.
2. Larry Richman-Project Management step by step, PHI New Delhi, Edition 2008.

Reference Books:

1. A Guide to the Project Management Body of Knowledge (PMBOK Guide) – Fourth Edition, An American National Standard, ANSI/PMI 990001-2008
2. James P.Clemats and Jack GIGO, Effective Project Management, Thomas South- Western, Edition 2007.
3. Santakki.V.C., Project Management, Himalaya Publishing House, Edition 2006.
4. Bhanesh M.Patel, Project Management, Vikash Publishing House Pvt Ltd, Edition 2008.
5. Project Management, Jack Gido and James P Clements, (Edition 2009) Cenage Learning India pvts Ltd., New Delhi.
6. A Risk Management Standard, AIRMIC Publishers, ALARM, IRM: 2002
7. Jerome D. Wiest and Ferdinand K. Levy, "A Management Guide to PERT/CPM", Prentice Hall of India

Publishers Ltd., New Delhi, 1994.

8. Punmia B. C. and Khandelwal K.K., "Project Planning and Control with PERT/CPM", Laxmi publications, New Delhi, 1989.
9. Srinath L.S., "PERT & CPM- Principles and Applications", Affiliated East West Press Pvt., Ltd., New Delhi, 2008

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17MBHS09	INTELLECTUAL PROPERTY RIGHTS AND ALTERNATE DISPUTE RESOLUTION	Category	L	T	P	Credit
		HSS	3	0	0	3

PREAMBLE: IPR & ADR

Intellectual Property Rights are valuable assets and most important for any kind of business because set the business apart from competitors, offer customers something new and different, be sold or licenced form an essential part of marketing or branding. ADR is a familiar mechanism to resolve the business issues in a faster way and less expensive with help of a neutral third party.

PREREQUISITE: Not Required

COURSE OBJECTIVES:

1. To understand and learn the basic concept of IPR and Patent filing procedure.
2. To understand and familiarize various procedure for grants of patent, trademark and trade secrets.
3. To apply various legal aspects in patent ownership and transfer.
4. To apply and practice the laws relating to the Intellectual property rights.
5. To Create model contexts to practice the ADR mechanism.

COURSE OUTCOMES:

After successful completion of the course, students will be able to

CO1: Understand the different aspects of intellectual property rights.	Understand
CO2: Explain the procedure and requirement of to apply New IPR development and related system in India and across the Globe.	Apply
CO3: Analyse the various issues of transfer of patent ownership with reference to International Patent Law.	Analyse
CO4: Evaluate the present system of Patent Act in India and changes aligned with international standards.	Evaluate
CO5: Prepare and assess the mechanism to apply in the business issues in the context of ADR	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	L	L	L	L	M	L	L	M	L	L
CO2	S	S	M	L	M	L	L	M	M	L	L	L
CO3	S	S	M	M	S	M	L	S	M	L	L	M
CO4	M	S	S	L	M	L	L	M	M	L	L	M
CO5	S	S	S	L	M	M	S	M	L	S	M	S

S- Strong; M-Medium; L-Low

SYLLABUS:

UNIT – I: Introduction To IPRs **9**

Basic concepts of Intellectual Property- Patents Copyrights, Geographic Indicators, History of IPRs- the way from WTO to WIPO- TRIPS, Nature of Intellectual Property, Industrial Property, Technological Research, Inventions and Innovations - Defining Intellectual Property and Patents, Patent Searches and Application.

UNIT – II: New Developments in IPR **9**

Procedure for grant of Patents, TM, GIs, Trade Secrets, Patenting under PCT, Administration of Patent system in India, Patenting in foreign countries - International Treaties and conventions on IPRs, The TRIPs Agreement.

UNIT – III: Patent Ownership and Transfer **9**

Defining Intellectual Property and Patents, Patent Searches and Application, Patent Ownership and Transfer, Patent Infringement, New Developments and International Patent Law

UNIT – IV: Legislation of IPRs **9**

The Patent Act of India, Patent Amendment Act (2005), Design Act, Trademark Act, Geographical Indication Act, Bayh- Dole Act and, IPR strength in India - Patent Ownership and Transfer, Patent Infringement, New Developments and International Patent Law

UNIT – V: Alternate Dispute Resolution **9**

Alternate Dispute Resolution and Arbitration – ADR Initiatives - Reason for Choosing ADR – Advantages and Disadvantages of ADR – Assessment of ADR's – Litigation – Arbitration - Effective Mechanism for Business Issues.

TEXT BOOK:

1. Deborah E. Bouchoux, Intellectual Property Rights, Delmar, Cengage Learning, 2005.

REFERENCES:

1. V. Sople Vinod, Managing Intellectual Property by (Prentice hall of India Pvt.Ltd), 2006.
2. A. Primer, R. Anita Rao and Bhanoji Rao, Intellectual Property Rights, Lastain Book company. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2006.
3. Tejaswini Apte, A single guide to Intellectual property rights, Biodiversity and Traditional knowledge.
4. WIPO Intellectual Property Hand book.
5. Intellectual Property rights and copyrights, Ess Ess Publications.

COURSE DESIGNERS:

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17MBHS11	ENGINEERING STARTUPS AND ENTREPRENEURIAL MANAGEMENT	Category	L	T	P	Credit
		HSS	3	0	0	3

PREAMBLE:

A startup is a company initiated by individual creator or entrepreneurs to search for a repeatable and scalable business model. More specifically, a startup is a newly emerged business venture that aims to develop a viable business model to meet a marketplace needs or wants in an optimum manner.

PREREQUISITE: Not Required

COURSE OBJECTIVES:

1. To understand the Startups Management basics and its components.
2. To impart the startups fund management practices
3. To inculcate the various kinds of stocks and employment considerations in startups.
4. To inculcate the importance of intellectual property rights and its procedures.
5. Explore the entrepreneurial mindset and culture that has been developing in companies of all sizes and industries.

COURSE OUTCOMES:

After successful completion of the course, students will be able to

CO1: Explain the concept of engineering startups, objectives and functions and its components.	Understand
CO2: Analyze the startups funding issues and remuneration practices in startups business.	Apply
CO3: Analyze the various kinds of stocks and employment opportunities consideration in startups business.	Apply
CO4: Compare and contrast the different forms of intellectual property protection in terms of their key differences and similarities.	Apply
CO5: Explore the entrepreneurial mindset and culture that has been developing in companies of all sizes and industries.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	-	-	-	-	M	S	S	-	M	-	-		
CO2	S	S	S	M	M	M	-	-	-	-	-	-		

CO3	S	S	S	M	M	M	-	-	-	-	-	-			
CO4	S	S	S	M	M	M	-	-	-	-	-	-			
CO5	S	S	S	M	M	M	-	-	-	-	-	-			

S- Strong; M-Medium; L-Low

SYLLABUS:

Elements of a successful Start up: Create Management Team and Board of Directors – Evaluate market and Target Customers – Define your product or service –Write your Business Plan

Funding Issues and Remuneration Practices: Funding Issues: Investment Criteria – Looking for seed cash – Seed, Startup, and subsequent Funding Rounds – Milestone Funding - Remuneration Practices for your Start –up : Salaries – Headhunters – Equity Ownership – Form of Equity incentive vehicles – Other compensation – Employment Contracts

Stock Ownership & startup Employment Considerations: Stock ownership: Risk-Reward Scale – Ownership Interest over time – Common and preferred stock – Authorized and outstanding shares – Acquiring stock – Restricted Stock Grants – Future Tax Liability on Restricted Shares - Compensation and startup Employment Considerations : Entrepreneurs Need Insurance – Do Fringe benefits – outsourcing your benefits work – Life Insurance – Health Insurance – Disability Insurance

Protecting Intellectual Property: Protecting your intellectual property: Copyrights - patents–Trade secrets – Trademarks - The Legal Form of your Startup: Corporation – Partnership – Limited Liability Company – Sole Proprietorship - – Making the startup decision: commitment – Leaving a current employer - stay fit.

Entrepreneurship: Entrepreneurship - Introduction to Technology Entrepreneurship and Technology Ventures – Engineers as Entrepreneurs, The Mindset of the Entrepreneurial Leader, Creating and Selling the Entrepreneurial Value Proposition - Essentials of Successful Entrepreneurs – Social environment in entrepreneurial development – Economic environment in entrepreneurial development.

Text Book:

1. James A. Swanson & Michael L. Baird, "Engineering your start-up: A Guie for theHigh-Tech Entrepreneur" 2nd ed, Professional Publications.inc
2. Donald F Kuratko, " Entreprenuership – Theory, Process and Practice", 9th Edition, Cengage Learning 2014.

Reference Books:

1. Hisrich R D, Peters M P, "Entrepreneurship" 8th Edition, Tata McGraw-Hill, 2013.
2. Mathew J Manimala, "Enterprenuership theory at cross roads: paradigms and praxis" 2nd Edition Dream tech, 2005.

3. Rajeev Roy, 'Entrepreneurship' 2nd Edition, Oxford University Press, 2011.
4. EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986.

COURSE DESIGNERS:

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BASIC SCIENCES - SYLLABUS

17CHBS01	Environmental Science & Engineering	Category	L	T	P	C
		FC(BS)	3	0	0	3

Preamble

Environmental science is an interdisciplinary field that integrates physical, chemical, biological, information andatmospheric sciences. Environmental studies also incorporate the social sciences for understanding human relationships and a solution to the environmental and social related problems.. Environmental engineering focuses on sustainable development for improving environmental quality in every aspect.

Prerequisite

NIL

Course Objective

1	To create the awareness of environment studies and its scope
2	To inculcate the knowledge of significance and conserving the natural resources.
3	To helps the learners to know the value of ecosystem and food chain.
4	To assess the importance of biodiversity
5	To familiarizes the different pollution sources, consequences and its control measures.
6	To educate the ways and means to manage natural calamities.
7	To help the learners to know the urban energy related problems and social issues.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Discuss and appreciate the unity of life in all its forms, the implications of life style on the environment.	Understand
CO2.	Initiate the awareness and recognize the social responsibility in environmental issues.	Apply
CO3.	Illustrate the importance of ecosystem and biodiversity	Apply
CO4.	Interpret the society on the various pollutions and their impact.	Apply
CO5.	Demonstrate the Solid waste and disaster management.	Apply
CO6.	Recognize the issues of environment and sustainable development	Understand
CO7.	Schedule the urban problems and social issues.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	-	-	S	S	S	-	-	-	S	L		
CO2	S	M	M	-	-	S	S	S	-	-	-	S	L		
CO3	S	L	M	-	-	S	S	S	-	-	-	S	L		
CO4	S	S	S	L	-	S	S	S	-	-	-	S	L		

CO5	S	S	S	M	-	S	S	S	-	-	-	S	L		
CO6	S	S	S	M	-	S	S	S	-	-	-	S	L		
CO7	S	S	S	M	-	S	S	S	-	-	-	S	L		

S- Strong; M-Medium; L-Low

Syllabus

ENVIRONMENT AND NATURAL RESOURCES

Environment - Definition, scope & importance - Public awareness- Forest resources, mineral resources , water resources, food resources , energy resources (uses, over -exploitation & adverse effects in each case) - Scope & role of environmental engineers in conservation of natural resources - Sustainability development.

ECOSYSTEMS AND BIO – DIVERSITY

Ecosystem - Definition, structure and function - Energy flow -Ecological succession - food chain, food web, ecological pyramids- Introduction, types, characteristics, structure and function of forest, grassland, desert and Aquatic ecosystems - Bio - Diversity :values and uses, hotspots, threats and conservation.

ENVIRONMENTAL POLLUTION

Pollution - Definition , man made impacts and control measures of air, water and land pollution - Water quality standards & characterization - Importance of sanitation -Nuclear hazards – Hazardous waste management : Solid waste, waste water and biomedical waste - Prevention of pollution and role of individual – Disasters management : Floods, earthquake, cyclone and land slides - Clean technology options.

SOCIAL ISSUES AND ENVIRONMENT

Urban problems related to energy - Water conservation – Resettlement and rehabilitation of people - Environmental ethics - Climate change - Global warming - Acid rain - Ozone depletion-Waste land reclamation, Environment Protection Act for air, water, wild life and forests - Pollution Control Board.

HUMAN POPULATION AND ENVIRONMENT

Population growth - Population explosion - Family welfare programme - Environment & human health - Human rights – Value education - Women and child welfare, Role of information technology in environment and human health.

Text Books

1	nmental Science and Engineering by Dr.A. Ravikrishnan, Sri Krishna ations, Chennai.

Reference Books

1	Wager K.D. "Environmental Management", W.B. Saunders Co. Philadelphia, USA, 1998

2	BharuchaErach "The Biodiversity of India" Mapin Publishing Pvt Ltd, Ahmedabad, India
3	Trivedi R.K. “Handbook of Environmental Laws", Rules, Guidelines,Compliances and Standards Vol I & II, Enviro media.
4	Environmental Science and Engineering by Dr. J. Meenambal ,MJP Publication , Chennai Gilbert M. Masters : Introduction to Environmental Engineering and Science , Pearson Education PvtLtd., II Edition, ISBN 81-297-0277-0, 2004
5	Miller T.G. Jr Environmental Science Wadsworth Publishing Co
6	Townsend C. Harper J. and Michael Begon, Essentials of Ecology,Blackwell Science.

Course Designers

S.No	**Faculty Name**	**Designation**	**Department/College**	**Email id**
1	Dr.T.Shanthi	Professor	Chemistry / VMKVEC	shanthi@vmkvec.edu.in
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3	Dr. R. Nagalakshmi	Assoc. Prof.	Chemistry / AVIT	

17CHBS04	**Subject Title** **INDUSTRIAL MATERIAL**	Category	L	T	P	C
		BS	3	0	0	3

PREAMBLE: The intellectual origins of materials from the Enlightenment, when researchers began to use analytical thinking from chemistry, physics and engineering to understand ancient, phenomenological observations in metallurgy and mineralogy. Materials science still incorporates elements of physics, chemistry, and engineering.

Prerequisite

Not required

Course Objectives

1	To impart fundamental knowledge relating to selection of material on basis of their application and service conditions.
2	To classify the Engineering Materials and their relevant applications
3	To Categorize the basics in composites, types and applications
4	To demonstrate the various forms of Smart Materials and its applications.
5	To lay foundation for applications of materials in various field.

Course Outcomes:

After Successful completion of this course, the students will be able to:

CO1.	Account how for materials to be selected in industry	understand
CO2.	Identify engineering materials, their properties and applications	understand
CO3.	Summarize the properties and applications of composites	understand
CO4.	Illustrate the various forms of smart materials and its applications	Apply
CO5.	Predict the failure of components due to wrong selection of materials and extend their knowledge in applications of materials in various field	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS0 1	PS0 2	PS0 3
CO1.	S	S	S	M	-	-	-	-	-	-		-	M	L	-
CO2.	S	S	M	L	-	-	-	-	-	-	-	-	L	-	-
CO3.	S	S	M	L	-	-	-	-	-	-	-	-	M	-	-
CO4.	S	M	M	L	-	-	-	-	-	-	-	-	M	-	-
CO5.	M	S	S	S	L	-	-	-	-	-	-	-	M	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT I:

Selection of materials: Service requirement, Structure - Property correlations and reappraisal of the role of crystal structure and structural defects on properties.

UNIT II:

Metallic materials: Engineering Ferrous materials, Aluminium, Copper, Nickel, Magnesium, Titanium alloys. Phase diagrams, properties and typical alloys with reference to their applications.

UNIT III:

Composite materials: Fiber reinforced, laminated and dispersed materials with metallic matrix of aluminium, copper and Titanium alloys and with non-metallic matrix of unsaturated polyesters and epoxy resins (properties and applications of these materials).

UNIT IV:

Smart materials: Shape Memory Alloys, Varistors and Intelligent materials for bio-medical applications, Polymers and Plastics from industry - properties and applications of these materials.

UNIT V:

Case study of the failure of components due to wrong selection of materials: Study and analysis of appropriate material for some specific application like aerospace, boiler tubes, turbine blades, automobiles and infrastructures (building and bridges).

TEXT BOOKS:

1.Engineering Material Technology, 5th edition, by James A. Jacobs & Thomas F. Kilduff. Prentice Hall. Copyright 2005.

2.Callister's Materials Science and Engineering by WD. Callister Jr., Wiley India Pvt. Ltd., 2010

REFERENCE:

1. Foundations of Materials Science and Engineering, 3rd edition, by William F. Smith. McGraw Hill, Copyright 2004.
2. Engineering materials1: An introduction to properties, applications and design by Michael F Ashby and David R H Jones, Elsevier Butterworth Heinmann Publishers, 2007

Course Designers:

S.No	Name of the Faculty	Mail ID
1.	Dr.T.Shanthi	Shanthi.thiruvengadam130@gmail.com

17MABS01	ENGINEERING MATHEMATICS	Category	L	T	P	Credit
		FC(BS)	2	2	0	3

PREAMBLE

The driving force in Engineering Mathematics is the rapid growth of technology and the sciences. Matrices have been found to be of great utility in many branches of engineering applications such as theory of electric circuits, aerodynamics, and mechanics and so on. Many physical laws and relations can be expressed mathematically in the form of differential equations. Based on this we provide a course in matrices, calculus and differential equations. Vector calculus is a form of mathematics that is focused on the integration of vector fields. An Engineer should know the Transformations of the Integrals, as Transformation of Line Integral to surface and then to volume integrals.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To recall the advanced matrix knowledge to Engineering problems.
2	To equip themselves familiar with the functions of several variables.
3	To improve their ability in solving geometrical applications of differential calculus problems
4	To examine knowledge in multiple integrals.
5	To improve their ability in Vector calculus.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Apply the concept of orthogonal reduction to diagonalise the given matrix	Apply
CO2. Find the radius of curvature, circle of curvature and centre of curvature for a given curve.	Understand
CO3. Classify the maxima and minima for a given function with several variables, through by finding stationary points	Analyze
CO4. Find double integral over general areas and triple integral over general volumes	Understand
CO5. Apply Gauss Divergence theorem for evaluating the surface integral.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO1 2	P S O	PSO2	PSO3

													1		
CO1	L	S	M	--	--	--	--	--	--	--	--	--	L	--	--
CO2	L	S	M	--	--	--	--	--	--	--	--	--	L	--	--
CO3	L	S	M	--	--	--	--	--	--	--	--	--	L	--	--
CO4	L	S	M	--	--	--	--	--	--	--	--	--	L	--	--
CO5	L	S	M	--	--	--	--	--	--	--	--	--	L	--	--

S- Strong; M-Medium; L-Low

SYLLABUS

MATRICES: Characteristic equation – Eigen values and eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors (Without proof) – Cayley-Hamilton theorem (excluding proof) – Orthogonal transformation of a symmetric matrix to diagonal form.

DIFFERENTIAL CALCULUS: Curvature – Cartesian and Parametric Co-ordinates – Centre and radius of curvature – Circle of curvature – Evolute.

FUNCTIONS OF SEVERAL VARIABLES: Partial Derivatives – Total Differentiation – Maxima and Minima constrained Maxima and Minima by Lagrangian Multiplier Method.

MULTIPLE INTEGRALS: Double integration – change of order of integration – Cartesian and polar coordinates – Area as a double integral – Triple integration.

VECTOR CALCULUS: Directional derivatives – Gradient, Divergence and Curl – Irrotational and solenoidal – vector fields – vector integration – Green's theorem, Gauss divergence theorem and Stoke's theorem (excluding proof).

TEXT BOOKS:

1. "Engineering Mathematics I & II", Department of Mathematics, VMKVEC (Salem) & AVIT (Chennai), (2017).
2. Dr.A.Singaravelu, "Engineering Mathematics I & II", 23rd Edition, Meenakshi Agency, Chennai (2016).

REFERENCES:

1. Veerarajan T., "Engineering Mathematics", Tata McGraw Hill Education Pvt, New Delhi (2011).
2. Grewal B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi (2012).
3. Kreyszig E., "Advanced Engineering Mathematics", 8th Edition, John Wiley and Sons (Asia) Pvt. Ltd., Singapore (2012).
4. Kandasamy P, Thilagavathy K, and Gunavathy K., "Engineering Mathematics", Volumes I & II (10th Edition).

COURSE DESIGNERS:

S.No	Name of the Faculty	Designation	Department /Name of the	Mail ID

			College	
1	Dr.G.Selvam	Asso.Prof	Maths / VMKVEC	selvam@vmkvec.edu.in
2	Dr. M.Vijayarakavan	Asso.Prof	Maths / VMKVEC	vijayarakavan@vmkvec.edu.in

<table>
<tr><td rowspan="2">17MABS04</td><td rowspan="2">MATHEMATICS FOR MECHANICAL SCIENCES</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td></tr>
<tr><td>FC(BS)</td><td>2</td><td>2</td><td>0</td><td>3</td></tr>
</table>

PREAMBLE

This course provides a solid undergraduate foundation in partial differential equations, probability theory and mathematical statistics and at the same time provides an indication of the relevance and importance of the theory in solving practical problems in the real world. Partial differential equation (PDE) is a differential equation that contains unknown multivariable functions and their partial derivatives. Its generally arise from the mathematical formulation of physical problems. Partial differential equations are derived from physics and instruct the methods for solving boundary value problems, that is, methods of obtaining solutions which satisfy the conditions required by the physical situations such as Heat flow equations of one dimension and two dimensions. Fourier analysis is to represent complicated functions in terms of simple periodic functions, namely cosines and sines. Probability is the science of how likely events are to happen. It's concerned with the roll of a dice, or the fall of the cards in a game. But probability is also vital to science and life more generally. It's used in such diverse areas as weather forecasting and to work out the cost of your insurance premiums. Statistics is permeated by probability. Statistics has been responsible for accelerating progress in all applied sciences by defining the correct methods of planning, collecting, analyzing and interpreting data for establishing cause and effect relationship.

PREREQUISITE

Engineering Mathematics

COURSE OBJECTIVES

1	To formulate and solve partial differential equations.
2	To represent a periodic function as a Fourier series.
3	To be familiar with applications of partial differential equations.
4	To be familiar with discrete and continuous random variables and describe the properties of discrete and continuous distribution functions
5	To provide an understanding for the graduate on statistical concepts to include measures of central tendency, curve fitting, correlation and regression.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Explain the methodology of forming and solving partial differential equations.	Understand
CO2. Demonstrate periodic functions arising in the study of engineering problems as Fourier series of sine and cosines and compute the Fourier coefficients numerically.	Apply
CO3. Solve partial differential equations arising in engineering problems like wave equations and heat flow equation by Fourier series.	Apply
CO4. Classify the random variables to determine the appropriate distributions.	Apply
CO5. Apply least square method to fit a curve for the given data and evaluate the	Apply

correlation coefficient and regression lines for the data.	

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	L	--	--	--	--	L	--	--	--	L	L	--	--
CO2	S	M	M	L	--	--	--	L	--	--	--	L	L	--	--
CO3	S	M	M	L	--	--	--	M	--	--	--	M	L	--	--
CO4	S	M	L	--	--	--	--	M	--	--	--	M	L	--	--
CO5	S	S	M	L	--	--	--	M	--	--	--	M	L	--	--

S- Strong; M-Medium; L-Low

SYLLABUS

PARTIAL DIFFERENTIAL EQUATIONS: Formation - Solutions of standard types f(p,q)=0, clairauts form, f(z,p,q)=0,f(p,x)=g(q,y) of first order equations - Lagrange's Linear equation - Linear partial differential equations of second and higher order with constant coefficients.

FOURIER SERIES: Dirichlet's conditions – General Fourier series – Half -range Sine and Cosine series – Parseval’s identity – Harmonic Analysis.

BOUNDARY VALUE PROBLEMS: Classification of second order linear partial differential equations – Solutions of one – dimensional wave equation, one – dimensional heat equation – Steady state solution of two – dimensional heat equation – Fourier series solutions in Cartesian coordinates.

STANDARD DISTRIBUTIONS: Moment generating function of random variables – Binomial – Poisson – Geometric – Uniform – Exponential – Gamma and Normal Distributions and their Properties (Mean Variance and Problems).

STATISTICS: Measures of central tendency, Curve fitting – Straight line and Parabola by least square method, Correlation, Rank correlation and Regression.

TEXT BOOKS:

1. Dr.A.Singaravelu, “Transforms and Partial differential Equations", 18th Edition, Meenakshi Agency, Chennai (2013).
2. A.Singaravelu, “Probability and Statistics”, Meenakshi Agencies, Chennai (2016)
3. S.C.Gupta, V.K.Kapoor, “Fundamentals of mathematical statistics”, Sultan Chand & Sons (2006).

REFERENCES:

1. T. Veerarajan, “Engineering Mathematics” (for semester III), Third Edition, Tata McGraw-Hill Publishing Company limited (2011).
2. Grewal, B.S., “Higher Engineering Mathematics”, 42nd Edition, Khanna Publishers, Delhi (2012).
3. Kreyszig, E., “Advanced Engineering Mathematics”, 8th Edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore (2012).
4. T. Veerarajan, “Probability, Statistics and Random processes” 2nd Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi (2006).

5. Johnson. R.A., "Miller & Freund's Probability and Statistics for Engineers", Sixth Edition, Pearson education, Delhi, 2000. (Chapters 7, 8, 9, 12).

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department / Name of the College	Mail ID
1	Dr. S.Punitha	Asso.Prof	Maths / VMKVEC	punitha@vmkvec.edu.in
2	Ms.M.Usha	Asst.Prof	Maths / VMKVEC	usha@vmkvec.edu.in

17MABS11	NUMERICAL METHODS FOR MECHANICAL SCIENCES	Category	L	T	P	Credit
		FC(BS)	3	2	0	3

Preamble

This course aims at developing the ability to formulate an engineering problem in a mathematical form appropriate for subsequent computational treatment and to choose an appropriate numerical approach. An Under Graduate Mechanical Engineering student needs to know sufficient numerical tools and techniques for solving engineering problems such as static orsteady state problems, vibration or stability problems and initial value or transient problems etc.

Prerequisite

1.Mathematics for Mechanical sciences

Course Objectives

1. To familiar with numerical solution of equations
2. To be get exposed to finite differences and interpolation
3. To be thorough with the numerical Differentiation and integration
4. To find numerical solutions of ordinary differential equations
5. To find numerical solutions of partial differential equations

Course Outcomes

On the successful completion of the course, students will be able to

CO1.Solve the system of linear algebraic equations and single non linear equations arising in the field of Mechanical Engineering.	**Apply**
CO2Apply methods to find intermediate numerical value & polynomial of numerical data.	**Apply**
CO3 Apply methods to find integration, derivatives of one and two variable functions.	**Apply**
CO4 Solve the initial value problems using single step and multistep methods.	**Apply**
CO5 Solve the boundary value problems using finite difference methods.	**Apply**

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	S	M	L	L	-	-	-	-	-	-	-	-	M	-	-
2	S	M	M	L	-	-	-	-	-	-	-	-	M	-	-
3	S	M	M	L	-	-	-	-	-	-	-	-	M	-	-
4	S	S	S	M	L	-	-	-	-	-	-	-	M	-	-
5	S	S	S	M	L	-	-	-	-	-	-	-	M	-	-

S- Strong; M-Medium; L-Low

Syllabus

SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS:
Method of false position, Newton-Raphson method for single variable, Solutions of a linear system by Gaussian, Gauss-Jordan, Jacobian and Gauss- Seidel methods. Inverse of a matrix by Gauss-Jordan method. Eigen value of a matrix by Power Method.

INTERPOLATION AND APPROXIMATION:

Interpolation with Newton's divided differences, Lagrange's polynomial, Newton forward and backward differences, central difference Formula (Stirling's and Bessel's).

NUMERICAL DIFFERENTIATION AND INTEGRATION:
Numerical differentiation with interpolation polynomials, Numerical integration by Trapezoidal and Simpson's (both 1/3rd and 3/8th) rules. Romberg's rule, Two and Three point Gaussian quadrature formula. Double integrals using Trapezoidal and Simpson's rule..

INITIAL VALUE PROBLEMS OF ODE:
Single Step Methods - Taylor Series, Euler and Modified Euler, Runge-Kutta method of fourth order -first and second order differential equations. Multistep Methods - Milne and Adam's-Bash forth predictor and corrector methods.

BOUNDARY VALUE PROBLEMS FOR ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS:
Finite difference solution for the second order ordinary differential equations, Finite difference solution for one dimensional heat equation (both implicit and explicit). One dimensional wave equation and two dimensional Laplace and Poisson equations.

Text Books

1. S.K Gupta, "Numerical Methods for Engineers", New Age International Pvt. Ltd. Publishers, 2015.
2. S. R. K. Iyengar, R. K. Jain, Mahinder Kumar Jain, "Numerical methods for Scientific and Engineering Computations", New Age International publishers , 6th Edition, 2012.
3. T. Veerarajan, T.Ramachandran, "Numerical Methods with Programs in C and C++", Tata McGraw-Hill (2004).

Reference Books

1. Joe D. Hoffman , Steven Frankel, "Numerical Methods for Engineers and Scientists", 3 rd Edition, 2015,Tata Mc-Graw Hill.(New York)
2. Steven C. Chapra, Raymond P. Canale, "Numerical Methods for Engineers", MC Graw Hill Higher Education, 2010

Course Designers:

S.No	Name of the Faculty	Designation	Department/College	Mail ID
1	Dr. M.Vijayarakavan	Associate Professor	Maths / VMKVEC	vijayarakavan@vmkvec.edu.in
2	Dr. G. Selvam	Associate Professor	Maths / VMKVEC	selvam@vmkvec.edu.in

17MABS20	PROBABILITY AND STATISTICS	Category	L	T	P	Credit
		BS	2	2	0	3

PREAMBLE

Probability is the science of how likely events are to happen. It is concerned with the roll of a dice, or the fall of the cards in a game. But probability is also vital to science and life more generally. It is used in such diverse areas as weather forecasting and to work out the cost of your insurance premiums. Statistics is permeating by probability. An understanding of basic probability is critical for the understanding of the basic mathematical underpinning of statistics. Strictly speaking, the word 'statistics' means one or more measures describing the characteristics of a population. We use the term here in a more idiomatic sense to mean everything to do with sampling and the establishment of population measures.

PREREQUISITE - Nil

COURSE OBJECTIVES

1	To get the knowledge on concepts of random variables and distributions
2	To acquire skills in handling situations involving more than one random variable and functions of random variables
3	To acquire knowledge of statistical techniques useful in making rational decision in management problems
4	To be exposed to statistical methods designed to contribute to the process of making scientific judgments in the face of uncertainty and variation
5	To familiar with the concepts of statistical quality control

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Classify the random variables to determine the appropriate distributions.	Apply
CO2. Calculate probabilities, and derive the marginal and conditional distributions of bivariate random variables.	Apply
CO3. Perform Test of hypothesis as well as calculate confidence interval for a population parameter for single sample and two sample cases.	Apply
CO4.Understand the assumptions and limitations of design of experiments. Conceive and conduct a designed experiment to characterize a process.	Apply
CO5. Demonstrate the ability to design and interpret control charts to variables and attributes	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	L	--	--	--	M	--	--	--	M	--	--	--
CO2	S	M	M	L	--	--	--	M	--	--	--	M	--	--	--
CO3	S	S	M	L	--	--	--	M	--	--	--	M	--	--	--
CO4	S	S	M	L	--	--	--	M	--	--	--	M	--	--	--
CO5	S	S	S	M	L	--	--	M	--	--	--	M	--	--	--

S- Strong; M-Medium; L-Low

SYLLABUS

RANDOM VARIABLES: Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Normal distributions.

TWO DIMENSIONAL RANDOM VARIABLES: Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

TESTING OF HYPOTHESIS: Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample test based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

DESIGN OF EXPERIMENTS: One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design.

STATISTICAL QUALITY CONTROL: Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

TEXT BOOKS:

1. Douglas C. Montgomery and George C.Runger, "Applied Statistics and Probability for Engineers", 6^{th} Edition, Wiley, 2013
2. S.P. Gupta, "Statistical Methods", Sultan Chand & Sons, New Delhi, 45th Revised Edition, 2017.

REFERENCES:

1. S.C.Gupta and V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 2015.
2. Miller, "Probability and Statistics for Engineers", Freund-Hall, Prentice India Ltd. 2009.

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Ms.M.Usha	Assistant Professor	Mathematics	usha@vmkvec.edu.in
2	Dr. P.Sasikala	Professor	Mathematics	sasikalap@vmkvec.edu.in

17MABS21	RESOURCE MANAGEMENT TECHNIQUES

Category	L	T	P	Credit
FC(BS)	2	2	0	3

Preamble

Operations Research is the study of optimization techniques. It is applied in decision theory. Rapid development and invention of new techniques occurred since the World War II essentially, because of the necessary to win the war with the limited resources available. It is applied for solving Inventory control problems, Maintenance and Replacement problems, Sequencing and Scheduling problems, Assignment of Jobs to applicants, Transportation problems, Network problems and Decision models. Entire subject is useful for all resource managers of various fields.

Prerequisite

NIL

Course Objectives

1.	Develop linear programming problems and find solutions of LPP and apply in management decisions
2.	To acquire knowledge of linear programming, assignment and transportation problems
3.	Techniques of PERT, CPM and sequencing
4.	Detailed knowledge of Inventory control
5.	Decision theory and Game theory techniques

Course Outcomes

On the successful completion of the course, students will be able to

CO1.Formulate the LPP. Conceptualize the feasible region. Solve the LPP with two variables using graphical method and By simplex method.	Understand& Apply
CO2. Become familiar with the types of problems that can be solved by applying a transportation model. Be able to identify the special features of the assignment problem.	Apply
CO3. Solve network problems using CPM and PERT techniques and apply sequencing model	Apply
CO4. Determine the order quantity.Determine the reorder point and safety stock forinventory systems.Design a continuous or periodic review inventorycontrolsystem..	Apply
CO5. Apply replacement models .To makedecisionsinacompetitive Environmentisaverycommonandimportantone.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1.	S	M	L	--	S	--	--	S	--	--	--	--
2.	S	M	L	--	S	--	--	S	--	--	--	--
3.	S	M	L	--	S	--	--	S	--	--	--	--
4.	S	S	L	--	M	--	--	S	--	--	--	--
5.	S	S	L	--	M	--	--	S	--	--	--	--

S- Strong; M-Medium; L-Low

Syllabus

LINEAR PROGRAMMING

Linear programming problem – Graphical method - Simplex method – Big M method – Duality principle.

TRANSPORTATION MODEL

Transportations problem – Assignment problem – Under Assignment -Travelling salesman problem

NETWORK MODEL

Project Network – CPM and PERT Networks – Critical path scheduling – Sequencing Models.

INVENTORY MODELS

Inventory Model – Economic Order Quantity Model – Purchasing Model (with and without shortages) – Manufacturing Model (with and without shortages) - Stochastic Inventory Model (Stock in discrete and continuous units).

DECISION MODEL

Decision Model – Game theory – Two Person Zero sum game – Algebraic solutions Graphical solutions – Replacement model – Model based on Service life – Economic life single / multivariable search technique.

Text Books

1. H.A.Taha, "Operations Research",Prentice Hall of India , 1999, Six Edition.
2. KantiSwarup,P.K.Gupta,Man Mohan, SultanChand& Sons, New Delhi(2010)

Reference Books

1. Sundarasen.V, Ganapathysubramaniyam . K.S. Ganesan.K. "Operations Research" ,A.R. Publications
2. Premkumar Gupta, Hira, "Operations Research" Chand & company New Delhi.

Assessment Pattern/Assessment Methods

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	
Remember	20	10	10	0
Understand	20	30	30	30
Apply	60	60	60	70
Analyse	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

Course Designers:

S.No	Name of the Faculty	Mail ID
1	V.T.Lakshmi	lak_msc@yahoo.co.in
2	S.Punitha	puni.jeeju80@gmail.com

17PCBS02	PHYSICAL SCIENCES PART A - ENGINEERING PHYSICS	Category	L	T	P	Credit
		FC(BS)	4	0	0	4

PREAMBLE

Engineering Physics is the application of the concepts of physics to various technological applications. Understanding the concepts of laser, types of lasers, the propagation of light through fibers, applications of optical fibers in communication and different types of non-destructive techniques will help an engineer to analyze and design various equipments.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To recall the properties of laser and to explain principles of laser
2	To examine the applications of laser
3	To outline the principles of fibre optics
4	To examine the applications of fibre optics
5	To explain various techniques used in Non-destructive testing

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Define the principles of laser	Understand
CO2. Use laser in designing equipments	Apply
CO3. Explain the principles of fiber optics & the propagation of light in optical fibers	Understand
CO4. Utilize fibre optics in communication systems and sensors	Apply
CO5. Inspect materials using non-destructive testing techniques	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO1 1	P O 12	PSO 1	PS O2	P S O 3
CO1	L	M	L	L									L		
CO2	S	S	M	M	S	M			L			M	L		
CO3	L	M	L	L									L		
CO4	S	S	M	M	S	M			L			M	L		
CO5	S	S	M	M	S	M			M			M	L		

S- Strong; M-Medium; L-Low

SYLLABUS

LASERS: Laser characteristics - Stimulated Emission – Population Inversion - Einstein coefficients – Lasing action – Types of Laser – Nd:YAG laser, CO2 laser, GaAs laser – Applications of Laser –

Holography – construction and reconstruction of a hologram

FIBRE OPTICS: Principle and propagation of light in optical fibres – numerical aperture and acceptance angle – types of optical fibres (material, refractive index, mode) – Applications: Fibre optic communication system – fibre optic displacement sensor and pressure sensor.

NON-DESTRUCTIVE TESTING: Introduction – Types of NDT - Liquid penetrant method – characteristics of penetrant and developer - ultrasonic flaw detector – X-ray Radiography: displacement method – X-ray Fluoroscopy.

TEXT BOOK

Engineering Physics, compiled by Department of Physics, Vinayaka Missions University, Salem.

REFERENCE BOOKS

1. Beiser, Arthur, Concepts of Modern Physics, 5th Ed., McGraw-Hill, 2009.
2. Halliday. D, Resnick. R, Walker. J, Fundamentals of Physics, Wiley & sons, 2013.
3.Gaur R. K. and Gupta S. L., Engineering Physics, DhanpatRai publishers, New Delhi, 2001.
4. Avanadhanulu. M. N., Arun Murthy. T. V. S, Engineering Physics Vol. I, S. Chand, 2014.
5. Rajendran. V, Engineering Physics, Tata McGraw Hill Publication and Co., New Delhi, 2009.
6. Baldev Raj et al. Practical Non-Destructive Testing, Narosa Publications, 2017.

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department / Name of the College	Mail ID
1	Dr.C.Senthil Kumar	Professor	Physics / VMKVEC	senthilkumar@vmkvec.edu.in
2	Dr.R.Sethupathi	Professor	Physics / VMKVEC	sethupathi@vmkvec.edu.in

17PCBS02	PHYSICAL SCIENCES (PART B - ENGINEERING CHEMISTRY)	Category	L	T	P	Credit
		BS	2	0	0	2

Engineering Chemistry explains the fundamentals of Engineering Chemistry and helps the learners to understand the applications of Engineering Chemistry. The electrodes, Cell and ba`tteries study gives a clear idea about electrochemistry. Water technology study gives the initiative about softening of water, desalination and corrosion. Conventional and Non-conventional energy field is essential for the current scenario and the advanced engineering materials are needed for our fast growing life style.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To impart fundamental knowledge in Chemistry so that the student will understand the engineering concept and can face the forthcoming years as well as the industry effectively.
2	To have a clear knowledge of electrochemistry, cells and electrodes.
3	To familiarizes the type of batteries and fuel cell.
4	To lay foundation for practical applications of water softening and desalination in engineering aspects.
5	To inculcate the knowledge of fuel, this is essential for current scenario.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Understand the vital knowledge in Engineering Chemistry helps the learners in future studies	Understand
CO2. Employ the basic knowledge of cells and electrodes	Apply
CO3. Demonstrate the applications of water softening	Apply
CO4. Apply desalination process with engineering aspects	Apply
CO5. Discuss about conventional and non-conventional fuel for the current scenario.	Understand
CO6 Generalize polymers and smart materials	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO 12	PSO 1	PS O2	PSO3
CO1	M	M	M	-	-	M	M	-	-	-	-	M	L		
CO2	M	M	M	-	-	M	M	-	-	-	-	S	L		
CO3	M	S	M	-	-	S	M	-	-	-	-	S	L		
CO4	M	M	M	-	-	M	M	-	-	-	-	S	L		
CO5	M	M	L	-	-	M	S	-	-	-	-	S	L		
CO6	M	M	M	-	-	M	M	-	-	-	-	S	L		

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT – I: ELECTROCHEMISTRY, BATTERIES AND FUEL CELLS

Electrode potential - Nernst equation – Electrodes (SHE, Calomel and Glass) - cells - EMF measurement. Primary battery (Daniel and dry cell) – secondary battery (lead Acid storage battery and Nickel-Cadmium battery) – Fuel cell (H_2-O_2 fuel cell)

UNIT – II: WATER TECHNOLOGY AND CORROSION

Sources of water – impurities – Hardness and its determination (problems to be avoided) – boiler troubles – water softening (Zeolite &Demineralisation) – Domestic water treatment – Desalination (Electrodialysis&ReverseOsmosis).

UNIT – III FUELS AND CHEMISTRY OF ADVANCED MATERIALS

Classification of Fuels (Solid, Liquid, Gaseous, Nuclear and Bio fuels) – Calorific Value of a fuel –Non Petroleum Fuels –Non conventional sources of Energy – combustion.

Basics and Applications:-Organic electronic material, shape memory alloys, polymers (PVC, Teflon, Bakelite)

TEXTBOOK

1.Engineering Chemistry by VMU.

REFERENCES

1. A text book of Engineering Chemistry by S.S. Dara, S.Chand& company Ltd., New Delhi
2. Engineering Chemistry by Jain & Jain, 15th edition Dhanpatrai Publishing Company (P) Ltd., New Delhi
3. A text book of Engineering Chemistry by ShashiChawla, Edition 2012 Dhanpatrai& Co., New Delhi.
4. Engineering Chemistry by Dr. A. Ravikrishnan, Sri Krishna Publications, Chennai.

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department / Name of the College	Mail ID
1	Dr.T.Shanthi	Professor	Chemistry / VMKVEC	shantht@vmkvec.edu.in

17PCBS81	PHYSICAL SCIENCES LAB: PART A – REAL AND VIRTUAL LAB IN PHYSICS	Category	L	T	P	Credit
		FC(BS)	0	0	4	2

PREAMBLE

Real and Virtual Lab in Physics trains the students to take readings with precision. The experiments involve the calculation of physical parameters. In addition to the above, the students have the hands-on experience in performing the experiments through virtual laboratory.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To impart basic skills in taking reading with precision of physics experiments
2	To inculcate the habit of handling equipments appropriately
3	To gain the knowledge of practicing experiments through virtual laboratory.
4	To know the importance of units
5	To obtain results with accuracy

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Operate the equipments with precision	Apply
CO2. Practice to handle the equipments in a systematic manner	Apply
CO3. Demonstrate the experiments through virtual laboratory	Apply
CO4. Recognize the importance of units while performing experiments, during calculating the physical parameters and in obtaining results	Understand
CO5. Calculate the result with accuracy	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	M	S				M			M	L		
CO2	S												L		
CO3	S	S	M	M	S							S	L		
CO4	S	S											L		
CO5	S	S											L		

S- Strong; M-Medium; L-Low

SYLLABUS

1. Young's modulus of a bar - Non-uniform bending
2. Rigidity modulus of a wire - Torsional Pendulum
3. Viscosity of a liquid - Poiseuille's method
4. Velocity of ultrasonic waves in liquids - Ultrasonic Interferometer
5. Particle size determination using Laser
6. Wavelength of spectral lines – grating – Spectrometer
7. Thickness of a wire - Air wedge Method
8. Thermal conductivity of a bad conductor - Lee's disc
9. Band gap determination of a thermistor - Post Office Box

10. Specific resistance of a wire – Potentiometer

LAB MANUAL

Physical Sciences Lab: Part A – Real And Virtual Lab In Physics Manual, prepared by the faculty of Department of Physics, Vinayaka Mission's Kirupananda Variyar Engineering College, Salem (2017).

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department / Name of the College	Email id
1	Dr.C.Senthil Kumar	Professor	Physics / VMKVEC	senthilkumar@vmkvec.edu.in
2	Dr.R.Sethupathi	Assistant Professor	Physics / VMKVEC	sethupathi@vmkvec.edu.in

17PCBS81	PHYSICAL SCIENCES PART B - ENGINEERING CHEMISTRY LAB	Category	L	T	P	Credit
		BS	0	0	2	1

Engineering Chemistry Lab experiments explains the basics and essentials of Engineering Chemistry. It also helps the students to understand the applications of Engineering Chemistry. The electrodes, Cell and batteries study gives clear basic application oriented knowledge about electrochemistry. Water technology study gives the idea about hardness and its disadvantages.. Now-a-days the practical and handling of equipments are needed for our fast growing life style.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To impart basic skills in Chemistry so that the student will understand the engineering concept.
2	To inculcate the knowledge of water and electrochemistry.
3	To lay foundation for practical applications of chemistry in engineering aspects.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Understand the basic skills for his/her future studies.	Understand
CO2 Analyze the water comprehensively.	Apply
CO3. Apply the practical knowledge in engineering aspects	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	-	L	M	M	S	-	-	-	M	L	-	-
CO2	S	M	M	-	L	M	M	L	-	-	-	M	L	-	-
CO3	S	S	M	-	L	M	M	M	-	-	-	M	L		

S- Strong; M-Medium; L-Low

1. Determination of Hardness by EDTA method
2. Estimation of Hydrochloric acid by conductometric method
3. Acid Base titration by pH method
4. Estimation of Ferrous ion by Potentiometric method
5. Determination of Dissolved oxygen by Winkler's method
6. Estimation of Sodium by Flame photometer
7. Estimation of Copper from Copper Ore Solution
8. Estimation of Iron by Spectrophotometer

Text Book:

1. Engineering Chemistry Lab Manual by VMU.

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department / Name of the College	Email id
1.	Dr.T.Shanthi	Professor	Chemistry / VMKVEC	shantht@vmkvec.edu.in

17PHBS05	SMART MATERIALS	Category	L	T	P	Credit
		FC (BC)	3	0	0	3

PREAMBLE

Smart Materials gives an outlook about various types of materials having potential application in Engineering and Technology. In particular, Students learn about Smart Materials and their applications, Properties of Crystalline Materials &Nanomaterials, Characteristics of Magnetic materials. They also get a clear picture about superconducting materials.

PRERQUISITE - NIL

COURSE OBJECTIVES

1	To explain the properties of smart materials
2	To demonstrate the structure of crystalline materials
3	To examine the synthesis of Nano materials
4	To explain the properties and classification of magnetic materials
5	To outline the concept of superconducting materials and their properties

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Utilize the smart materials for designing equipments	Apply
CO2. Interpret the structure of crystalline materials	Apply
CO3. Develop equipments using nano materials	Analyze
CO4. Use the properties of magnetic materials in designing equipments	Apply
CO5. Develop the efficiency of superconducting materials	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	S	M	S				M			M	L		
CO2	S	M	S	M	S				M			M	L		
CO3	S	S	S	S	S				S			M	L		
CO4	S	M	S	M	S				M			M	L		
CO5	S	S	S	S	S				S			M	L		

S- Strong; M-Medium; L-Low

SYLLABUS

SMART MATERIALS: Shape Memory Alloys (SMA) – Characteristics and properties of SMA, Application, advantages and disadvantages of SMA. Metallic glasses – Preparation, properties and applications.

CRYSTALLINE MATERIALS: Unit cell – Bravais lattice – Miller indices – Calculation of number of atoms per unit cell – atomic radius – coordination number – packing factor for SC, BCC, FCC, HCP structures.

NANO MATERIALS: Nanophase materials – Top-down approach - Mechanical Grinding -

Lithography - Bottom-up approach – Sol-gel method – Carbon nanotubes – Fabrication – applications.

MAGNETIC MATERIALS: Basic concepts – Classification of magnetic materials – Domain theory – Hysteresis – Soft and Hard magnetic materials.

SUPERCONDUCTING MATERIALS: Superconducting phenomena – properties of superconductors – Meissner effect – isotope effect – Type I and Type II superconductors – High Tc Superconductors – Applications of superconductors.

TEXT BOOK:

Mani P, Engineering Physics II, Dhanam Publications, 2011.

REFERENCES:

1. Pillai S.O., Solid State Physics, New Age International (P) Ltd., publishers, 2009.

2. Senthilkumar G. Engineering Physics II. VRB Publishers, 2011.

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department / Name of the College	Mail ID
1	Dr.C.Senthil Kumar	Professor	Physics / VMKVEC	senthilkumar@vmkvec.edu.in
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17PHBS06	ENERGY PHYSICS	Category	L	T	P	C
		FC(BS)	3	0	0	3

Preamble
The objective is to make the learners understand about Energy Physics

Prerequisite
NIL

Course Objective

1	Understand concept of physics behind the various energy modes.
2	Learn the essential information about energy resources and their utilization
3	Learn the physics involved energy sources

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Understand the concept of light and optical properties of solids	Understand
CO2.	Understand the various applications of energies	Understand
CO3.	Improve their knowledge in nuclear physics	Acquire
CO4.	Familiarize their knowledge of sound based energy in piezoelectric	Apply
CO5.	Analyze Technology based wind energy resources	Analyze
CO6.	Simulation of energy wave generation	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO 12	PS O1	PS O2	PSO 3
CO1	S	M	L	M	S	M	S	M	L	M	S	M	-	-	-
CO2	S	-	M	S	M	L	M	S	M	S	L	M	-	-	-
CO3	M	L	-	L	S	M	S	L	M	S	-	L	-	-	-
CO4	S	M	-	-	L	M	S	M	S	L	S	M	-	-	-
CO5	M	M	M	-	S	-	S	L	S	M	L	L	-	-	-
CO6	S	L	S	L	-	L	M	-	M	L	-	M			

S- Strong; M-Medium; L-Low

Syllabus	
Solid state light energy	
Light Sources, Luminaries, Ballasts; Lamp Types and their Features. Florescence, Phosphorescence, Electroluminescence, development of electroluminescent materials and thin film devices, solid state display devices-Applications	
Wave energy systems	
Wave Characteristics and Statistics- Plane and Spherical Waves-. Longitudinal and Transverse Waves-Plane Progressive Waves-Pressure of a Longitudinal Wave-Energy Transport-Intensity of Wave- Ripple and Gravity Waves- Wave Energy Devices. -Applications	
Atomic Energy	
Introduction-Nuclear Fission and Nuclear Fusion- Power from fission, Conversion and breeding, Neutron transport equation, Diffusion theory approximation, Nuclear Energy and the Environment. Nuclear reactors-Applications. .	
Geothermal Energy	
Introduction -Nature of Geothermal energy resources- Definition and Classification-Geothermal energy concepts-Utilization of Geothermal Resources - Geothermal Technologies-Applications.	
Piezoelectric Energy	
Introduction- Ultrasound - Characteristics of piezoelectric effect- materials and mathematical description of piezoelectricity - piezoelectric parameters and modeling- piezoelectric generators.- piezoelectric energy harvesting applications.	
Text Books	
1	Nuclear Energy by Raymond Murray Keith Holbert, 7th Edition.
Reference Books	
	1. “OPTICAL PROPERTIES OF SOLIDS “by Frederick. Wooten, Department of Applied Sciences University of California Davis, California. 2. Introduction to Wind Energy Systems: Basics, Technology and Operation (Green Energy and Technology), by Hermann-Josef Wagner, ISBN: 9783642020223, Publisher: Springer, September 2009. 3. Classification of geothermal systems – a possible scheme –Subir K. Sanyal – GeothermEx, Inc. 4. Geothermal reservoir engineering – Geothermal Communities (GEOCOM) project EU Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.

	5. Handbook of Ocean Wave Energy- Arthur PecherJens Peter Kofoed Editors. 6. Piezoelectric Energy Harvestingby Mohammad Adnan Ilyas

Course Designers

S.No	**Faculty Name**	**Designation**	**Department/College**	**Email id**
1	Dr.Latha	Assoc.Prof	H&S/AVIT	
2				
3				

17PHBS07	SPACE SCIENCE	Category	L	T	P	Credit
		FC(BS)	3	0	0	3

PREAMBLE

Space Science is the study about the Universe by using the principles & concepts of Physics. Space Science involves the study about solar system, planets, stars, galaxies, meteors, asteroids, orgin of universe. Understanding the space will provide opportunity for a mechanical engineer to designing various equipments for further understanding about our universe.

PREREQUISITE

-

COURSE OBJECTIVES

1	To recall the structure of universe.
2	To explain about comets, meteors and asteroids
3	To examine the structure of sun.
4	To correlate the origin and types of stars.
5	To outline the origin of universe.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Define the basic principles and properties of universe	Remember
CO2. Describe the dynamics of comets, meteors	Understand
CO3. Illustrate the structure of sun.	Apply
CO4. Illustrate the types of starts	Analyze
CO5. Analyze the origin of universe	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO 11	PO 12	PS O1	PSO 2	PSO3
CO1	M	L	M	L	L				L			M			
CO2	M	L	L	L	L				L			M			
CO3	M	M	M	L	M				M			M			
CO4	M	S	M	L	M				L			M			
CO5	M	S	L	L	M				L			M			

S- Strong; M-Medium; L-Low

SYLLABUS

UNIVERSE PLANETS: Interior planets - exterior planets - crust, mantle and core of the earth - different - region of earth's atmosphere - rotation of the earth - magnetosphere - Van Allen belts - Aurora.

COMETS, METEORS, ASTEROIDS: Composition and structure of comets - periodic comets – salient features of asteroids, meteors and its use

STRUCTURE OF SUN: Sun Structure of photosphere, chromosphere, corona - sunspots – solar flares - solar prominences - solar piages - satellites of planets -structure, phases and their features of moon.

TYPES OF STARS & GALAXIES: Stars Constellations - binary stars - their origin and types star clusters – globular clusters - types of variable stars - types of galaxies.

ORIGIN OF UNIVERSE: Big bang theory - pulsating theory - steady state theory – composition of universe expansion

REFERENCES:

1. K.D. Abyankar, Astrophysics of the solar system, University press, India (1999)

2. BaidyanathBasu, Sudhindra Nath Biswas And Tanuka Chattopadhyay, An Introduction To Astrophysics, Prentice Hall OfIndia, New Delhi (2010)

3. Prof. P. Devadas, The fascinating Astronomy, Devadas Telescopies, Chennai

4. R.P. Singhal, Elements of Space Physics, PHI, (2009)

COURSE DESIGNERS

S.No.	Name of the Faculty	Mail ID
1	Dr. C. SENTHIL KUMAR	senthilbdu@gmail.com
2	Dr. R. SETHUPATHI	sethupathivmkv@gmail.com

17PHBS08	FUNDAMENTALS OF NANOSCIENCE	Category	L	T	P	Credit
		FC(BS)	3	0	0	3

PREAMBLE

The goal of this course is to provide an insight into the fundamentals of nanoscience and nanotechnology. Then the whole spectrum of nanomaterials ranging from overview, synthesis, properties, and characterization of nanophase materials.

PRERQUISITE

-

COURSE OBJECTIVES

1	To acquire the knowledge of basic sciences required to understand the fundamentals of Nanomaterials.
2	To acquire the knowledge of electronic, optical and magnetic properties of nanomaterials.
3	To know the importance of the synthesis method addressed in the material properties and give practical experience of nanomaterials synthesis/properties and characterization; investigations into the various factors influence the properties of nanomaterials.
4	To know about carbon nano tubes
5	To learn about various characterization techniques

COURSE OUTCOMES

On the successful completion of the course, students will be able to

1. To understand the fundamentals of nanoscience and technology	Understand
2. To synthesis of nanomaterials by various method	Create
3. To construct the nanostructure material by lithographic techniques	Create
4. To demonstrate the praparation, properties and application of carbon nanotube	Apply
5. To examine the nanomaterials by various characterization technique	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	L	M	L	M			M			M			
CO2	S	M	M	M	M	M			M			M			
CO3	S	S	S	S	S	M			M			M			
CO4	S	S	S	S	S	M			M			M			
CO5	S	S	S	S	S	M			M			M			

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nanoparticles -quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

PREPARATION METHODS

Bottom-up Synthesis-Top-down Approach: Precipitation, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

FOUNDATION - BASIC SCIENCES - SYLLABUS

17CMES02	BASICS OF CIVIL AND MECHANICAL ENGINEERING PART A- BASICS OF CIVIL ENGINEERING	Category	L	T	P	Credit
		FC(ES)	4	0	0	4

PREAMBLE-The aim of the subject is to provide a fundamental knowledge of basic Civil Engineering

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To understand the basic concepts of surveying and construction materials.
2	To impart basic knowledge about building components.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. An ability to apply knowledge of mathematics, science, and engineering.	Apply
CO2. An ability to design and conduct experiments, as well as to analyze and interpret data.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	-	M	S	-	-	-	-	-	-	M	-	-
CO2	S	M	L	S	M	S	-	-	M	-	-	-	-	S	-

S- Strong; M-Medium; L-Low

SYLLABUS

SURVEYING AND CIVIL ENGINEERING MATERIALS
SURVEYING: Objects – types – classification – principles – measurements of distances – angles – levelling – determination of areas – illustrative examples.

CIVIL ENGINEERING MATERIALS: Bricks – stones – sand – cement – concrete – steel sections.
BUILDING COMPONENTS AND STRUCTURES :
FOUNDATIONS: Types, Bearing capacity – Requirement of good foundations.

SUPERSTRUCTURE: Brick masonry – stone masonry – beams – columns – lintels – roofing – flooring – plastering – Mechanics – Internal and external forces – stress – strain – elasticity – Types of Bridges and Dams – Basics of Interior Design and Landscaping.

TEXT BOOKS:

1. 1."Basic Civil and Mechanical Engineering", VMU, (2017). Company Ltd., New Delhi,2009

REFERENCES:

1. Ramamrutham S., "Basic Civil Engineering", Dhanpatrai Publishing Co. (P) Ltd., 2009.
2. Seetharaman S., "Basic Civil Engineering", Anuradha Agencies.

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department / Name of the College	Mail ID
1	S. Supriya	Assist. Professor	CIVIL / VMKVEC	jansupriyanair@gmail.com
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17CMES02	B-BASICS OF MECHANICAL ENGINEERING	Category	L	T	P	Credit
		FC(ES)	4	0	0	4

Preamble

Basic Mechanical Engineering gives the fundamental ideas in the areas of engineering design, manufacturing and Automobile engineering. An engineer needs to understand, the basic manufacturing techniques and working principle of an Automobile Engineering Components.

Prerequisite –NIL

Course Objective

1	To demonstrate the principles of casting and metal joining processes in manufacturing.
2	To describe and to apply the in depth knowledge in automotive engines and important components.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Illustrate the application of casting and metal joining processes in manufacturing	Apply
CO2.	Demonstrate the operation of automotive engines and important components	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	L	L	M	-	-	-	-	-	M	L	-	-
CO2	S	M	L	L	L	M	-	-	-	-	-	M	L	-	-

S- Strong; M-Medium; L-Low

Syllabus

FOUNDRY AND WELDING

Foundry: Introduction to Casting - Types, Pattern- Definition, Function. Foundry tools. Green Sand Moulding application.

Welding: Introduction to welding, Classification – Gas welding, Arc Welding, TIG, MIG, Plasma – Definitions. Arc Welding - Methods and Mechanisms – Applications.

AUTOMOTIVE ENGINES AND COMPONENTS

Introduction, Two stroke and four stroke cycle – Petrol and Diesel Engines - Construction and working, Fundamentals of automotive components - Brakes, Clutches, Governor, Flywheel, Axles, Drives etc., Fuel supply systems, Exhaust emission and control.

Text Books

1	Basic Civil and Mechanical Engineering, School of Mechanical Engineering Sciences, VMU, Salem

Reference Books

1	K.Venugopal, Basic Mechanical Engineering, Anuradha Publications, Chennai
2	NR. Banapurmath, Basic Mechanical Engineering, Vikas Publications, Noida
3	TJ.Prabu, Basic Mechanical Engineering, SCITECH Publications, Chennai

Course Designers

S.No	Faculty Name	Designation	Department / Name of the College	Email id
1	S. Duraithilagar	Associate Professor	Mech / VMKVEC	sduraithilagar@vmkvec.edu.in
2	T.Raja	Assistant Professor	Mech / VMKVEC	rajat@vmkvec.edu.in

17CMES81	ENGINEERING SKILLS PRACTICE LAB PART A - BASIC CIVIL ENGINEERING LAB	Category	L	T	P	Credit
		FC(ES)	0	0	4	2

PREAMBLE

Engineering Skills Practice is a hands-on training practice to Mechanical, Civil and Mechatronics Engineering students. It deals with fitting, carpentry, sheet metal and related exercises. Also, it will induce the habit of selecting right tools, planning the job and its execution.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To understand the basic concepts of surveying and construction materials.
2	To impart basic knowledge about building components.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Prepare the different types of fitting.	Apply
CO2. Prepare the different types of joints using wooden material	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	S	L	L	L	-	L	L	M	L	L	L	L	M	-	-
CO2	S	S	S	L	L	-	L	L	L	L	S	L	-	S	-

S- Strong; M-Medium; L-Low

LIST OF EXPERIMENTS:

BUILDINGS:

1. Study of plumbing and carpentry components of residential and industrial buildings, Safety aspects.

PLUMBING WORKS:

2. Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
3. Study of pipe connections requirements for pumps and turbines.
4. Preparation of plumbing line sketches for water supply and sewage works.
5. Hands-on-exercise: Mixed pipe material connection – Pipe connections with different joining components.
6. Demonstration of plumbing requirements of high-rise buildings.

CARPENTRY USING POWER TOOLS ONLY:

7. Study of the joints in roofs, doors, windows and furniture.
8. Hands-on-exercise: Wood work, joints by sawing, planning and cutting.

TEXT BOOKS:

1. “Laboratory Reference Manualby VMKVEC Civil Engineering Department

COURSE DESIGNERS				
S.No	Name of the Faculty	Designation	Department / Name of the College	Mail ID
1.	S.Supriya	Assist. Professor	Civil / VMKVEC	jansupriyanair@gmail.com
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17CMES81	ENGINEERING SKILLS PRACTICE LAB B. BASIC MECHANICAL ENGINEERING	Category	L	T	P	Credit
		FC(ES)	0	0	4	2

Preamble

Workshop is a hands-on training practice to Mechanical Engineering students. It deals with fitting, carpentry, foundry and welding related exercises. Also, it will induce the habit of selecting right tools, planning the job and its execution.

Prerequisite –NIL

Course Objective

1	To perform the practice in different types of fitting processes.
2	To executive joints using wooden materials.
3	To apply in depth knowledge in metal joining processes.
4	To demonstrate the pattern using foundry processes

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Perform the different types of fitting using MS plate.	Apply
CO2.	Practice the different types of joints using wooden material	Apply
CO3.	Demonstrate the different types of joints in metal by Arc Welding	Apply
CO4.	Utilize the different types of green sand mould	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PS O3
CO1	S	-	L	-	-	-	-	-	M	-	-	-	L	-	-
CO2	S	-	L	-	-	-	-	-	M	-	-	-	L	-	-
CO3	S	-	-	-	-	-	-	-	-	-	-	-	L	-	-
CO4	S	-	L	-	-	-	-	-	M	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

Syllabus

LIST OF EXPERIMENTS

Tee – Fitting
Vee – Fitting
Preparation of a mould for a single piece pattern
Preparation of a mould for a split piece pattern
Half- Lap Joint in Carpentry
Dove Tail Joint in Carpentry
Lap Joint – Welding
Butt Joint – Welding

Text Books

1	**BASIC MECHANICAL ENGINEERING, LAB MANUAL**

Reference Books

1	K.Venugopal, Basic Mechanical Engineering, Anuradha Publications, Chennai
2	NR. Banapurmath, Basic Mechanical Engineering, Vikas Publications, Noida

Course Designers

S.No	Faculty Name	Designation	Department / Name of the College	Email id
1	V K Krishnan	Associate Professor	Mech / VMKVEC	vkkrishnan@vmkvec.edu.in
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17CSES01	ESSENTIALS OF COMPUTING	CATEGORY	L	T	P	CREDIT
		FC(ES)	3	0	0	3

PREAMBLE

This course aims to provide the fundamental concepts of Computer operations like hardware and software installation, and emphasizing principles application packages. Studying the fundamentals concepts of Algorithms, to resolve the real world application.

PRERQUISITE-NIL

COURSE OBJECTIVES

1	To provide basic knowledge of hardware and software components of computers.
2	To introduce and demonstrate various software application packages.
3	To study Problem solving Techniques and program development cycle.
4	To learn about various algorithm and identifying the algorithm efficiency.
5	To learn different algorithm for various application

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Basic knowledge on hardware and software terminologies.	Remember and Understand
CO2. Demonstration about various Application Packages like MS-word, MS- Excel etc.	Apply
CO3. Understand Program Devolvement Cycle and apply various Problem Solving Techniques.	Understand, Apply.
CO4. Identifying and analyzing the efficiency of Algorithms.	Understand.
CO5. Implementation of Algorithms for various concepts.	Understand and Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO 3
CO1	S	-	-	-	-	-	-	-	-	-	-	-	L		
CO2	S	M	-	-	-	-	-	-	-	-	-	-	L		
CO3	S	S	S	-	M	-	-	-	-	-	-	-	L		
CO4	S	S	S	-	S		-	-	-	-	-	-	L		
CO5	S	M	M	-	M	-	-	-	-	-	-	-	L		

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT-I

BASICS OF COMPUTER AND INFORMATION TECHNOLOGY: Computer – Generations, Types of Computers, Block diagram of a computer – Components of a computer system –Hardware and software definitions – Categories of software – Booting – Installing and Uninstalling a Software –Software piracy – Software terminologies – Applications of Computer – Role of Information Technology – History of Internet – Internet Services.

UNIT-II

SOFTWARE APPLICATIONS: Office Automation: Application Packages – Word processing (MS Word) – Spread sheet (MS Excel) – Presentation (MS PowerPoint).

UNIT-III

PROBLEM SOLVING METHODOLOGIES: Problems Solving Techniques - Program Development Cycle – Algorithm Development – Flow chart generation –Programming Constructs (Sequential, Decision-Making, Iteration) – Types and generation of programming Languages.

UNIT-IV

INTRODUCTION TO ALGORITHMS: Implementation of Algorithms – program verification – The efficiency of algorithms – The analysis of algorithms.

UNIT-V

IMPLEMENTATION OF ALGORITHMS: Fundamental Algorithms: Introduction – Exchanging the values of two variables – Counting – Summation of a set of Numbers – factorial computation – Generation of the Fibonacci sequence – Reversing the digits of an integer.

TEXT BOOKS:

1. Essentials of Computer Science and Engineering", Department of Computer Sciences, VMKVEC, Salem, Anuradha Publishers, 2017.
2. Dromey.R.G, "How to Solve it by Computer", Prentice-Hall of India, 1996.

REFERENCES:

1. Aho.A.V., Hopcroft.J.E and Ullman.J.D, "The Design and Analysis of Computer Algorithms", Pearson Education, 2004.

2. Knuth,D.E., "The Art of computer programming Vol 1:Fundamental Algorithms", 3rd Edition, Addison Wesley,1997.

COURSE DESIGNERS

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1	Dr. NitishaAggarwal	Associate Professor	CSE / AVIT	nitishaaggarwal@avit.ac.in
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4	Mrs.T.Geetha	Assistant Professor	CSE / VMKVEC	geetha@vmkvec.edu.in

17CSES05	PROGRAMMING IN PYTHON	CATEGORY	L	T	P	CREDIT
		FC(ES)	3	0	0	3

PREAMBLE

The purpose of this course is to introduce Python, a remarkably powerful dynamic programming language to write code for different operating systems along with application domain. Python has evolved on more popular and powerful open source programming tool

PRERQUISITE

NIL

COURSE OBJECTIVES

1	To provide basic knowledge on Python programming concepts.
2	To introduce different methods in list, string, tuple, dictionary and sets.
3	To compute different programs using python control statements.
4	To learn about different functions in python.
5	To compute the exception handling functions, file concepts and CSV and JSON.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Learn python statements, comments and indentation, tokens, input and output methods using various example programs.	Remember and Understand
CO2. Learn the different methods involved in List, String, Tuples and Dictionary.	Apply
CO3. Design solutions for complex programs using decision making and looping statements.	Understand and Apply.
CO4. Develop the function programs with all the concepts like lambda, decorators and generators.	Understand, Apply and analyze.
CO5. Compute the exception handling programs, file concept programs and understand the concepts of CSV and JSON.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO 1	PO 2	PO3	PO 4	PO5	PO 6	PO 7	PO8	PO 9	PO10	PO11	PO12	PS O1	PSO 2	PSO 3
CO1	S	M	L	-	M	L	-	-	L	M	M	S	L	-	-
CO2	S	M	L	-	-	L	-	-	L	M	M	S	L	-	-
CO3	S	S	S	S	M	L	-	-	L	M	M	S	L	-	-
CO4	S	S	S	S	-	L	-	-	S	M	M	S	L	-	-
CO5	S	M	M	-	-	L	-	-	S	M	M	S	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT-1 INTRODUCTION

Introduction to python-Advantages of python programming-Tokens-Variables-Input/output methods-Data types-Operators

UNIT-2 DATA STRUCTURES

Strings-Lists-Tuples-Dictionaries-Sets

UNIT-3 CONTROL STATEMENTS

Flow Control-Selection control Structure-if-if-else-if-elif-else-Nested if iterative control structures-while loop, for loop and range.

UNIT-4 FUNCTIONS
Declaration-Types of Arguments-Fixed arguments, variable arguments, keyword arguments and keyword variable arguments-Recursions-Anonymous functions: lambda- Decorators and Generators.
UNIT-5 EXCEPTION HANDLING
Exception Handling-Regular Expression-Calendars and clock files:File input/output operations-Dictionary operations-Reading and writing in structured files:CSV and JSON.

TEXT BOOKS:

1. Bill Lubanovic, "Introducing Python Modern Computing in Simple Packages", 1st Edition, O'Reilly Media, 2014.
2. Programming With Python Book ‘Himalaya Publishing House Pvt Ltd
3. “Dive Into Python” by Mark Pilgrim

REFERENCES:

1. Mark Lutz, “Learning Python”, 6th Edition, O'Reilly Media, 2014.
2. David Beazley, Brian K. Jones, "Python Cookbook", 3rd Edition, O'Reilly Media, 2015.
3. Mark Lutz, “Python Pocket Reference”, 6th Edition, O'Reilly Media, 2015.

COURSE DESIGNERS

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1	K.Karthik	Assistant Professor	CSE / AVIT	karthik@avit.ac.in
2	E.Srividhya	Assistant Professor	CSE / AVIT	srividhya@avit.ac.in
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17CSES83	PROGRAMMING IN PYTHON LAB	Category	L	T	P	Credit
		FC(ES)	0	0	4	2

PREAMBLE

This laboratory enables the students clearly understand the basic concepts of python, control statements and file commands in python.

PRERQUISITE - NIL

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1.Learn python statements, comments and indentation, tokens, input and output methods using various example programs.	Remember and Understand
CO2. Learn the different methods involved in List, String, Tuples and Dictionary.	Remember and Understand
CO3. Design solutions for complex programs using decision making and looping statements.	Understand, Apply, analyze and evaluate
CO4. Develop the function programs with all the concepts like lambda, decorators and generators.	Understand, Apply, analyze and evaluate
CO5. Compute the exception handling programs, file concept programs and understand the concepts of CSV and JSON.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO10	PO11	PO12	PS O1	PS O2	PSO 3
CO1	S	M	L	-	-	-	-	-	-	-	-	-	L		
CO2	S	M	L	-	-	-	-	-	-	-	-	-	L		
CO3	S	M	M	-	-	-	-	-	-	-	-	-	L		
CO4	S	M	M	-	-	-	-	-	-	-	-	-	L		
CO5	S	M	M	-	-	-	-	-	-	--	-	-	L		

S- Strong; M-Medium; L-Low

LIST OF EXPERIMENTS

1. Write a program to sum of series of N natural numbers
2. Write a program to calculate simple interest.
3. Write a program to generate Fibonacci series using for loop
4. Write a program to calculate factorial using while loop
5. Write a program to find the greatest of three numbers using if condition
6. Write a program for finding the roots of a given quadratic equation using conditional control statements
7. Write a program to find the greatest of three numbers using conditional operator
8. Write a program to compute matrix multiplication using the concept of arrays
9. Write a program to implement recursive function
10. Write a program to read and write data using file concepts

REFERENCES:

1. Mark Lutz, “Learning Python”, 5th Edition, O'Reilly Media, 2013.
2. David Beazley, Brian K. Jones, "Python Cookbook", 3rd Edition, O'Reilly Media, 2013.
3. Mark Lutz, “Python Pocket Reference”, 5th Edition, O'Reilly Media, 2014.

COURSE DESIGNERS

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17EEES03	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING A. BASIC ELECTRICAL ENGINEERING	Category	L	T	P	Credit
		FC(ES)	4	0	0	4

PREAMBLE

It is a preliminary course which highlights the basic concepts and outline of Electrical engineering. The concepts discussed herein are projected to deliver explanation on basic electrical engineering for beginners of all engineering graduates.

PREREQUISITE–NIL

COURSE OBJECTIVES

1	To understand the electrical inventions, basic concepts of AC and dc circuit and basic laws of electrical engineering.
2	To gain knowledge about the working principle, construction, application of DC and AC machines and measuring instruments.
3	To understand the fundamentals of safety procedures, Earthing and Power system.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO 1: Explain the evolution of electricity, name the inventors, electrical quantities and basic laws of electrical engineering.	Remember
CO 2: Demonstrate Ohm's and Faraday's Law.	Apply
CO 3: Understand the basic concepts of measuring instruments, electrical machineries and its applications.	Understand
CO 4: Analyze the various types of electrical loads, power rating of electrical machineries and energy efficient equipment.	Analyze
CO 5: Explain the electrical safety and protective devices.	Understand
CO 6: Compare the various types electrical power generation systems by application of conventional and non-conventional sources.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	-	S	-	-	-	-	-	-	L	L	-	-
CO2	S	M	S	S	-	-	-	-	M	-	-	M	L	-	-
CO3	L	S	L	-	S	-	-	-	-	L	-	L	L	-	-
CO4	S	M	S	L	L	S	S	-	-	S	-	L	L	-	-
CO5	L	M	S	M	-	S	M	M	-	S	-	L	L	-	-
CO6	S	L	S	L	M	S	S	-	-	M	-	L	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

HISTORY OF ELECTRICITY, QUANTITIES AND CIRCUITS

Evolution of Electricity and Electrical inventions, Electrical quantities- Charge, Electric potential, voltage, current– DC & AC, power, energy, time period, frequency, phase, flux, flux density, RMS, Average, Peak, phasor& vector diagram. Electric Circuits - Passive components (RLC), Ohm's law, KCL, KVL, Faraday's law, Lenz's law. Electrical materials – Conducting and insulating materials.

MEASURING INSTRUMENT AND ENERGY CALCULATION

Measuring Instruments – Analog and Digital meters – Types and usage. AC and DC Machines & Equipment-

Types, Specifications and applications.
Loads – Types of Loads- Power rating and Energy calculation – for a domesticloads. Energy Efficient equipments – star ratings.

ELECTRICALSAFETY AND INTRODUCTIONTOPOWERSYSTEM
Protection & Safety - Hazards of electricity - shock, burns, arc-blast, Thermal Radiation, explosions, fires, effects of electricity on the human body. Electrical safety practices, Protection devices.
Electric Power- Generation resources, Transmission types & Distribution system (levels of voltage, power ratings and statistics)-Simple layout of generation, transmission and distribution of power.

TEXT BOOKS:

1. Metha.V.K,RohitMetha,"*BasicElectricalEngineering*",Fifthedition,Chand.S&Co,2012
2. Kothari.D.PandNagrath.I.J,"*BasicElectricalEngineering*",Secondedition,TataMcGraw-Hill,2009
3. R.K.Rajput , "Basic Electrical and Electronics engineering", Second Edition, Laxmi Publication, 2012

REFERENCE BOOKS:

1. SmarajtGhosh,"*FundamentalsofElectrical&ElectronicsEngineering*",Secondedition,PHILearning,2007

COURSE DESIGNERS

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17EEES03	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING B. BASIC ELECTRONICS ENGINEERING	Category	L	T	P	Credit
		FC(ES)	4	0	0	4

PREAMBLE

The course aims to impart fundamental knowledge on electronics components, digital logics and communication engineering concepts. The course begins with classification of various active and passive components, diodes and transistors. It enables the student to design small digital logics like multiplexer, demultiplexer, encoder, decoder circuits, etc. It crafts the students to get expertise in modern communication systems.

PREREQUISITE–NIL

COURSE OBJECTIVES

1	To learn and identify various active and passive components and their working principles.
2	To understand the number conversion systems.
3	To learn the digital logic principles and realize adders, multiplexer, etc.,
4	To understand the application oriented concepts in the communication systems.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Classify the electronic components and make out the working principle of diodes and transistors	Understand
CO2. Explore the working principle of rectifiers, regulators and transistors.	Analyze
CO3. Execute number system conversions and digital logic operations.	Apply
CO4. Realize the design of adders, Multiplexer, De-Multiplexer, Encoder, Decoder circuits.	Analyze
CO5. Familiarize with application oriented concepts in the communication systems.	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	-	-	-	-	-	-	-	-	-	-	L		-
CO2	S	M	M	L	-	-	-	-	-	-	-	-	L		-
CO3	S	M	L	-	-	-	-	-	-	-	-	-	L		-
CO4	S	M	M	L	-	-	-	-	-	-	-	-	L		-
CO5	M	L	-	-	-	-	-	-	-	-	-	L	L		-

S- Strong; M-Medium; L-Low

SYLLABUS

SEMICONDUCTOR DEVICES

Passive and Active Components - Resistors, Inductors, Capacitors, Characteristics of PN Junction Diode - Zener Diode and its Characteristics - Half wave and Full wave Rectifiers - Voltage Regulation. Bipolar Junction Transistor, JFET, MOSFET & UJT.

DIGITAL FUNDAMENTALS

Number Systems – Binary, Octal, Decimal and Hexa-Decimal – Conversion from one to another – Logic Gates – AND, OR, NOT, XOR, Universal Gates – Adders, Multiplexer, De Multiplexer, Encoder, Decoder – Memories

COMMUNICATION AND ADVANCED GADGETS

Modulation and Demodulation – AM, FM, PM – RADAR – Satellite Communication – Mobile Communication, LED, HD, UHD, OLED, HDR & Beyond, Smart Phones – Block diagrams Only.

TEXT BOOKS:

1. R.K. Rajput, "Basic Electrical and Electronics Engineering", Laxmi Publications, Second Edition, 2012.

2. "Basic Electrical and Electronics Engineering", Department of EEE & ECE, Faculty of Engineering & Technology, VMRFDU, Anuradha Agencies, 2017.
3. Edward Hughes, "Electrical and Electronics Technology", Pearson Education Limited, Ninth Edition, 2005.

REFERENCES:

1. John G.Proakis and DimitrisG.Manolakis, "Digital Signal Processing Principles, Algorithms and Applications", Prentice-Hall of India, Fourth Edition, 2006.
2. VinayK.Ingle and John G.Proakis, "Digital Signal Processing using MATLAB" CL Engineering, Third Edition, 2011
3. Sophocles J.Orfanidis "Introduction to Signal Processing", Prentice Hall, 1996.
4. John G.Proakis and MasoudSalehi, "Communication Systems Engineering" Prentice Hall, Second Edition, 2002.

COURSE DESIGNERS

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1	Dr.T.Sheela	Associate Professor	ECE / VMKVEC	sheela@vmkvec.edu.in
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17EEES82	ENGINEERING SKILLS PRACTICE LAB A. BASIC ELECTRICAL ENGINEERING LAB	Category	L	T	P	Credit
		FC(ES)	0	0	4	2

PREAMBLE

It is a laboratory course which familiarizes the basic electrical wiring, measurement of electrical quantities and various types of earthing methods.

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To learn the residential wiring and various types of electrical wiring.
2	To measure the various electrical quantities.
3	To know the necessity and types of earthingand measurement of earth resistance.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO 1: Implement various types of electrical wiring.	Apply
CO 2: Measure fundamental parameters of AC circuits.	Analyze
CO 3: Measure the earth resistance of various electrical machineries.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	S	M	L	-	S	-	-	-	-	-	-	L	L	-	-
CO2	S	M	S	S	-	-	-	-	M	-	-	M	L	-	-
CO3	L	S	L	-	S	-	-	-	-	L	-	L	L	-	-

S- Strong; M-Medium; L-Low

List of Experiments

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring.
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

REFERENCES

1. Laboratory Reference Manual

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department / Name of the College	Mail ID
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17EEES82	ENGINEERING SKILLS PRACTICES LAB PART B - BASIC ELECTRONICS ENGINEERING	Category	L	T	P	Credit
		FC(ES)	0	0	4	2

PREAMBLE

This course is to provide a practical knowledge in Basic Electronics Engineering. It starts with familiarization of electronic components and electronic equipments. It enables the students to construct and test simple electronic projects.

PRERQUISITE – NIL

COURSE OBJECTIVES

1	To familiarize the electronic components, basic electronic equipments and soldering techniques.
2	To study the characteristics of Diodes, BJT and FET.
3	To understand the principles of various digital logic gates.
4	To understand the concept of basic modulation techniques.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Understand the basics of various electronic components and equipments and their working principles.	Understand
CO2. Understand the fundamentals of soldering techniques for active and passive components	Understand
CO3. Know the characteristics of Diodes, BJT and FET.	Understand
CO4. Verify the truth tables of logic gates (AND, OR, NOT, NAND, NOR, XOR).	Understand
CO5. Distinguish between amplitude and frequency modulation techniques.	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M	L	-	-	-	-	M	-	L	-	M	-	L		
CO2	M	L	-	-	-	-	M	-	L	-	M	-	L		
CO3	M	L	-	-	-	-	M	-	M	-	M	-	L		
CO4	M	L	-	-	-	-	M	-	M	-	M	-	L		
CO5	M	L	-	-	-	-	M	-	M	-	M	-	L		

S- Strong; M-Medium; L-Low

LIST OF EXPERIMENTS

1.Identifying Electronics Components.
2. Practicing of Soldering and Desoldering.
3. Characteristics of PN junction Diode.
4. Characteristics of Zener diode.
5. Input & Output characteristics of BJT.
6. Transfer characteristics of JFET.
7. Verification of Logic Gates.
8. Study of Amplitude Modulation.
9. Study of Frequency Modulation.

COURSE DESIGNERS

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		Professor	VMKVEC	
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17MEES84	ENGINEERING GRAPHICS (Theory & Practice)	Category	L	T	P	Credit
		FC(ES)	1	0	4	3

Preamble

Engineering Graphics is referred as language of engineers. An engineer needs to understand the physical geometry of any object through its orthographic or pictorial projections. The knowledge on engineering graphics is essential in proposing new product through drawings and interpreting data from existing drawings. This course deals with orthographic and pictorial projections, sectional views and development of surfaces.

Prerequisite – NIL

Course Objective

1	To implement the orthographic projections of points, straight lines, plane surfaces and solids.
2	To construct the orthographic projections of sectioned solids and true shape of the sections.
3	To develop lateral surfaces of the uncut and cut solids.
4	To draw the pictorial projections (isometric and perspective) of simple solids.
5	To sketch by free hand the orthographic views from the given pictorial view.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Execute in the form of drawing of the orthographic projections of points, straight lines, plane surfaces and solids.	Apply
CO2.	Demonstrate in the form of drawing of the orthographic projections of sectioned solids and true shape of the sections.	Apply
CO3.	Develop lateral surfaces of the solid section and cut section of solids.	Apply
CO4.	Draw the pictorial projections (isometric and perspective) of simple solids.	Apply
CO5.	Implement the free hand sketch of the orthographic views from the given pictorial view.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO 2	PO3	PO 4	PO5	PO 6	PO7	PO8	PO 9	PO1 0	PO 11	PO 12	PSO 1	PS O2	PS O3
CO1	S	S	L	S	L	-	-	-	-	-	-	-	L	-	-
CO2	S	S	L	S	L	-	-	-	-	-	-	-	L	-	-
CO3	S	S	L	S	L	-	-	-	-	-	-	-	L	-	-
CO4	S	M	L	S	S	-	-	-	-	-	-	-	L	-	-
CO5	S	S	L	S	L	-	-	-	-	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

Syllabus

PLANE CURVES AND FREE HAND SKETCHING

Conics – Construction of ellipse– First angle projection – layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

PROJECTION OF POINTS, LINES

Projection of points, Projection of straight lines located in the first quadrant: inclined to both planes – Determination of true lengths and true inclinations – rotating line method only.

PROJECTION OF SOLIDS

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to any one reference plane by change of position method.

SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES

Sectioning of above solids in simple vertical position by cutting planes inclined to any one reference plane and perpendicular to the other – Obtaining true shape of section. Development of lateral surfaces of simple and truncated solids like Prisms, pyramids, cylinders and cones.

ISOMETRIC VIEW AND PERSPECTIVE PROJECTION

Principles of isometric View – isometric scale – isometric view of simple solids- Introduction to

Perspective projection				
Text Books				
1	Natarajan K V, "Engineering Graphics", Tata McGraw-Hill Publishing Company Ltd. New Delhi.			
2	K.Venugopal and V.Prabhu Raja, "Engineering Graphics", New Age International Private Limited.			
3	K.R.Gopalakrishna"Engineering Drawing" (Vol. I & II), Subhas Publications, 2014.			
Reference Books				
1	N.D. Bhat and V.M. Panchal, Engineering Graphics, Charotar Publishers 2013			
2	E. Finkelstein, "AutoCAD 2007 Bible", Wiley Publishing Inc., 2007			
3	R.K. Dhawan, "A text book of Engineering Drawing", S. Chand Publishers, Delhi,2010.			
4	DhananjayA.Jolhe, "Engineering Drawing with an Introduction to AutoCAD", Tata McGraw Hill Publishing Company Limited, 2008.			
5	G.S. Phull and H.S.Sandhu, "Engineering Graphics", Wiley Publications, 2014.			
Course Designers				
S.No	Faculty Name	Designation	Department / Name ofthe College	Email id
1	Dr. S.VENKATESAN	Professor	Mech / VMKVEC	venkatesan@vmkvec.edu.in
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LITHOGRAPHY FOR NANOSCALE DEVICES
Introduction to optical/UV electron beam and X-ray Lithography systems and processes, Wet etching, dry (Plasma /reactive ion) etching, Etch resists-dip pen lithography

CARBON NANO TUBE
Introduction to Carbon Nano Tube (CNT) - Types of carbon nano tube - Characteristics of carbon nano tube - synthesis of CNT- Properties of CNT- Application of CNT.

CHARECTERISATION TECHNIQUES
X-ray diffraction technique, Scanning Electron Microscopy – environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS Nano-indentation

TEXT BOOK:
1. Chatwal and Anand. Instrumental Methods of Analysis.
2. Skoog, D., 2000. Instrumental Methods of Analysis.

REFERENCES:
1. Campbell, I.D. and Dwek, R.A., 1986. Biological Spectroscopy, Benjamin Cummins and Company.
2. Atkins, P.W., 1990. Physical Chemistry, 4thEdition
3. Willard, H.H., Merrit, J.A., Dean, L.L. and Setlle, F.A., 1986. Instrumental Methods of Analysis. CBS Publishers and Distributors.Edn., Oxford.
4. Gordon G. Hammes., 2005. Spectroscopy for Biological Science. Wiley & Sons Publications.

COURSE DESIGNERS

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CORE COURSES

17CVCC33	STRENGTH OF MATERIALS	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

The aim of the course is to understand the concepts of stress and strain and their use in the analysis and design of structures

PREREQUISITE - ENGINEERING MECHANICS

COURSE OBJECTIVES

1	To understand basic mechanical forces acting on rigid and deformable bodies.
2	To learn to draw shear force and bending moment diagram for various types of beams.
3	To learn the torsional effects on circular bars, shafts, helical spring.
4	To learn the deflection equations of beams and columns for different end conditions.
5	To learn the two dimensional stresses and deformation of cylinders and spherical shells.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Compute resultant, resolve several concurrent forces and also to apply equilibrium concepts, Compute simple stresses and strains	Apply
CO2. Practice shear force and bending moment computations and construct shear force and bending moment diagrams	Apply
CO3. Torsional effects on circular bars, shafts, helical spring.	Apply
CO4. Evaluation of beam deflection and slope	Apply
CO5. Compute bending and shear stresses for various sections and plot the variation across the cross section	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	M	M	M	-	-	-	-	S	-	-	L	-	M	-	-
CO2.	S	S	S	-	-	-	-	-	-	-	S	-	L	L	-
CO3.	S	S	S	M	-	-	-	-	-	-	S	-	-	M	-
CO4.	S	S	S	S	-	M	-	S	-	-	S	-	-	L	L
CO5.	S	S	S	S	-	M	-	-	-	-	S	-	M	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

STRESS- STRAIN AND DEFORMATION OF SOLIDS: Properties of material, Concept of Stress and Strain, Hook's Law, Stress Strain Diagram for structural steel and Non-ferrous materials. Poisson's Ratio & principles of superposition, Total elongation of tapering bars of circular and rectangular cross-sections. Elongation due to self-weight, volumetric strain. Expression for Volumetric strain, Elastic constants, relationship among elastic constants, compound bars Rigid and Deformable bodies – Strength- Stiffness and Stability – Stresses; Tensile-Compressive and Shear – Elastic constants – Strain energy and unit strain energy – Strain energy in uniaxial loads.

BEAMS - LOADS AND STRESSES : Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever- Simply supported and Overhanging beams – Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section – Shear stresses in beams.

TORSION: Analysis of torsion of circular bars – Shear stress distribution – Bars of Solid and hollow circular section – Stepped shaft – Twist and torsion stiffness – Compound shafts – Fixed and simply supported shafts – Application to close-coiled helical springs – Maximum shear stress in spring section including Wahl Factor – Deflection of helical coil springs under axial loads – Design of helical coil springs.

DEFLECTION OF BEAMS : Elastic curve of Neutral axis of the beam under normal loads – Evaluation of beam deflection and slope: Double integration method- Macaulay Method- and Moment-area Method –Columns – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine formula for columns – Introduction to curved beams.

ANALYSIS OF STRESSES IN TWO DIMENSIONS: Biaxial state of stresses – Thin cylindrical and spherical shells – Deformation in thin cylindrical and spherical shells – Biaxial stresses at a point – Stresses on inclined plane – Principal planes and stresses – Mohr's circle for biaxial stresses – Maximum shear stress - Strain energy in bending and torsion.

TEXT BOOKS:

1. Ramamrutham.S- Strength of Materials- S.Chand&B Co. - New Delhi-2007.
2. Beer F. P. and Johnston R- "Mechanics of Materials"- McGraw-Hill Book Co- Third Edition- 2008.
3. Srinath L.N., " Advanced Mechanics of Solids ", Tata McGraw Hill Publishing Company Ltd., New Delhi,2009
4. Dr.R.K.Bansal,"A Textbook of Strength of Materials"Laxmi Publications,2010

REFERENCE BOOKS:

1. Nash W.A- "Theory and problems in Strength of Materials"- Schaum Outline Series-, McGraw-Hill Book Co- New York- 2005
2. Ryder G.H- "Strength of Materials"- Macmillan India Ltd.- Third Edition- 2007
3. Ray Hulse- Keith Sherwin & Jack Cain- "Solid Mechanics"- Palgrave ANE Books- 2006.
4. Singh D.K "Mechanics of Solids" Pearson Education 2009.

COURSE DESIGNERS

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1	A.FizoorRahman	Assistant Professor	CIVIL	fizoorr@gmail.com
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3	A.Senthilkumar	Assistant Professor	MECHANICAL	senthilkumar@avit.ac.in

17CVCC34	FLUID MECHANICS AND MACHINERY	Category	L	T	P	Credit
		CC	3	0	0	3

Preamble

The aim of the subject is to provide a fundamental knowledge in fluid mechanics and machinery.

Prerequisite : NIL

Course Objective

1	To learn the fundamentals in Fluid Mechanics
2	To understand the kinematics of the fluid flow.
3	To understand the fluid flow concepts
4	To learn the working principle, applications & design of various hydraulic turbines.
5	To learn the working principle, applications &, design of various hydraulic pumps.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Determine the variation of pressure in fluid at rest and calculate the hydrostatic forces and point of application on a plane or curved surface.	Apply
CO2.	Distinguish between various types of flows and derive the continuity equation for compressible and incompressible flow	Apply
CO3.	Understand the use and limitations of the Bernoulli's equation and apply it to solve a variety of fluid flow problems.	Apply
CO4.	Describe the condition under which the flow in a circular pipe is laminar or turbulent	Apply
CO5.	Estimate the major and minor losses in pipe flow and calculate the flow through pipes connected in series and in parallels	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	S	M	M	L	M	L	-	-	-	-	-	L	L	-	-
CO2	S	M	M	L	L	L	-	-	-	-	-	M	L	-	-
CO3	S	M	M	L	L	L	-	-	-	-	-	L	L	-	-
CO4	S	S	S	M	L	L	-	L	-	-	L	M	L	-	-
CO5	M	M	M	L	L	M	-	-	-	-	L	M	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS
BASIC CONCEPTS AND PROPERTIES
Fluid – Definition - solid and fluid - Units and dimensions - Properties of fluids – Temperature - Viscosity - Compressibility - Vapour pressure - Capillary and surface tension - Fluid statics: concept of fluid static pressure - Pressure measurements by manometers and pressure gauges. Introduction to CFD, geophysical fluid dynamics. Velocity and density measurement methods.
FLUID KINEMATICS AND SIMILARITIES
Fluid Kinematics - Flow visualization - Lines of flow - Types of flow - Velocity field and acceleration - Continuity equation (one and three dimensional differential forms)- Equation of streamline - Stream function - Velocity potential function - Circulation - Flow net – Fluid dynamics - Equations of motion - Euler's equation along a streamline - Bernoulli's equation – Applications - Venturi meter - Orifice meter - Pitot tube - Dimensional analysis - Buckingham's π theorem- Applications - Similarity laws and models.
INCOMPRESSIBLE FLUID FLOW
Viscous flow - Navier-Stoke's equation - Shear stress - Pressure gradient relationship - Laminar flow between parallel plates - Laminar flow through circular tubes (Hagen poiseulle's) - Hydraulic and energy gradient - Flow through pipes - Darcy - Weisbagh's equation - Pipe roughness -Friction factor- Moody's diagram - Minor losses - Flow through pipes in series and in parallel - Power transmission - Boundary layer flows - Boundary layer thickness - Boundary layer separation - Drag and lift coefficients. Major losses-design aspect in application of drags and lift coefficients. Piping Engineering-Introduction and Applications.
HYDRAULIC TURBINES
Fluid machines: definition and classification - Exchange of energy - Euler's equation for turbo machines - Construction of velocity vector diagrams - Head and specific work - Components of energy transfer - Degree of reaction. Hydro turbines: definition and classifications - Pelton turbine - Francis turbine - propeller turbine - Kaplan turbine - Working principles - Velocity triangles - Work done - Specific speed - Efficiencies - Performance curve for turbines. Energy saving design requirements for turbine.
HYDRAULIC PUMPS
Pumps: definition and classifications - Centrifugal pump: classifications - Working principle- velocity triangles - Specific speed - Efficiency and performance curves - Reciprocating pump: classification - Working principle - Indicator diagram -Work saved by air vessels and performance curves - Cavitations in pumps - Rotary pumps- Applications.

Text Books

1	Bansal- R.K. - “Fluid Mechanics and Hydraulics Machines”- (5^{th} edition) - Laxmi publications (P) Ltd- New Delhi- 2005.
2	Modi.P.N. & Seth.S.M., a Textbook on Fluid Mechanics, Standard Publishers Ltd.

Reference Books

1	White- F.M. - “Fluid Mechanics”- Tata McGraw-Hill- 5^{th} Edition- New Delhi- 2003.
2	Ramamurtham. S- "Fluid Mechanics and Hydraulics & Fluid Machines"-Dhanpat Rai & Sons, Delhi- 2003.

Course Designers

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17CVCC93	HYDRAULICS AND STRENGTH OF MATERIALS LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

The aim of the subject is to provide make the students to understand the basic mechanism in hydraulics and strength of materials.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To understand the concepts of fluid mechanics and performances of various pumps
2	To get hands on experience to conduct testing of materials.
3	To perform operations in hydraulic machineries and test various materials.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Measure the flow in pipe section using orificemeter and venturimeter and discharge in channels using notches	Apply
Co2. Determine the major and minor losses in pipes	Apply
Co3. Study the performance of different types of hydraulic turbines and pumps	Apply
Co4. Determine the behavior of structural elements, such as bars, beams and springs subjected to tension, compression, shear, bending, and torsion by means of experiments	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO12	PSO 1	PS O2	PSO3
CO1	S	M	M	L	-	-	-	M	-	-	-	M			
CO2	S	M	M	L	-	-	-	M	-	-	-	M			
CO3	S	M	M	M	L	-	-	-	-	-	-	M			
CO4	M	M	M	M	--	L	--	M	L	M	M	L			

S- Strong; M-Medium; L-Low

LIST OF EXPERIMENTS

CYCLE -I

1. A comparative analysis of Coefficient of discharge using Orifice meter &venturimeter.
2. Determination of pipe loses(major & minor).
3. Conducting experiments and draw the characteristic curves of centrifugal pump/submersible pump/jet pump/reciprocating pump/Gear pump (any 3 pump experiments must be done).

4. Study about the performance characteristics of Pelton wheel and Francis turbine.
5. Determination of Tensile strength and Compression strength on a given specimen.

CYCLE –II

6. Determination of shear strength of Mild steel and Aluminium rods
7. Determination of Torsional strength of mild steel rod
8. Determination of Impact strength
9. Conduct of Hardness test on metals - Brinell and Rockwell Hardness.
10. Conduct of Deflection test on beams

TEXT BOOKS:

‘HYDRAULICS AND STRENGTH OF MATERIALS LAB MANUAL’, Department of Civil engineering, VMKV engineering College, Vinayaka Mission’s Research Foundation (Deemed to be University),Salem.

REFERENCES:

1. Modi P.N and Seth S.M, “Hydraulics and Fluid Mechanics Including Hydraulic Machines” Standard Book House” New Delhi, 20thEdition 2015.
2. Bansal R.K, “Fluid Mechanics and Hydraulic Machines” Laxmi Publications, New Delhi, 2015.
3. Rajput. R.K, “A Text book of Fluid Mechanics and Hydraulic Machines”, S.Chand and Company, New Delhi, 2011.

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Name of the College	Mail ID
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17MECC01	BASIC MANUFACTURING PROCESS	Category	L	T	P	Credit
		CC	3	0	0	3

Preamble

This course provides an introduction to Basic Manufacturing Process with a focus casting, welding, forming process, Sheet metal working and plastic Engineering.

Prerequisite – NIL

Course Objective

1	To apply molding and casting process.
2	To discuss the various metal joining work to the student.
3	To employ the different mechanical working of metals like rolling, forging etc.
4	To employ and apply the sheet metal forming methods.
5	To perform the plastic forming and Its applications in various fields.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Implement the concept of making green sand mould and cost the metals on the mould. Understand the pattern making concepts and allowances.	Apply
CO2.	Demonstrate and apply the knowledge of various metal joining process and applications. Issues present in these process and their remedies.	Apply
CO3.	Explain the concept of mechanical working of materials. Hot and cold working processes. Refining of grin size and strength variations. Variations in the mechanical behavior of metals.	Understand
CO4.	Identify the geometry to get the different shapes using the sheet metals and it is applied for various engineering and other applications.	Understand
CO5.	Select suitable conventional materials to replace plastics and also to reduce the cost and weight of the product.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	-	-	-	-	-	-	-	-	-	-	L	-	-
CO2	S	S	S	-	-	-	-	-	-	-	-	-	L	-	-
CO3	S	M	M	L	-	-	-	-	-	L	-	-	L	-	-
CO4	S	M	M	L	-	-	-	-	-	L	-	-	L	-	-
CO5	S	M	M	L	L	-	-	-	-	L	-	-	L	-	-

S- Strong; M-Medium; L-Low

Syllabus

Introduction to Casting Processes

Introduction: Concept of manufacturing process, Classification and its importance of manufacturing processes, Casting processes: steps involved, advantages and limitations - allowances and their importance, core making process - Moulding sand: constituents, types, properties, Cupola furnace and Electric Arc furnace - Sand casting processes: mould making, pouring, casting. Special casting processes - Shell and investment casting - Centrifugal casting - Casting defects and remedies.

Metal Joining Processes

Introduction to various Welding processes – Classification of welding processes –Gas welding, Arc welding, TIG, MIG, Submerged arc welding–Resistance welding – Friction welding - seam welding – Percussion welding – Introduction to friction stir welding, Brazing and soldering processes - Weld defects and control measures. Introduction to inspection methods

Mechanical Working of Metals

Hot and Cold working of materials - Forging: hot and cold forging, open and close forging, types forging machines, types of forging operations. Extrusion: hot and cold extrusion, forward and backward extrusion, types operations. Rolling: hot and cold rolling, types and operations, wire drawing and tube piercing. Drawing: Hot and cold drawing – sheet metal drawing, deep drawing, bar drawing, tube drawing, tube piercing, wire drawing, plastic drawing

Sheet Metal Forming Processes

Sheet metal processes: characteristics, Typical shearing, bending, curling, embossing, coining and drawing operations – Stretch forming operations: Formability of sheet metal – Working principle and applications– various special forming processes.

Plastic Engineering

Plastics: Etymology -classification and properties– applications and environmental effects- Manufacturing processes of plastics -High performance plastics– plastic joining methods.

Text Books

1	Elements of Workshop Technology- Vol. I -SK Hajra Choudhury - Indian book distributing company, Calcutta- 1986.
2	“Manufacturing Engineering and Technology”, Serope Kalpakjian-Steven R.Schmid - Pearson Education- Inc. 2002 (Second Indian Reprint).
3	“Manufacturing Technology”, Vol-1- P.N.Rao - Tata McGraw-Hill Publishing Limited- IInd Edition- 2002
4	Prabhu.T.J, Jai Ganesh. V and Jebaraj.S, “Basic Mechanical Engineering”, Scitech Publications, Chennai, 2000.

Reference Books

1	“Elements of Manufacturing Processes”, B.S. Nagendra Parashar & R.K. Mittal- Prentice Hall of India learning pvt. ltd- 2012.
2	“A text book of production technology”, P.C. Sharma- S. Chand and Company, 2006.
3	“Manufacturing science”, Amithaba Gosh & Asok kumar Malik, Ellis horwood, 1986.
4	Hajra Choudhury. S.K, Hajra Choudhury. A.K, Nirjhar Roy, “Elements of Workshop Technology”, Vol. 1, Media Promoters, 2009.
5	Kalpakjian, S. and Schmid, S.R., 2014. Manufacturing engineering and technology (p. 913). Upper Saddle River, NJ, USA: Pearson.
6	Hitomi, K., 2017. Manufacturing Systems Engineering: A Unified Approach to Manufacturing Technology, Production Management and Industrial Economics. Routledge.

Course Designers				
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17MECC02	ENGINEERING THERMODYNAMICS	Category	L	T	P	Credit
		CC	2	1	0	3

Preamble

Thermodynamics is a branch of science that deals with energy and its transfer. All activities in nature involve some interaction between energy and matter. Engineering thermodynamics plays a major part in the design and analysis of automotive engines, rockets, jet engines, refrigeration and air-conditioning systems, and power plants, etc. Therefore, developing a good understanding of the basic principles of engineering thermodynamics is essential for mechanical engineers. This course deals with the basic principles and concepts of thermodynamics, laws of thermodynamics, energy and entropy of ideal gas, steam, and mixture of gases.

Prerequisite

NIL

Course Objectives

1	To discuss the basic concepts and laws of thermodynamics
2	To apply the concept of enthalpy and entropy in thermal systems
3	To discuss the working principle of steam cycles and pure substances.
4	To calculate the properties of gas and vapour mixtures
5	To perform combustion analysis and exhaust gas analyzer

Course Outcomes

On the successful completion of the course, students will be able to

CO 1.	Discuss the basic concepts and laws of thermodynamics	Understand
CO 2.	Apply concept of enthalpy and entropy in thermal systems	Apply
CO 3.	Discuss the working principle of steam cycles and pure substances.	Understand
CO 4.	Calculate properties of gas and vapour mixtures	Apply
CO 5.	Perform combustion analysis and in exhaust gas analyzer	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1.	M	L	--	--	--	--	--	--	--	--	--	--	L	--	--
2.	S	M	L	--	--	--	--	--	--	--	--	--	L	--	--
3.	S	M	L	--	--	--	--	--	--	--	--	--	L	--	--
4.	S	S	M	L	--	--	--	--	--	M	--	--	L	--	--
5.	S	S	S	M	--	--	--	--	--	M	--	--	L	--	--

S- Strong; M-Medium; L-Low

Syllabus

BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS

Definition of Thermodynamics, macroscopic and microscopic approach, thermodynamic systems and surroundings, thermodynamic properties, thermodynamic equilibrium, state, path, process and cycle, reversible and irreversible processes, work, energy, and heat, state postulate and Zeroth- law of thermodynamics, thermometer and thermometric property, temperature Scales.Internal energy, First law of thermodynamics, perpetual motion machine of the first kind PMM I, application of first law to non-flow processes or closed system and related problems, application of first law to steady flow process, steady flow energy equation. Problems

SECOND LAW OF THERMODYNAMICS

Limitations of First law of thermodynamics, thermal reservoir, heat engine, refrigerator, and heat pump, statements of Second law of thermodynamics, perpetual motion machine of II Kind - PMM II, Carnot cycle, , Carnot theorem, corollary of Carnot's theroem, Clausius inequality. Problems on heat engine, refrigerator and heat pump. Entropy, Temperature – entropy diagram, entropy changes for a closed system. Problems on entropy change calculations in different processes. Availability and irreversibility , available and unavailable energy, availability in non-flow and steady flow systems. Problems on irreversibility and avaialbility.

PURE SUBSTANCES AND THERMODYNAMIC RELATIONS

Definition of pure substance, phase change of a pure substance, p-T diagram, p-V-T Surface, phase change terminology, property diagram in common use. Formation of steam, sensible heat, latent heat, dryness fraction, enthalpy, superheated steam, thermodynamic properties of steam and steam table, work, internal energy, entropy calculation, Mollier diagram, calorimeters for determination of dryness fraction. Problems determining thermodynamic properties of steam.
Thermodynamic relations : Thermodynamic potentials, thermodynamic gradients, general thermodynamics relations, entropy (Tds) equations, equations for internal energy and enthalpy, equation of state, coefficient of expansion and compressibility, specific heats, Joule Thomson coefficient, Clausius –Claperyon equation, Maxwell's relations.

GASES AND VAPOUR MIXTURES

Ideal gas, equation of state for a perfect gas, Joules law, internal energy, enthalpy & specific heat capacities of an ideal gas, real gases, Van der waals equation – Amagats experiment , the cooling effect. Law of corresponding states, reduced properties, compressibility chart. Problem on calculation of properties ideal and real gases. Daltons law, Gibbs – Daltons law, volumetric analysis of a gas mixture, apparent molecular weight and gas constant, specific heats of a gas mixture, adiabatic mixing of perfect gases. Problems on gas mixture property values.

FUELS AND COMBUSTION

Characteristics of an ideal fuel, properties of fuel , flash point , fire point, cloud point, pour point, viscosity, combustion reaction and combustion analysis, theoretical air and excess air, stoichiometric air fuel ratio, analysis of combustion products, internal energy and enthalpy of formation, calorific value, determination of calorific value of fuels, Junkers gas calorimeter, Orsat apparatus, exhaust gas analyser, problem on calculation of air fuel ratio.

TEXT BOOK:

1. Yunus. A.Cengel et al, Thermodynamics: An Engineering Approach, McGH, 8^{th} Edn, 2015.
2. P.K.Nag, Engineering Thermodynamics, Mc Graw Hill, 5^{th} edition,2013.

REFERENCES:

1. R.K.Rajput, A text book of Engineering Thermodynamics , Laxmi Publications, 5^{th} Edn, 2016.
2. D.S.Kumar, Engineering Thermodynamics : Principles and Practices, Laxmi Publications, Katsun Books 2012.

Course Designers:

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3				
4				

17MECC03	ENGINEERING MECHANICS	Category	L	T	P	Credit
		CC	2	1	0	3

Preamble

This course provides the basic knowledge about the behavior of the bodies which are under static and dynamic conditions.

Prerequisite

NIL

Course Objective

1	To explain the basic laws of mechanics and forces
2	To relate the basic concepts and application of rigid bodies under equilibrium in two dimension
3	To employ the concepts of properties of surfaces and to find the Centroid and moment of Inertia using various methods in solid sections.
4	To practice problems in the areas of Friction and Rigid body dynamics by understanding the basic concepts of Friction and Rigid body dynamics.
5	To calculate and categorize of problems in the area of dynamics of particles.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Identify the engineering problems using the concept of static equilibrium	Understand
CO2.	Solve problems of rigid bodies under equilibrium in two dimension and apply various conditions	Apply
CO3.	Determine the Centroid of a line, areas, and volumes, center of mass of body and moment of inertia of composite areas, mass moment of inertia	Apply
CO4.	Solve problems involving frictional phenomena.	Apply
CO5.	Solve problems in engineering systems using the concept of dynamic equilibrium and analyze the numerical results	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	L	L		L							L		
CO2	S	L	L	M		L							L		
CO3	S	M	M	M		L							M		
CO4	S	M	M	M		L							M		
CO5	S	S	S	S		L							S		

S- Strong; M-Medium; L-Low

SYLLABUS	
BASICS & STATICS OF PARTICLES	
Introduction - Units and Dimensions - Laws of Mechanics - Lame's theorem. Parallelogram and triangular law of forces - Coplanar Forces - Resolution and Composition of forces - Equilibrium of a particle - Forces in space - Equilibrium of a particle in space - Equivalent systems of forces - Principle of transmissibility - Single equivalent force.	
EQUILIBRIUM OF RIGID BODIES	
Free body diagram - Types of supports and their reactions - requirements of stable equilibrium - Moments and Couples - Moment of a force about a point and about an axis - Vectorial representation of moments and couples - Scalar components of a moment - Varignon's theorem - Equilibrium of Rigid bodies in two dimension.	
PROPERTIES OF SURFACES AND SOLIDS	
Determination of Areas and Volumes - First moment of area the Centroid of sections - Rectangle, circle, triangle from integration - T section, I section, Angle section, Hollow section by using standard formula - second and product moments of plane area - Rectangle, triangle, circle from integration - T section, I section, Angle section, Hollow section by using standard formula - Parallel axis theorem and perpendicular axis theorem - Polar moment of inertia - Principle moments of inertia of plane areas - Mass moment of inertia.	
FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS	
Frictional force - Laws of Coloumb friction - simple contact friction - Rolling resistance - Belt friction. Translation and Rotation of Rigid Bodies - Velocity and acceleration - General Plane motion.	
DYNAMICS OF PARTICLES	
Displacement, Velocity and acceleration, their relationship - Relative motion - Curvilinear motion - Newton's law - Work Energy equation of particles - Impulse and Momentum - Impact of elastic bodies.	
Text Books	
1	Beer & Johnson, Vector Mechanics for Engineers. Vol. I Statics and Vol. II Dynamics, McGraw Hill International Edition, 1995.
2	Kottiswaran N,Engineering Mechanics-Statics & Dynamics,Sri Balaji Publications,2014.
3	Meriam, Engineering Mechanics, Vol. I Statics & Vol. II Dynamics 2/e, Wiley Intl., 1998.
Reference Books	
1	Rajasekaran.S, and Sankara Subramanian G, “Engineering Mechanics”, Vikas Publishing Co. New Delhi.
2	Irving H. Sharma, Engineering Mechanics - Statics & Dynamics, III Edition, Prentice Hall of India Pvt. Ltd., 1993.
3	K.L.Kumar, Engineering Mechanics III Edition, Tata McGraw Hill Publishing Co. Ltd., 1998

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17MECC04	MANUFACTURING TECHNOLOGY	Category	L	T	P	Credit
		CC	3	0	0	3

Preamble

This course aims to provide knowledge on the working, advantages, limitations and applications of various machining processes. Machine tools are power driven machine for making products of a given shape, size and accuracy by removing metal from the metal block.

Prerequisite : NIL

Course Objective

1	To apply fundamentals of metal cutting processes and cutting tools.
2	To discuss the types, construction and different operations of lathes.
3	To apply the knowledge of different operations on special machines and various types of work holding devices
4	To employ the types, specification and operations of sawing, broaching and gear cutting machines.
5	To explain classification, working and process parameter of grinding machines

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Calculate the cutting forces and cutting tool life.	Apply
CO2.	Understand the working principle and various operations of lathes.	Understand
CO3.	Design work holding & tool holding devices for special machining operations.	Apply
CO4.	Effectively select sawing, broaching and gear cutting for different types of operations to get better surface finish	Apply
CO5.	Gain application oriented knowledge related to grinding machines and super finishing process	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	L	L	-				L				L		
CO2	S	L	L		-				L				L		
CO3	S	L	L		-				L				L		
CO4	S	L	L		-				L				L		
CO5	S	L	L	L	-				L				L		

S- Strong; M-Medium; L-Low

SYLLABUS	
Fundamentals of Metal cutting & Cutting tools	
Basics of metal cutting: Mechanism of chip formation (orthogonal and oblique cutting)-Chip thickness ratio-Velocity ratio-Merchant circle diagram-Cutting forces in orthogonal and oblique cutting -measurement of cutting forces-Types of chips: continuous, discontinuous & continuous with built up edge-Chip breakers- Basics of cutting tools: Characteristics, Cutting tool materials, properties and applications-Tool life: Taylor's equation-Variables affecting tool life and Tool wear**:** Causes-Mechanisms and types-machinability-Definition-Cutting fluids: Functions and types.	
Centre Lathe and Special Purpose Lathe	
Centre lathe: specifications-description-Nomenclature of single point cutting tool-taper turning methods-thread cutting methods-lathe accessories & attachments-Work & tool holding methods/devices-Process parameters **-** Definition of process parameters - cutting speed, feed, Depth of cut (DOC) & machining time. Capstan & Turret lathe: Automats – Swiss type–automatic screw type.	
Shaper, Milling, Drilling and boring Machines	
Shaper: Introduction- types- specifications-description-quick return mechanism. Milling: Column and Knee type milling machine-specifications-description-attachments-milling cutters-Nomenclature of plain milling cutter & operations performed-Work & tool holding methods/devices. Drilling: Introduction to Radial drilling machine and horizontal boring machine -specifications-description-Nomenclature of drill-operations performed on drilling machine-Work & tool holding methods/devices.	
Sawing, Broaching and Gear Cutting	
Sawing machine: hack saw- band saw- circular saw; Broaching machine: Introduction- types-specifications- description-Types of Broaches & Operations, advantages. Gear Generation: forming-shaping- hobbing.	
Grinding Machines and Super Finishing Process	
Grinding: Introduction-Classification-working of grinding machines-Grinding wheel (Abrasives & Bond)-Selection of Grinding wheel-mounting, glazing & loading, dressing, balancing, Work & tool holding methods/devices-Process parameters **-** Definition of process parameters - cutting speed, feed, DOC & machining time-Super finishing processes: Lapping-Honing-Super finishing- Polishing & Buffing	
Text Books	
1	Jain.R.K, "Production Technology : Manufacturing Processes, Technology and Automation", 17^{th} Edition, Khanna Publishers, 2011
2	Rao.P.N, "Manufacturing Technology, Vol I and II", Tata McGraw Hill Publishing Co.,2^{nd} edition.
3	S. K. Hajra Choudhury, Nirjhar Roy, A. K. Hajra Choudhury, "Elements of Work shop Technology, Vol – II Machine Tools", Media Promoters and Publishers Pvt. Ltd, 2009
Reference Books	
1	Serope Kalpakjian and Steven R.Schmid, "Manufacturing Engineering and Technology", Sixth Edition, PHI, 2010
2	P.N.Rao, "Manufacturing Technology", Volume-2, Tata McGraw Hill, New Delhi, Third Edition, 2011.
3	P.C. Sharma, "A Text Book of Production Technology (Manufacturing Processes)", S. Chand & Company Ltd., New Delhi, Seventh Reprint, 2012.

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17MECC05	MECHANICAL BEHAVIOUR OF MATERIALS AND METALLURGY	Category	L	T	P	Credit
		CC	3	0	0	3

Preamble
This course provides basic knowledge in materials behavior and metallurgy.

Prerequisite - NIL

Course Objective

1	To discuss the classification, properties and application of various engineering materials.
2	To describe the strengthening mechanisms, failure modes of materials and study of phase diagrams.
3	To apply the various heat treatment methodologies and mechanical treatment methodologies.
4	To apply the various forms of corrosion, protection methods.
5	To analyze the basic concepts in powder metallurgy, composite materials and working of SEM

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Identify materials for industrial applications based on microstructure and mechanical property relationship.	Understand
CO2.	Select suitable strengthening mechanism and its effects for a crystalline material.	Understand
CO3.	Identify heat treatment methods and surface treatments to improve mechanical properties of materials for applications in engineering industries.	Apply
CO4.	To makes an analysis of the formation and effects of corrosion on various materials.	Apply
CO5.	Perform testing and mechanical properties evaluation of materials for real-time applications. Select advanced materials and various fabrication techniques	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	-	-	-	-	L	-	-	-	-	-	L		
CO2	M	S	M	L	-	-	L	-	-	-	-	-	L		
CO3	S	M	L	M	-	-	L	-	-	-	-	-	L		
CO4	S	S	L	S	-	-	L	-	-		-	-	L		
CO5	L	S	M	S	-	-	L	-	-		-	-	L		

S- Strong; M-Medium; L-Low

SYLLABUS				
METALLIC & NON-METALLIC MATERIALS				
Classification - Metallic materials- Ferrous materials -steel, classifications, effects of alloying elements added in steel, Cast iron- classifications; Non-Ferrous materials-aluminium, copper, titanium, and alloys. Non-Metallic materials- polymers, ceramics; Properties and applications.				
BEHAVIOR OF MATERIALS				
Introduction to plastic deformation - Slip and twinning – Types of fracture –brittle fracture, ductile fracture - Creep and fatigue. Grain Growth: Recovery & Re-crystallization. Phase diagrams - Iron – Iron carbide equilibrium diagram - Time Temperature Transformation (TTT) and Cooling Curve Transformation (CCT) curve.				
MATERIAL TREATMENT				
Heat treatment- Annealing, Normalizing - Hardening and Tempering, Case hardening, Hardenability - Jominy end quench test. Mechanical Treatment- strengthening mechanisms - strain hardening, solid solution hardening, grain size reduction				
CORROSION				
Introduction- forms of corrosion-pitting, intergranular, stress corrosion, corrosion fatigue, dezincification, erosion-corrosion, Crevice Corrosion, Fretting-Protection methods - PVD, CVD.				
ADVANCED MATERIALS & CHARACTERIZATION				
Powder metallurgy – powder production, blending, compaction, sintering-applications. Composites -Types- Metal Matrix Composites (MMC), Polymer Matrix Composites (PMC), Ceramic Matrix Composites (CMC) - properties & applications. Sample preparation methods of MMC, PMC. SEM - working principle and applications				
Text Books				
1	William D Callister “Material Science and Engineering”, John Wiley and Sons 2005.			
2	Sydney H.Avner “Introduction to Physical Metallurgy” McGraw Hill Book Company.			
Reference Books				
1	George E. Dieter, “Mechanical Metallurgy”			
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17MECC06	KINEMATICS OF MACHINES	Category	L	T	P	Credit
		CC	3	0	0	3

Preamble

The students completing this course are expected to understand the nature and role of the kinematics of machinery, the mechanisms and machines. The course includes velocity and acceleration diagrams, analysis of mechanisms joints, Cams and their applications. It exposes the students to various kinds of power transmission devices like belt, rope, chain and gear drives and their working principles and their merits and demerits.

Prerequisite : Engineering Mechanics

Course Objective

1	To study about forces acting on various parts of mechanisms.
2	To learn the velocity and acceleration of various mechanisms.
3	To learn the construction of cam.
4	To study and analyze various types of Gears.
5	To study and analyze various types of Friction drives.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Explain the principles of kinematic pairs, chains and their classification, DOF, inversions, equivalent chains and planar mechanisms.	Understand
CO2.	Determine the position, velocity and acceleration of planer mechanisms.	Apply
CO3.	Design cams and followers for specified motion profiles.	Apply
CO4.	Design gear tooth geometry by select the appropriate gears for the required applications.	Apply
CO5.	Explain friction and its effects in mechanical components	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PSO3
CO1	S	M	L	-	L	L							-	-	-
CO2	M	S	M	M	-	L							L	-	L
CO3	S	M	L	-	L	L							M	-	M
CO4	M	L	S	L	-	L							M	-	M
CO5	S	M	L	-	-	L							L	-	L

S- Strong; M-Medium; L-Low

Syllabus

BASICS OF MECHANISM	
Rigid body, Mechanism and Machine, Kinematic Link, Kinematic Pair -Degree of Freedom - Mobility-Kutzbach criterion- Gruebler's Criterion for degrees of freedom - Grashoff's law-Kinematic Inversions of 4-bar chain and slider crank chains-Mechanical Advantage-Transmission angle-Description of common Mechanisms-Single - Double and offset slider mechanisms - Quick return mechanisms - Ratchets and escapements - Indexing Mechanisms - Rocking Mechanisms - Straight line generators.	
KINEMATICS OF LINKS	
Velocity analysis: Instantaneous centre method, Kennedy's theorem, Locating instantaneous centres, Relative velocity method for slider-crank mechanism, and crank and slotted lever mechanism. Acceleration analysis: Klein's construction, slider crank mechanism, Coriolis acceleration component, Crank and slotted lever mechanism.	
KINEMATICS OF CAM	
Classifications - Displacement diagrams-parabolic- Simple harmonic and Cycloidal motions - Layout of plate cam profiles - Derivatives of Follower motion - High speed cams - circular arc and tangent cams - Standard cam motion.	
GEARS	
Gears and Gear trains: Classification, Terminology, Law of Gearing, Interferences, methods of avoiding interferences, path of contact, arc of contact. Simple gear train, compound gear train, reverted gear train, planetary/epicyclic gear train, Sun and planet gear.	
FRICTION	
Surface contacts-Sliding and Rolling friction - Friction drives – Friction in screw threads - Friction clutches - Belt and rope drives- Friction aspects in Brakes.	
Text Books	
1	Rattan S.S, "Theory of Machines", Tata McGraw-Hill Publishing Company Ltd. New Delhi.
2	Khurmi.R.S. - Gupta, "Theory of Machines". S.Chand & Co., 2001
3	Dr. Sadhu Singh, "Theory of Machines", Pearson Education
Reference Books	
1	Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 2005
2	Ghosh A and A.K.Mallick, "Theory of Mechanisms and Machines", Affiliated East-West Pvt.Ltd., New Delhi.
3	Shigley J.E and Vickes J.J, "Theory of Machines & Mechanism", McGraw Hill, 2000
4	P L Ballaney, "Theory of Machines", Khanna Publisher
5	Kenneth J Waldron, "Kinematics, Dynamics and Design of Machinery", Gary L Kinzel Wiley Edition.

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17MECC07	THERMAL ENGINEERING	Category	L	T	P	Credit
		CC	2	1	0	3

Preamble

Thermal Engineering is the application of thermodynamics that deals with theoretical and practical of thermal based equipment and applications. Thermal Engineering plays a major part in the design and analysis of automotive engines, rockets, jet engines, refrigeration and air-conditioning systems, and power plants, etc. This course deals with the Gas and Vapour Power Cycle, IC Engine, Compressor, Nozzles, Turbine, Refrigeration and Air conditioning.

Prerequisite

Engineering Thermodynamics

Course Objective

1	To apply thermodynamic principles in vapour power cycles, steam nozzles and steam turbines of steam power.
2	To apply the knowledge of various thermodynamic processes to air and gas power cycles and analysis of air and gas power cycles.
3	To apply the knowledge of various thermodynamic processes in Combustion process in IC Engine and compressor.
4	To apply and analyze the performance characteristics of refrigeration systems and properties of refrigerants.
5	To applying the psychrometric properties and their effects in various psychrometric processes in air conditioning.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Knowledge of various thermodynamic processes to vapour power cycles and application of thermodynamic principles in steam nozzles and steam turbines in steam power plants.	Apply
CO2.	Apply the knowledge of various thermodynamic processes and cycles in Air and Gas power cycle of Gas power plants.	Apply
CO3.	Identify the application of thermodynamic principles of internal combustion engines of automobiles and air compressor.	Apply
CO4.	Apply and analyze the performance characteristics of refrigeration systems	Analyze
CO5.	Analyze the psychrometric properties and their effect in various psychrometric processes and Air-conditioning systems.	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	M	M		L							L		
CO2	M	M	L	M		L							L		
CO3	S	M	L	M		L							L		
CO4	S	S	M	S		L				M			L		
CO5	S	S	S	S		L				M			L		

S- Strong; M-Medium; L-Low
SYLLABUS
VAPOUR POWER CYCLES, STEAM NOZZLES AND STEAM TURBINES
Rankine cycles, effect of operating conditions on Rankine cycle efficiency, Modified Rankine cycle, regenerative cycle, reheat cycle, Binary Vapour cycle. Problems on Rankine cycle with reheat and regeneration conditions. Steam nozzles, property calculation of steam flow through nozzles, metastable expansion of steam in a nozzle, steam injector. Problems for velocity and discharge calculation of steam. Steam turbines, classifications, impulse and reaction turbine, compounding of steam turbines, bleeding , governing & control.
AIR AND GAS POWER CYCLES
Air standard cycles, Carnot cycle, Otto cycle, Diesel cycle, Dual cycle, problems on determination of efficiency, mean effective pressure and work. Comparison of air standard cycles. Atkinson cycle, Ericsson cycle, Stirling cycle. Brayton cycle , gas turbines, classification, open cycle and closed cycle, Gas turbine fuels, Calculation of work output and efficiency on Brayton cycle, Application of gas turbine, problems on Brayton cycle.
INTERNAL COMBUSTION ENGINES AND AIR COMPRESSORS
Internal Combustion engines, evolution and classification , components of internal combustion engines , two stroke and four stroke engine, S.I and C.I engines, Valve timing and port timing , fuel supply systems- carburettor and fuel injection , ignition systems, cooling systems – air cooling and liquid cooing systems, lubrication systems, perfomance of I.C engines. Problems on performance calculation. Air compressors- classification, reciprocating air compressor, staging, calculation of work and efficiency, clearance in compressors, intercooler, and applications. Rotary compressor, classification, centrifugal compressor, axial flow compressor, compressor characteristics – surging, choking and stalling. Problems on air compressor – single stage and multi stage.
REFRIGERATION
Refrigeration – refrigeration systems , methods of refrigeration, Air refrigeration system, Reversed carnot cycle, reversed brayton cycle, vapour compression refrigeration cycle-components and functions , factors affecting the performance, vapour absorption systems-components and functions, COP calculations, refrigerant- classifications, properties of an ideal refrigerant, common refrigerants and its applications.
PSYCHROMETRICS AND AIRCONDITIONING
Psychrometry - terms and psychometric relations, psychrometers, psychrometric charts, processes, mixing of air stream, sensible heating, sensible cooling, cooling and dehumidification, cooling and humidification, heating and humidification. Problems using psychrometic charts. Air-conditioning systems, components and its functions, air-conditioning cycle, classification of central air conditioning, zoned systems, unitary systems, unitary – central systems, selection criteria of systems, applications, window type package units and console type package units, filters – types and functions, fans, controls – methods. Air Distribution systems – methods and functions, cooling load estimation methods, Heat load estimation.
Text Books

1	Kothandaraman.C.P, Domkundwar.S, AnandDomkundwar, “A Course in Thermal Engineering”, DhanpatRai& Co. (P) Ltd., 2010.

2	Rajput.R.K, “Thermal Engineering”, Laxmi Publications, 10th Edition, New Delhi, 2015.
Reference Books	
1	Manohar Prasad., (2007), Refrigeration and Air Conditioning, New Age International.
2	Mathur.M.L & Sharma R.P, (2009), Internal Combustion Engine, Dhanpat Rai Publications.

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17MECC08	DYNAMICS OF MACHINES	Category	L	T	P	Credit
		CC	2	1	0	3

Preamble

The student will undergo a sequential understanding of the concept, analyse the applications and gain knowledge in various mechanisms, vibrations and balancing of masses.

Prerequisite : KINEMATICS OF MACHINES

Course Objective

1	To Analyze the concepts of forces acting on machines and its members.
2	To provide an in-depth knowledge and application of balancing of machines.
3	To Analyze and apply the concepts of free vibrations.
4	To Analyze and apply the concepts of forced vibrations.
5	To apply the knowledge of Governors and Gyroscopic forces

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Analyze the concepts of forces acting on machines and its members	Apply
CO2.	Identify the application of balancing of machines.	Apply
CO3.	Analyze the concepts and gain the application of free vibration	Apply
CO4.	Analyze the concepts and gain the application of forced vibration	Apply
CO5.	Apply the knowledge of Governors and Gyroscopic forces	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	S	L	-	-	-	-	-	L	-	-	M		
CO2	S	M	S	L	L	M	-	-	-	L	-	-	M		
CO3	S	S	M	L	M	L	-	-	-	M	-	-	M		
CO4	S	S	M	L	M	L	-	-	-	M	-	-	M		
CO5	S	M	M	L	L	L	-	-	-	M	-	-	M		

S- Strong; M-Medium; L-Low

SYLLABUS

FORCE ANALYSIS
Dynamic force analysis - Inertia force and Inertia torque - D'Alemberts principle - The principle of superposition - Dynamic Analysis in Reciprocating Engines – Gas Forces - Equivalent masses - Bearing loads - Crank shaft Torque - Turning moment diagrams - Fly wheels -Engine shaking Forces
BALANCING
Static and dynamic balancing - Balancing of rotating masses - Balancing a single cylinder Engine - Balancing Multi-cylinder Engines - Partial balancing in locomotive Engines - Balancing linkages - balancing machines.
FREE VIBRATIONS
Basic features of vibratory systems - idealized models - Basic elements and lumping of parameters - Degrees of freedom - Single degree of freedom - Free vibration - Equations of motion - natural frequency - Types of Damping - Damped vibration- critical speeds of simple shaft - Torsional vibration - Natural frequency of two and three rotor systems
FORCED VIBRATIONS
Response to periodic forcing – Harmonic Forcing - Forcing caused by unbalance - Support motion - Force transmissibility and amplitude transmissibility. - Vibration isolation.
MECHANISMS FOR CONTROL
Governors; Force analysis of Porter, Proel and spring controlled governors. Controlling force, stability, sensitiveness, effort and power of governors. Characteristics - Effect of friction. **Gyroscopic Forces**: Gyroscopic couple, Effect of Gyroscopic couple on vehicle; Applications of Gyroscopic forces. - Ships and airplanes

Text Books	
1	Rattan S.S, "Theory of Machines", Tata McGraw-Hill Publishing Company Ltd. New Delhi.
2	Khurmi R.S. - Gupta, "Theory of Machines". S.Chand & Co., 2011
Reference Books	
1	Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 2005
2	Ghosh A and A.K.Mallick, "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., New Delhi.
3	Shigley J.E and Vickes J.J, "Theory of Machines & Mechanism", McGraw Hill, 2009

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17MECC09	DESIGN OF MACHINE ELEMENTS	Category	L	T	P	Credit
		CC	2	1	0	3

Preamble

Students will be able to demonstrate the fundamentals of stress analysis, theories of failure and material science in the design of machine components. Students will be able to make proper assumptions with respect to material, factor of safety, static and dynamic loads for various machine components. Enable the students to have high ethical standards in terms of team work to be a good design engineer.

Prerequisite: Strength Of Materials

Course Objective

1	To familiarize the various steps involved in the Design Process.
2	To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
3	To learn to use standard practices and standard data.
4	To learn to use catalogues and standard machine components.
5	To learn the designing procedure for energy storing elements.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Explain the influence of steady and variable stresses in machine component design.	Understand
CO2.	Apply the concepts of design to shafts, keys and couplings.	Apply
CO3.	Apply the concepts of design to temporary and permanent joints.	Apply
CO4.	Apply the concepts of design to energy absorbing members, connecting rod and crank shaft.	Apply
CO5.	Apply the concepts of design to bearings.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	-	-	-	L	-	-	-	-	-	-	-L	-	-
CO2	S	M	L	-	-	L	-	-	-	-	-	-	L	-	-
CO3	S	M	L	-	-	L	-	-	-	-	-	-	M	-	-
CO4	S	S	M	L	-	L	-	-	-	M	-	-	M	-	-
CO5	S	S	S	M	-	L	-	-	-	M	-	-	L	-	-

S- Strong; M-Medium; L-Low

Syllabus				
STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS				
Introduction to the design process - factor influencing machine design**-** Direct- Bending and torsional stress equations -Calculation of principal stresses for various load combinations- Factor of safety - theories of failure – stress concentration – design for variable loading – Soderberg- Goodman and Gerber relations				
DESIGN OF SHAFTS AND COUPLINGS				
Design of solid and hollow shafts based on strength- rigidity and critical speed – Design of rigid and flexible couplings.				
DESIGN OF FASTENERS AND WELDED JOINTS				
Threaded fasteners - Design of bolted joints including eccentric loading – Design of welded Joints for pressure vessels and structures - Theory of bolted joints.				
DESIGN OF SPRINGS				
Design of helical- leaf- disc and torsional springs under constant loads and varying loads – Concentric torsion springs				
DESIGN OF BEARINGS AND FLYWHEELS				
Design of bearings – sliding contact and rolling contact types– Design of journal bearings calculation of bearing dimensions – Design of flywheels involving stresses in rim and arm.				
Text Books				
1	Design of Machine Elements-V.B.Bhandari			
2	Mechaniacl Engineering Design: Joseph E Shigley and Charles R. Mischke			
Reference Books				
1	Machine Design :Robert L.Norton, Pearson Education,2001			
2	Design of Machine Elements-M.F.SPotts, T.E.Shoup,pearson Edn,2006.			
3	Fundamentals of Machine component Design–Robert C.Juvinall, Wiley India Pvt.Ltd, 3rdEdn, 2007.			
4	Engineering Design G.E. Dieter.			
Course Designers				
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17MECC10	ENGINEERING METROLOGY AND MEASUREMENTS	Category	L	T	P	Credit
		CC	3	0	0	3

Preamble

The aim of the subject is to provide basic knowledge in instrumentation and measurements

Prerequisite - NIL

Course Objective

1	To apply the fundamentals of basic engineering measurement system.
2	To discuss the various instruments used for linear, angular measurement, form measurement and surface finish
3	To apply the knowledge of different measuring instruments like linear, angular measurement, form measurement and surface finish
4	To explain the principle, concepts, applications and advancements of temperature, pressure and flow measurements
5	To explain the classifications, working and processes of optical measuring instruments, also to acquire the data and store in computer

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Calculate the sensitivity of the instruments by evaluating the error in measurements	Apply
CO2.	Understand the working principle and usage of various instruments used for linear, angular measurement, form measurement and surface finish	Understand
CO3.	Design the various setups used for measuring linear, angular measurement, form measurement and surface finish	Apply
CO4.	Effectively select the appropriate instruments for temperature, pressure and flow measurements	Apply
CO5.	Gain application oriented knowledge in the use of optical measuring instruments	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	--	--	L	L							L		
CO2	S	S	M	--	--	L							L		
CO3	M	L	M	S	--	L							L		
CO4	S	S	--	M	--	L							L		
CO5	S	M	S	M	M	L					M	M	L		

S- Strong; M-Medium; L-Low

SYLLABUS

BASIC PRINCIPLES & LINEAR / ANGULAR MEASUREMENT

Basic principles of measurement - generalized configuration and functional descriptions of measuring instruments - Sensitivity- Readability - Range of accuracy - Precision - Static and dynamic performance characteristics –sources of error, classification and elimination of error. Repeatability - Systematic and random errors – Correction - Calibration - Interchangeability. Linear and angular Measurements :Vernier – micrometer - interval measurement - Slip gauges and classification - optical flats - limit gauges - Comparators: mechanical - pneumatic and electrical types – applications. -Sine bar - optical bevel protractor - Autocollimator- Angle Decker – Taper measurements.	
DISPLACEMENT, SPEED & ACCELERATION / VIBRATION MEASUREMENT	
Measurement of displacement: Theory and construction of various transducers to measure displacement – piezo electric, inductive, capacitance, resistance, ionization and photo electric transducers, calibration Procedures. Measurement of speed**:** Mechanical tachometers, electrical tachometers, stroboObjective, noncontact type of tachometer. Measurement of acceleration and vibration : Piezoelectric Accelerometer, Seismic Accelerometer , principles of seismic instruments – vibrometer.	
TEMPERATURE, PRESSURE AND FLOW MEASUREMENT	
Measurement of temperature:Classification , ranges, various principles of measurement, expansion, electrical resitance, thermistor , thermocouple, pyrometers , temperature indicators.Measurement of pressure **:** Units, classification , different principles used., manometers, piston, bourdon , pressure gauges, bellows– diaphragm gauges. low pressure measurement, thermal conductivity gauges – ionization pressure gauges, Mcleod pressure gauge, Knudsen gauge. calibration of pressure gauges. Measurement of level : Direct method – indirect methods– capacitative, ultrasonic, magnetic, cryogenic fuel level indicators – bubler level indicators. Measurement of flow :Rotameter, magnetic, ultrasonic, turbine flow meter, hot – wire anemometer, Laser Doppler anemometer (LDA).	
FORCE, TORQUE, & STRAIN MEASUREMENTS	
Measurement of force : Load cells, cantilever beams, proving rings, differential transformers. Measurement of torque: Torsion bar dynamometer, servo controlled dynamometer, absorption dynamometers. Power Measurements. Strain Measurements**:** Various types of stress and strain measurements – electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – usage for measuring torque, Strain gauge, Rosettes. Strain gauge calibration.	
FORM MEASUREMENTS AND OPTICAL MEASUREMENTS	
Form measurements : Measurement of screw threads - thread gauges - Floating carriage micrometer-measurement of gears-tooth thickness-constant chord and base tangent method-Gleason gear testing machine – radius measurements-surface finish - Straightness - Flatness and roundness measurements.Optical measurements : Optical MicroObjective , interference microObjective, tool makers microObjective, profile projector, vision Systems, laser interferometer – linear and angular measurements.	
Text Books	
1	Kumar D.S., Mechanical Measurements and Control, Tata McGraw Hill.

2	Jain R.K., Engineering Metrology, Khanna Publishers, 1994.
3	GuptaS.C.- "Engineering Metrology"- Dhanpatrai Publications- 1984
Reference Books	
1	Alan S. Morris- "The Essence of Measurement"- Prentice Hall of India- 1997
2	Jayal A.K- "Instrumentation and Mechanical Measurements"- Galgotia Publications 2000
3	Beckwith T.G- and N. Lewis Buck- "Mechanical Measurements"- Addison Wesley- 199
4	Donald D Eckman- "Industrial Instrumentation"- Wiley Eastern-1985.

Course Designers

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1	J.SatheesBabu	Associate Professor	Mech / VMKVEC	satheesbabu@vmkvec.edu.in
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17MECC11	GAS DYNAMICS AND JET PROPULSION	Category	L	T	P	Credit
		CC	2	1	0	3

Preamble

This subject is providing knowledge of insight into the applications of compressible flows and the fundamentals of jet propulsion system. Formulate and solve problems in one -dimensional steady compressible flow including isentropic nozzle flow, constant area flow with friction (Fanno flow) and constant area flow with heat transfer (Rayliegh flow). To enhance the knowledge of determining the change in flow conditions through Prandtl-Meyer expansion wave and characteristic methods to solve problems in two-dimensional compressible flows

Prerequisite – ENGINEERING THERMODYNAMICS

Course Objective

1	To understand the compressible flow fundamentals
2	To analyze the flow through variable area ducts.
3	To study the compressible flow with friction and heat transfer.
4	To know the application of normal shock in compressible flow
5	To study the aircraft propulsion systems and rocket propulsion and its applications

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Understand the basic of compressible flow.	Understand
CO2.	Know to solve flow through variable area ducts.	analyze
CO3.	Know the differences between compressible and incompressible flows.	analyze
CO4.	Solve problems in Rayleigh and Fanno flow.	analyze
CO5.	Understand the knowledge about the rocket propulsion and various propellants.	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	M	L	M	M	M	L							L		
CO2	M	M	L	M	L	L							L		
CO3	S	M	L	M	M	L							L		
CO4	S	S	M	S	M	L							L		
CO5	S	S	S	S	M	L							L		

S- Strong; M-Medium; L-Low

SYLLABUS				
COMPRESSIBLE FLOW –FUNDAMENTALS				
Energy and momentum equations for compressible fluid flows, various regions of flows, reference velocities, stagnation state, velocity of sound, critical states, Mach number, critical Mach number, types of waves, Mach cone, Mach angle, effect of Mach number on compressibility.				
FLOW THROUGH VARIABLE AREA DUCTS				
Isentropic flow through variable area ducts, T-s and h-s diagrams for nozzle and diffuser flows, area ratio as a function of Mach number, mass flow rate through nozzles and diffusers, effect of friction in flow through nozzles.				
FLOW THROUGH CONSTANT AREA DUCTS				
Flow in constant area ducts with friction (Fanno flow) -Fanno curves and Fanno flow equation, variation of flow properties, variation of Mach number with duct length. Flow in constant area ducts with heat transfer (Rayleigh flow), Rayleigh line and Rayleigh flow equation, variation of flow properties, maximum heat transfer.				
NORMAL AND OBLIQUE SHOCK				
Governing equations, variation of flow parameters like static pressure, static temperature, density, stagnation pressure and entropy across the normal shock, Prandtl –Meyer equation, impossibility of shock in subsonic flows, flow in convergent and divergent nozzle with shock. Flow with Oblique Shock – Fundamental relations, Prandtl"s equation, Variation of flow parameters				
PROPULSION				
Aircraft propulsion –types of jet engines –study of turbojet engine components –diffuser, compressor, combustion chamber, turbine and exhaust systems, performance of turbo jet engines–thrust, thrust power, propulsive and overall efficiencies, thrust augmentation in turbo jet engine, ram jet and pulse jet engines. Rocket propulsion –rocket engines thrust equation –effective jet velocity specific impulse–rocket engine performance, solid and liquid propellants.				
Text Books				
1	Yahya. S.M., Fundamental of compressible flow with Aircraft and Rocket propulson", New Age International (p) Ltd., New Delhi, 2005.			
2	Ganesan. V., "Gas Turbines", Tata McGraw-Hill, New Delhi, 1999.			
Reference Books				
1	Rathakrishnan. E., "Gas Dynamics", Prentice Hall of India, New Delhi, 2001.			
2	Patrich.H. Oosthvizen, William E.Carscallen, "Compressible fluid flow", McGraw-Hill, 1997.			
Course Designers				
S.No	**Faculty Name**	**Designation**	**Department/Name of the College**	**Email id**
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3.	R. MAHESH	Assistant Professor	MECH / AVIT	mahesh@avit.ac.in

17MECC12	COMPUTER INTEGRATED MANUFACTURING	Category	L	T	P	Credit
		CC	3	0	0	3

Preamble

The students completing this course are expected to understand the nature and role of computers in manufacturing. The course includes computer aided design, fundamentals of CNC machines, programming of CNC machines, group technology, computer aided process planning techniques, shop floor control and flexible manufacturing systems. It exposes the students to various current trends followed in the industries.

Prerequisite: Nil

Course Objective

1	To understand the importance of CAD and CAM
2	To enable student to learn about Solid modelling techniques and various graphics standards in CAD
3	To understand about the fundamentals and programming of CNC machines
4	To gain knowledge about GT and CAPP
5	To enable students to learn about FMS and SFC

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Discuss the basic concepts of Computer Aided Design and Manufacturing	Understand
CO2.	Apply the concept of Modeling techniques for designing the products	Apply
CO3.	Discuss the basics, working principles of various components of CNC machines.	Apply
CO4.	Write the CNC programs for various mechanical componentswith different operations.	Apply
CO5.	Apply the concepts of Group technology and discuss the concepts of Computer aided process planning techniques.	Apply
CO6	Analyze the functions of various components of Shop Floor Control and Flexible Manufacturing Systems.	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	-	-	-	-	-	-	-	-	-	-	L		
CO2	S	M	L	-	-	-	-	-	-	-	-	-	L		
CO3	S	M	L	-	-	-	-	-	-	-	-	-	M		

CO4	S	S	M	L	-	-	-	-	-	M	-	-	M		
CO5	S	S	S	M	-	-	-	-	-	M	-	-	L		
CO6	S	S	S	M	S	-	-	-	-	S	-	-	L		

S- Strong; M-Medium; L-Low

Syllabus

INTRODUCTION TO CAD/CAM

The design process - Morphology of design, Product cycle - Computer Aided Design, Benefits of CAD. Role of computers - principles of computer graphics - Current trends in manufacturing engineering - Design for Manufacturing and Assembly - Sequential and concurrent engineering -Rapid prototyping.

SOLID MODELING

Graphic software: coordinate representation- graphic functions, software standards. Graphical Kernel system (GKS) - Initial graphics exchange system (IGES) - Graphic packages. Geometric Modeling - Wire frame, Surface and Solid models - Constructive Solid Geometry (CSG) and Boundary Representation (B-REP) Techniques - Features of Solid Modeling Packages.

FUNDAMENTALS OF CNC MACHINES

CNC Technology - Functions of CNC Control in Machine Tools - Classification of CNC systems - Contouring System - Interpolators, open loop and closed loop CNC systems - CNC Controllers, Direct Numerical Control (DNC Systems). - Work holding devices and tool holding devices-Automatic Tool changers. Feedback devices - Principles of Operation-Machining Centers - Tooling for CNC machines

Numerical control codes - Standards - Manual Programming - Canned cycles and subroutines - Computer Assisted Programming, CAD / CAM approach to NC part programming - APT language, machining from 3D models.

GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING

Introduction to CIM and its related activities-History of group technology- role of G.T. in CAD/CAM integration - part families - classification and coding - DCLASS and MICLASS and OPITZ coding systems-facility design using G.T. - benefits of G.T. - cellular manufacturing. Process planning - role of process planning in CAD/CAM integration - approaches to computer aided process planning - variant approach and generative approaches - CAPP and CMPP process planning systems.

SHOP FLOOR CONTROL AND INTRODUCTION OF FMS

Shop floor control-phases-factory data collection system -automatic identification methods- Bar code technology-automated data collection system. FMS-components of FMS - types -FMS workstation -material handling and storage systems- FMS layout -computer control systems-application and benefits.

Text Books

1	Mikell.P.Groover “Automation, Production Systems and Computer Integrated

	manufacturing", Pearson Education 2001.
2	Radhakrishnan P, Subramanyan.S. and Raju V., "CAD/CAM/CIM", 2nd Edition New Age International (P) Ltd., New Delhi, 2000.
Reference Books	
1	Yoremkoren, "Computer Integrated Manufacturing System", McGraw-Hill, 1983.
2	Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International, 1986.
3	David D.Bedworth, Mark R.Hendersan, Phillip M.Wolfe "Computer Integrated Design and Manufacturing", McGraw-Hill Inc.
4	Roger Hanman "Computer Integrated Manufacturing", Addison – Wesley, 1997.

Course Designers

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17MECC13	DESIGN OF TRANSMISSION SYSTEMS	Category	L	T	P	Credit
		CC	2	1	0	3

Preamble

This course provides basic design knowledge of various transmission systems.

Prerequisite - DESIGN OF MACHINE ELEMENTS

Course Objective

1	To understand the design procedure for power transmission by belt, ropes and chain drives
2	To design the spur and helical gears.
3	To study the design procedure for bevel and worm gears.
4	To learn the importance of gear box and design concepts.
5	To study the design procedure for clutches and brakes.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Understand the basic design procedures and designing of belts, ropes and chain drives	Understand
CO2.	Design the spur and helical gears at various load conditions	Apply
CO3.	Design the bevel and worm gear as per the requirement.	Apply
CO4.	Design the gear box for given application	Analyze
CO5.	Design the clutches and brakes for the given application	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	M	L	-	-	-	-	-	-	L	S		
CO2	S	S	S	M	L	-	-	-	-	-	-	L	S		
CO3	S	S	M	M	L	-	-	-	-	-	-	L	S		
CO4	S	S	S	M	L	-	-	-	-		-	L	S		
CO5	S	M	M	M	L	-	-	-	-		-	L	S		

S- Strong; M-Medium; L-Low

SYLLABUS

DESIGN OF FLEXIBLE DRIVES

Flat belts - V belts -Wire ropes and Chain Drives.

DESIGN OF SPUR GEARS AND HELICAL GEARS

Spur Gears-Helical gears- Simple gear design procedure with problems

DESIGN OF BEVEL GEARS AND WORM GEARS

Straight Bevel Gears-worm gears- Simple gear design procedure with problems

DESIGN OF GEAR BOXES

Design of multi speed gear box-Geometric progression - Standard step ratio - Ray diagram-kinematics layout -– gear box design problems (No. of speeds not more than 12).				
DESIGN OF CLUTCHES AND BRAKES				
Design of plate clutches –axial clutches-cone clutches- internal and external shoe brakes-problems.				
Text Books				
1	Shigley, Mischke, Mechanical Engineering Design, Tata Mc Graw Hill.			
2	Prabhu. T.J. - "Design of Transmission Elements"- Mani Offset- Chennai			
Reference Books				
1	Md.Jalaludeen- Machine Design- Anuradha Publicatiions,Chennai.			
2	Maitra G.M. - Prasad L.V. - "Hand book of Mechanical Design"- II Edition- Tata McGraw-Hill			
3	Design Data,PSG College of Technology, Coimbatore			
Course Designers				
S.No	**Faculty Name**	**Designation**	**Department/ Name of the College**	**Email id**
1	J.SENTHIL	Associate Professor	Mech / AVIT	jsenthil@avit.ac.in

17MECC14	HEAT AND MASS TRANSFER	Category	L	T	P	Credit
		CC	2	1	0	3

Preamble

The purpose of this subject is to enable students understood different principles of heat transfer and its extensive engineering applications**.**

Prerequisite

ENGINEERING THERMODYNAMICS

Course Objective

1	To enable students understand their conduction mechanism in steady state emphasizing on application in engineering.
2	To enable students understand their conduction mechanism in unsteady state emphasizing on application in engineering.
3	To make students understand convection principles and its application.
4	To provide radiation concepts and Heat exchangers.
5	To enable students to understand Mass transfer and its application.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	To gain the knowledge of basic elements& Types of conduction systems.	Understand
CO2.	To obtain the various methods of Transient heat conduction systems.	Apply
CO3.	To apply the concepts of convection systems.	Apply
CO4.	To discuss the concepts of Radiation & types of Heat Exchangers.	Apply
CO5.	To discuss various terminologies of Mass transfer.	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO 1	PSO 2	PSO 3
CO1	S	M	L	M	L	L							L		
CO2	S	M	L	M	L	L							L		
CO3	S	M	M	M	L	L							L		
CO4	S	M	M	M	L	M							L		
CO5	S	M	L	M	L	M							L		

S- Strong; M-Medium; L-Low

SYLLABUS

CONDUCTION

Introduction -Fourier law of conduction- General equation in Cartesian coordinates- One dimensional steady state conduction across Large plane wall, Long cylinder and Sphere- Composite wall – Composite cylinder – Composite sphere, Overall heat transfer coefficients, Critical Radius of insulation, conduction with Heat generation, Thermal contact resistance – Heat transfer through Walls and Roofs- Fins or extended surfaces- Pin fins, annular fins, longitudinal fins- Problems.

TRANSIENT HEAT CONDUCTION

Introduction to Unsteady state conduction – Lumped system analysis, semi – infinite solids. Transient Heat Conduction in Large Plane Walls, Long cylinders and Spheres- Refrigeration and Freezing of Foods- Problems.

CONVECTION

Introduction – Physical Mechanism on Convection, Classification of Fluid Flows, Velocity Boundary Layer, Thermal Boundary Layer, Laminar and Turbulent Flows. External Forced convection – Flow over a Flat plate, cylinder, sphere and Tube Banks. Internal Forced Convection - Flow through pipes – annular spaces and noncircular conducts. Natural convection from vertical, inclined and horizontal surfaces. Boiling – Types of Boiling. Condensation – Types of Condensation- Problems.

RADIATION AND HEAT EXCHANGERS

Introduction – Thermal Radiation – Black body Radiation – Radiation Intensity- Radioactive Properties – Atmospheric and Solar Radiation – View Factor- Simple Problems- Black surfaces and Grey Surfaces – Net Radiation – Heat Transfer in Two and Three Surface Enclosures- Radiation Shield – Problems – Radiation Exchange with Emitting and Absorbing Gases.

Heat Exchangers- Types- Overall heat transfer co-efficient- Analysis of Heat Exchangers – LMTD method – Effectiveness - NTU Method – Selection of Heat Exchangers – Problems.

MASS TRANSFER

Introduction – Analogy between Heat and Mass Transfer – Mass Diffusion - Fick's law – Steady mass diffusion through a wall – Water vapour migration in buildings – Transient Mass Diffusion- Diffusion in a Moving Medium – Mass convection – Simultaneous Heat and Mass transfer – Problems.

TEXT BOOKS

1. YUNUS A CENGEL "Heat Transfer"- Tata Mc Graw Hill – New Delhi.
2. KOTHANDARAMAN C.P "Fundamentals of Heat and Mass Transfer" New Age International.
3. SACHDEVA R C- "Fundamentals of Engineering Heat and Mass Transfer" New Age International.

Reference Books

1. OZISIK M.N- "Heat Transfer"- Tata McGraw-Hill Book Co.
2. NAG P.K- "Heat Transfer"- Tata McGraw-Hill- New Delhi.
3. HOLMAN J.P "Heat and Mass Transfer" Tata McGraw-Hill.
4. INCROPRA and DEWITE, Heat Transfer – John Wiley.

Course Designers

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17MECC15	FINITE ELEMENT ANALYSIS	Category	L	T	P	Credit
		CC	2	1	0	3

Preamble

This course provides to learn the basic concepts of finite element analysis (FEA) and its application in engineering.

Prerequisite

Strength of Materials.

Course Objective

1	To learn basic principles of finite element analysis procedure
2	Study the basics of Standard truss, beam, plane triangular and quadrilateral elements
3	Analysis of one and two-dimensional problems
4	Learn to model complex geometry problems and solution techniques
5	Understand the concepts of heat transfer and structural analysis

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Apply the basic concepts in various finite element structures	Understand
CO2.	Solve the finite element problems using the different approaches	Apply
CO3.	Apply finite element method to solve problems in solid mechanics and Heat transfer.	Apply
CO4.	Formulate and solve problems in one dimensional structures including trusses, beams and frames.	Apply
CO5.	Formulate FE characteristic equations for two dimensional elements and analyze plain stress, plain strain, and axi-symmetric and plate bending problems.	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	L	L	-	-	-	-	-	-	-	-	L		
CO2	S	S	M	L	L	-	-	-	-	-	-	-	M		
CO3	S	S	S	S	S	L	-	-	M	L	-	L	M		
CO4	S	S	S	M	M	L	-	-	M	L	-	-	S		
CO5	S	S	S	S	M	-	-	-	-	-	-	-	S		

S- Strong; M-Medium; L-Low

SYLLABUS	
BASIC CONCEPTS OF THE FINITE ELEMENT ANALYSIS	
Basics of FEA, Derive the stiffness matrix of Spring, bar and beam elements – Derive the stiffness matrix of beam elements – Problems on spring and bar elements – Local and global coordinate systems – assembly of elements, calculation of element stress – simple applications, trusses, Drive the stiffness matrix – Problems on Trusses, stiffness matrix calculation, Member stress calculation.	
VARIATIONAL AND WEIGHTED RESIDUAL APPROACHES	
Variational problems, Euler's Equation – Problems on solving first order differential using 2-node 1D element – Example problems, solving first order differential equation using 1D-sub-parametric elements – Weighted residualapproaches, Galerkinformulation and Point-collocation – Problems on Galerkin formulation and Point-collocationsimple regular beam sections with different types of loads – Sub-domain collocation, Least-square minimization – Problems on Sub-domain collocation and Least-square minimization regular beam sections with different types of loads.	
TWO DIMENSIONAL ISOPARAMETRIC ELEMENTS AND GAUSS NUMERICALINTEGRATION	
Natural coordinate systems – Interpolation function for Triangular Elements (CST, LST and QST) – Interpolation function for 4-node, 8-node and 9-node quadrilateral Elements – Element stiffness matrix formulation for two dimensional elements – Gauss Numerical Integration – Derivation of one point and two point formula (1D problems).	
EIGEN VALUE PROBLEMS FOR ONE DIMENSIONPROBLEMS (DYNAMIC CONSIDERATION)	
Formulation – Hamilton's Principle – Characteristic polynomialTechnique – Element mass matrix formulation for one dimensional Elements (2-node isoparametric and 3-node sup-parametricelements) – Problems for 1-D Problems to find eigenvalues andeigenvectors using 2-node isoparametric and 3-node isoparametric.	
STEADY STATE HEAT TRANSFERANALYSIS	
Introduction, straight uniform fin analysis, Derivation 1DElement matrices – Problems on straight uniform fin analysis and Taper fin analysis Heat Flex BoundaryConditions – Analysis of uniform fins using 1D Quadratic Elements – Two Dimensional Steady state Problems using CSTElements – 1-D and 2-D simple Problems using any commercial FEAsoftware.	
Text Books	
1	Hutton, D.V., "Fundamentals of Finite Element Analysis", McGraw Hill, International Edition, 2004.
2	Segerlind, L.J., "Applied Finite Element Analysis", John Wiley & Sons, 1984.
Reference Books	
1	Chandrupatla, T.R., Belegundu, A.D., "Introduction to Finite Elements in Engineering", Prentice Hall of India, 2002.
2	Zienkiewicz, O.C., "Finite Elements and Approximation", Dover International, 2006.
3	Cook R.D., Malkus, D.S., Plesha, M.E., Witt, R.J., "Concepts and Applications of Finite Element Analysis", 4th Edition, John Wiley & Sons, 2001.

Course Designers				
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17MECC16	INDUSTRIAL AUTOMATION	Category	L	T	P	Credit
		CC	3	0	0	3

Preamble

To introduce the need, evolution, and motivation for Industrial Automation. Familiarization with basic concepts and different automation strategies being used in practice worldwide.

Prerequisite NIL

Course Objective

1	To understand the factory automation and integration
2	To learn about hydraulics/pneumatics circuits
3	To understand the various design of pneumatic and electro-pneumatic circuits
4	To learn about PLC and its applications
5	To understand the automation in transfer machines & assembly.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Understand need and scope of industrial automation	Remember
CO2.	Understand the basics and need for implementation hydraulic and pneumatic systems.	Understand
CO3.	Design of pneumatic and electro-pneumatic circuits	Apply
CO4.	Know about PLC and its applications	Understand
CO5.	Understand the basics of automatic transfer machines & assembly automation	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	M											L	L		
CO2	M											L	L		
CO3	M	M	S	S	M							L	L		
CO4	M		M	S	M							L	L		
CO5	M		M	S	M							L	L		

S- Strong; M-Medium; L-Low

SYLLABUS	
INTRODUCTION TO FACTORY AUTOMATION AND INTEGRATION	
Basic concepts and scope of industrial automation, socio-economic considerations, modern developments in automation in manufacturing and its effect on global competitiveness.-Need and implications of automation in manufacturing- Different types of production systems and automation-Hard/fixed automation	
INTRODUCTION TO HYRDAULICS/PNEUMATICS	
Basic elements of hydraulics/pneumatics, electro-pneumatic controls and devices, electro-pneumatic systems, fluid power control elements and standard graphical symbols for them, construction and performance of fluid power generators, hydraulic and pneumatic actuators, their design and control devices-Sequence operation of hydraulic /pneumatic actuators-Applications in manufacturing- Hydraulic & pneumatic valves for pressure, flow & direction control, servo valves and simple servo systems with mechanical feedback, solenoid-Different sensors for hydraulic, pneumatic & electro-pneumatic systems.	
DESIGN OF PNEUMATIC AND ELECTRO-PNEUMATIC LOGIC CIRCUITS	
Logic circuits to be designed for a given time displacement diagram or sequence of operation-Pneumatic safety and control circuits and their applications to clamping, traversing and releasing operations.	
PROGRAMMABLE LOGIC CONTROLLERS (PLC)	
PLC for design demonstration, programming and interface the hardware with software for modern manufacturing applications.	
AUTOMATIC TRANSFER MACHINES & ASSEMBLY AUTOMATION	
Classifications, analysis of automated transfer lines, without and with buffer storage, group technology and flexible manufacturing system- Types of assembly systems, assembly line balancing, performance and economics of assembly system.	
Text Books	
1	Esposito, A., Fluid Power with Applications, Prentice Hal of India, New Delhi .,
2	Majumdar, S. R., Pneumatic Systems, Tata McGraw Hill, New Delhi
Reference Books	
1	Auslander, D. M. and Kempf, C. J., Mechatronics: Mechanical System Interfacing, Prentice Hall Inc., New Jersey .
2	Deppert, W. and Stoll, K., Pneumatic Control, Vogel Verlag, Wurzburg, Germany,
3	Herbert, E.M., Hydraulic Control System, John Wiley & Sons, New York

Course Designers

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1	M.SARAVANAN	ASST. PROF	MECH./ AVIT	saravanan@avit.ac.in

17MECC17	AUTOMOTIVE ENGINEERING	Category	L	T	P	Credit
		CC	3	0	0	3

Preamble

The aim of the subject is to provide an overview of a complete automobile engineering

Prerequisite : NIL

Course Objective

1	To study the construction and working of different engine components.
2	To study about the different auxiliary systems of an automobile.
3	To study about the transmission system of an automobile.
4	To understand the different types of steering, brakes and suspension systems of an automobile.
5	To study the various modern alternate technologies of automobiles.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Demonstrate the basic lay-out of an automobile.	Understand
CO2.	Compare the working of petrol and diesel injection systems	Understand
CO3.	Explain the principles of transmission systems of the automobile	Understand
CO4.	Identify the different types of suspension and braking systems available	Apply
CO5.	Make use of the latest developments in automobiles.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	L	L									L		
CO2	S	S	M	S						S			L		
CO3	S	L	M										L		
CO4	S	M	L										L		
CO5	S	S	M	L								L	L		

S- Strong; M-Medium; L-Low

SYLLABUS

VEHICLE STRUCTURE AND ENGINES

Types of automobiles, vehicle construction and different layouts, chassis, frame and body,
IC Engine – Classification, components of engine and their functions.

ELECTRONIC ENGINE CONTROL SYSTEMS

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system - Unit injector system, Rotary distributor type and common rail direct injection system, Electronic ignition system, Types of Sensor

TRANSMISSION SYTEMS

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, over drive, transfer box, fluid flywheel – propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.

STEERING, BRAKES AND SUSPENSION SYSTEMS

Steering geometry, Types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, ABS and Traction Control

ALTERNATIVE FUELS & EMISSION SYSTEM

Liquefied Petroleum Gas, Bio-fuels in Automobiles- Electric and Hybrid Vehicles, Fuel Cell. Engine modifications required -Performance, Engine emission control by three way catalytic converter system, Turbo chargers, EGR.

Text Books

1	R.B. Gupta- “Automobile Engineering "- SatyaPrakashan
2	Kirpal Singh, “ Automobile Engineering Vol 1 & 2 “, Standard Publishers, Seventh Edition, New Delhi
3	Jain, K.K., and Asthana .R.B, “Automobile Engineering” Tata McGraw Hill Publishers, New Delhi
4	Ganesan. V “Internal combustion Engine

Reference Books

1	William Crouse- “Automobile Engineering Series "- McGraw-Hill
2	Newton and Steeds- “Motor Vehicles "- ELBS
3	Duffy Smith- “Auto Fuel Systems "- The Good Heat Willcox Company Inc.
4	Osamu Hirao and Richard K. Pefley- “Present and Future Automotive Fuels "- John Wiley and Sons

Course Designers

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1	SANGEETHA.S	ASSOC. PROF	MECH./ AVIT	sangeethas@avit.ac.in

17MECC18	MANUFACTURING ENGINEERING	Category	L	T	P	Credit
		CC	3	0	0	3

Preamble

This course provides knowledge and understanding on various types of manufacturing processes

Prerequisite : NIL

Course Objective

1	To understand the all process that involved in metal casting technology.
2	To impart the knowledge of various metal joining processes.
3	To apply the various conventional machining operations and metal forming processes.
4	To impart the knowledge of forming and shaping in plastics processes
5	To impart the knowledge of various metal forming and powder metallurgy.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	To understand the concepts of casting technology	Understand
CO2.	Apply the concepts of various welding processes.	Apply
CO3.	Enhance the application of various machining processes	Apply
CO4.	To understand the applications of various forming and shaping of plastics.	Understand
CO5.	Apply the concepts of various metal forming and powder metallurgy.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	L	M	M						M	M		
CO2	L	S	S	M	M	M						M	M		
CO3	L	S	M	M	M	M						M	M		
CO4	L	M	S	M	M	M						M	M		
CO5	M	S	S	M	M	M						M	M		

S- Strong; M-Medium; L-Low

SYLLABUS
Introduction and Casting
Castingtypes,proceduretomakesandmould,typesofcoremaking,mouldingtools,machinemoulding,special moulding processes–CO_2 moulding;shellmoulding,investmentmoulding,permanentmouldcasting,pressuredie casting, centrifugal casting, continuous casting, casting defects.
Welding
Classification of welding processes. Principles of Oxy-acetylene gas welding. A.C metal arc welding, Resistance welding submerged arc welding, tungsten inert gas welding, metal inert gas welding, plasma arc welding, thermit welding, electron beam welding, laser beam welding, defects in welding, soldering and brazing.
Machining
General principles (with schematic diagrams only) of working and commonly performed operations in the following machines: Lathe, Shaper, Planer, Horizontal milling machine, Universal drilling machine, Cylindrical grinding machine, Capstan and Turret lathe. Basics of CNC machines. General principles and applications of the following processes: Abrasive jet machining, Ultrasonic machining, Electric discharge machining, Electro chemical machining, Plasma arc machining and Electron beam machining and Laser beam machining.
Forming And Shaping Of Plastics
Typesofplastics-Characteristicsoftheformingandshapingprocesses–MouldingofThermoplastics–Workingprinciplesand typical applications of-Injection moulding–Plunger and screw machines–Blow moulding – Rotationalmoulding–Filmblowing–Extrusion-Typicalindustrialapplications–Thermoforming–Processing of Thermo sets–Working principles and typical applications-Compression moulding–Transfer moulding–Bonding of Thermoplastics– Fusion and solvent methods – Induction and Ultrasonic methods.
Metal Forming And Powder Metallurgy
Principles and applications of the following processes: Forging, Rolling, Extrusion, Wire drawing and Spinning, Powder metallurgy– Principal steps involved advantages, disadvantages and limitations of powder metallurgy.

Text Books

1	Hajra Choudhury, “Elements of Workshop Technology”, Vol. I and II, Media Promoters and Publishers Pvt., Ltd., Mumbai, 2005
2	Nagendra Parashar B.S. and MittalR.K.,“ElementsofManufacturingProcesses”,Prentice-HallofIndia Private Limited, 2007

Reference Books

1	Serope Kalpajian, Steven R.Schmid, “Manufacturing Processes for Engineering Materials”, 4/e, Pearson Education, Inc. 2007
2	Jain. R.K.,and S.C. Gupta, “Production Technology”, 16th Edition, Khanna Publishers, 2001
3	“H.M.T. "Production Technology– Handbook”, Tata McGraw-Hill, 2000.

Course Designers

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17MECC19	MECHANICS OF MACHINES	Category	L	T	P	Credit
		CC	3	0	0	3

Preamble
The student will acquire the concept and mechanism employed in machines and engines

Prerequisite : NIL

Course Objective

1	To compile the types of kinematics of mechanisms.
2	To distinguish the knowledge on the various types of gears and gear trains.
3	To employ the effect of friction.
4	To catagorize the knowledge of static force analysis.
5	To distiguish the knowledge of balancing and vibrations.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Describe the types of kinematics of mechanisms.	Understand
CO2.	Distinguish and evaluate gear tooth geometry, types of gears and gear trains for different applications.	Analyze
CO3.	Employ the cam and followers for specified motion profiles	Apply
CO4.	Categorize the static force and dynamic force.	Analyze
CO5.	Distinguish balancing problems in rotating and reciprocating machinery.	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO 1	PSO 2	PSO 3
CO1	S	L	L	M	L	L	-	-	-	-	-	-	L	-	-
CO2	M	L	S	L	L	L	-	-	-	-	-	-	L	-	-
CO3	S	L	L	M	M	L	-	-	-	-	-	-	L	-	-
CO4	S	S	S	S	M	L	-	-	-	-	-	-	L	-	-
CO5	S	S	M	S	S	L	-	-	-	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

KINEMATIC OF MECHANICS

Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain – kinematics analysis in simple mechanisms – velocity and acceleration polygons – Analytical methods – computer approach	
GEARS AND GEAR TRAINS	
Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains – automotive transmission gear trains	
KINEMATICS OF CAM	
Classifications - Displacement diagrams-parabolic- Simple, harmonic and Cycloidal motions - Layout of plate cam profiles - Derivatives of Follower motion - High speed cams - circular arc and tangent cams - Standard cam motion	
FORCE ANALYSIS	
Applied and Constrained Forces – Free body diagrams – static Equilibrium conditions – Two, Three and four members – Static Force analysis in simple machine members – Dynamic Force Analysis – Inertia Forces and Inertia Torque – D‘Alembert‘s principle – superposition principle – dynamic Force Analysis in simple machine members.	
BALANCING AND VIBRATION	
Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines-Direct and reverse crank method Free vibrations – Equations of motion – natural Frequency – Damped Vibration –critical speed of simple shaft – Torsional vibration – Forced vibration	
Text Books	
1	Ambekar A.G., ―Mechanism and Machine Theory‖ Prentice Hall of India, New Delhi, 2007
2	Shigley J.E., Pennock G.R and Uicker J.J., ―Theory of Machines and Mechanisms‖, Oxford University Press, 2003
3	Khurmi.R.S. and Gupta, Theory of Machines, S.Chand @ Co., 2005.
Reference Books	
1	Thomas Bevan, ―Theory of Machines‖, CBS Publishers and Distributors, 1984.
2	Ghosh.A, and A.K.Mallick, ―Theory and Machine‖, Affiliated East-West Pvt. Ltd., New Delhi, 1988
3	Rao.J.S. and Dukkipatti R.V. ―Mechanisms and Machines‖, Wiley-Eastern Ltd., New Delhi, 1992.
4	Ramamurthi. V., "Mechanisms of Machine", Narosa Publishing House, 2002
5	Robert L.Norton, "Design of Machinery", McGraw-Hill, 2004.
Course Designers	

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17MECC81	MANUFACTURING PROCESS LAB	Category	L	T	P	Credit
		CC	0	0	4	2

Preamble

The aim of the subject is to provide knowledge in basic manufacturing process. To machining the components using lathe and understand about the basic operations like turning, facing, tapper turning, threading, knurling and eccentric turning operations.

Prerequisite - NIL

Course Objective

1	To Demonstrate the basic operations in the lathe.
2	To execute the thread cutting and tapper turning operations in the lathe
3	To implement the knurling and eccentric turning operations.
4	To perform other basic operations like drilling boring threading on the MS plate

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Operate all the basic operations in lathe independently	Apply
CO2.	Calculate and operate tapper Turing, internal threading and thread cutting	Apply
CO3.	Perform the basic cylindrical operation in the components from the lathe like drilling, boring, knurling and eccentric turning operations	Apply
CO4.	Execute basic operations like drilling boring threading on the MS plate	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	S	M	L	L	-	-	-	-	L	-	-	-	L	-	-
CO2	S	M	L	L	-	-	-	-	L	-	-	-	L	-	-
CO3	S	L	L	L	-	-	-	-	L	-	-	-	L	-	-
CO4	S	L	L	L	-	-	-	-	L	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

Syllabus

LIST OF EXPERIMENTS

1. Exercise on plain turning and facing of given cylindrical MS specimen.
2. Exercise on step turning and chamfering.
3. Exercise on taper turning of given specification on a cylindrical specimen.
4. Manufacture of external or internal threads of given specification on a cylindrical Specimen.
5. Exercise on step turning with knurling of given specification on a cylindrical specimen
6. Exercise on drilling, boring and reaming on the given MS plate.
7. Exercise on eccentric turning in lathe on a given specimen.
8. Exercise on drilling with internal thread on a given specimen

Text Books

1	**MANUFACTURING PROCESS LAB, MANUAL**

References

1	Elements of Workshop Technology- Vol. I -SK HajraChoudhury - Indian book distributing company, Calcutta- 1986.
2	"Manufacturing Technology", Vol-1- P.N.Rao - Tata McGraw-Hill Publishing Limited- IIndEdition- 2002

Course Designers

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17MECC82	MACHINE DRAWING LAB	Category	L	T	P	Credit
		CC	1	0	4	2

Preamble

Machine Drawing is an indispensable communicating medium employed in industries, to furnish all the information required for the manufacture and assembly of the components of a machine. It deals with the preparation of orthographic projections of various machine parts and assemblies and all details of product, regarding size, shape, material, processes, surface finish, tool and equipment as per Indian Standards on drawing practices and standard components.

Prerequisite

NIL

Course Objective

1	To identify the machine components and create assembly drawing
2	To practice application of concept of part drawing for creating assembled view.
3	To practice application of concept of assembled drawing for creating part view.
4	To apply the concept of production drawing from machine component
5	To practice the knowledge of application in orthographic views of machine element using drafting package

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Interpret the drawing and represent any matter or object with the help of diagrams.	Understand
CO2.	Draw the assembled view of the mechanical products from the part drawing.	Apply
CO3.	Draw the part drawing of the mechanical products from the assembled drawing.	Apply
CO4.	Draw the production drawing of machine component	Apply
CO5.	Draw the orthographic views of machine element using drafting package.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PS O3
CO1	S	S	-	-	-	-	-	-	-	-	L	-	L		
CO2	S	L	S	L	-	-	-	-	-	-	L	-	L		
CO3	S	L	-	L	-	-	-	-	-	-	M	-	L		
CO4	S	M	L	-	-	-	-	-	-	-	M	-	L		
CO5	L	L	L	-	-	-	L	-	-	-	L	-	L		

S- Strong; M-Medium; L-Low

SYLLABUS

LIST OF EXPERIMENTS				
Drawing of Machine Elements and simple parts				
Selection of Views, additional views for the following machine elements and parts with every drawing proportions. a) Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws. b) Keys, cotter joints and knuckle joint. c) Riveted joints for plates d) Shaft coupling, spigot and socket pipe joint. e) Journal, pivot and collar and foot step bearings.				
Assembly Drawings				
Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions. a) Engine parts –stuffing boxes, cross heads, Eccentrics, Petrol Engine connecting rod, piston assembly. b) Other machine parts -Screws jacks, Machine Vices Plummer block, Tailstock. c) Valves: Steam stop valve, spring loaded safety valve, feed check valve and air cock.				
Text Books				
1	Bhatt-N.D.-"Machine Drawing"-Published by R.C.Patel- Chartstar Book Stall- Anand- India- 2003			
2	P.S.G. Design Data Book			
Reference Books				
1	Sidheswar- N. - Kanniah- P. and Sastry- V.V.S. - "Machine Drawing ". TMH.			
2	P.S. Gill, "A Text Book of Machine Drawing", Seventh edition Reprint, S. K. Kataria & Sons. New Delhi. 2004.			
3	R.K. Dhawan, "A Text book of Machine Drawing", First Edition, Sultan Chand and Sons, New Delhi, 1996.			
Course Designers				
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17MECC83	MANUFACTURING TECHNOLOGY LAB	Category	L	T	P	Credit
		CC	0	0	4	2

Preamble

The aim of the subject is to provide knowledge in using of the special machines. To handle the different machines like Shaping machine, Milling Machine, Slotting machine, Grinding Machines, Gear Hobbing etc. Using these machines produce different components with specified shape and size.

Prerequisite

NIL

Course Objective

1	To practice square, inclined and hexagonal shapes using the shaping machine.
2	To practice to make a slotting operation on a job.
3	To practice and perform the indexing operations in milling machine.
4	To practice about milling machine operations.
5	To practice the grinding operations in different grinding machines.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Apply the basic operations in the shaping machine including stroke adjustment and position adjustment etc	Apply
CO2.	Produce the different shaped components using plain surface machining	Apply
CO3.	Make gears using milling machine and hobbing machines.	Apply
CO4.	Produce large flat surfaces using planning machines.	Apply
CO5.	Handle different grinding machines like cylindrical, surface and centre less grinding machines.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	-	-	-	-	-	-	-	-	L	-	L		
CO2	S	L	S	L	-	-	-	-	-	-	L	-	L		
CO3	S	L	-	L	-	-	-	-	-	-	M	-	L		
CO4	S	M	L	-	-	-	-	-	-	-	M	-	L		
CO5	L	L	L	-	-	-	L	-	-	-	L	-	L		

S- Strong; M-Medium; L-Low

SYLLABUS				
LIST OF EXPERIMENTS				

1. Make a square end from a given round bar by using shaping machine.
2. Make an inclined surface from a given specimen by using shaping machine.
3. Make a hexagonal block from a given round stock by using plain milling machine.
4. Make a spur gear from the given blank by using universal milling machine.
5. Make an external keyway on a given round rod by using vertical milling machine.
6. Make an internal keyway on a given hallow specimen by using slotting machine.
7. Make a grinding process on a machined surface as given surface finish by using cylindrical grinding machine.
8. Make an internal thread cutting on a given specimen as per given dimensions by the sequence drilling, boring, reaming and tapping by using respective tools and machines.

Text Books	
1	**MANUFACTURING TECHNOLOGY LAB Manual**

Reference Books	
1	HajraChoudhury, "Elements of Workshop Technology", Vol. I and II, Media Promoters and Publishers Pvt., Ltd., Mumbai, 2005.
2	NagendraParashar B.S. and Mittal R.K., "Elements of Manufacturing Processes", Prentice- Hall of India Private Limited, 2007.

Course Designers

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17MECC84	METALLURGY LAB	Category	L	T	P	Credit
		CC	0	0	4	2

Preamble

This course provides the basic knowledge about the physical metallurgy - metallographic

Prerequisite - NIL

Course Objective

1	To discuss the basics of Metallographic
2	To practice the methodologies for preparing the specimens of ferrous and non ferrous materials.
3	To practice experience on the finding out of ferrous material specimens through Metallurgical microscope
4	To practice experience on the finding out of non ferrous material specimens through Metallurgical microscope
5	To practice the different types of heat treatment methods for engineering materials.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	To learn the basic knowledge about the ferrous and non ferrous metals and their properties	Understand
CO2.	Apply different methodologies for preparing specimens of ferrous and non ferrous materials	Apply
CO3.	Apply the knowledge of different microstructures to find out ferrous material specimens through Metallurgical microscope	Apply
CO4.	Apply the knowledge of different microstructures to find out non ferrous material specimens through Metallurgical microscope	Apply
CO5.	Apply different types of heat treatment methods for engineering materials and analyze their properties.	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	L	L	L	-	-	-	-	-	-	-	L	L		
CO2	S	S	M	S	-	-	-	-	M	-	-	M	L		
CO3	S	S	S	S	-	-	-	-	M	-	-	M	S		
CO4	S	S	S	S	-	-	-	-	M	-	-	M	S		
CO5	S	S	S	S	-	-	-	-	S		-	S	S		

S- Strong; M-Medium; L-Low

SYLLABUS:

LIST OF EXPERIMENTS:

1. Introduction to Metallographic
2. Preparation of Metallographic specimen
3. Identification of Ferrous specimens (minimum 4)
4. Identification of Non-Ferrous specimens (minimum 2)
5. Heat treatment – Annealing- comparison between annealed and un heat treated specimen
6. Heat treatment – Normalizing- comparison between normalized and un heat treated specimen
7. Heat treatment – Hardening- comparison between hardened and un heat treated specimen
8. Heat treatment -Tempering- comparison between hardened and un heat treated specimen

Text Books

1	**METALLURGY LAB Manual**

Reference Books

1	William D Callister "Material Science and Engineering", John Wiley and Sons 2005.
2	Sydney H.Avner "Introduction to Physical Metallurgy" McGraw Hill Book Company.

Course Designers

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17MECC85	ENGINE TESTING LAB	Category	L	T	P	Credit
		CC	0	0	4	2

Preamble

This Laboratory course is intended to give the students, experimental knowledge on the performance and operations of I.C. Engines.

Prerequisite

NIL

Course Objective

1	To practice the students to get the knowledge of testing of fuels in internal combustion engines.
2	To provide a knowledge in fuels and lubricants properties.
3	To practice the students to conduct the performance and heat balance test on IC engines.
4	To practice the students to get the knowledge in performance characteristics of internal combustion engine.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	To learn the testing of various fuels in internal combustion engines.	Understand
CO2.	Understand the various properties of fuels and lubrication properties.	Understand
CO3.	Understand actual port and valve timing diagram and comparison with theoretical diagram.	Understand
CO4.	Conduct the Performance test and retardation test on a four stroke single/ twin cylinder diesel engine	Understand
CO5.	To Perform test on variable compression ratio engine with biofuel.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	M	M		L							L		
CO2	S	L	M	M		L							L		
CO3	S	L	L	M		M							L		
CO4	S	L	L	L	M	M							L		
CO5	S	L	M	L	M	M							L		

S- Strong; M-Medium; L-Low

SYLLABUS LIST OF EXPERIMENTS				
1. Determination of Viscosity of the given specimen oil by using Red Wood Viscometer.				
2. Determination of Flash Point and Fire Point of the given fuel sample.				
3. Actual valve timing diagram of a four stroke engine and comparison with theoretical valve timing diagram.				
4. Actual port timing diagram of a two stroke engine and comparison with theoretical port timing diagram.				
5.Performance test on a four stroke single/ twin cylinder diesel engine.				
6. Determination of frictional power of a four cylinder petrol engine by conducting a Morse test.				
7. Conduct a retardation test and determine frictional power in a diesel engine.				
8. Performance test on variable compression ratio engine with biofuel.				
Text Books				
1	**ENGINE TESTING LAB Manual**			
Course Designer				
S.No	**Faculty Name**	**Designation**	**Department/Name of the College**	**Email id**
1.	A.SENTHILKUMAR	AP-II	MECH/AVIT	senthilkumar@avit.ac.in

17MECC86	DYNAMICS AND METROLOGY LAB	Category	L	T	P	Credit
		CC	0	0	4	2

Preamble
The aim of the subject is to provide basic knowledge in mechanisms related to machine dynamics and measuring instruments

Prerequisite
NIL

Course Objective

1	To impart practical concepts of regulation the speed as an engine experimental setups with needed Instrumentation.
2	To enable students understand the Motions, suspensions, vibrations of the machine parts with experimental setups with needed instrumentation
3	To make students understand the concepts of angular measurement
4	To provide the concepts of measurement with flow, speed, displacement, temperature with experimental setups with needed instrumentation
5	To provide the concepts of measurement of the cutting forces with experimental setups

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	To capable of doing the experiments of various governor equipments.
CO2.	To capable of conduct the various dynamic and vibrating equipments
CO3.	To able to conduct the static equipments ,for measure the angle, contour
CO4.	To capable the measuring experiments with proper equipments for flow,temp,speed
CO5.	To able to conduct dynamic equipments ,for measure the forces,angles

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	L	-	-	-	-	-	-	-	L	-	L	-	-
CO2	S	M	M	L	-	-	-	-	-	-	L	-	L	-	-
CO3	S	L	-	M	-	-	-	-	-	-	L	-	L	-	-
CO4	S	S	M	-	M	M	L	-	-	-	M	-	L	-	-
CO5	S	S	L	-	M	M	-	-	-	-	M	-	L	-	-

S- Strong; M-Medium; L-Low

LIST OF EXPERIMENTS
1. To perform an experiment on Watt and Porter Governor to prepare performance characteristic curves and to find stability and sensitivity
2. To determine the position of sleeve against controlling force and speed of a Hartnell governor and to plot the characteristic curve of radius of rotation
3. To analyse the motion of a motorized gyroscope when the couple is applied along its spin axis and determine gyroscopic couple
4. Determine the Moment of Inertia by compound pendulum and tri-filar suspension.
5. To determine the frequency of undamped free vibration and damped forced vibration of an equivalent spring mass system.
6. To determine whirling speed of shaft theoretically and experimentally.
7. Angular Measurements using Bevel Protector and Sine Bar
8. Flow Measurement using a Rotameter.
9. Fundamental dimension measurement of a gear using a contour projector.
10. Measurement of Displacement using Linear Variable Differential Transducer.
11. Measurement of speed of Motor using Stroboscope.
12.Measurement of cutting forces using Lathe Tool Dynamometer
TEXT BOOKS 1. Dynamics lab manual 2. Metrology and Measurements lab Manual
Course Designers

S.No	Faculty Name	Designation	Department/ Name of the College	Email id
1	R.MAHESH	ASSISTANT PROFESSOR (GRADE-II)	Mechanical/AVIT	mahesh@avit.ac.in

17MECC87	AUTOMOBILE ENGINEERING LAB	Category	L	T	P	Credit
		CC	0	0	4	2

Preamble

To impart training in assembling and dismantling of different types of engine components

Prerequisite – NIL

Course Objective

1	To familiarize and train the students on the constructional arrangements of different Engine Models of different vehicles.
2	To familiarize and train the students on the constructional arrangements of different Chassis of different vehicles.
3	To learn the function of Automotive Electronics components of testing and measurements

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Apply the Dismantle and Assemble of the constructional arrangements of different Engine Models of different vehicles.	Apply
CO2.	Apply the Dismantle and Assemble of the constructional arrangements of different Chassis of different vehicles.	Apply
CO3.	Evaluate the function of Automotive Electronics components of testing and measurements	Evaluate

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PS O1	PSO 2	PSO 3
CO1	S	S	-	-	-	-	-	-	L	-		-	L		
CO2	S	L	S	L	M	-	-	-	L	-		-	L		
CO3	S	s	-	L	M	-	-	-	L	-		-	L		

S- Strong; M-Medium; L-Low

SYLLABUS:

LIST OF EXPERIMENTS:

1) Dismantling & assembling of 6 cylinder petrol engine.
2) Dismantling & assembling of 4 cylinder petrol engine.
3) Dismantling & assembling of 3 cylinder diesel engine.
4) Gear box – Sliding mesh, Constant mesh & Synchromesh Gear Box, Transfer case
5) Steering system, Braking system
6) Study of oil filter, fuel filter, fuel injection system, carburetor, MPFI
7) Study of ignition system components – coil, magneto and electronic ignition systems.
8) Study of engine cooling system components, Study of engine lubrication system components
9) Ovality and taper measurement of cylinder bore and comparison with standard specifications
10) Clutch 2 types – Coil spring& Diaphragm spring clutches

REFERENCES				
1. Automobile engineering practices R.P GUPTA.				
2. Automobile engineering KIRPAL SINGH				
S.No	**Faculty Name**	**Designation**	**Department/ College**	**Email id**
1	SAMUVEL MICHAEL	Asso.Prof Gr-II	MECH/AVIT	samuvelmichael@avit.ac.in

17MECC88	COMPUTER INTEGRATED MANUFACTURING LAB	Category	L	T	P	Credit
		CC	0	0	4	2

Preamble

This course provides the basic knowledge about CNC machine and CNC programming

Prerequisite – NIL

Course Objective

1	To discuss the basics of manual part programming for turning and milling.
2	To practice the methodologies for writing the CNC program .
3	To learn and write the program using mirroring, left / right hand radius compensation concept.
4	To write the program for rectangular and circular pocketing.
5	To write the program in canned cycles and subroutines.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	To learn the basic knowledge about G and M codes	Understand
CO2.	Apply the programming knowledge to write the program for linear and circular interpolation	Apply
CO3.	Apply the knowledge of mirroring and subroutine concepts to write the CNC program	Apply
CO4.	Apply the knowledge of Left hand and right hand radius compensation.	Apply
CO5.	Analyze the different types of canned cycles including turning, facing, grooving, drilling, boring and threading etc.,	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	L	L	L	L	-	-	-	-	-	-	-	L	L		
CO2	S	S	M	S	-	-	-	-	M	-	-	M	L		
CO3	S	S	S	S	-	-	-	-	M	-	-	M	S		
CO4	S	S	S	S	-	-	-	-	M	-	-	M	S		
CO5	S	S	S	S	-	-	-	-	S		-	S	S		

S- Strong; M-Medium; L-Low

SYLLABUS:

LIST OF EXPERIMENTS:

Introduction:

1. Study of G and M codes
2. Manual Part Programming for CNC Machines using Stand G and M Code.
3. Machining practice on Trainer Type CNC Machines-
4. Simulation of tool path using any CAM Software

Part programming in CNC Milling:

1. Point to point motions
2. Linear motions
3. Circular interpolations
4. Contour motions
5. Rectangular pocketing
6. Mirroring
7. Circular Pocketing
8. Fixed /canned cycles
9. Subroutines

Part programming for CNC Turning :

1. Turning and facing
2. Step turning, Taper Turning
3. Grooving
4. Fixed/Canned Cycles :
5. Thread cutting Cycles
6. Peck Drilling Cycles

Text Books

1	**CAM LAB Manual**

Course Designers

S.No	**Faculty Name**	**Designation**	**Department/ College**	**Email id**
1	M.SARAVANAN	Asst. Professor	Mech / VMKVEC	msaravanan94@gmail.com

17MECC89	HEAT TRANSFER LAB	Category	L	T	P	Credit
		CC	0	0	4	2

Preamble

The Purpose of the practical course is to provide the students an understanding of different modes of heat transfer by practically experiments in setups.

Prerequisite

NIL

Course Objective

1	To impart practical concept of conduction heat transfer in experimental setups with needed Instrumentation.
2	To enable students understand their conduction mechanism in unsteady state emphasizing on application in engineering.
3	To make students understand convection principles and its application.
4	To provide radiation concepts and Heat exchangers.
5	To enable students to understand Stefan Boltzmann’s constant concepts.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	To capable of doing the experiments in conduction systems.	Apply
CO2.	To apply the knowledge of conducting experiments of transient conduction systems.	Apply
CO3.	To conducting the experiments of convection systems.	Apply
CO4.	To Perform the experiments of Radiation Heat Exchangers.	Apply
CO5.	To capable of doing the experiments Stefan Boltzmann’s setup.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	-	-	-	-	-	-	-	-	L	-	L	-	-
CO2	S	L	S	L	-	-	-	-	-	-	L	-	L	-	-
CO3	S	L	-	L	-	-	-	-	-	-	M	-	L	-	-
CO4	S	M	L	-	-	-	-	-	-	-	M	-	L	-	-
CO5	L	L	L	-	-	-	L	-	-	-	L	-	L	-	-

S- Strong; M-Medium; L-Low

LIST OF EXPERIMENTS
1.Determination of Thermal conductivity(Lagged Pipe)
2.Determination of Emissivity
3.Determination of Heat transfer co-efficient through Forced Convection
4.Determination of Heat transfer co-efficient through Natural Convection
5.Determination of Heat transfer co-efficient of Pin-Fin Apparatus.
6.Determination of Stefan Boltzmann' s Constant
7.Determination of Thermal conductivity(Two Slabs Guarded Hot Plate Method)
8.Determination of Effectiveness of a Heat Exchanger By Parallel Flow
9.Determination of Effectiveness of a Heat Exchanger By Counter Flow
10.Determination of Thermal conductivity of the Composite wall
11.Determination of Thermal conductivity (Insulating Powder)

TEXT BOOKS

1. Heat Transfer lab Maual prepared by C.Thiagarajan,Mech/AVIT

Course Designers

S.No	Faculty Name	Designation	Department/ Name of the College	Email id
1	C.THIAGARAJAN	ASSISTANT PROFESSOR (GRADE-II)	Mechanical/AVIT	cthiagarajan@avit.ac.in

17MECC90	FINITE ELEMENT ANALYSIS LAB	Category	L	T	P	Credit
		CC	0	0	4	2

Preamble
To provide hands-on experience to the students in finite element analysis software.

Prerequisite
NIL

Course Objective

1	Learn basic procedure of finite element analysis
2	Use computer as a tool in analysis
3	Analysis of modeled parts
4	Analysis of one and two-dimensional problems using software
5	To model multi-dimensional heat transfer problems using ANSYS

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Apply the basic concepts to stress and strain problems for different materials	Understand
CO2.	Solve the finite element problems to trusses, beams and frames	Apply
CO3.	Apply finite element method to find solutions for various machine members and structures.	Apply
CO4.	Apply finite element method to solve Heat transfer problems.	Apply
CO5.	Solve linear, non-linear and Harmonic analysis problems	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	L	L	L	L	-	-	-	-	-	L	L		
CO2	S	S	M	L	S	M	-	-	-	L	-	M	M		
CO3	S	S	S	S	S	M	-	-	M	L	-	L	S		
CO4	S	S	S	M	S	M	-	-	M	L	-	L	S		
CO5	S	S	S	S	S	L	-	-	-	L	-	L	S		

S- Strong; M-Medium; L-Low

SYLLABUS

1. Study of analysis and its benefits
2. Stress analysis of cantilever and simply supported beam
3. Application of distributed loads
4. Nonlinear analysis of cantilever beam
5. Buckling analysis
6. Stress analysis of axi-symmetry vessels
7. Static analysis of two dimensional truss
8. Transient thermal conduction
9. Conductive heat transfer analysis
10. Plane stress bracket
11. Modal analysis of simply supported beam
12. Harmonic analysis of a cantilever beam

Text Books

1	Finite Element Analysis lab Manual

Reference Books

1	Hutton, D.V., "Fundamentals of Finite Element Analysis", McGraw Hill, International Edition, 2004.
2	Chandrupatla, T.R., Belegundu, A.D., "Introduction to Finite Elements in Engineering", Prentice Hall of India, 2002.

Course Designers

S.No.	Faculty Name	Designation	Department/Name of the College	Email id
1	K.Vijayakumar	Assistant Professor	Mech / AVIT	vijayakumar@avit.ac.in

17MECC91	INDUSTRIAL AUTOMATION LAB	Category	L	T	P	Credit
		CC	0	0	4	2

Preamble
To train the students in hydraulic and pneumatic circuit design using different control devices

Prerequisite NIL

Course Objective

1	Design Hydraulic and Pneumatic circuits for low cost automation
2	To understand the working of logical circuits
3	To understand the operation of basic electro pneumatic circuits
4	To design open loop and closed loop control circuit of AC servo motor
5	Application of PLC to design a system.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Understand principles, strategies and advantages of industrial automation	Understand
CO2.	Design material handling and material storage systems for an automated factory	Analyze
CO3.	Devise automated shopfloorcontrolsandpartidentificationmethods	Understand
CO4.	Outline the IoT Technologies used in a manufacturing plant and their role in Industry	Understand
CO5.	Understand the basics of vehicle collision and its effects.	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	L		M							L		
CO2	S	S	S	S	M	S				S			L		
CO3	S	M	L			L							L		
CO4	S	M	L		L	L							L		
CO5	S	S	M	L		M						L	L		

S- Strong; M-Medium; L-Low

LIST OF EXPERIMENTS:

1. To design a Speed control circuits for double acting cylinder.
2. To design a Synchronization circuit for two cylinders.
3. To design a Continuous reciprocation of double acting cylinder.
4. To design a Sequencing of two cylinder circuits.
5. To design a Cascading circuit for trapped signals-2 groups
6. Implementation of Logic Circuits: AND,OR
7. Design of Basic Electro Pneumatic Circuits: Continuous reciprocation of cylinder (with timer and counter)
8. Design and testing of Force, Velocity calculations in Hydraulic Linear actuation
9. Automatic bottle filling Machine
10. Design and simulation of PLC Control Pneumatic/ Hydraulic linear actuator circuits.
11. To design a Water Level Controller using PLC.

12. To design a PLC Controlled Material Handling System.

Text Books

1	**INDUSTRIAL AUTOMATION LAB Manual**

Course Designers

S.No	**Faculty Name**	**Designation**	**Department/Name of the College**	**Email id**
1	M.SARAVANAN	ASST. PROF	MECH./ AVIT	saravanan@avit.ac.in

17MECC92	DYNAMICS LAB	Category	L	T	P	Credit
		CC	0	0	4	2

Preamble

The aim of the subject is to provide the knowledge in performing vibration measurements . To measure the dynamics forces induced during working conditions.

Prerequisite

NIL

Course Objective

1	T o calculate the mass moment of inertia and Radius of gyration of the compound pendulum.
2	To determine experimentally the moment of inertia of a rectangular bar of a Bifilar suspension system.
3	To determine experimentally the moment of inertia and radius of a circular plate Trifilar suspension system.
4	The objective of this experiment to determine the natural frequency if a spring mass system.
5	The objective of this centrifugal governor to study the dynamic characteristics and to determine its controlling force at various positions and compare the experimental and theoretical values.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Estimate the mass moment of inertia of using , bi-filar suspension Trifilar Suspension, compound pendulum.
CO2.	Inspect the critical speed of shaft under the given load conditions and the gyroscopic effect and couple on motorized gyroscope.
CO3.	Determine the characteristic curves of Watt, Porter, Proell and Hartnell governors.
CO4.	To Find the Natural Frequency of Spring Mass System.

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	L	-	-	-	-	L	-	-	-	L	-	-
CO2	S	M	L	L	-	-	-	-	L	-	-	-	L	-	-
CO3	S	L	L	L	-	-	--	-	L	-	-	-	L	-	-
CO4	S	L	L	L	-	-	-	-	L	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

LIST OF EXPERIMENTS				
1. Perform an Experiment on Watt and Porter Governor and to find the stability and sensitivity. 2. To Determine the controlling force and speed of a Proell Governor. 3. To Determine the position of sleeve against controlling force and speed of a Hartnell Governor. 4. Determination of Gyroscopic couple using Motorized Gyroscope. 5. Determination of critical speed of Whirling Shaft. 6. Determination of Natural Frequency of single degree of freedom system in a spring mass system. 7. Determination of Radius of Gyration- compound Pendulum 8. To Determine the moment of inertia by Trifilar and Bifilar Suspension.				
Text Book				
DYNAMICS Lab Manual				
Course Designers				
S.No	**Faculty Name**	**Designation**	**Department/ Name of the College**	**Email id**
1.	K.SURENDRABABU	ASSOCIATE Professor	Mechanical/AVIT	ksbtkm@gmail.com
2.	R.MAHESH	ASSOCIATE Professor	Mechanical/AVIT	maheshavit.ac.in

17MECC93	HYDRAULICS AND PNEUMATIC SYSTEM LAB	Category	L		P	Credit
		CC	0	0	4	2

Preamble

Togain knowledge about components used in fluid power system and familiarize various circuits used in industry

Prerequisite – NIL

Course Objective

1	To impart practice in hydraulic circuit and pneumatic circuit
2	To apply the practical training by using trainer kit.
3	To apply the skills to design a circuit for any application

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Undergo practical skill training in hydraulic system	Apply
CO2.	Undergo practical skill training in pneumatic system	Apply
CO3.	Gain the of knowledge skill practice in designing circuits for automation	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	S	S	S	M	M	L	M	-	M			L	L		
CO2	S	S	S	M	M	L	M	-	M			L	L		
CO3	S	S	M	M	L	M	L	-	M			M	L		

S- Strong; M-Medium; L-Low

SYLLABUS:
LIST OF EXPERIMENTS:

1. Study of Speed Control Circuit on Hydraulic Trainer
2. Study of Sequencing Circuit on Hydraulic Trainer
3. Study of Synchronizing Circuit on Hydraulic Trainer
4. Study of Regenerative Circuit on Hydraulic Trainer
5. Study of Counterbalancing Circuit on Hydraulic Trainer
6. Study of ISO/GIS Fluid Power Symbols
7. Design and assembly of hydraulic / pneumatic circuit
8. Visit Report for Demonstration of Fluid Power Circuit

Text Book				
HYDRAULICS AND PNEUMATIC SYSTEM LAB Manual				
Course Designers				
S.No	**Faculty Name**	**Designation**	**Department/ College**	**Email id**
1	M.SARAVANAN	Assistant Professor	Mech / VMKVEC	rajat@vmkvec.edu.in

17MECC94	MANUFACTURING ENGINEERING LAB	Category	L		P	Credit
		CC	0	0	4	2

Preamble

To impart practice in operation of special machines like turning, milling shaping and grinding.

Prerequisite – NIL

Course Objective

1	To impart practice in lathe operations
2	To apply the practical training by using drilling machine, shaping machine operations
3	To apply the practical training by using milling, planning and grinding machines

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Undergo practical skill training in lathe machine and various Lathe machining operations	Apply
CO2.	Undergo practical skill training in drilling machine, shaping machine	Apply
CO3.	Gain the of knowledge skill practice in planning and grinding machines	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	S	S	M	M	L	M	L	-	M	M			L		
CO2	S	S	M	M	L	M	L	-	M	M			L		
CO3	S	S	M	M	L	M	L	-	M	M			L		

S- Strong; M-Medium; L-Low

SYLLABUS:

LIST OF EXPERIMENTS:

1. Plain turning and step turning on lathe.
2. Taper turning on lathe.
3. Thread cutting on lathe.
4. Drilling, reaming and tapping in a drilling machine.
5. Plain milling.
6. Making square shape job in shaping machine.
7. Making Cutting key ways in a slotting machine.
8. To Perform Grinding process using a grinding machine

Text Book				
MANUFACTURING ENGINEERING LAB Manual				
Course Designers				
S.No	**Faculty Name**	**Designation**	**Department/ College**	**Email id**
1	T.Raja	ASSITANT PROFESSOR	AUTO/VMKVEC	rajat@vmkvec.edu.in
2	R.Prabhakar	ASSITANT PROFESSOR	AUTO/VMKVEC	rprabhakar@vmkvec.edu.in

ELECTIVE COURSES

SPECIALIZATION – AERONAUTICAL ENGINEERING

17ARSE43	AERODYNAMICS	Category	L	T	P	Credit
		EC-SPL	3	0	0	3

Preamble

This subject provides a detailed description of the methodology and the behaviour of airflow both internal and external in compressible flow regime with particular emphasis on supersonic flows. It will provide students an in-depth knowledge of the compressible flow and also about the shock waves. With this knowledge the students can also apply the experimental techniques for high speed flows.

Course Objectives

1.	To understand the fluid mechanics concepts for advanced applications
2.	To study two dimensional flows in aerodynamics
3.	To study ideal flows over wings
4.	To Study the high speed flows over airfoils, wings and airplane configurations
5.	To Study the boundary layer interaction

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	Gather the knowledge of fundamental principles of fluid mechanics.	Remember
CO2.	Use the concepts of two dimensional flows in aerodynamics.	Understand
CO3.	Implement the concept and compute relevant results for ideal flow over wings.	Apply
CO4.	Compute the results for high speed flows over airfoils and wings by applying various methods	Apply
CO5.	Implement the performance of experimental techniques for high speed flows analysis	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	L	L	-	-	-	-	-	-	-	-	-	L	L	L	L
CO2.	M	M	M	L	-	-	-	-	-	-	-	-	L	L	L
CO3.	M	S	S	M	M	-	-	-	-	-	-	-	M	M	S
CO4.	S	M	S	S	S	-	-	-	-	-	-	L	S	S	S
CO5.	M	S	S	S	S	-	-	-	L	--	-	M	S	S	S

S- Strong; M-Medium; L-Low

Syllabus

UNIT – I	INTRODUCTION TO LOW SPEED FLOW	9
Euler equation, incompressible Bernoulli's equation. circulation and vorticity, Green's Lemma and Stoke's theorem, Barotropic flow, Kelvin's theorem, Reynolds number, streamline, stream function, irrotational flow, potential function, Equi-potential lines, elementary flows and their combinations		
UNIT – II	**TWO DIMENSIONAL INVISCID INCOMPRESSIBLE FLOW**	**9**
Ideal Flow over a circular cylinder, D'Alembert's paradox, Magnus effect, Kutta-Joukowski's theorem, starting vortex, Kutta condition, real flow over smooth and rough cylinder		
UNIT – III	**SUBSONIC WING THEORY**	**9**
Vortex filament, Biot and Savart law, bound vortex and trailing vortex, horse shoe vortex, lifting line theory and its limitations, various types of wings and its applications		
UNIT – IV	**HIGH SPEED FLOW OVER AIRFOILS, WINGS AND AIRPLANE CONFIGURATION**	**9**
Critical Mach number, Drag divergence Mach number, Shock Stall, Supercritical Airfoil Sections, Transonic area rule, Swept wing, Airfoils for supersonic flows, Lift, drag, Pitching moment and Centre of pressure for supersonic profiles, Shock-expansion theory, wave drag, supersonic wings, Design considerations for supersonic aircraft- aerodynamic heating.		
UNIT – V	**EXPERIMENTAL TECHNIQUES FOR HIGH SPEED FLOWS**	**9**

Wind tunnels for transonic, Supersonic and hypersonic flows, shock tube, Gun tunnels-peculiar problems in the operation of hypersonic tunnels - Supersonic flow visualization methods
TEXT BOOK:
1. Anderson, J. D, Modern Compressible Flow, McGraw-Hill & Co., 2002. 2. Rathakrishnan., E, Gas Dynamics, Prentice Hall of India, 2004.
REFERENCES:
1. Shapiro, A. H., Dynamics and Thermodynamics of Compressible Fluid Flow, Ronald Press, 1982. 2. Zucrow, M. J. and Anderson, J. D., Elements of Gas Dynamics, McGraw- Hill & Co., 1989. 3. Oosthuizen,P.H., &Carscallen,W.E., Compressible Fluid Flow, McGraw- Hill & Co., 1997.

Course Designers:

S.No	**Name of the Faculty**	**Mail ID**
1	Senthilkumar M	senthil@vmkvec.edu.in
2	Gowri Shankar R	gowrishankar@vmkvec.edu.in
3	Sanjay Singh	sanjay@vmkvec.edu.in

17ARSE44	AEROSPACE PROPULSION	Category	L	T	P	Credit
		CORE	3	0	0	3

Preamble

This course provides knowledge and creates a base for the students to develop a strong concept of propulsive device used in aerospace propulsion.

Course Objectives

1	To understand the basic concepts of propulsion.
2	To provide an in-depth study of propulsion subject.
3	To develop analytical skills for selection of propulsive method.
4	To develop criticizing skills for modification and designing of components.
5	To develop entrepreneurial skills.

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	Define principles of operation and identification of components of an engine.	Remember
CO2.	Explain working of internal combustion engines.	Understand
CO3.	Employ analytical skills for trouble shooting.	Apply
CO4.	Categorise the propulsive devices and estimate reliability.	Analyze
CO5.	Evaluate and modify the system.	Evaluate
CO6.	Formulate and design a new modified aero engine	Create

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO2.	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO3.	S	S	S	S	-	-	-	-	-	-	-	-	M	M	M
CO4.	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S
CO5.	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S
CO6.	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S

S- Strong; M-Medium; L-Low

Syllabus

UNIT I	**FUNDAMENTALS OF ENGINES**	**7**
History and classifications of Aero engines, Working of gas turbine engine – Thrust equation – Efficiency, Specific fuel consumption, Methods of thrust augmentation – Characteristics of propeller, turboprop, turbofan and turbojet engines.		
UNIT II	**INLETS AND NOZZLES**	**7**
Subsonic inlets– External and internal flow pattern – inlet performance criterion –Boundary layer separation – Supersonic inlets–Theory of flow in isentropic nozzles – Losses in nozzles –– Interaction of nozzle flow with adjacent surfaces – Thrust reversal		
UNIT III	**COMPRESSORS, TURBINES AND COMBUSTION CHAMBERS**	**12**
Principle of operation of centrifugal compressor – Work done and pressure rise – Elementary theory of axial flow compressor – Elementary theory of axial flow turbine– blade cooling - Classification of combustion chambers – Important factors affecting combustion chamber design – Combustion process		
UNIT IV	**ROCKETS – SOLID, LIQUID AND HYBRID**	**12**
Selection criteria of solid propellants – propellant grain design considerations – Progressive, Regressive and neutral burning in solid rockets, Liquid propellant rockets – selection of liquid propellants – various feed systems for liquid rockets –cryogenic techniques - Thrust vector control – Cooling in liquid rockets – advantages of liquid rockets over solid rockets - introduction to hybrid propulsion – advantages and limitations of hybrid propulsion		
UNIT V	**ADVANCED PROPULSION TECHNIQUES**	**7**
Electric rocket propulsion – Plasma as a fluid- Diffusion in Partially Ionized gases - Ion propulsion – Nuclear rocket, Solar Sail		

TEXT BOOK:
1. Hill, P.G. & Peterson, C.R, Mechanics & Thermodynamics of Propulsion, Addison – Wesley Longman INC, 1999. 2. Sutton, G.P., “Rocket Propulsion Elements”, John Wiley & Sons Inc., New York, 8th Edition, 2010.
REFERENCES:
1. Ahmed F. El-Sayed, Aircraft Propulsion and Gas turbine engines, CRS Press, 2008 2. SaeedFarokhi, Aircraft Propulsion, John Wiley & Sons, Inc ., 2009 3. J D Mattingly, “Elements of Propulsion - Gas Turbines and Rockets “, AIAA Education Series, 2006. 4. Dan M.Goebel, Ira Katz, ‘Fundamentals of Electric Propulsion’, John Wiley & Sons Inc, New York, 2003.

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17ARSE45	**AIRCRAFT STRUCTURES**	Category	L	T	P	Credit
		EC - SPL	3	0	0	3

Preamble

This subject provides knowledge on the aircrafts basic structural load and the behaviours of the structure under loading condition. It will also provide the detailed study on the failure theory which provides the student a deep knowledge on designing a safe structure.

Course Objectives

1.	To remember the various methods ofjoints in the structural member.
2.	To provide the students an understanding on the static analysis of determinate and indeterminate structure.
3.	To understand the various energy methods.
4.	To apply the knowledge on structural design using different failure theories.
5.	To analyse the various industrial and thermal stresses.

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	Generalize the various bending of different types of member under loading.	Remember
CO2.	Calculate the Shear flow in aircraft members related to open section.	Understand
CO3.	Calculate the columns in aircraft members.	Understand
CO4.	Describe the various types of buckling of plates and the deformation of it.	Apply
CO5.	Relate the various real time problems in industries.	Analyse

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	S	L	S	-	-	M	L	-	-	-	-	S	L	S	L
CO2.	S	S	M	M	-	-	-	-	-	-	-	-	M	L	-
CO3.	S	S	M	L	-	L	-	-	L	-	-	L	L	-	-
CO4.	S	M	M	S	M	-	-	-	-	-	-	-	S	S	S
CO5.	S	S	S	M	-	-	-	-	-	--	-	M	S	S	S

S- Strong; M-Medium; L-Low

Syllabus

UNIT – I	**STATICALLY DETERMINATE& INDETERMINATE STRUCTURES**	**9**
Plane truss analysis – method of joints – method of sections – method of shear – 3-D trusses –principle of super position, Clapeyron’s 3 moment equation and moment distribution method for indeterminate beams.		
UNIT – II	**STRESS ANALYSIS OF WING AND FUSELAGE**	**10**
Loads on an aircraft –V-n diagram – shear force and bending moment distribution over theaircraft wing and fuselage – shear flow in thin-webbed beams with parallel and non-parallel flanges –complete tension field beams – semi-tension field beam theory.		
UNIT – III	**COLUMNS**	**10**
Euler’s column curve – inelastic buckling – effect of initial curvature – the South well plot – columns with eccentricity – use of energy methods – theory of beam columns – beam columns with different end conditions – stresses in beam columns.		
UNIT – IV	**UNSYMMETRICAL BENDING**	**9**
Bending of symmetric beams subject to skew loads - bending stresses in beams of unsymmetrical sections – generalized ‘K’ method, neutral axis method, and principal axis method.		
UNIT – V	**INDUCED STRESSES**	**7**
Thermal stresses – impact loading – Fatigue – Creep - Stress Relaxation.		
TEXT BOOK:		
1. Timoshenko and Gere, "Mechanics of Materials", Tata McGraw Hill, 1993. 2. Megson T M G, "Aircraft Structures for Engineering students" Elsevier Science and Technology, 2007 3. Peery and Azar, "Aircraft Structures		

REFERENCES:
1. Donaldson, B.K., "Analysis of Aircraft Structures - An Introduction", McGraw Hill, 1993. 2. Bruhn E F, "Analysis and Design of Flight Vehicle Structures", Tri-State Off-set Company, USA,1985 3. Peery, D.J. and Azar,J.J., "Aircraft Structures", 2nd Edition, McGraw – Hill, N.Y, 1999.

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17ARCC09	AIRCRAFT PERFORMANCE STABILITY AND CONTROL	Category	L	T	P	Credit
		EC - SPL	3	0	0	3

Preamble

This course will provide the student a strong knowledge on the Aircrafts various stability criteria's along the different axis and the controls involved in it and also the various flight performance in different flying conditions.

Course Objectives

1	To understand the various performance of flight during cruising condition
2	To understand the various maneuvering of flight
3	To provide an in-depth study of longitudinal static stability and its control.
4	To provide an in-depth study of directional and lateral static stability
5	To identify the Stability derivatives for dynamic stability.

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	Relate the various performance flights according to the maneuvers.	Remember
CO2.	Explain various flight maneuvers properly.	Understand
CO3.	Demonstrate the stability criteria's along the longitudinal axis of flight.	Apply
CO4.	Demonstrate the stability criteria's along the directional and lateral axis.	Apply
CO5.	Identify varies stability derivative problems.	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	M	L	M	S	-	-	-	-	-	-	-	-	-S	L	L
CO2	L	M	L	L	-	-	-	-	-	-	-	-	L	M	S
CO3	S	M	S	S	-	-	-	-	-	-	-	-	M	M	S
CO4	S	M	S	S	-	-	-	-	-	-	-	-	M	S	M
CO5	S	S	M	M	-	-	-	-	-	-	-	-	M	S	M

S- Strong; M-Medium; L-Low

Syllabus

UNIT – I	CRUISING FLIGHT PERFORMANCE	10
International Standard Atmosphere - Forces and moments acting on a flight vehicle -Equation of motion of a rigid flight vehicle - Different types of drag –estimation of parasite drag co-efficient by proper area method- Drag polar of vehicles from low speed to high speeds - Variation of thrust, power with velocity and altitudes for air breathing engines . Performance of airplane in level flight - Power available and power required curves. Maximum speed in level flight - Conditions for minimum drag and power required		
UNIT – II	**MANOEUVERING FLIGHT PERFORMANCE**	**11**
Range and endurance - Climbing and gliding flight (Maximum rate of climb and steepest angle of climb, minimum rate of sink and shallowest angle of glide) -Turning performance (Turning rate turn radius). Bank angle and load factor – limitations on turn - V-n diagram and load factor.		
UNIT – III	**STATIC LONGITUDINAL STABILITY**	**10**
Degree of freedom of rigid bodies in space - Static and dynamic stability - Purpose of controls in airplanes -Inherently stable and marginal stable airplanes – Static, Longitudinal stability - Stick fixed stability - Basic equilibrium equation - Stability criterion - Effects of fuselage and nacelle - Influence of CG location - Power effects - Stick fixed neutral point -Stick free stability-Hinge moment coefficient - Stick free neutral points-Symmetric maneuvers - Stick force gradients - Stick _ force per 'g' - Aerodynamic Balancing.		
UNIT – IV	**LATERAL AND DIRECTIONAL STABILITY**	**8**
Dihedral effect - Lateral control - Coupling between rolling and yawing moments – Adverse yaw effects - Aileron reversal - Static directional stability - Weather cocking effect – Rudder requirements - One engine inoperative condition - Rudder lock.		

UNIT – V	DYNAMIC STABILITY	6
Dutch roll and spiral instability, Auto rotation and spin, Stability derivatives for lateral and directional dynamics.		

TEXT BOOKS:

1. Perkins, C.D., and Hage, R.E., “Airplane Performance stability and Control”, John Wiley & Son:, Inc, NY, 1988.
2. Nelson, R.C. “Flight Stability and Automatic Control”, McGraw-Hill Book Co., 2004.
3. McCornick. W., “Aerodynamics, Aeronautics and Flight Mechanics”, John Wiley, NY, 1979.

REFERENCES:

1. Etkin, B., “Dynamics of Flight Stability and Control”, Edn. 2, John Wiley, NY, 1982.
2. Babister, A.W., “Aircraft Dynamic Stability and Response”, Pergamon Press, Oxford, 1980.
3. Dommasch, D.O., Sherby, S.S., and Connolly, T.F., “Aeroplane Aero dynamics”, Third Edition, Issac Pitman, London, 1981.
4. McCornick B. W, “Aerodynamics, Aeronautics and Flight Mechanics”, John Wiley, NY, 1995.

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17ARCC10	AIRCRAFT MATERIALS AND PROCESSES	Category	L	T	P	Credit
		CC	3	0	0	3

Preamble
This course provides basic knowledge in aircraft materials and its process.

Prerequisite
NIL

Course Objectives

1. To understand the structure of solid materials, crystal structures and physical metallurgy.
2. To understand the various deformation mechanisms, failure modes and phase diagram
3. To learn the various types of heat treatment methodologies and study of corrosion behaviour of materials.
4. To know the various types of engineering materials, properties and applications.
5. To learn about the exposure to high temperature materials for space applications

Course Outcomes
On the successful completion of the course, students will be able to

CO1. To know the elements of aerospace materials like crystallography.	Understand
CO2. To analyse the behaviour of materials using mechanical testing methods to know the properties of materials.	Apply
CO3. Identify heat treatment methods and surface treatments to improve mechanical properties of materials for applications in engineering industries. To make an analysis of the formation and effects of corrosion on various materials and to make an analysis of the formation and effects of corrosion on various materials.	Apply
CO4. Identify materials for industrial applications based on microstructure and mechanical property relationship	Analyze
CO5. To study and analyze the different types of high temperature materials for space applications	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO	S	L	-	-	-	-	-	-	-	-	-	-	L		
CO	M	S	M	L	-	-	-	-	-	-	-	-	L		
CO	S	M	L	M	-	-	-	-	-	-	-	-	L		
CO	S	S	L	S	-	-	-	-	-		-	-	L		
CO	L	S	M	S	-	-	-	-	-		-	-	L		

S- Strong; M-Medium; L-Low

.SYLLABUS
ELEMENTS OF AEROSPACE MATERIALS
Structure of solid materials – Atomic structure of materials – crystal structure – miller indices – density – packing factor – space lattices – x-ray diffraction – imperfection in crystals – physical metallurgy - general requirements of materials for aerospace applications.
MECHANICAL BEHAVIOUR OF MATERIALS
Linear and non linear elastic properties – Yielding, strain hardening, fracture, Bauchinger's effect –Notch effect testing and flaw detection of materials and components – creep and fatigue -comparative study of metals, ceramics plastics and composites.
CORROSION & HEAT TREATMENT OF METALS AND ALLOYS

Types of corrosion – effect of corrosion on mechanical properties – stress corrosion cracking –corrosion resistance materials used for space vehicles heat treatment of carbon steels – aluminium alloys, magnesium alloys and titanium alloys – effect of alloying treatment, heat resistance alloys –tool and die steels, magnetic alloys,
CERAMICS AND COMPOSITES
Introduction – powder metallurgy - modern ceramic materials – cermets - cutting tools – glass ceramic – production of semi fabricated forms - plastics and rubber – carbon/carbon composites, fabrication processes involved in metal matrix composites - shape memory alloys – applications in aerospace vehicle design, open and close mould processes.
HIGH TEMPERATURE MATERIALS CHARACTERIZATION
Classification, production and characteristics – methods and testing – determination of mechanical and thermal properties of materials at elevated temperatures – application of these materials in thermal protection systems of aerospace vehicles – super alloys – high temperature material characterization.
Text Books
1. Tifferton.G., "Aircraft Materials and Processes", V Edition, Pitman Publishing Co., 1995.
Reference Books
1. Martin, J.W., "Engineering Materials, Their properties and Applications", Wykedham Publications (London) Ltd., 1987. 2. VanVlack.L.H., "Materials Science for Engineers", Addison Wesley, 1985.3. 3. Raghavan.V., "Materials Science and Engineering", Prentice Hall of India, New Delhi, 1993.
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17ARSE34	AIRCRAFT GENERAL ENGINEERING AND MAINTENANCE PRACTICES	Category	L	T	P	Credit
		EC - SPL	3	0	0	3

Preamble

This course will provide the student a strong knowledge on the Aircrafts basic and regular maintenance to be followed to have a smooth and safety fly.

Course Objectives

1	To remember the various maintenance practices involved in aircraft.
2	To understand the various procedures to be followed during maintenance.
3	To provide an in-depth study of the safety precautions to be followed.
4	To identify the various special problems involved in the aircraft through inspection.
5	To fully equipped with the knowledge of the flight maintenance in all the aspects.

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	Recall the various maintenance practices involved in aircraft.	Remember
CO2.	Demonstrate the various procedures to be followed during maintenance.	Understand
CO3.	Generalize the various primary safety precautions to be followed.	Apply
CO4.	Calculate the various special problems involved in the aircraft.	Apply
CO5.	Categorize the various flight maintenance procedures in all the aspects.	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	M	L	M	S	-	-	-	-	-	-	-	-	S	L	L
CO2	L	M	L	L	-	-	-	-	-	-	-	-	L	M	S
CO3	S	M	S	S	-	-	-	-	-	-	-	-	M	M	S
CO4	S	M	S	S	-	-	-	-	-	-	-	-	M	S	M
CO5	S	S	M	M	-	-	-	-	-	-	-	-	M	S	M

S- Strong; M-Medium; L-Low

Syllabus

UNIT – I	AIRCRAFT GROUND HANDLING AND SUPPORT EQUIPMENT	10
Mooring, jacking, leveling and towing operations – Preparation – Equipment – precautions – Engine Starting procedures – Piston engine, turboprops and turbojets – Engine fire extinguishing – Groundpower unit.		
UNIT – II	**GROUND SERVICING OF VARIOUS SUB SYSTEMS**	**8**
Air conditioning and pressurization – Oxygen and oil systems – Ground units and their maintenance.		
UNIT – III	**MAINTENANCE OF SAFETY**	**5**
Shop safety – Environmental cleanliness – Precautions		
UNIT – IV	**INSPECTION**	**10**
Process – Purpose – Types – Inspection intervals – Techniques – Checklist – Special inspection – Publications, bulletins, various manuals – FAR Air worthiness directives – Type certificate Data sheets – ATA Specifications		
UNIT – V	**AIRCRAFT HARDWARE, MATERIALS, SYSTEM PROCESSES**	**12**
Hand tools – Precision instruments – Special tools and equipments in an airplane maintenance shop– Identifiation terminology – Specification and correct use of various aircraft hardware (i.e. nuts, bolts,rivets, screws etc) – American and British systems of specifications – Threads, gears, bearings, etc – Drills, tapes and reamers – Identification of all types of fluid line fittings. Materials, metallic and non - metallic Plumbing connectors – Cables – Swaging procedures, tests, Advantages of swaging oversplicing.		

TEXT BOOKS:
1. Kroes Watkins Delp, "Aircraft Maintenance and Repair", McGraw Hill, New York, 1993
REFERENCES:
1. A&P Mechanics, "Aircraft Hand Book", FAA Himalayan Book House, New Delhi, 1996 2. A&P Mechanics," General Hand Book", FAA Himalayan Bok House, New Delhi, 1996

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17ARSE41	AIRCRAFT STRUCTURE LAB	Category	L	T	P	Credit
		LAB - SPL	0	0	4	2

Preamble

The aim of the subject is to provide a practical knowledge in aircraft structure.

Course Objectives

1	To know how to find the Young's modulus of various materials.
2	To know about the fracture patterns for various materials.
3	To know about the behaviours of beam when it is subjected to various end condition.
4	To know about the loads similarity with respect to distance
5	To know which type of joint should be made to have a strong structure.

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	Remember the various materials to be used for various loads.	Remember
CO2.	Understand about the various fracture patterns for various materials.	Understand
CO3.	Apply the knowledge on behaviours of beam with various end condition.	Apply
CO4.	Apply the Maxwell's Reciprocal theorem & principle of superposition on various beam condition.	Apply
CO5.	Analyze the character sticks of various material with various loading condition.	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO2	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO3	S	S	S	S	-	-	-	-	-	-	-	M	M	M	M
CO4	S	S	S	S	-	-	-	-	-	-	-	S	S	S	S
CO5	S	S	S	S	-	-	-	-	-	-	-	S	S	S	S

S- Strong; M-Medium; L-Low

LIST OF EXPERIMENTS:

1. Determination of Young's modulus of steel using mechanical extensometers.
2. Shear centre location for closed sections
3. Determination of fracture strength and fracture pattern of ductile materials.
4. Determination of fracture strength and fracture pattern of brittle materials.
5. Stress Strain curve for various engineering materials.
6. Flexibility matrix for cantilever beam
7. Verification of Maxwell's Reciprocal theorem & principle of superposition.
8. Column – Testing.
9. Unsymmetrical bending of beams
10. Riveted Joints.

REFERENCE:

Aircraft Structure Lab Manual.

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		Category	L	T	P	Credit
17ARSE42	**AERO ENGINE LAB**	**CORE**	**0**	**0**	**4**	**2**

Preamble

This course provides sufficient knowledge and creates a base for the students to develop concepts of working independently in aero engines.

Course Objectives

1	To understand the basic concepts of aero engines used in small and large aircrafts.
2	To provide practical knowledge on working of components of aero engines.
3	To develop analytical skills for trouble shooting.
4	To develop confidence in working independently on an aircraft engine.
5	To develop personality and an attitude of team work.

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	Define principles of operation and identify components.	Remember
CO2.	Explain working of internal combustion engines.	Understand
CO3.	Employ analytical skills in finding faults and mal-functioning in operation.	Apply
CO4.	Categorise the troubles and pin point the technical malfunction.	Analyze
CO5.	Evaluate and modify the system to meet certain requirement.	Evaluate
CO6.	Formulate and design a new concept for a better output.	Create

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO2.	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO3.	S	S	S	S	-	-	-	-	-	-	-	-	M	M	M
CO4.	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S
CO5.	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S
CO6.	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S

S- Strong; M-Medium; L-Low

LIST OF EXPERIMENTS

1.	Identification of older and newer versions of piston engines and their components.
2.	Maintenance aspect – Cleaning, Visual Inspection and Dimensional checks.
3.	Crankshaft and its parts – dimensional checks and deformation analysis
4.	Fuel and oil systems - maintenance and trouble shooting.
5.	Reassembly of dismantled components.
6.	Identification of older and newer versionsof jet engine and their components.
7.	Maintenance aspect – Cleaning, Visual Inspection and Dimensional checks.
8.	Non Destructive Testing of components.
9.	Study of Ignition System of jet engine.
10.	Jet Engine –Reassembly of dismantled components.
REFERENCES:	
AERO ENGINE LAB MANUAL	

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17ARCC84	AERODYNAMICS LABORATORY	Category	L	T	P	Credit
		LAB-SPL	0	0	4	2

Preamble

The aim of the subject is to provide knowledge in wind tunnel testing

Course Objectives

1	To study experimentally the aerodynamic forces on different bodies at low speeds
2	To familiarize with the Calibration of a subsonic Wind tunnel
3	To familiarize with Pressure distribution over a smooth circular cylinder
4	To familiarize with the Pressure distribution over a symmetric aerofoil
5	To familiarize with the Flow visualization studies in subsonic flows

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	Collect the knowledge of various flow equations.	Remember
CO2.	Implement the working concepts of various wind tunnel.	Understand
CO3.	Utilize the knowledge and compute the results for Pressure distribution over a smooth circular cylinder.	Apply
CO4.	Implement the concept and compute relevant results for Pressure distribution over a symmetric aerofoil	Apply
CO5.	Compute the performance of Flow visualization studies in subsonic flows.	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	L	-	-	-	-	-	-	-	-	-	-	-	L	L	L
CO2.	M	L	M	-	-	-	-	-	-	-	-	-	L	L	L
CO3.	S	S	S	S	-	-	-	-	-	-	-	-	M	M	M
CO4.	M	S	-	-	-	-	-	-	-	-	-	-	M	M	M
CO5.	S	S	S	-	-	-	-	-	-	--	-	S	S	S	S

S- Strong; M-Medium; L-Low

LIST OF EXPERIMENTS:

1. Application of Bernoulli’s Equation – venture meter and orifice meter.
2. Frictional loss in laminar flow through pipes.
3. Frictional loss in turbulent flow through pipes.
4. Calibration of a subsonic Wind tunnel.
5. Determination of lift for the given airfoil section.
6. Pressure distribution over a smooth circular cylinder.
7. Pressure distribution over a rough circular cylinder.
8. Pressure distribution over a symmetric aerofoil.
9. Pressure distribution over a cambered aerofoil.
10. Flow visualization studies in subsonic flows.

REFERENCE:

Aerodynamics Lab Manual

Course Designers:

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17ARCC83	AEROSPACE PROPULSION LAB	Category	L	T	P	Credit
		CORE	0	0	4	2

Preamble

This course provides and creates a base for the students to develop concepts of working independently in aero engines.

Course Objectives

1	To understand the basic concepts of a propulsion system.
2	To provide practical knowledge on working of components of propulsion system.
3	To develop analytical skills for fault finding.
4	To develop confidence in working on an aircraft engine.
5	To develop an attitude of team work.

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	Define principles of operation and identify components.	Remember
CO2.	Explain working of internal combustion engines.	Understand
CO3.	Employ analytical skills in finding faults in operation.	Apply
CO4.	Categorise the troubles and pin point the technical malfunction.	Analyze
CO5.	Evaluate and modify the system.	Evaluate
CO6.	Formulate and design a new modified engine.	Create

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO2.	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO3.	S	S	S	S	-	-	-	-	-	-	-	-	M	M	M
CO4.	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S
CO5.	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S
CO6.	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S

S- Strong; M-Medium; L-Low

LIST OF EXPERIMENTS

1.	Study, dismantling and identification of types of piston engine and their components.
2.	Piston Engine Components – Cleaning, Visual Inspection and Dimension checks.
3.	Study of Camshaft operation, firing order and magneto, valve timing.
4.	Study of various auxillary systems of piston engine.
5.	Piston Engine –Reassembly of dismantled components.
6.	Study, dismantling and identification of types of jet engine and their components.
7.	Jet Engine Components – Cleaning, Visual Inspection and Dimension checks.
8.	Non Destructive Testing of components.
9.	Study of various auxillary systems of jet engine.
10.	Jet Engine –Reassembly of dismantled components.
REFERENCES:	
AEROSPACE PROPULSION LAB MANUAL	

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ELECTIVE COURSES

SPECIALIZATION - AUTOMOTIVE ENGINEERING

17ATCC03	AUTOMOTIVE CHASSIS	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

A chassis is the internal framework of an artificial object, which supports the object in its construction and use. An example of a chassis is a vehicle frame, the under part of a motor vehicle, on which the body is mounted; if the running gear such as wheels and transmission, and sometimes even the driver's seat, are included, then the assembly is described as a rolling chassis.

Prerequisite

Not Required

Course Objectives

1. To apply the concept of entire process involved in vehicle frame and steering systems.
2. To perform the application of propeller shaft and final drive
3. To employ the concepts of axles and tyres.
4. To perform the application of Suspension System.
5. To apply the concepts of braking system in automotive chassis

Course Outcomes

On the successful completion of the course, students will be able to

CO1. Demomstrate the concepts and application of vehicle frame and steering systems	Apply
CO2. Employ the applications of propeller shaft and final drive	Apply
CO3. Practice the knowledge and application of axles and tyres..	Apply
CO4. Utilize the applications ideas of Suspension System.	Apply
CO5. Operate the concepts and application of braking system .	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1.	S	M	L	M	-	-	-	-	-	-	-	-	L	-	-
2.	S	L	L	M	-	-	-	-	-	-	-	-	L	-	-
3.	S	M	L	M	-	-	-	-	-	-	-	-	L	-	-
4.	S	M	M	M	-	-	-	-	-	-	-	-	L	-	-
5.	S	M	M	M	-	-	-	-	-	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

Syllabus

INTRODUCTION, FRAME, STEERING SYSTEM

Types of Chassis layout, with reference to Power Plant location and drive, various types of frames, Loads acting on vehicle frame, Constructional details and materials for frames, Testing of frames, Types of Front Axles and Stub Axles, Front Wheel Geometry, namely, Castor, Camber, King Pin Inclination and Toe–in, Condition for True Rolling Motion of Wheels during Steering, Ackerman's and Davis Steering Mechanisms, Steering Error Curve, Steering Linkages, Different Types of Steering Gears, Slip Angle, Over–Steer and Under–Steer, Reversible and Irreversible Steering, Power–Assisted Steering.

PROPELLER SHAFT AND FINAL DRIVE

Effect of Driving Thrust, torque reactions and side thrust, Hotchkiss drive, torque tube drive, radius rods and stabilizers, Propeller Shaft, Universal Joints, Constant Velocity Universal Joints, Front Wheel drive, Final drive, different types, Double reduction and twin speed final drives, Multi–axled vehicles, Differential principle and types, Differential housings, Non–Slip differential, Differential locks, Final drive of Crawler Tractors.

AXLES AND TYRES

Construction and Design of Drive Axles, Types of Loads acting on drive axles, Full – Floating, Three–Quarter Floating and Semi–Floating Axles, Axle Housings and Types, Types and Constructional Details of Different Types of Wheels and Rims, Different Types of Tyres and their constructional details.

SUSPENSION SYSTEM

Need for Suspension System, Types of Suspension Springs, Constructional details and characteristics of Single Leaf, Multi–Leaf, Coil, Torsion bar, Rubber, Pneumatic and Hydro – elastic Suspension Spring Systems, Independent Suspension System, Shock Absorbers, Types and Constructional details, Design of Leaf and Coil Springs.

BRAKING SYSTEM

Theory of Automobile Braking, Stopping Distance Time and Braking Efficiency, Effect of Weight Transfer during Braking, Theory of Drum Brakes, Leading and Trailing Shoes, Braking Torque, Constructional Details of Drum Brake and its Activators, Disc Brake Theory, Hydraulic, Mechanical, Pneumatic and Power–Assisted Braking System, Servo Brakes, Retarders, Anti–Lock Braking System.

TEXT BOOK:

1. Kripal Singh, Automobile Engineering, Standard Publisher, New Delhi, 2006.
2. R.K. Rajput, A Text–Book of Automobile Engineering, Laxmi Publications Private Limited, 2007.
3. N.K. Giri, Automotive Mechanics, Kanna Publishers, 2007.

REFERENCES:

1. Heldt P.M., Automotive Chassis, Chilton Co., New York, 1990
2. Newton Steeds and Garret, Motor Vehicles, 13th Edition, Butterworth, London, 2005.
3. Heinz Hezler, Modern Vehicle Technology, Butterworth, London, 2005.

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17ATCC04	AUTOMOTIVE ELECTRICAL AND ELECTRONICS SYSTEMS	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

Automotive electrical and electronic systems used in road vehicles, enable study analyze and apply the concepts of various electrical and electronics component such as battery alternator ignition system and other engine management systems.

Prerequisite

Fundamentals of Automotive Engines

Course Objectives

1. To perform the concepts of battery and charging systems..
2. To compilet the knowledge of starting systems in the vehicle.
3. To employ the knowledge in the application of various types of charging system & lighting system.
4. To demonstrate the application and knowledge of fundamental of automotive electronics.
5. To employ the application and knowledge of sensors and actuators.

Course Outcomes

On the successful completion of the course, students will be able to

CO1. Generalize concepts of application in battery and charging systems	Apply
CO2. Determine the various concept of starting systems in the vehicle.	Understand
CO3. Employ the knowledge of various types of charging system & lighting system.	Apply
CO4. Generalize the application of fundamental of automotive electronics.	Apply
CO5. Employ the knowledge of application of sensors and actuators.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1.	M	M	S	S	-	-	-	-	-	-	-	-	L	-	-
2.	S	S	M	M	-	-	-	-	-	-	-	-	L	-	-
3.	M	S	S	S	-	-	-	-	-	-	-	-	L	-	-
4.	M	S	S	S	-	-	-	-	-	-	-	-	L	-	-
5.	S	S	S	S	-	-	-	-	-	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

Syllabus

BATTERIES

Principle and construction of lead-acid battery. Characteristics of battery, rating, capacity and efficiency of batteries. Various tests on battery condition, charging methods. Details of modern storage batteries.

STARTING SYSTEM

Condition of starting Behavior of starter during starting. Series motor and its characteristics. Principle & construction of starter motor. Working of different starter drive units. Care & maintenance of starter motor, Starter switches.

CHARGING SYSTEM & LIGHTING SYSTEM

Generation of direct current, shunt generator characteristics, armature reaction,third brush regulation, cutout. Voltage and current regulators, compensatedvoltage regulator, alternators principle and constructional aspects and bridgerectifiers, new developments.Lighting system: insulated and earth return system, details of head light and sidelight, LED lighting system, head light dazzling and preventive methods – Horn,wiper system and trafficator.

FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS

Current trends in automotive electronic engine management system, electromagnetic interference suppression, electromagnetic compatibility, electronic dashboard instruments, onboard diagnostic system, security and warning system.

SENSORS AND ACTUATORS

Types of sensors: sensor for speed, throttle position, exhaust oxygen level,manifold pressure, crankshaft position, coolant temperature, exhaust temperature,air mass flow for engine application. Solenoids, stepper motors, relay.

TEXT BOOK:

1. Kholi,P.L., Automotive Electrical Equipment, Tata McGraw-Hill Co. Ltd., New Delhi, 1975.
2. Judge,A.W., Modern Electrical Equipment of Automobiles, Chapman & Hall, London, 1992.
3. Younng A.P & Griffiths L, “Automobile Electrical and Electronic Equipments”, English Languages Book Society & New Press, 1990
4. Tom Weather Jr and Cland C.Hunter, “Automotive Computers and Control system”, Prentice Hall Inc., New Jersey.

REFERENCES:

1. Vinal,G.W., Storage Batteries, John Wiley & Sons Inc., New York, 1985.
2. Crouse,W.H., Automobile Electrical Equipment, McGraw Hill Book Co. Inc., New York, 1980.
3. Spreadbury,F.G., Electrical Ignition Equipment, Constable & Co. Ltd., London, 1962.
4. Automotive Hand Book, fifth edition, Robert Bosch, Bently Publishers, 2003.

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17ATCC13	ENGINE AND VEHICLE MANAGEMENT SYSTEM	Category	L	T	P	C
		EC(SE)	3	0	0	3

Preamble

To study and purpose is to understand engine management system

Prerequisite

NIL

Course Objectives

1	To understand the fundamentals of automotive electronics in details.
2	To understand the types sensors
3	To impart knowledge on SI engine management system.
4	To impart knowledge on CI engine management system.
5	To understand the vehicle management systems

Course Outcomes:

After Successful completion of this course, the students will be able to:

CO1.	Understand the vehicle motion control and stabilization system	Understand
CO2.	Know the importance of Driver assistance, security and warning system	Understand
CO3.	Understand the various safety concepts used in passenger cars	Understand
CO4.	Understand the basics of vehicle collision and its effects.	Understand
CO5.	Gain the knowledge of Safety and comfort system	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	--	--	--	--	M		--	--	--	--	M	L	--	--
CO2	--	M	S	--	M		M	--	--	--	--	--	L	--	--
CO3	--	M	--	S	--	--	--	M	M	--	--	--	L	--	--
CO4	S	--	M	M	--	--	--	--	--	M	M	--	L	--	--
CO5	S	S	M		--	--	--	--	--	--	--	S	L	--	--

S- Strong; M-Medium; L-Low

Syllabus

FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS

Microprocessor architecture, open and closed loop control strategies, PID control, Look up tables, Introduction to modern control strategies like Fuzzy logic and adaptive control. Parameters to be controlled in SI and CI enignes and in the other parts of the automobile

SENSORS

Inductive, Hall effect, hot wire, thermistor, piezo electric, piezoresistive, based sensors. Throttle position, air mass flow, crank shaft position, cam position, engine and wheel speed, steering position, tire pressure, brake pressure, steering torque, fuel level, crash, exhaust oxygen level (two step and linear lambda), knock, engine temperature, manifold temperature and pressure sensors

SI ENGINE MANAGEMENT

Three-way catalytic converter, conversion efficiency versus lambda. Layout and working of SI engine management systems like Bosch L-Jetronic and LH-Jetronic. Group and sequential injection techniques. Working of the fuel system components. Cold start and warm up phases, idle speed control, acceleration and full load enrichment, deceleration fuel cutoff. Fuel control maps, open loop control of fuel injection and closed loop lambda control. Electronic ignition systems and spark timing control. Closed loop control of knock.

CI ENGINE MANAGEMENT

Fuel injection system parameters affecting combustion, noise and emissions in CI engines. Pilot, main, advanced post injection and retarded post injection. Electronically controlled Unit Injection system. Layout of the common rail fuel injection system. Working of components like fuel injector, fuel pump, rail pressure limiter, flow limiter, EGR valve

VEHICLE MANAGEMENT SYSTEMS

ABS system, its need, layout and working. Electronic control of suspension – Damping control, Electric power steering, Supplementary Restraint System of air bag system – crash sensor, seat belt tightening. Cruise control. Vehicle security systems- alarms, vehicle tracking system. On board diagnostics. Collision avoidance Radar warning system.

TEXT BOOK:

1. William B Ribbens "Understanding Automotive Electronics", SAE Publications, 1998
2. Eric Chowanietz "Automobile Electronics" SAE Publications, 1994

REFERENCES:

1. Robert Bosch "Diesel Engine Management" SAE Publications, 2006
2. Robert Bosch, "Gasoline Engine Management" SAE Publications, 2006.

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17ATCC14	VEHICLE MAINTENANCE	Category	L	T	P	C
		EC(SE)	3	0	0	4

Preamble

To study and purpose is to understand various vehicle maintenance

Prerequisite

Nil

Course Objectives

1	To understand the maintenance of records and schedules.
2	To understand the engine maintenance and repair and overhauling.
3	To understand the chassis maintenance and repair and overhauling
4	To impart the various electrical system maintenance service and repairs.
5	To understand the various maintenance of cooling, fuel, lubrication and body.

Course Outcomes:

After Successful completion of this course, the students will be able to:

CO1.	To learn the detailed study of maintenance records and schedule	Understand
CO2.	To learn the detailed study of maintenance, repair and overhauling of engine	Understand
CO3.	To learn the detailed study of maintenance, repair and overhauling of chassis drive line components	Understand
CO4.	To learn the detailed study of maintenance, repair and servicing of electrical systems	Understand
CO5.	To learn of detailed study of maintenance, repair and servicing of cooling lubrication system, fuel system and body	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	--	--	--		M		--	--	--	--	M	L	--	--
CO2	--	M	S	--	M	--	M	--	--	--	--	--	L	--	--
CO3	--	M	--	S	--	--	--	M	M	--	--	--	L	--	--
CO4	S	--	M	M	--	--	--	--	--	M	M	--	L	--	--
CO5	S	S	M	--	--	--	--	--	--			L	L	--	--

S- Strong; M-Medium; L-Low

Syllabus

MAINTENANCE OF RECORDS AND SCHEDULES

Importance of maintenance, preventive (scheduled) and breakdown (unscheduled) maintenance, requirements of maintenance, preparation of check lists. Inspection schedule, maintenance of records, log sheets and other forms, safety precautions in maintenance..

ENGINE MAINTENANCE – REPAIR AND OVERHAULING

Dismantling of engine components and cleaning, cleaning methods, visual and dimensional inspections, minor and major reconditioning of various components, reconditioning methods, engine assembly, special tools used for maintenance overhauling, engine tune up

CHASSIS MAINTENANCE - REPAIR AND OVERHAULING

Mechanical and automobile clutch and gear box, servicing and maintenance, maintenance servicing of propeller shaft and differential system. Maintenance servicing of suspension systems. Brake systems, types and servicing techniques. Steering systems, overhauling and maintenance. Wheel alignment, computerized alignment and wheel balancing.

ELECTRICAL SYSTEM MAINTENANCE - SERVICING AND REPAIRS

Testing methods for checking electrical components, checking battery, starter motor, charging systems, DC generator and alternator, ignitions system, lighting systems. Fault diagnosis and maintenance of modern electronic controls, checking and servicing of dash board instruments.

MAINTENANCE OF FUEL SYSTEM, COOLING SYSTEMS, LUBRICATION SYSTEM AND VECHICLE BODY

Servicing and maintenance of fuel system of different types of vehicles, calibration and tuning of engine for optimum fuel supply. Cooling systems, water pump, radiator, thermostat, anticorrosion and antifreeze additives. Lubrication maintenance, lubricating oil changing, greasing of parts. Vehicle body maintenance, minor and major repairs. Door locks and window glass actuating system maintenance

TEXT BOOK:

1. John Doke "Fleet Management", McGraw-Hill Co. 1984
2. Venk Spicer, "Automotive Maintenance and Trouble Shooting".

REFERENCES:

1. James D Halderman - Advanced Engine Performance Diagnosis – PHI - 1998
2. Judge.A.W., "Maintenance of high speed diesel engines",Chapman Hall Ltd., London.

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17ATCC15	**TWO AND THREE-WHEELER TECHNOLOGY**	**Category**	**L**	**T**	**P**	C
		EC(SE)	**3**	**0**	**0**	3

Preamble

To study and purpose is to understand two and three-wheeler technology

Prerequisite

NIL

Course Objectives

1	To understand the power units.
2	To understand the fuel and ignition systems
3	To understand the fuel and ignition systems
4	To understand the brakes and wheels
5	To impart the various types of two and three-wheeler case study

Course Outcomes:

After Successful completion of this course, the students will be able to:

CO1.	To learn the detailed study of the power unit	Understand
CO2.	To learn the detailed study of chassis and sub-systems	Understand
CO3.	To learn the detailed study of brakes and wheels	Understand
CO4.	To learn the detailed study of two wheelers	Understand
CO5.	Apply the detailed study of three wheelers	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	--	--	--	--	M	--	--	--	--	--	M	L	--	--
CO2	--	M	S	--	M	--	M	--	--	--	--	--	L	--	--
CO3	--	M	--	S	--	--	--	M	M	--	--	--	L	--	--
CO4	S	--	M	M	--	--	--	--	--	M	M	--	L	--	--
CO5	S	S	M	--	--	--	--	--	--	--	--	S	L	--	--

S- Strong; M-Medium; L-Low

Syllabus

THE POWER UNIT

Two stroke and four stroke SI engine, merits and demerits, symmetrical and unsymmetrical port timing diagrams. Types of scavenging processes, merits and demerits, scavenging efficiency. scavenging pumps. rotary valve engine..

FUEL AND IGNITION SYSTEMS

Fuel system, Fuel injection system, Lubrication system. Magneto coil and battery coil spark ignition system. Electro ignition system. Starting system. Kick starter system

CHASSIS AND SUB-SYSTEM

Main frame, its types. Chassis and shaft drive. Single, multiple plates and centrifugal clutches. Gear box and gear controls. Front and rear suspension systems. Shack absorbers. Panel meters and controls on handle bar.

BRAKES AND WHEELS

Drum brakes, disc brakes, front and rear brake links layouts. spoked wheel, cast wheel. Disc wheel. Disc types. Tyres and Tubes

TWO AND THREE WHEELERS CASE STUDY

Case study of Sports bike, Motor cycles, Scooters and Mopeds - Auto rickshaws, Pick up van, Delivery van and Trailer. Servicing and maintenance. Recent developments

TEXT BOOK:

1. Irving, P.E., Motor cycle Engineering, Temple press Book, Loondon,1992
2. Bryaut, R.V., Vespa Maintenance and repair series. RAYMOND Broad, Lambretta- A practical guide to maintenance and repair, 1987

REFERENCES:

1. The Cycle Motor Manual, Temple Press Ltd., London, 1990
2. Encyclopedia of Motor cycling, 20 volumes, Marshall Cavensih, New York and London, 1989.

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17ATCC82	AUTOMOTIVE CHASSIS LAB	Category	L	T	P	Credit
		EC(SE)	0	0	4	2

Preamble

To impart knowledge in the assembling and dismantling of different types of systems like steering system, transmission system and braking system.

Prerequisite

Automotive Chassis

Course Objectives

To employ the knowledge and measurement of light and heavy commercial Vehicle chassis
To demonstrate the knowledge to dismantling, study and Assembling of front and rear axle .
To demonstrate the knowledge to dismantling, study and Assembling of Clutch, Gearbox, Steering gearbox, Breaking and Differential systems

Course Outcomes

On the successful completion of the course, students will be able to

CO1. Employ practice of measurement of light and heavy commercial Vehicle chassis	Apply
CO2. Demonstrate Thoroughly develop knowledge of dismantling, study and Assembling of front and rear axle.	Apply
CO3. Demonstrate the knowledge in dismantling, study and Assembling of clutch, gearbox, steering gearbox, breaking and differential systems	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	S	S	L	M	M	-	-	-	-	-	L	-	-
CO2	S	S	S	S	M	M	M	-	-	-	-	-	L	-	-
CO3	S	S	S	S	M	M	M	-	-	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

Syllabus

LIST OF EXPERIMENTS

1. Study and measurement of Light commercial vehicle chassis layout
2. Study and measurement of Heavy commercial vehicle chassis layout
3. Dismantling, study and Assembling of Front Axle Systems.
4. Dismantling, study and Assembling of Rear Axle Systems
5. Dismantling, study and Assembling of steering systems with different Steering gearboxes
6. Dismantling, study and Assembling of Clutch.
7. Dismantling, study and Assembling of Gear box with different gear box
8. Dismantling, study and Assembling of Differential.
9. Dismantling, study and Assembling of Braking system.
10. Dismantling, study and Assembling of different types of suspension system.

Text Books

1. 'Automotive Chassis Lab Manual', Department of Automobile Engineering, VMKV engineering College, Vinayaka Mission's Research Foundation (Deemed to be University),Salem.

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17ATCC83	AUTOMOTIVE ELECTRICAL AND ELECTRONICS LAB	Category	L	T	P	Credit
		EC(SE)	0	0	4	2

Preamble

To familiarize and train the students on the constructional arrangements of different electrical system of automobiles and study the automobile electronics components.

Prerequisite

Automotive Electrical and Electronics

Course Objectives

1.	To perform in battery tests, charging system and starting system trouble shooting.
2.	To demonstrate the application knowledge in the operation of alternator and lighting system.
3.	To describe the temperature and optical sensor.

Course Outcomes

On the successful completion of the course, students will be able to

CO1. Practice the application of battery tests, charging system and starting system trouble shooting	Apply
CO2. Demonstrate thoroughly develop knowledge in application of operation of alternator and lighting system.	Apply
CO3. Describe thoroughly understand concepts temperature and optical sensor	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	M	M	-	-	-	-	-	-	-	-	L	-	-
CO2	M	M	M	M	-	-	-	-	-	-	-	-	L	-	-
CO3	S	S	M	M	-	-	-	-	-	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

Syllabus

LIST OF EXPERIMENTS

1. Testing, charging and discharging of lead acid battery used in automobiles.
2. Testing and troubleshooting of starting system in automobiles.
3. Starter motor component test.
4. Testing and troubleshooting of charging system in automobiles.
5. Alternator component test.
6. Testing and troubleshooting of lighting system in automobiles.
7. Testing of lighting conventional analog instrumentation, indicator light, warning devices.
8. Study of Temperature measurement using thermocouple.
9. Study of optical sensor

Text Books

1. 'Automotive Electrical and Electronics Lab Manual', Department of Automobile Engineering, VMKV engineering College, Vinayaka Mission's Research Foundation (Deemed to be University),Salem

Course Designers:

S.No	Name of the Faculty	Designation	Department/College	Mail ID
1	T.Raja	Associate Professor	Auto / VMKVEC	rajat@vmkvec.edu.in
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3				
4				

17ATCC88	TWO AND THREE WHEELER LAB	Category	L	T	P	C
		EC(SE)	**0**	**0**	**4**	2

Preamble

To impart knowledge on clutch, gear box and performance on two and three wheeler

Prerequisite

Two and Three Wheeler Technology

Course Objectives

1	To understand the performance shock absorber and coil spring
2	To understand the two wheeler chain tension
3	To study three wheeler chassis frame.

Course Outcomes:

After Successful completion of this course, the students will be able to:

CO1.	Undergo practical training in to performance test on shock absorber and coil spring.	Apply
CO2.	To gain the knowledge for finding tension in the two wheeler	Apply
CO3.	To gain the knowledge of various parts of Three wheeler chassis frame.	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	M	L	M	L	-	M	M	M	M	M	M	S
CO2	S	S	M	M	L	M	L	-	M	M	M	M	M	M	S
CO3	S	S	M	M	L	M	L	-	M	M	M	M	M	M	**S**

S- Strong; M-Medium; L-Low

Syllabus

LIST OF EXPERIMENTS

1. Performance test of a shock absorber.
2. Performance test on coil spring.
3. Two wheeler chain tension test.
4. Brake and Clutch adjustment as per specification.
5. Dismantling and assembling of two wheeler gear box and finding gear ratio.
6. Dismantling and assembling of three wheeler gear box and finding gear ratios.
7. Dismantling and assembling of three wheeler steering system.
8. Study of three wheeler chassis frame and power transmission system.

Course Designers:

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17ATCC89	VEHICLE MAINTENANCE AND SERVICING LAB	Category	L	T	P	C
		EC(SE)	0	0	4	2

Preamble

To provide in house training in vehicle servicing and maintenance

Prerequisite

Vehicle Maintenance

Course Objectives

1	To understand the clutch and gear box servicing
2	To understand the Differential unit
3	To understand the Ackermann Steering geometry

Course Outcomes:

After Successful completion of this course, the students will be able to:

CO1.	Undergo practical training in servicing of Gear box..	Apply
CO2.	To gain the knowledge in servicing of Differential unit.	Apply
CO3.	To undergo the training in various steering geometry available in four wheeler.	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	M	L	M	L	-	M	M	M	M	M	M	S
CO2	S	S	M	M	L	M	L	-	M	M	M	M	M	M	S
CO3	S	S	M	M	L	M	L	-	M	M	M	M	M	M	S

S- Strong; M-Medium; L-Low

Syllabus

LIST OF EXPERIMENTS

1. Clutch assembly and servicing
2. Gearbox assembly and servicing
3. Differential unit assembly and servicing
4. Transaxle assembly and servicing
5. Different types of rear axle assembly and servicing
6. Brake system trouble shooting
7. Wheel alignment testing
8. Ackermann Steering geometry verification
9. Electrical signal and circuits
10. Servicing of accessories such as wiper motor, A/C system

Course Designers:

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17ATEC04	SPECIAL TYPES OF VEHICLES	Category	L	T	P	C
		EC(SE)	3	0	0	3

Preamble

This course reviews the fundamental concepts of earth moving equipments, power train concepts, sub systems of special types of vehicles, farm equipment, military and combat vehicles and special purpose vehicles for industrial applications.

Prerequisite

Nil

Course Objectives

1	To learn the detailed study of earth moving and constructional equipments
2	To learn the detailed study of power train concepts
3	To learn the detailed study of sub systems of special types of vehicles
4	To learn the detailed study of farm equipments, military and combat vehicles
5	To learn of detailed study of special purpose vehicles for industrial applications

Course Outcomes:

After Successful completion of this course, the students will be able to:

CO1.	Understand earth moving and constructional equipments	Understand
CO2.	Know the power train concepts	Understand
CO3.	Know the sub systems of special types of vehicles	Understand
CO4.	Use farm equipments, military and combat vehicles	Apply
CO5.	Use special purpose vehicles for industrial applications	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	L	--	L	L	--	--	--	--	L	--	--	--
CO2	S	M	M	M	M	L	L	--	--	--	--	L	--	--	--
CO3	S	S	S	S	S	M	M	--	--	--	L	--	--	--	--
CO4	S	S	S	S	S	M	M	--	--	--	L	--	--	--	--
CO5	S	S	S	S	S	S	S	--	--	--	--	--	--	--	--

S- Strong; M-Medium; L-Low

Syllabus

CLASSIFICATION AND REQUIREMENTS OF OFF ROAD VEHICLES

Construction layout, capacity and applications. Power Plants, Chassis and Transmission, Multivalve vehicles.

EARTH MOVING MACHINES

Earthmovers like dumpers, loaders - single bucket, Multi bucket and rotary types- bulldozers, excavators, backhoe loaders, scrappers, drag and self powered types, Bush cutters, stumpers, tree dozer, rippers etc. – Power and capacity of earthmoving machines.

SCRAPPERS, GRADERS, SHOVELS AND DITCHERS

Scrappers, elevating graders, motor graders, self powered scrappers and graders, Power shovel, revolving and stripper shovels – drag lines – ditchers – capacity of shovels.

FARM EQUIPMENTS, MILITARY AND COMBAT VEHICLES

Power take off, special implements. Special features and constructional details of tankers, gun carriers and transport vehicles.

VEHICLE SYSTEMS, FEATURES

Brake system and actuation – OCDB and dry disc caliper brakes. Body hoist and bucket operational hydraulics. Hydro-pneumatic suspension cylinders. Power steering system. Kinematics for loader and bulldozer operational linkages. Safety features, safe warning system for dumper. Design aspects on dumper body, loader bucket and water tank of sprinkler.

TEXT BOOK:

1. Off the road wheeled and combined traction devices – Ash gate Publishing Co.Ltd. 1988
2. Satyanarayana. B., Construction planning and equipment, standard publishers and distributors, New Delhi.

REFERENCES:

1. Abrosimov.K. Branberg.A and Katayer.K, Road making machinery, MIR Publishers, Moscow, 1971.
2. Bart H Vanderveen, Tanks and Transport vehicles, Frederic Warne and Co Ltd.,London.
3. Nakra C.P., “Farm machines and equipments” Dhanparai Publishing company Pvt. Ltd.
4. Robert L Peurifoy, “Construction, planning, equipment and methods” Tata McGraw Hill Publishing company Ltd.

Course Designers:

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17ATEC15	VEHICLE TRANSPORT MANAGEMENT	Category	L	T	P	C
		EC(SE)	3	0	0	3

Preamble

This course reviews the methods of training and training procedure in the transport management, scheduling and fare structure of various public and private and state government undertaking vehicles , maintenance and motor vehicle act

Prerequisite

Nil

Course Objectives

1	To study the various test of selection processes and personal management
2	To learn the various transport system
3	To learn the various fare collecting methods and problems on scheduling
4	To study the Motor vehicle Act of India
5	To study the maintenance of transport industry and design of Bus depot layout

Course Outcomes:

After Successful completion of this course, the students will be able to:

CO1.	Apply the personal management and training for selection processes	Understand
CO2.	Understand the various division of transport management	Apply
CO3.	Construct table for various fare collecting methods and apply it	Apply
CO4.	Know the motor vehicle Act of India	Apply
CO5.	Apply the maintenance system of transport	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	--	--	--	--	L	--	--	--	--	--	--	L	--	--
CO2	S	--	--	--	--		--	--	--	--	--	--	L	--	--
CO3	S	L	M	M	M	--	--	L	L	--	--	--	L	--	--
CO4	S	--	--	--	--	M	L		L	L	--	--	L	--	--
CO5	S	M	M	M	M	--	--	M	L	M	M	M	L	--	--

S- Strong; M-Medium; L-Low

Syllabus

INTRODUCTION

Personnel management; objectives and functions of personnel management, psychology, sociology and their relevance to organization, personality problems. Selection process: job description, employment tests, interviewing, introduction to training objectives, advantages, methods of training, training procedure, psychological tests.

TRANSPORT SYSTEMS

Introduction to various transport systems. Advantages of motor transport. Principal function of administrative, traffic, secretarial and engineering divisions. Chain of responsibility forms of ownership by state, municipality, public body and private undertakings

SCHEDULING AND FARE STRUCTURE

Principal features of operating costs for transport vehicles with examples of estimating the costs. Fare structure and method of drawing up of a fare table. Various types of fare collecting methods. Basic factors of bus scheduling. Problems on bus scheduling

MOTOR VEHICLE ACT

Traffic signs, fitness certificate, registration requirements, permit insurance, constructional regulations, description of vehicle-tankers, tippers, delivery vans, recovery vans, Power wagons and fire fighting vehicles. Spread over, running time, test for competence to drive.

MAINTENANCE

Preventive maintenance system in transport industry, tyre maintenance procedures. Causes for uneven tyre wear; remedies, maintenance procedure for better fuel economy, Design of bus depot layout.

TEXT BOOK:

1. John Duke, "Fleet Management", McGraw-Hill Co, USA, 1984.

REFERENCES:

1. Government Motor Vehicle Act, Publication on latest act to be used as on date

Course Designers:

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4				

ELECTIVE COURSES

SPECIALIZATION - ENERGY ENGINEERING

17MESE01	ENERGY CONSERVATION IN THERMAL SYSTEMS	Category	L	T	P	CREDIT
		EC(SE)	3	0	0	3

Preamble

This course is intended to introduce principles of energy auditing and to provide measures for energy conservation in thermal utilities

Prerequisite

NIL

Course Objectives

1	To provide him the present energy scenario and the need for energy conservation.
2	To understand energy monitoring / targeting aspects of Energy
3	To study the different measures for energy conservation and financial implications of various thermal utilities.
4	To study the different measures of energy conservation in thermal systems.
5	To provide energy conservation measures of different thermal utilities.

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Understand the energy sources and scenario.	Understand
CO2	Understand energy monitoring / targeting aspects of Energy	Analysis
CO3	To apply the measures for energy conservation and financial implications of various thermal utilities.	Apply
CO4	To apply the concepts and performance study of different types of corrosion	Apply
CO5	Performance analysis of thermal utilities	Analysis

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	M	L	L	-	-	-	-	-	-	L	-	-
CO2	S	M	S	M	L	L	L	-	-	-	M	M	S	M	-
CO3	S	M	S	M	L	L	L	-	-	-	M	M	S	M	-
CO4	S	M	S	M	L	L	L	-	-	-	M	M	S	M	-
CO5	M	M	M	L	L	L	M	-	-	-	M	M	M	M	-

S- Strong; M-Medium; L-Low

Syllabus

INTRODUCTION
Indian Energy Scenario – Types & Forms of Energy - Primary / Secondary Energy Sources – Energy Conservation – Need – EC Act 2003 : Salient Features – Energy Intensive Industries – Barriers - Roles & Responsibility of Energy Managers – Energy Auditing : Preliminary & Detailed - Benchmarking.
ENERGY MONITORING & TARGETING
Data & Information Analysis – Cost / Energy Share Diagram – Data Graphing – Break Even Analysis – Depreciation – Financial Analysis Techniques – CUSUM Technique – ESCO Concept – ESCO Contracts.
PERFORMANCE STUDY OF THERMAL UTILITIES – 1
Boiler – Stoichiometry – Combustion Principles – Heat Loss Estimation – Steam Traps – Steam Piping & Distribution – Thermic Fluid Heaters – Furnaces – Insulation & Refractories
PERFORMANCE STUDY OF THERMAL UTILITIES – 2
Introduction- forms of corrosion-pitting, intergranular, stress corrosion, corrosion fatigue, dezincification, erosion-corrosion, Crevice Corrosion, Fretting-Protection methods-PVD, CVD.
PERFORMANCE STUDY OF THERMAL UTILITIES – 3
Basics of R & A/C – COP / EER / SEC Evaluation – Psychometric Chart Analysis – Types & Applications of Cooling Towers – Basics – Performance Analysis – DG Set – Performance Prediction– Cost of Power Generation – Scope for Energy Conservation in all these
Text Books:
1 Smith, CB Energy Management Principles, Pergamon Press, NewYork, 1981 2 Hamies, Energy Auditing and Conservation; Methods Measurements, Management and Case study, Hemisphere, Washington, 1980 3 Trivedi, PR, Jolka KR, Energy Management, Commonwealth Publication, New Delhi, 1997
Reference:
1. Write, Larry C, Industrial Energy Management and Utilization, Hemisphere Publishers, Washington, 1988 2. Diamant, RME, Total Energy, Pergamon, Oxford, 1970 3. Handbook on Energy Efficiency, TERI, New Delhi, 2001 4. Guide book for National Certification Examination for Energy Managers and Energy Auditors (Could be downloaded from www.energymanagertraining.com)

Course Designers:

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1	R.ANANDAN	Rajanand0072000@yahoo.com
2		
3		

17MESE02	ENERGY CONSERVATION AND MANAGEMENT	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

The aim of the subject is to provide basic knowledge of energy consumption, utilization and energy auditing

Prerequisite

NIL

Course Objective

1	To compare the energy consumption details worldwide.
2	Analyzing and interpretation of energy data in industries.
3	Carrying out energy accounting and balancing.
4	Conducting energy audit and suggest methodologies for energy savings in various equipment.
5	To utilize the available energy resources in optimal ways.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	To gain the knowledge of the basic concepts of Energy scenario, energy auditing &role of energy managers
CO2.	To obtain the methods of Electric managements, Lightings
CO3.	To apply the concepts of boiler testing, steam distribution & thermal insulators
CO4.	To apply the techniques for Energy conservation in pumps, fans and Refrigeration
CO5.	To apply the techniques for payback period, energy management & internal rate of Return

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	M	L	L	-						L	-	-
CO2	S	M	S	M	L	L	L						L	-	-
CO3	S	M	M	L	M	L	M						L	-	-
CO4	S	M	S	M	M	M	L						L	-	-
CO5	S	M	S	M	M	M	L						L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS :
IMPORTANCE OF ENERGY CONSERVATION AND MANAGEMENT

Energy-Power – Past & present scenario of World; National Energy consumption data– environmental aspects – Energy prices, policies – Energy auditing: Need, Types, methodology and analysis. Role of energy managers. Instruments used for auditing.

ELECTRICAL SYSTEMS

AC / DC current systems, Demand control, power factor correction, load management, Motor drives: motor efficiency testing, Variable frequency drives – Lighting: lighting levels, efficient options, day lighting, timers, Energy efficient windows – Advanced fuel cell technology

THERMAL SYSTEMS

Boiler – efficiency testing, excess air control, Steam distribution & use – steam traps, condensate recovery, flash steam utilization, Thermal insulation and refractories. Thermic fluid heaters.

ENERGY CONSERVATION

Energy conservation in Pumps, Fans (flow control) and blowers, Compressed Air Systems, Refrigeration and air conditioning systems – Waste heat recovery recuperators, heat sheets, heat pipes, heat pumps.

ENERGY MANAGEMENT &ECONOMICS

Energy resource management – Energy Management information systems – Computerized energy management – Energy economics – discount rate, payback period, internal rate of Return, life cycle costing – Financing energy conservation Projects.

TEXT BOOKS

1. L.C. Witte, P.S. Schmidt, D.R. Brown, Industrial Energy Management and Utilisation, Hemisphere Publications, Washington.
2. O. Callaghn, P.W. Design and Management for Energy Conservation, Pergamon Press, Oxford.

Reference Books

1. Dryden, I.G.C. The Efficient Use of Energy, Butterworths, London
2. Turner, W.C. Energy Management Hand Book, Wiley, New York.
3. Murphy, W.R. and Mc KAY, G. Energy Management, Butterworths, London

Course Designers

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17MESE03	HYDROGEN AND FUEL CELL TECHNOLOGY	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

PREAMBLE

To enlighten on various technological advancements, benefits and prospects of utilizing hydrogen/fuel cell for meeting the future energy requirements.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To detail on the hydrogen production methodologies, possible applications and various storage options.
2	To discuss on the working of a typical fuel cell, its types and to elaborate on its thermodynamics and kinetics.
3	To analyze the cost effectiveness and eco-friendliness of Fuel Cells.
4	To make students understand the different fuel cells and their applications.
5	To enable students to understand the economics of fuel cells.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Know the hydrogen production methodologies and various storage options	Understand
CO2. Know the working of fuel cell and its types with thermodynamic performance.	Understand
CO3. Understand the cost effectiveness and eco-friendliness of fuel cells.	Understand
CO4. Know the different types of fuel cells and their applications.	Understand
CO5.Understand the economics of fuel cells.	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	S	S	S	S	S	S						L		
CO2	S	S	S	M	M	M	L						L		
CO3	M	L	--	--	M	M	S						L		
CO4	S	M	M	--	M	M	M						L		
CO5	M	L	--	--	L	L	L						L		

S- Strong; M-Medium; L-Low

SYLLABUS

HYDROGEN – BASICS AND PRODUCTION TECHNIQUES: Hydrogen – physical and chemical properties, salient characteristics. Production of hydrogen – steam reforming – water electrolysis – gasification and woody biomass conversion – biological hydrogen production – photo dissociation – direct thermal or catalytic splitting of water.

HYDROGEN STORAGE AND APPLICATIONS: Hydrogen storage options – compressed gas – liquid hydrogen – Hydride – chemical Storage – comparisons. Safety and management of hydrogen. Applications of Hydrogen.

FUEL CELLS: History – principle - working - thermodynamics and kinetics of fuel cell process – performance evaluation of fuel cell – comparison on battery Vs fuel cell.

FUEL CELL – TYPES: Types of fuel cells – AFC, PAFC, SOFC, MCFC, DMFC, PEMFC – relative merits and demerits.

APPLICATION OF FUEL CELL AND ECONOMICS: Fuel cell usage for domestic power systems, large scale power generation, Automobile, Space. Economic and environmental analysis on usage of Hydrogen and Fuel cell. Future trends in fuel cells**.**

TEXT BOOKS:

1. Viswanathan, B and M Aulice Scibioh, Fuel Cells – Principles and Applications, Universities Press (2006)
2. Rebecca L. and Busby, Hydrogen and Fuel Cells: A Comprehensive Guide, Penn Well Corporation, Oklahoma (2005
3. Bent Sorensen (Sørensen), Hydrogen and Fuel Cells: Emerging Technologies and Applications, Elsevier, UK (2005)

REFERENCES:

1. Kordesch, K and G.Simader, Fuel Cell and Their Applications, Wiley-Vch, Germany (1996)
2. Hart, A.B and G.J.Womack, Fuel Cells: Theory and Application, Prentice Hall, New York Ltd., London (1989)
3. Jeremy Rifkin, The Hydrogen Economy, Penguin Group, USA (2002).

COURSE DESIGNERS

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17MESE04	RENEWABLE SOURCE OF ENERGY	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

Renewable source of energy are developing fast throughout the world, and their combination is increasingly able to meet the needs for available, agreeable, and affordable energy, also for the people that lack access to energy today. In addition, local energy resources are not hit by the high energy price increases that are threatening to reverse the progress in providing energy to the poor people that lack appropriate energy today. This is why sustainable energy, the combination of renewable energy and energy efficiency, is increasingly become a part of the efforts to reduce poverty.

Prerequisite - NIL

Course Objective

1	To understand the importance of solar energy.
2	To learn the importance of wind energy.
3	To know the importance of bio energy.
4	To know various renewable energy power plants.
5	To learn the necessity of latest and modern energy sources.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	To apply the solar radiation , measurements of solar radiation and solar thermal collectors	apply
CO2.	To apply wind data ,energy estimation and wind energy conversion systems	apply
CO3.	To apply the Biomass directs Combustion, Biomass gasifier and Biogas plant.	apply
CO4.	To apply the Wave energy ,Open and closed OTEC Cycles and Small hydro plant turbines	apply
CO5.	To apply the power generation, transport , Fuel cells and its technologies	apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	M	-	-	-	-	-	-	-	-	-	M		
CO2	S	M	M	-	-	-	-	-	-	-	-	-	M		
CO3	S	M	M	-	-	-	-	-	-	-	-	-	M		
CO4	S	M	M	M	-	-	-	-	-	-	-	-	M		
CO5	S	M	M	M	-	-	-	-	-	-	-	-	M		

S- Strong; M-Medium; L-Low

SYLLABUS				
SOLAR ENERGY				
Solar Radiation – Measurements of solar Radiation – Solar Thermal Collectors – Flat Plate and Concentrating Collectors – Solar Applications – fundamentals of photo Voltaic Conversion – solar Cells – PV Systems – PV Applications				
WIND ENERGY				
Wind Data and Energy Estimation – wind Energy Conversion Systems – Wind Energy-Generators and its performance – Wind Energy Storage – Applications – Hybrid systems				
BIO – ENERGY				
Biomass, Biogas, Source, Composition, Technology for utilization – Biomass direct Combustion – Biomass gasifier – Biogas plant – Digesters – Ethanol production – Bio Diesel production and economics.				
OTEC, TIDAL, GEOTHERMAL AND HYDEL ENERGY				
Tidal energy – Wave energy –Open and closed OTEC Cycles – Small hydro plant turbines – Geothermal energy sources- environmental issues.				
NEW ENERGY SOURCES				
Hydrogen generation, storage, transport and utilization, Applications - power generation- transport – Fuel cells – technologies, types – economics and the power generation				
Text Books				
1	G.D. Rai, "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 1999.			
2	S.P. Sukhatme, "Solar Energy", Tata McGraw Hill Publishing Company Ltd., New Delhi,1997.			
Reference Books				
1	Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 1996			
2	Twidell, J.W. & Weir, A., "Renewable Energy Sources", EFN Spon Ltd., UK, 1986			
3	G.N. Tiwari, "Solar Energy Fundamentals Design, Modelling and applications", Narosa Publishing House, New Delhi, 2002			
4	L.L. Freris, "Wind Energy Conversion systems", Prentice Hall, UK, 1990			
Course Designers				
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17MESE05	WASTE ENERGY CONVERSION TECHNOLONGY	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

This subject deals with various techniques involved in waste treatment, waste disposal and how to convert energy from that waste. Detailed study extends to the method of thermo chemical and bio chemical conversion techniques. Also deals a case study of environmental and health impact due energy conversion to waste.

Prerequisite - NIL

Course Objective

1	To understand the waste and waste processes.
2	To understand waste treatment and disposal.
3	To apply how to convert waste to energy from thermo chemical conversion.
4	To apply how to convert waste to energy from bio chemical conversion.
5	To analysis the environmental impact due to waste with case study.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Explained types of waste and source of waste	understand
CO2.	Understand various waste treatment and disposal	understand
CO3.	Apply the various techniques to convert waste to energy by thermo chemical conversion.	apply
CO4.	Apply various methods to convert waste to energy from bio chemical conversion.	apply
CO5.	Analysis the environmental and health impacts due to waste with case study.	analysis

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L											L		
CO2	S	M	L										L		
CO3	S	M	L										L		
CO4	S	S	M	L									L		
CO5	S	S	S	M									L		

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO WASTE & WASTE PROCESSING

Definitions, sources, types and composition of various types of wastes; Characterisation of Municipal SolidWaste (MSW) , Industrial waste and Biomedical Waste (BMW), waste collection and transportation; waste processing-size reduction, separation; waste management hierarchy, waste minimization and recycling of MSW; Life Cycle Analysis (LCA), Material Recovery Facilities (MRF), recycling processes of solid waste.

WASTE TREATMENT AND DISPOSAL

Aerobic composting, incineration, different type of incineration; medical and pharmaceutical waste incinerations- land fill classification, types, methods and sitting consideration, layout and preliminary design of landfills: composition, characteristics, generation, movement and control of landfill leachate and gases, environmental monitoring system for land fill gases.

ENERGY FROM WASTE-THERMO CHEMICAL CONVERSION

Sources of energy generation, incineration, pyrolysis, gasification of waste using gasifiers, briquetting, utilization and advantages of briquetting,-environmental and health impacts of incineration; strategies for reducing environmental impacts.

ENERGY FROM WASTE- BIO-CHEMICAL CONVERSION

Anaerobic digestion of sewage and municipal wastes, direct combustion of MSW-refuse derived solid fuel, industrial waste, agro residues, anaerobic digestion- biogas production, land fill gas generation and utilization, present status of technologies for conversion of waste into energy, design of waste to energy plants for cities, small townships and villages.

ENVIRONMENTAL AND HEALTH IMPACTS-CASE STUDIES

Environmental and healthimpacts of waste to energy conversion, case studies of commercial waste to energy plants,waste to energy- potentials and constraints in India, eco-technological alternatives for waste to energy conversions - Rules related to the handling, treatment and disposal of MSW and BMW in India.

Text Books

1	Parker, Colin, & Roberts, "Energy from Waste An Evaluation of Conversion Technologies", Elsevier Applied Science, London, 1985.
2	Shah, Kanti L., "Basics of Solid & Hazardous Waste Management Technology", Prentice Hall, 2000.

Reference Books

1	Robert Green, From Waste to Energy, Cherry Lake Publication, 2009.
2	Velma I Grover and Vaneeta Grover, "Recovering Energy from Waste Various Aspects", Science Pub Inc, 2002.

Course Designers

S.No	**Faculty Name**	**Designation**	**Department/Name of the College**	**Email id**
1	R.CHANDRASEKAR	Assistant Professor	MECH / VMKVEC	chandrasekar@vmkvec.edu.in

17MESE06	BIO ENERGY TECHNOLOGY	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

To disseminate the technologies for utilizing bio-energy and its manifold benefits compared to conventional fossil fuels.

Prerequisite - NIL

Course Objective

1	To provide the students the sources of biomass.
2	To make understand the students on different processes of biomethanation.
3	To study the combustion of bio fuels,
4	To study the gasification methods of biomass.
5	To provide the students on liquefied biofuels.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	To gain the knowledge of the basic concepts of Biomass preparation and also fuel assessments.	Understand
CO2.	To obtain the methods of biogas production and biogas plants.	Understand
CO3.	To apply the concepts of combustion processes and fuel handling systems.	Apply
CO4.	To apply the techniques for preparation of biogases and coals.	Apply
CO5.	To apply the techniques for preparation of biodiesels from vegetables.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO 1	PSO 2	PSO 3
CO1	S	M	L	M	L	L							L	-	-
CO2	S	M	S	M	M	M							L	-	-
CO3	S	M	M	L	M	L							L	-	-
CO4	S	M	S	M	S	S							L	-	-
CO5	S	M	S	M	S	S							L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS :
INTRODUCTION

Biomass: types – advantages and drawbacks – Indian scenario – characteristics – carbon neutrality – conversion mechanisms – fuel assessment studies – densification technologies – Comparison with coal – Proximate & Ultimate Analysis - Thermo Gravimetric Analysis – Differential Thermal Analysis – Differential Scanning Calorimetry

BIOMETHANATION

Microbial systems – phases in biogas production – parameters affecting gas production – effect of additives on biogas yield – possible feed stocks. Biogas plants – types – design – constructional details and comparison – biogas appliances – burner, luminaries and power generation – effect on engine performance

COMBUSTION

Perfect, complete and incomplete combustion - stoichiometric air requirement for biofuels - equivalence ratio – fixed Bed and fluid Bed combustion – fuel and ash handling systems – steam cost comparison with conventional fuels

GASIFICATION,PYROLYSIS AND CORBONISATION

Chemistry of gasification - types – comparison – application – performance evaluation – economics – dual fuelling in IC engines – 100 % Gas Engines – engine characteristics on gas mode – gas cooling and cleaning systems - Pyrolysis - Classification - process governing parameters – Typical yield rates. Carbonization Techniques – merits of carbonized fuels

LIQUID BIOFUELS

History of usage of Straight Vegetable Oil (SVO) as fuel - Biodiesel production from oil seeds, waste oils and algae - Process and chemistry - Biodiesel health effects / emissions / performance. Production of alcoholic fuels (methanol and ethanol) from biomass – engine modifications

TEXT BOOKS

1. Tom B Reed, Biomass Gasification – Principles and Technology, Noyce Data Corporation, 1981
2. David Boyles, Bio Energy Technology Thermodynamics and costs, Ellis Hoknood Chichester, 1984.
3. Khandelwal KC, Mahdi SS, Biogas Technology – A Practical Handbook, Tata McGraw Hill, 1986

Reference Books

1. Mahaeswari, R.C. Bio Energy for Rural Energisation, Concepts Publication,1997
2. Best Practises Manual for Biomass Briquetting, I R E D A, 1997 .
3. Eriksson S. and M. Prior, The briquetting of Agricultural wastes for fuel, FAO Energy and Environment paper, 1990
4. Iyer PVR et al, Thermochemical Characterization of Biomass, M N E S

Course Designers

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1	R.MAHESH	ASSISTANT PROFESSOR (GR-II)	Mechanical/AVIT	mahesh@avit.ac.in

17MESE07	NUCLEAR POWER ENGINEERING	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

Nuclear engineering is the branch of science that deals with theory of nuclear fission and fusion, nuclear reactors and preventive maintenance such as protection from radiation. In order to understand the construction and operation of nuclear reactors, it is necessary to have a basic grounding in atomic physics. The course provides a fundamental knowledge in nuclear power generation and nuclear power plant operation.

Prerequisite - NIL

Course Objective

1	To describe the mechanisms of nuclear fission and fusion reactions.
2	To explain the various nuclear fuel cycles and its characteristics.
3	To discuss the reprocessing methods of nuclear spent fuel.
4	To study separation of reactor products
5	To describe the various safety systems and disposal methods of nuclear wastes

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Know the nuclear fission and fusion processes	Understand
CO2.	Explain the various nuclear fuel cycles and its characteristics	Understand
CO3.	Discuss the reprocessing methods of nuclear spent fuel	Understand
CO4.	Study separation of reactor products	Understand
CO5.	Describe the various safety systems and disposal methods of nuclear wastes	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	M	L	L										L		
CO2	S	M	L										L		
CO3	S	M	L										L		
CO4	S	S	M	L									L		
CO5	S	S	S	M									L		

S- Strong; M-Medium; L-Low

SYLLABUS				
NUCLEAR REACTORS				
Mechanism of nuclear fission –Nuclides -Radioactivity –Decay chains -Neutron reactions -Fission process –Reactors -Types of reactors –Design and construction of nuclear reactors -Heat transfer techniques in nuclear reactors -Reactor shielding.				
REACTOR MATERIALS				
Nuclear fuel cycles –Characteristics of nuclear fuels –Uranium –Production and purification of uranium –Conversion to UF4 and UF6 –Other fuels like Zirconium, Thorium, Berylium.				
REPROCESSING				
Nuclear fuel cycles -Spent fuel characteristics -Role of solvent extraction in reprocessing -Solvent extraction equipment				
SEPARATION OF REACTOR PRODUCTS				
Processes to be considered -Fuel element dissolution -Precipitation process –Ion exchange -Redox -Purex -TTA –Chelation -U235 -Hexone -TBP and Thorax processes -Oxidative slagging and electro-refining -Isotopes –Principles of isotope separation				
WASTE DISPOSAL AND RADIATION PROTECTION				
Types of nuclear wastes –Safety control and pollution control and abatement -International convention on safety aspects –Radiation hazards prevention				
Text Books				
1	Thomas J.Cannoly, "Fundamentals of nuclear Engineering",John Wisley, 2002			
2	Collier J.G., and Hewitt G.F, "Introduction to Nuclear power", Hemispherepublishing, New York, 2002.			
Reference Books				
1	A.E. Walter and A.B. Reynolds (1981), Fast Breeder Reactor, Pergamon Press.			
2	M.M. El-Wakil (1971), Nuclear Energy Conversion, Intext Educational Publish.			
Course Designers				
S.No	**Faculty Name**	**Designation**	**Department/Name of the College**	**Email id**
1	V.K.Krishanan	Asso Prof	Mech / VMKVEC	

17MESE81	ENERGY LAB	Category	L	T	P	Credit
		EC(SE)	**0**	**0**	**4**	**2**

Preamble
To conduct experiments on various Energy Engineering devices to study the performance and its applications.

Prerequisite
NIL

Course Objective

1	To impart practice in solar water heater.
2	To apply the practical training by using biogas plant
3	To apply the practical training by various pump and its characteristics
4	To study and apply for performance analysis and optimization of energy utilities
5	To study the Performance on various Heat Exchangers

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Understand the working principle of different renewable energy sources.	Apply
CO2.	Measure the properties of different fuels.	Apply
CO3.	Apply the practical training by various pump and its characteristics	Apply
CO4.	Procedure to be adopted for performance analysis and optimization of energy utilities	Apply
CO5.	To study the Performance on various Heat Exchangers	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	-	-	-	-	-	-	-	-	L	-	L		
CO2	S	L	S	L	-	-	-	-	-	-	L	-	L		
CO3	S	L	-	L	-	-	-	-	-	-	M	-	L		
CO4	S	M	L	-	-	-	-	-	-	-	M	-	L		
CO5	L	L	L	-	-	-	L	-	-	-	L	-	L		

S- Strong; M-Medium; L-Low

SYLLABUS

LIST OF EXPERIMENTS

1. Performance study in a solar water heater.
2. Characteristics study of solar photovoltaic devices.
3. Performance study of biogas plant.
4. Fuel characterization study in different fuels (proximate analysis, calorific value, viscosity, specific gravity etc.,)
5. Measurements of direct and diffused solar radiation.
6. Performance study on boiler.
7. Performance characteristics of motor test rig.
8. Computation of pump & pumping system characteristics (pump curve, system curve and BEP)
9. Analysis on fans characteristic curves
10. Performance study on various Heat Exchangers.
11. Performance characteristics of Vapour Compression Refrigeration test rig.
12. Study on fuel cell Systems.
13. Study on thermal storage systems
14. Study on biomass gasifiers.
15. Study on various alternate fuels for IC engines

Text Books

1	**ENERGY LAB Manual**

Reference Books

1	Twidell, J.W. & Weir, A., “Renewable Energy Sources”, EFN Spon Ltd., UK, 1986
2	G.N. Tiwari, “Solar Energy Fundamentals Design, Modelling and applications”, Narosa Publishing House, New Delhi, 2002

Course Designers

S.No	**Faculty Name**	**Designation**	**Department/ College**	**Email id**
1	A.SENTHILKUMAR	Assistant Professor	Mech / AVIT	senthilkumar@avit.ac.in

17MESE82	ALTERNATE FUEL TESTING LAB	Category	L	T	P	Credit
		EC(SE)	0	0	4	2

Preamble
To impart knowledge on performance and emission characteristics on petrol and diesel engine.

Prerequisite
NIL

Course Objective

1	To familiarize and train the students on the how to check VCR engine performance
2	To familiarize and train the students how to check the VCR engine in different methods'
3	To familiarize and train the students how to measure the emission gases of IC engine

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Analysis and performance testing of different oil used in VCR engine	Apply
CO2.	Analysis and performance testing of Alternate Fuel using by different component in VCR engine	Apply
CO3.	Evaluate the function of Emmision gas testing and measurements by Gas Analyzer	Evaluate

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	S	S	-	-	-	-	-	-	S	-		-	S		
CO2	S	L	S	L	M	-	-	-	M	-		-	S		
CO3	S	s	-	L	M	-	-	-	S	-		-	M		

S- Strong; M-Medium; L-Low

SYLLABUS

LIST OF EXPERIMENTS

1. Performance Test on VCR engine using alternate fuel in different loads
2. Performance Test on VCR engine using alternate fuel in different comparison ratio.
3. Performance Test on VCR engine using alternate fuel in EGR
4. Performance Test on VCR engine using alternate fuel in Turbo Charger
5. Performance Test on VCR engine using alternate fuel in different Nuzzle hole
6. Measurement of HC, CO , CO_2, O_2 using exhaust gas analyzer.
7. Diesel Engine Smoke Measurement.
8. Study of NDIR gas Analyzer and FID.

9. Study of Chemiluminescent NOx Analyzer				
Text Books				
1	**ALTERNATE FUEL TESTING LAB Manual**			
Reference Books				
1	R.B. Gupta- “Automobile Engineering "- SatyaPrakashan			
2	Ganesan, V- “Internal Combustion Engines”- Tata McGraw-Hill Co.- 2003.			
Course Designers				
S.No	**Faculty Name**	**Designation**	**Department/ College**	**Email id**
1	SAMUVEL MICHAEL	Asso.Prof Gr-II	MECH/AVIT	samuvelmichael@avit.ac.in

ELECTIVE COURSES

SPECIALIZATION - INDUSTRIAL ENGINEERING

17MESE38	INDUSTRIAL ENGINEERING	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

This course deals with productivity measurements, method study techniques, work measurement, production planning and control and industrial Legislation.

Prerequisite

NIL

Course Objective

1	To understand the importance of work study methods and its importance in various fields.
2	To develop the skills of selection of a plant and also material handling equipment required.
3	To learn PPC and its functions.
4	To learn the skills of purchasing materials and their management.
5	To learn the awareness on various labour acts and management principles.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Evaluate the work methods through work measurement	Understand
CO2.	Establish the efficient work system	Apply
CO3.	Identify the suitable forecasting techniques for given applications	Analyze
CO4.	Prepare the charts, diagrams and production plan.	Apply
CO5.	Describe the theory in industrial engineering and their applications.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	S	M	M	L	S	-	-	-	-	-	-	-	M	-	S
CO4	S	M	M	L	-	-	-	-	-	-	-	-	M	-	M
CO5	S	S	S	S	S	-	-	-	S	M	-	-	S	-	S

S- Strong; M-Medium; L-Low

SYLLABUS				
WORK MEASUREMENT AND WORK STUDY				
Evolution and importance of industrial engineering–Production-Classification-Productivity- Factors influencing productivity-quality route to productivity- Introduction to Work measurement and its Techniques-Work study-Definition-Procedure and benefits of work study-Charting techniques-Time study-Stop watch time study-Motion study-Work sampling procedure-collection of data-Method study.				
PLANT LAYOUT AND MATERIAL HANDLING9 Hours				
Plant location and site location-factors influencing the location-Plant layout-Types, needs, factors influencing the plant layout-Plant layout procedure-Material handling-scope and principles of material handling-Types of Material Handling equipment-Factors influencing material handling-Methods of material handling.				
PRODUCTION PLANNING AND CONTROL 9 Hours				
Introduction-Objectives and Functions of PPC-Forecasting-Sales Forecasting Techniques-Types of Forecasting-Routing-Objectives and procedure of routing-Scheduling-Master Production Schedule-purpose and preparation of schedules-Scheduling techniques like CPM and PERT- Dispatching-Dispatch Procedure-Centralized and Decentralized dispatching-Tool dispatching				
MATERIAL MANAGEMENT 9 Hours				
Procurement of materials-codification of materials-Inventory control-Objectives of inventory control-EBQ & EOQ values-Inventory models-ABC analysis-Material requirements planning(MRP)-Enterprise resource planning(ERP)-supply chain management(SCM)-Inspection and quality control-SQC-control charts-Sampling procedures-Benchmarking				
INDUSTRIAL LEGISLATION AND MANAGEMENT CONCEPTS9 Hours				
Importance and necessity of labour acts-principles of labour legislation-various acts-Industrial Ownership and various types-Functions of management-Manpower Planning-Recruitment and Selection-Break Even Analysis-Managerial applications of breakeven point-Decision making -Techniques of decision making.				
Text Books:				
1	Khan, M.I, “**Industrial Engineering**”, New Age International, 2nd Edition, 2009.			
2	Kapoor N.D, “**Handbook of Industrial Law**”, sultan Chand & sons, 14th revised edition 2013.			
Reference Books:				
1	Khanna, O.P, “**Industrial Engineering and Management**”, Dhanpat Rai and Sons, 2008.			
2	Samuel Eilon, "**Elements of Production Planning and Control**", Universal Publishing Corporation, Bombay, 1994.			
3	Panneerselvam R, "**Production and Operations Management**”, PHI, New Delhi, 2006.			
Course Designers				
Sl.No	**Faculty Name**	**Designation**	**Department/Name of the College**	**Email id**
1	B.SELVA BABU	Assistant Professor	Mech / AVIT	selvababu@avit.ac.in

17MESE39	LEAN MANUFACTURING SYSTEMS	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

This course provides basic knowledge in various tools and techniques in lean manufacturing systems.

Prerequisite – NIL

Course Objective

1	To gain the knowledge and understanding the basic concepts of lean manufacturing process
2	To understand the various quality improvement methods in lean manufacturing.
3	To learn the basic concepts of JIT and VSM.
4	To analyse the importance of JIDOKA and its role.
5	To understand the importance of employee involvement and systematic planning.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Remember and understand the Principles, basic concepts in lean manufacturing.	Understand
CO2.	Understand, analyse and design a suitable method for quality improvement	Analyse
CO3.	Understand the JIT methodology, Kanban rules and the importance of defining value.	Apply
CO4.	Understand and Analyse the importance of Jidoka and the implementation	Analyze
CO5.	Learn the requirement of employee involvement in the implementation of lean culture.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M	L	S	L	S	L	-	-	-	-	-		M		
CO2	M	L	S	L	S	L	-	-	-	-	-		M		
CO3	M	L	S	L	S	L	-	-	S	-	-		S		
CO4	M	L	S	L	S	L	-	-	S		-		S		
CO5	M	L	S	L	S	L	-	L	S		-		S		

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Objectives of lean manufacturing-key principles -- traditional Vs lean manufacturing-Origin of lean production system – Necessity – Lean revolution in Toyota – Systems and systems thinking – Basic image of lean production – Customer focus – Muda (waste).

STABILITY OF LEAN SYSTEM

Standards in the lean system–5S system–Total Productive Maintenance–standardized work–Elements of standardized work–Charts to define standardized work–Man power reduction–Overall efficiency–standardized work and Kaizen–Common layouts.

JUST IN TIME

Introduction - JIT system-Principles and elements of JIT – Kanban rules – Expanded role of conveyance

– Production leveling – Pull and Push systems – Process Mapping and Value stream mapping				
JIDOKA (AUTOMATION WITH A HUMAN TOUCH)				
Jidoka concept – Poka-Yoke (mistake proofing) systems – Inspection systems and zone control – Types and use of Poka-Yoke systems – Implementation of Jidoka.				
WORKER INVOLVEMENT AND SYSTEMATIC PLANNING METHODOLOGY				
Involvement – Activities to support involvement – Quality circle activity – Kaizen training - Suggestion Programmes – Hoshin Planning System (systematic planning methodology) – Phases of Hoshin Planning – Lean culture				
Text Books				
1	Pascal Dennis, Lean Production Simplified: A Plain-Language Guide to the World's Most Powerful Production System, (Second edition), Productivity Press,New York.			
2	Mike Rother and John Shook, Learning to See: Value Stream Mapping to Add Value and Eliminate MUDA, Lean Enterprise Institute.			
Reference Books				
1	Jeffrey Liker, the Toyota Way: Fourteen Management Principles from the World's Greatest Manufacturer, McGraw Hill.			
2	Michael L. George, Lean Six SIGMA: Combining Six SIGMA Qualities with Lean Production Speed, McGraw Hill.			
Course Designers				
S.No	**Faculty Name**	**Designation**	**Department/ Name of the College**	**Email id**
1	J.SENTHIL	Associate Professor	Mech / AVIT	jsenthil@avit.ac.in

17MESE40	INSPECTION AND STATISTICAL QUALITY CONTROL	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

PREAMBLE

The aim of this subject is to understand the inspection and statistical quality control concepts.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To understand the various inspection principles
2	To explore the importance of Quality in industry
3	To study the fundamentals of statistical concept in quality control
4	To explore the phenomenon of various control charts
5	To study the OC curves and about the sampling inspection

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Understand the principles of inspection.	Understand
CO2. Identify the quality system in industry.	Apply
CO3. Identify the various control charts.	Apply
CO4. Analyze the OC curves and the sampling inspection.	Analyze
CO5. Apply various sampling techniques	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	---	----	---	---	L							L		
CO2	M	---	---	---	---	L							L		
CO3	M	---	M	---	---	---							L		
CO4	M	---	---	---	S	---							L		
CO5	M	M	M	M	M	---							L		

S- Strong; M-Medium; L-Low

SYLLABUS

INSPECTION: Introduction and Definition of Inspection, Principle of Inspection, Floor Inspection - advantages and disadvantages.

QUANTITY FUNCTION IN INDUSTRY:
Introduction, definition of quality, basic concept of quality, Quality of design, conformance and performance. Factors affecting quality, Concept of reliability and maintainability, definition of SQC, benefits and limitation of SQC.

FUNDAMENTALS OF STATISTICAL CONCEPT IN QUALITY CONTROL:
Variation in process causes of variation, Types of quality characteristics: variable, attribute and variable treated as attribute, Terminology used in frequency distribution, Graphical presentation of frequency distribution (Histogram, Frequency Bar Chart, and Frequency Polygon), Normal distribution Curve - Description and its construction.

CONTROL CHARTS IN S.Q.C.:
Theory of control chart- uses of control chart – Control chart for variables – X chart, R chart and σchart -process capability – process capability studies and simple problems. Control chart for attributes -p chart, C and U charts, State of control and process out of control identification in charts, pattern study.

SAMPLING INSPECTION & OC CURVES
Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans.

TEXT BOOKS:

1. Douglas.C. Montgomery, "Introduction to Statistical quality control", 4th edition, John Wiley 2001.
2. Srinath. L.S., "Reliability Engineering", Affiliated East west press, 1991.
3. R K Jain, "Engineering Metrology", Khanna Publishers.

REFERENCES:

1. John.S. Oakland. "Statistical process control", 5th edition, Elsevier, 2005
2. Connor, P.D.T.O., "Practical Reliability Engineering", John Wiley, 1993
3. Grant, Eugene .L "Statistical Quality Control", McGraw-Hill, 1996
4. Manohar Mahajan, "Statistical Quality Control", Dhanpat Rai & Sons, 2001.

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department / Name of the College	Mail ID
1	G.ANTONY CASMIR	Asst. Prof. - II	Mechanical, AVIT	antonycasmir@avit.ac.in

17MESE41	MAINTENANCE MANAGEMENT	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

The aim of the subject is to provide basic knowledge of Maintenance and safety about industries

Prerequisite

NIL

Course Objective

1	To understand the maintenance systems
2	To study about the maintenance planning and control systems
3	To study about the prevention and maintenance monitoring
4	To learn about the safety system in industries
5	To learn about the total production maintenance systems

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Understand the basic elements of maintenance system and function of Maintenance management	Understand
CO2.	Know the systematic method of maintenance planning and control	Apply
CO3.	Know the operating and shutdown maintenance of logistics	Apply
CO4.	Know the safety measures and reliability of maintenance	Apply
CO5.	Know the fundamental of total productive maintenance systems	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	S	L	L	L	L	L							L	-	-
CO2	S	M	L	L	L	L							L	-	-
CO3	S	M	M	M	L	L							L	-	-
CO4	S	S	S	M	L	M							L	-	-
CO5	S	S	S	M	M	M							L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS
INTRODUCTION Basic elements of maintenance system – inspection, planning & scheduling, job execution, record keeping, data analysis, learning & improvement. Maintenance objectives and Scope – Challenges and functions of Maintenance management
MAINTENANCE PLANNING AND CONTROL Establishing a Maintenance Plan - Preliminary considerations, Systematic method of Maintenance Plan and schedule planning and schedule of Plant shut downs
MAINTENANCE LOGISTICS Preventive, operating and shutdown maintenance; Condition based maintenance and condition monitoring –Resource requirements: Optimal size of service facility – Optimal repair effort — Spares control.
OVERVIEW OF SAFETY Five Zero concept –FMECA – Maintainability prediction– Design for maintainability – Reliability Centered Maintenance
TOTAL PRODUCTIVE MAINTENANCE TPM fundamentals – Chronic and sporadic losses – Six big losses — TPM pillars– Autonomous maintenance – computer-aided maintenance management system
TEXT BOOKS 1. Bikas Badhury & S.K.Basu, “Tero Technology: Reliability Engineering and Maintenance Management”, Asian Books. Seichi Nakajima, “Total Productive Maintenance”, Productivity Press
Reference Books
1.Industrial Maintenance – H.P.Garg
2. Andrew K.S.Jardine & Albert H.C.Tsang, “Maintenance, Replacement and Reliability”, Taylor and Francis

Course Designers

S.No	Faculty Name	Designation	Department/ Name of the College	Email id
1	K.SURENDRABABU	ASSOCIATE Professor	Mechanical/AVIT	ksbtkm@gmail.com

17MESE42	DESIGN FOR QUALITY	Category	L	T	P	C
		EC(SE)	3	0	0	3

PREAMBLE

This course reviews the statistical techniques, designing various experiments and special experiments and optimization techniques

PREREQUISITE: NIL

COURSE OBJECTIVES

1	To know about Design principles and analysis of statistical techniques
2	To Understand single factor & multi factorial experiments
3	To know about factorial designs
4	To know about the Selection of orthogonal arrays
5	Principles of robust design

COURSE OUTCOMES

On the successful completion of the course, students will be able to

The various statistical techniques	Understand
CO2. design single factor & multi factorial experiments	Apply
CO3. special designs in factorial experiments	Apply
CO4. To design orthogonal experiments	Analyze
CO5. To design robust design and how to optimize those data	**Analyze**

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	**S**	**S**	**S**	**M**	**M**	**M**							**L**		
CO2	**S**	**S**	**S**	**M**	**M**	**M**							**L**		
CO3	**S**	**S**	**S**	**M**	**M**	**M**							**L**		
CO4	**S**	**S**	**S**	**M**	**M**	**M**							**L**		
CO5	**S**	**S**	**S**	**M**	**M**	**M**							**L**		

S- Strong M-Medium L- Low

Syllabus

INTRODUCTION

Perception of quality, Taguchi's definition of quality – quality loss function, Planning of experiments, design principles, terminology, normal probability plot, Analysis of variance, Linear regression models.

FACTORIAL EXPERIMENTS

Design and analysis of single factor and multi-factor experiments, tests on means, EMS rules

SPECIAL DESIGNS
2 K Factorial designs, Fractional factorial designs, Nested designs, Blocking and Confounding.
ORTHOGONAL EXPERIMENTS
Selection of orthogonal arrays (OA’s), OA designs, conduct of OA experiments, data collection and analysis of simple experiments, Modification of orthogonal arrays
ROBUST DESIGN
Variability due to noise factors, Product and process design, Principles of robust design, objective functions in robust design - S/N ratios , Inner and outer OA experiments, optimization using S/N ratios, fraction defective analysis, case studies
Text Books:
1. Krishnaiah, K. and Shahabudeen, P. Applied Design of Experiments and Taguchi Methods, PHI learning private Ltd., 2012 2. Douglas C Montgomery, " Design and Analysis of Experiments" , John Wiley & Sons Ltd.
Reference:
1. Larry B. Barrentine, “An introduction to Design of Experiments A simplified approach”, New Age International Publishers, 2010 2. Nicolo Belavendram, “Quality by design” Taguchi techniques for Industrial experimentation, Prentice Hall.
Course Designer

S. No.	Name of the Faculty	Designation	Department / Name of the College	Mail ID
1	**Dr.D.Bubesh Kumar**	**Associate Professor**	**Mechanical/ AVIT**	**bubeshkumarmech@gmail.com**

17MESE43	MANAGEMENT FOR ENGINEERS	Category	L	T	P	C
		EC(SE)	3	0	0	3

PREAMBLE

This course reviews the statistical techniques, designing various experiments and special experiments and optimization techniques

PREREQUISITE: Nil

COURSE OBJECTIVES

1	To understand the various principles of management
2	To explore the prospects of Human resource management
3	To study the principles of production and operations management
4	To study the principles of marketing and financial management
5	To understand the basic principles of TQM

Course Outcomes

On the successful completion of the course, students will be able to

CO1: the basic concepts of management	Understand
CO2 : understand the concepts human resource management	Understand
CO3: understand the production and operations management	Understand
CO4: the concepts of marketing and financial management	Apply
CO5: the basic concepts of total quality management	Apply

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PS O1	PSO 2	PS O3
CO1	M	L	-	-	L	M							L		
CO2	M	L	-	-	L	M							L		
CO3	M	L	-	-	L	M							L		
CO4	M	L	-	-	L	M							L		
CO5	M	L	-	-	L	M							L		

S- Strong M-Medium L- Low

SYLLABUS

INTRODUCTION TO MANAGEMENT

Meaning of Management, Definitions of Management, Characteristics of Management, Management Vs. Administration. Management- Art, Science and Profession. Importance of Management. Development of

Management Thoughts. Principles of Management.

HUMAN RESOURCE MANAGEMENT

The Management Functions, Inter-Relationship of Managerial Functions, Significance of Staffing, Personnel Management, Functions of Personnel Management, Manpower Planning, Process of Manpower Planning, Recruitment, Selection, Training Methods, Communication, Performance Appraisal, Employee Retention, Social Responsibility and Ethics

PRODUCTION AND OPERATIONS MANAGEMENT

Production and Operations Management Definition, Objectives, Functions and Scope, Production Planning and Control; Its Significance, Stages In Production Planning and Control. Brief Introduction to the Concepts of Material Management, Inventory Control; Its Importance and Various Methods.

MARKETING AND FINANCIAL MANAGEMENT

Definition of Marketing, Objectives and Functions of Marketing. Marketing Research - Meaning; Definition; Objectives; Importance; Limitations; Marketing Mix, Objectives of Financial Management, Brief Introduction to the Concept of Capital Structure and Various Sources of Finance

TOTAL QUALITY MANAGEMENT

Introduction , Need for quality, Basic concepts of TQM , Contributions of Various Quality Gurus - Barriers to TQM, Quality statements, Quality Councils, Quality circles, PDCA cycle, 5S, Kaizen .

Text Books:

1. Ricky W. Griffin, *"Fundamentals of Management"*, Cengage Learning, 7th edition

2. Aswathappa, *"Human Resource Management"*, Tata McGraw-Hill Education, 6th Edition

3. Panneerselvam, *"Production and Operations Management"*, PHI Learning

Reference:

1. Ramaswamy, *"Marketing Management: Global Perspective Indian Context"*,Macmillan Publications

2.Khan and Jain, *"Financial Management"* Tata McGraw-Hill Education.

3.Dale H Besterfield, "*Total Quality Management*" Pearson Education.

Course Designer

S. No.	Name of the Faculty	Designation	Department / Name of the College	Mail ID
1	Dr.D.Bubesh Kumar	Associate Professor	Mechanical/ AVIT	bubeshkumarmech@gmail.com

17MESE44	SIX SIGMA QUALITY MANAGEMENT	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

This course provides basic knowledge of Six sigma concepts used in industries.

Prerequisite

NIL

Course Objective

1	To Study about six sigma stories, and methods of improvement of quality
2	To understand basic concept and advanced in belt technologies
3	To learn about implementation and selection of projects idea
4	To learn about project tools and design
5	To learn about the software technologies in six sigma

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Able to know about the six sigma concept, stories, and methods of quality improvement	Remember
CO2.	To understand the concepts of six sigma used in industry and belt technologies	Understand
CO3.	To apply the six sigma methodology concept in used in project selection and to know about the types of mapping	Apply
CO4.	Applying the different six sigma tools in projects	Apply
CO5.	To know about the software technologies developed in six sigma	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M												L		
CO2	M												L		
CO3	M	M	M			M							L		
CO4	M	M	M	M		M							L		
CO5	M		S	S	S	M							L		

S- Strong; M-Medium; L-Low

SYLLABUS
INTRODUCTION TO SIX SIGMA
Introduction to quality, Definition of six sigma, origin of six sigma, Six sigma concept, Critical success factors for six sigma. Six Sigma success stories. Statistical foundation and methods of quality improvement
SIX SIGMA CONCEPT
Six Sigma for manufacturing, Six Sigma for service, Understanding Six Sigma organization, Leadership council, Project sponsors and champions, Black Belt, Green Belts.
METHODOLOGIES
Methodology of Six Sigma, DMAIC, DFSS, Models of Implementation of Six Sigma, Selection of Six Sigma Projects. Selecting projects – Benefit/Effort graph, Process mapping, value stream mapping
PROJECT SELECTION FOR SIX SIGMA
Six Sigma Tools: Project Charter, Process mapping, Measurement system analysis, Hypothesis Testing, Quality Function deployment, Failure mode effect analysis, Design of Experiments
INTRODUCTION TO SOFTWARES FOR SIX SIGMA
Sustenance of Six Sigma, Communication plan, Company culture, Reinforcement and control, Introduction to softwares for Six Sigma, Understanding Minitab, Graphical analysis of Minitab plots

Text Books

1	Michael L. George, Lean Six Sigma, McGraw-Hill
2	Forrest W. Breyfogle III, Implementing Six Sigma: Smarter solutions Using Statistical Methods

Reference Books

1	Ra Geoff Tennant, Six Sigma: SPC and TQM in manufacturing and service, Gower Publishing Co
2	Greg Brue, Six Sigma for managers, TMH
3	Peter S. Pande, The Six Sigma Way, TMH Team Field book

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	Mr.S.Kalyanakumar	Asst.Prof Gr-II	Mech / AVIT	kalyanakumar@avit.ac.in
2				

17MESE45	STRATEGIC QUALITY MANAGEMENT	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble
This course is to explore the strategies in quality management

Prerequisite
NIL

Course Objective

1	To explore the basics in strategies in quality management
2	To understand the various concepts in improvement process
3	To understand the phenomenon of productivity and cost of quality
4	To study the various tools of quality
5	To explore the possibilities of team building and quality awards

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Know about the fundamental of quality and strategy in quality management	Remember
CO2.	To understand the concepts and importance of Continuous Improvement Process using some strategies	Understand
CO3.	To understand about productivity and cost of quality	Understand
CO4.	To know about bench marking and to utilize various quality control tools	Apply
CO5.	To explore the possibilities of team building and quality awards	Remember

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M												L		
CO2	M			L									L		
CO3	M				L								L		
CO4	M	M		L	S								L		
CO5	M												L		

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Quality as a Strategic Decision: Meaning of Strategy and Strategic Quality Management, Mission and Vision Statements, Quality Policy, Quality Objectives, Strategic Planning and Implementation, McKinsey 7s Model, Competitive Analysis, Management Commitment to Quality

CONTINUOUS IMPROVEMENT PROCESS

Process Concept, Meaning and Importance of Continuous Improvement Process, Elements of Continuous Improvement, Juran Trilogy, Kaizen, PDSA Cycle and Other Improvement Strategies, Business Process Reengineering

PRODUCTIVITY & COST OF QUALITY

Defining Productivity, Importance of Productivity, Productivity Factors, Workforce and Productivity, Work study for productivity, Managing Improvement, Cost of Quality, Categories of Cost of Quality, Models of Cost of Quality, Optimising Costs, Preventing Cost of Quality

BENCHMARKING & QUALITY CONTROL TOOLS

Definition of Benchmarking, Reasons for Benchmarking, Types of Benchmarking, Benchmarking Process, Advantages of Benchmarking, Limitations of Benchmarking: Check Sheet, Histogram, Pareto Chart, Cause & Effect Diagram, Scatter Diagram, Control charts.

EMPLOYEE INVOLVEMENT, TEAM BUILDING AND QUALITY AWARDS

Importance of Employee Involvement, Empowerment, Motivation &Theories of Motivation, Suggestion System, Teams in Organisations, Recognition and Rewards, Malcolm Baldrige National Quality Award, Deming Prize-categories-criteria-committee, Rajiv Gandhi National Quality Award- Eligibility requirements- Award categories- Assessment criteria, IMC Ramakrishna Bajaj National Quality Awards, Award categories, Award criteria, Quality Bodies in India, EFQM award

Text Books

1	Besterfield, DH, et.al. 2003, Total Quality Management, 3rd edn, Prentice Hall
2	Goetsch, DL & Davis, B 2006, Quality Management: Introduction to Total Quality Management for Production, Processing and Services, 5th edn, Pearson

Reference Books

1	Gryna FM 2001, Quality Planning & Analysis, 4th edn, Jr., McGraw-Hill
2	Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House,

Course Designers

S.No	**Faculty Name**	**Designation**	**Department/Name of the College**	**Email id**
1	Mr.S.Kalyanakumar	Asst.Prof Gr-II	Mech / AVIT	kalyanakumar@avit.ac.in
2				

17MESE46	WORK DESIGN AND ERGONOMICS	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

This course is designed to teach the fundamentals of Work Study and Ergonomics, which are both used in the examination of human and work in all their contexts

Prerequisite - NIL

Course Objective

1	To accurately recognize and evaluate hazards (ergonomic in nature) which are likely to cause occupational illnesses or injuries.
2	To design and redesign tasks and workstations to fit employees.
3	To apply the knowledge, skills and abilities into an industrial based problem.
4	To develop and use of human factor data
5	To understand about human body structure and functions.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	To understand accurately recognizing and evaluating hazards	Understand
CO2.	To understand and redesign of tasks and workstations to fit employees	Understand
CO3.	To sort out the skills in solving industrial based problems	Apply
CO4.	To apply the knowledge and developing to used human factor data	Apply
CO5.	To study about human body structures and functions	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO 1	PSO 2	PSO 3
CO1	S	L		L			L						L		
CO2	S	M											L		
CO3	S	S	M	M									M		L
CO4	S	S	M	M									M		M
CO5	S	M		M	M		L						L		S

S- Strong; M-Medium; L-Low

SYLLABUS	
METHOD STUDY	
Various recording techniques like outline process charts, flow process charts, man machine charts, two handed process charts. String diagram, flow diagram, multiple activity chart, simo, cyclo-graphs and chrono-cyclographs; critical examination, development, installation and maintenance of improved method	
WORK MEASUREMENT	
Introduction & definition, objectives and basic procedure of work measurement; application of work measurement in industries; Time study: basic procedure, equipment needed and methods of measuring time, selection of jobs, breaking a job into elements; numbers of cycles to be timed.	
JOB EVALUATION AND INCENTIVE SCHEMES	
Starlight line, Tailor, Merrick and Gantt incentive plans. Standard data system; elemental & non-elemental predetermined motion system, work factors system Methods Time Measurement (MTM), MOST	
HUMAN FACTOR ENGINEERING	
Definition and history of development of human factors engineering, Types & characteristics of man-machine-system. Relative capabilities of human being and machines; development and use of human factor data; information input and processing.	
HUMAN PHYSICAL DIMENSION CONCERN	
Human body- structure and function, anthropometrics. Anthropometry: body growth and somatotypes. Static and dynamic anthropometry, Stand Posture, Anthropometry landmark: Sitting postures, squatting and cross-legged postures	
Text Books	
1	M. P. Goover, Work Systems and the Methods, Measurement and Management of Work, Pearson Prentice Hall
2	Khan MI; Industrial Ergonomics; PHI Learning
Reference Books	
1	B. Niebel and Freivalds, Methods standards and Work Design, McGraw-Hill, 2003
2	Sandera M and Mc Cormick E; Human Factors in Engg and design; MGHill
3	Currie RM; Work study; BIM publications

Course Designers

S. No	Faculty Name	Designation	Department/Name of the College	Email id
1	N. Fedal Castro	Asst. Prof	Mechanical / AVIT	fedal@avit.ac.in

ELECTIVE COURSES

SPECIALIZATION – MANUFACTURING ENGINEERING

17MESE16	INDUSTRIAL TRIBOLOGY	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

To present the engineering concepts of friction, its effects and different lubrication theories and types used in industries.

Prerequisite NIL

Course Objective

1	To understand the concept of tribology.
2	To learn about the various types of wear
3	To understand the film lubrication theory
4	To learn about the various types of lubricants
5	To understand the various surface engineering and bearing materials.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Gain the knowledge and concepts of tribology in industrial scenario	Understand
CO2.	Know about the various types of wear and wear mechanism	Remember
CO3.	Understand about the various film lubrication theory	Understand
CO4.	Gain the knowledge about the various types of lubricants	Remember
CO5.	Understand the various surface engineering and bearing materials.	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M					L						L	L		
CO2	M	M			M	L						M	L		
CO3	M	M	L			L						M	L		
CO4	M					L						M	L		
CO5	M	M	L		M	L						M	L		

S- Strong; M-Medium; L-Low

SYLLABUS

SURFACES AND FRICTION

Introduction to the concept of tribology, Tribological problems- Nature of engineering surfaces, Surface topography- Surface profilometer, measurement of surface topography-Contact between surfaces, Sources of sliding Friction- Friction due to ploughing, Friction due to adhesion- Friction characteristics of metals and non-metals -Sources of rolling friction, Stick slip motion -Friction of ceramic materials and polymers-Measurement of friction.

WEAR

Wear and Types of Wear-Simple theory of sliding wear mechanism-Abrasive wear-Adhesive wear-Corrosive wear-Surface fatigue wear situations-Wear of ceramics-Wear of polymers-Wear measurements.

FILM LUBRICATION THEORY

Coefficient of viscosity, Fluid film in simple shear-Viscous flow between very close parallel plates:Tutorials-Lubricant supply, Lubricant flow rate-Cold jacking,Couette flow-Cavitations, Film rupture, oil whirl-Shear stress variation within the film-Lubrication theory by Osborne Reynolds: Tutorials-Pressure fields for full sommerfeld, Half sommerfeld-Reynolds boundary conditions.

LUBRICANTS AND LUBRICATION TYPES

Types of Lubricants-Properties of Lubricants-Testing methods-Hydrodynamic Lubrication-Elasto-hydrodynamic Lubrication-Hydrostatic lubrication

SURFACE ENGINEERING AND MATERIALS FOR BEARINGS

Classification of Surface modifications and Surface coatings-Surface modifications, Transformation hardening-Surface modifications, surface fusion-Thermo chemical Processes-Surface coatings -Materials for rolling element bearings- Materials for fluid film bearings-Materials for marginally lubricated and dry bearings.

Text Books

1	Bearing Tribology: priniciples and applications.
2	Williams.J.A, “Engineering Tribology”, Oxford University Press.
3	GwidonStachowiak, Andrew W Batchelor., “Engineering tribology”, Elsevier Butterworth – Heinemann, USA.

Reference Books

1	Industrial Tribology: Tribosystems, Friction, Wear and Surface Engineering, Lubrication Hardcover , by Theo Mang, Kirsten Bobzin, Thorsten Bartels
2	Cameron.A, “Basic Lubrication Theory”, Longman, U.K.
3	Neale.M.J. (Editor), “Tribology Handbook”, Newnes Butter worth, Heinemann, U.K.

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	M.SARAVANAN	ASST. PROF	MECH./ AVIT	saravanan@avit.ac.in

17MESE17	MODERN MANUFACTURING METHODS	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

This course aims to teach the physics, modelling, and mathematical inferences of variousadvanced manufacturing processes used in industries for making products. Thestudents will get complete knowledge of the unconventional processes in termsof aspects stated above.

Prerequisite - NIL

Course Objective

1	To discuss the basic concepts various unconventional machining processes
2	To Demonstrate the Mechanical energy basedunconventional machining processes.
3	To Demonstrate the Electrical energy based unconventional machining processes.
4	To Demonstrate the Chemical & Electro-Chemical energy basedunconventional machining processes.
5	To Demonstrate the Thermal energy based unconventional machining processes.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Discuss the basic concepts various unconventional machining processes	Understand
CO2.	Demonstrate the Mechanical energy based unconventional machining processes.	Apply
CO3.	Demonstrate the Electrical energy based unconventional machining processes.	Apply
CO4.	Demonstrate the Chemical & Electro-Chemical energy based unconventional machining processes.	Apply
CO5.	Demonstrate the Thermal energy based unconventional machining processes.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	M	L	-	-	-	M	S	-	-	-	-	M	M	-	M
CO2	M	L	-	-	-	M	S	-	-	-	-	M	M	-	M
CO3	M	L	-	-	-	M	S	-	-	-	-	M	M	-	M
CO4	M	L	-	-	-	M	S	-	-	-	-	M	M	-	M
CO5	M	L	-	-	-	M	S	-	-	-	-	M	M	-	M

S- Strong; M-Medium; L-Low

SYLLABUS
INTRODUCTION
Unconventional machining Process – Need – classification – Brief overview–merits –demerits–Applications
MECHANICAL ENERGY BASED PROCESSES
Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining - Ultrasonic Machining. Working Principles & Applications – equipment used – process parameters – MRR - Variation in techniques used.
ELECTRICAL ENERGY BASED PROCESSES
Electric Discharge Machining - working principle and applications – equipments - process parameters - surface finish and MRR- Power and control circuits–Wire cut EDM – working principle and Applications.
CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES
Chemical machining and Electro-Chemical Machining- Electro Chemical Grinding and Electro chemical Honing-working principle and applications-Process Parameters -Surface finish and MRR -Etchants–Maskants
THERMAL ENERGY BASED PROCESSES
Laser Beam Machining and drilling, Plasma Arc Machining and Electron Beam Machining Working principles & Applications – Equipment –Types - Beam control techniques. Micromachining and Nanofabrication Techniques

Text Books	
1	Vijay.K. Jain "Advanced Machining Processes" Allied Publishers Pvt. Ltd.
2	P.K.Mishra , " Non Conventional Machining "- - The Institution of Engineers (India) Text Books: Series.

Reference Books	
1	Benedict. G.F. "Nontraditional Manufacturing Processes" Marcel Dekker Inc., NewYork
2	Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw-Hill, New Delhi.
3	Paul De Garmo, J.T.Black, and Ronald.A.Kohser, "Material and Processes in Manufacturing" Prentice Hall of India Pvt. Ltd., New Delhi, 8th Edition.

Course Designers

S.No	**Faculty Name**	**Designation**	**Department/Name of the College**	**Email id**
1	S.PRAKASH	Assistant Professor (Gr-II)	Mech / AVIT	prakash@avit.ac.in
2				

17MESE18	METAL FORMING AND JOINING PROCESS	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

This course aims to provide the basic knowledge on plasticity taught in mechanical metallurgy is extended to theory and applications of metal forming. Various metal forming processes and their analysis are studied in detail and also the students can understand the process used and the allied welding metallurgy in order to make a successful weld.

Prerequisite

NIL

Course Objective

1	To Acquire basic knowledge on fundamentals of metal forming
2	To Understand the various forming processes and its application
3	To Acquire basic knowledge on metal joining processes
4	To Understand the various metal joining processes and its application
5	To Understand the welding of alloy steels and non-ferrous metals

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Explain basic knowledge on fundamentals of metal forming	Apply
CO2.	Explain the various forming processes and its application	Understand
CO3.	Explain basic knowledge on metal joining processes	Apply
CO4.	Explain the various metal joining processes and its application	Understand
CO5.	Explainthe welding of alloy steels and non-ferrous metals	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	L	M	S	S							S		
CO2	S	S	M	L	S	M							M		
CO3	S	M	M	M	S	S							M		
CO4	S	M	L	L	S	S							S		
CO5	S	M	L	L	S	S							L		

S- Strong; M-Medium; L-Low

SYLLABUS

FUNDAMENTALS OF METAL FORMING

Fundamentals of metal forming- Effect of temperatures, speed and metallurgical microstructure on forming processes - Mechanics of Metal Forming.
Yield criteria for ductile metals - Flow theories – strain hardening – recrystallization.

METAL FORMING PROCESSES

Forging Processes Forging Equipment, Forging defects - Types of Rolling mill – processvariables – defects. Types of extrusion - Process variables - Wire drawing - Drawing and Deep drawing – Sheet metal working . High energy rate forming processes..

FUNDAMENTALS OF METAL JOINING

Classification of welding processes: Arc welding power sources, power source characteristiccurves, flux covering, different types of electrodes and their applications, gas welding andcutting, flame characteristics

METAL JOINING PROCESSES

Gas tungsten arc welding process, electrode polarity, shielding gas, use of pulsed arc welding process; gas metal arc welding, mode of metal transfers, pulsed MIG welding process. Submerged arc welding, advantages and limitations. Orbital welding of tubes / pipes; Plasma-arc welding process, transferred and non- transferred arc welding and their applications, plasma cutting, surfacing and applications Working Principle of resistance welding process-spot, seam, projection, upset and flash butt Welding, electro slag and electro gas welding.
Radiant energy welding processes - equipment -electron beam welding (EBW) - laser beam Welding (LBW) - applications of EBW and LBW- Friction Steel Welding.

WELDING OF ALLOY STEELS AND NON-FERROUS METALS

Welding of stainless steels, types of stainless steels, overview of joining ferritic and martensitic types, welding of austenitic stainless steels, Sensitisation, hot cracking, sigma phase andchromium carbide formation, ways of overcoming these difficulties, welding of cast iron.Welding of non-ferrous materials: Joining of aluminium, copper, nickel and titanium alloys,problems encountered and solutions. Defects in welding. Introduction to International Standards and Codes

Text Books

1. Narayanasamy,R., “Metal forming technology”2nd Edition, Ahuja Pub.
2. R. S.Parmar, “Welding Engineering and Technology” 2nd edition M/s. Khanna Publishers.

Reference Books

1. George E.Dieter , “Mechanical Metallurgy”,1 edition McGraw Hill book Co.- Koga,.
2. William F Hosford and Robert M Caddell“ Metal Forming Mechanics and Metallurgy” Third Edition, Cambridge University Press.
3. ASM Handbook on Forming and Forging, Vol.14, 9thEdition ,ASM International
4. BaldevRaj,ShankarV,Bhaduri A K“.Welding Technology for Engineers” Narosa Publications.
5. “AWS Welding Hand book”, 9th edition, Vol-1,“Welding Science and Technology”.
6. Nadkarni S.V., „Modern Arc Welding Technology‟, 1st Edition, IBH Publishing.
7. Kearns W. H, „Welding Hand Book (Welding Processes)‟, Volume II and III, 7thEdition,AWS.

Course Designers

S.No	Faculty Name	Designation	Department/ Name of the College	Email id
1	S.ASHOKKUMAR	Asst.Professor G-II	Mech / Avit	Ashokkumar@avit.ac.in

17MESE19	PROCESS PLANNING AND COST ESTI MATION	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

PREAMBLE

This course reviews the various steps involved in process planning concepts and cost estimation for various products after process planning.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To know about Work study, Ergonomics
2	To understand about process planning and its approaches.
3	To know about elements of cost estimation.
4	To understand various Cost Estimation methods.
5	To calculate the total production cost estimation.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Understand the work study and ergonomics.	Understand
CO2. Identify the steps involved in process planning.	Apply
CO3. Identity the various elements of cost estimation.	Apply
CO4. Apply the various cost estimation methods in production.	Apply
CO5. Calculate the cost estimation of various jobs involved in production.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO 1	PO 2	PO 3	PO4	PO 5	PO6	PO 7	PO8	PO 9	PO1 0	PO11	PO1 2	PSO1	PSO2	PSO3
CO1	M	---	---	----	----	----							L		
CO2	M	M	L	---	---	----							L		
CO3	M	---	M	---	---	L							L		
CO4	M	L	L	L	---	L							L		
CO5	M	M	L	L	---	L							L		

S- Strong; M-Medium; L-Low

SYLLABUS

WORK STUDY AND ERGONOMICS:
Method study – Definition – Objectives-Motion economy- Principles – Tools and Techniques-Applications – Work measurements- purpose – use – procedure – tools and techniques- Standard time –Ergonomics –principles – applications.

PROCESS PLANNING :
Definition – Objective – Scope – approaches to process planning- Process planning activities – Finished part requirements operating sequencesmachine selection material selection parameters- Set of documents for process planning Developing manufacturing logic and knowledge production time calculation – selection of cost optimal processes.

INTRODUCTION TO COST ESTIMATION:
Objective of cost estimation- costing – cost accounting- classification of cost-Elements of cost.

COST ESTIMATION:
Types of estimates – methods of estimates – data requirements and sources- collection of cost- allowances in estimation.

PRODUCTION COST ESTIMATION
Estimation of material cost, labour cost and over heads, allocation of overheads – Estimation for different types of jobs

TEXT BOOKS:

1. Sinha.B.P., "Mechanical Estimating and Costing", Tata McGraw-Hill, Publishing Co.2002

REFERENCES:

2. Russell.R.S and Tailor, B.W, "Operations Management", PHI, 4th Edition.
3. Chitale.A.V. and Gupta.R.C., "Product Design and Manufacturing", PHI, 2nd Edition.

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department / Name of the College	Mail ID
1	G.ANTONY CASMIR	Asst. Prof. - II	Mechanical, AVIT	antonycasmir@avit.ac.in

17MESE20	RAPID PROTOTYPING AND TOOLING	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

PREAMBLE

The student will understand in detail about the various Rapid Prototyping Process and its applications

PREREQUISITE: NIL

COURSE OBJECTIVES

1	Identify suitable time compression techniques for rapid product development.
2	Model complex engineering products and develop process plans for rapid production.
3	Analyze and select a rapid manufacturing technology for a given component.
4	Identify the errors during generation of STL files and minimize them.
5	Optimize FDM process parameters to improve the quality of the parts.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1.	Understand the working principle and various RPT techniquies.	Understand
CO2.	Understand the working principle of liquid ,solid based process methods.	Understand
CO3.	Understand the working principle of powder based process methods.	Understand
CO4.	Design tooling and mouldingdevices for RPTl machining operations.	Apply
CO5.	Gain application oriented knowledge related to RPT application process	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	S	L	--	--	-						L		
CO2	S	M	S	L	-M	--	-L						L		
CO3	S	M	M	L	-M	--	-L						L		
CO4	S	S	S	M	M	--	M						L		
CO5	S	S	S	M	M	--	--						L		

S- Strong; M-Medium; L-Low

Syllabus
INTRODUCTION History – Development of RP systems – RP process chain - Impact of Rapid Prototyping on Product Development –Digital prototyping - Virtual prototyping-Rapid Manufacturing- Principle – Fundamental – File format – Other translators-Data Processing for Rapid Prototyping: CAD model preparation, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation.
LIQUID AND SOLID BASED PROCESS: Classification – Liquid based system – Stereolithography Apparatus (SLA)-Solid Ground Curing (SGC)-products, Advantages, Limitations, Applications and Uses. Solid based system – Fused Deposition Modeling-Laminated Object Manufacturing-Multi Jet Modeling Sysytem-principle, process, products, advantages, applications and uses
POWDER BASED PROCESS Selective Laser Sintering – Three Dimensional Printing – Direct shell production casting –Laser Engineered Net Shaping (LENS)- -Direct Metal Deposition-Principle-Materials-process- products,-advantages- limitations-applications
RAPID TOOLING Introduction-Need-Types -Advatages-Applications-Indirect rapid Tooling-silicone Rubber Tooling-Spray metal tooling-RSP Tooling-Reaction Injection Moulding-Direct Rapid Toling-Direct AIM-DMLS-Copper Polyamide-Laminated Tooling
REVERSE ENGINEERING Introduction-concept of Reverse Engineering - Generic Process - Scanning-measuring device- contact type and non-contact type -Point Processing- CAD model creation from point clouds-preprocessing, point clouds to surface model creation, medical data processing – types of medical imaging, software for making medical models, medical materials, other applications
TEXT BOOKS:
1. Rafiq I. Noorani, Rapid Prototyping, “Principles and Applications”, Wiley & Sons, 2006. 2. Chua C.K, Leong K.F and Lim C.S, “Rapid Prototyping: Principles and Applications”, Second Edition, World Scientific, 2003.
REFERENCES:
1. N.Hopkinson, R.J.M, Hauge, P M, Dickens, “Rapid Manufacturing – An Industrial revolution for the digital age”, Wiley, 2006 2. Ian Gibson, “Advanced Manufacturing Technology for Medical applications: Reverse Engineering, Software conversion and Rapid Prototying”, Wiley, 2006 3.Paul F.Jacobs, “Rapid Prototyping and Manufacturing : Fundamentals of Stereolithography”, McGraw Hill 1993. 4.Pham. D.T., and Dimov. S.S., “Rapid Manufacturing”, Springer Verlog 2001.

S.No	**Name of the Faculty**	**Designation**	**Department / Name of the College**	**Mail ID**
1	SAMUVEL MICHAEL	Asso.Prof	MECH/AVIT	samuvelmichael@avit.ac.in

17MESE21	IRON AND STEEL MAKING	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

PREAMBLE

This course aims tounderstand the process of production of iron and steel from raw material, primary processing to refinement to special steels The student will understand the kinetics involved in the production of iron and steel. The student also gains knowledge on the refinement of steels to obtain a quality product.

PREREQUISITE- NIL

COURSE OBJECTIVES

1	Acquire the knowledge of raw materials and burden preparation
2	Understand the principles and processes of iron making
3	Understand the principles and processes of steel making
4	Acquire knowledge on various steel making processes
5	Understand and gain knowledge on production practice followed and recent development

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Understand the problems associated with Indian raw materials and burden preparation.	Understand
CO2. Understand and apply the extraction techniques of pig iron by reduction and smelting in blast furnace from iron ores.	Apply
CO3. Understand the principles and need for development of steel making processes	Understand
CO4.Acquire knowledge on various furnaces for steel manufacturing and select suitable furnaces.	Apply
CO5. Apply the modern development in the steel and cast iron making production practice	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	S	-	-	M	L	M						L		
CO2	S	S	L	-	M	-	M						L		
CO3	L	M	M	-	-	M	S						L		
CO4	S	L	-	-	M	-	M						L		
CO5	S	M	M	-	-	-	M						L		

S- Strong; M-Medium; L-Low

SYLLABUS

RAW MATERIALS AND BURDEN PREPARATION

Iron ore classification, Indian iron ores, limestone and coking coal deposits, problems associated with Indian raw materials, Iron ore beneficiation and agglomeration, Briquetting, sintering, Nodulising and pelletizing, testing of burden materials, burden distribution on blast furnace performance.

PRINCIPLES AND PROCESSES OF IRON MAKING

Blast furnace parts, construction and design aspects, ancillary equipment for charging, preheating the blast, hot blast stoves, gas cleaning, Blast furnace operation, irregularities and remedies, Blast furnace instrumentation and control of furnace Compositional control of metal and slag in blast furnace, modern trends in blast furnace practice. Reduction of iron ores and oxides of iron by solid and gaseous reductions-thermodynamics and kinetics studyof direct and indirect reduction, Gruner's theorem, blast furnace reactions. C-O and Fe-C-O equilibria, Rist diagrams, Ellingham diagram, material and heat balance- Sponge Iron making.

PRINCIPLES OF STEEL MAKING

Development of steel making processes, physico-chemical principles and kinetic aspects of steel making, carbon boil, oxygen transport mechanism, desulphurisation, dephosphorisation, Slag Theories, slag-functions, composition, properties and theories, raw materials for steel making and plant layout

STEEL MAKING PROCESSES

Open Hearth process- constructional features, process types, operation, modified processes, Duplexing, pre-treatment of hot metal. Bessemer processes, Side Blown Converter, Top Blown processes-L.D, L.D.A.C., Bottom blown processes, combined blown processes, Rotating oxygen processes-Kaldo and Rotor, Modern trends in oxygen steel making processes-Electric Arc and Induction furnace-constructional features. Steel Classifications and Standards-National and International.- Alloy Designation.

STEELS AND CAST IRON LADLE METALLURGY

Production practice for plain carbon steels, low alloy – Cast irons and ductile iron, stainless, tool and special steels, modern developments. Secondary steel making processes,continuous steel casting process – Deoxidation and teeming practice. Principle, methodsand their comparison, Killed, Rimmed and Capped steels, Degassing practices, ingotproduction, ingot defects and remedies. Recent trends in steel making technology.

Text Books:

1. Tupkary, R. H., "Modern Iron Making", 4th edition, Khanna Publishers, New Delhi.
2. Tupkary, R. H., "Modern Steel Making", 4th Edition, Khanna Publications, New Delhi.

Reference:

1. Biswas, A. K., "Principles of blast furnace iron making: theory and practice", SBA Publications, Kolkata.
2. Bashforth, G. R., "Manufacture of Iron and Steel", Vol. I, Chapman and Hall London.
3. Bashforth, G. R., "Manufacture of Iron and Steel", Vol.2, 3rd Edition, Chapman & Hall, London.
4. "Making, Shaping and Treating of Steel", US Steel Corporation, 11th edition.
5. AhindraGhosh and Amitchatterjee, "Iron Making and Steel Making – Theory and Practice", Prentice Hall of India Private Ltd., New Delhi.

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department / Name of the College	Mail ID
1	S.Arunkumar	Assistant Professor	Mech/VMKVEC	

17MESE22	AUTOMOTIVE INFOTRONICS	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

To study and understand about the automotive Infotronics used in the automobiles

Prerequisite NIL

Course Objective

1	To Study About The Vehicle Control And Vehicle Monitoring
2	To study about the positioning and navigation system
3	To understand about the warning and detection system
4	To study about the comfort systems in automobiles
5	To study about the security and smart card system..

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Understand the vehicle motion control and stabilization system	Understand
CO2.	Know the importance of Driver assistance, security and warning system	Analyze
CO3.	Gain the knowledge of Safety and comfort system	Understand
CO4.	Understand the various safety concepts used in passenger cars.	Understand
CO5.	Understand the basics of vehicle collision and its effects.	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	L									L		
CO2	S	S	S	S						S			L		
CO3	S	M	L												
CO4	S	M	L												
CO5	S	S	M	L								L	L		

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Driver information, driver perception, driver convenience, driver monitoring, general vehicle control, longitudinal and lateral control, collision avoidance and vehicle monitoring.

TELEMATICS

Global positioning system, geographical information systems, navigation system, architecture, automotive vision system and road recognition.

COLLISION WARNING AND AVOIDANCE

Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system interactions.

COMFORTSYSTEMS

Adaptive cruise control system, adaptive noise control, active suspension system, power steering, collapsible and tiltable steering column and power windows, Adaptive lighting system

SECURITYSYSTEMS

Antitheft technologies–mechanical, electromechanical and electronic immobilizers, alarm system, stolen vehicle tracking system, remote keyless entry, smart card system and number plate coding..

Text Books

1	LjuboVlacic,MichelParentandFumioHarashima,“IntelligentVehicleTechnologies”,Butterworth-Heinemannpublications,Oxford,
2	RobertBosch, “AutomotiveHandBook”,SAE
3	RonaldKJurgen, “Navigation and Intelligent Transportation Systems ProgressinTechnology”,AutomotiveElectronicsSeries,SAE,USA,

Reference Books

1	WilliamBR,“UnderstandingAutomotiveElectronics”,ButterworthHeinemannWoburn,
2	Bechhold,“UnderstandingAutomotiveElectronics”,SAE,
3	AllanWMB, “AutomotiveComputerControlledSystems”,Elsevier Butterworth-Heinemann,2011.

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	M.SARAVANA KUMAR	ASST. PROF GRII	MECH./ AVIT	saravanakumar@avit.ac.in

17MESE23	MICRO AND NANO MACHINING	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

To present the basics of micro and nano machining technology and its applications

Prerequisite

NIL

Course Objective

1	To teach students fundamental as well as advanced knowledge of Micro Nano machining technology.
2	To teach students the basic principles and mechanism of Traditional Micro Nano machining and its applications.
3	To teach students the basic principles and applications of Advanced Micro Nano Machining.
4	To teach students the basic principles and applications of different Abrasive based Micro Nano Machining.
5	To teach students fundaments of MEMS and its techniques.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Understand the basic need of Micro Nano Machining in different industries	Understand
CO2.	Demonstrate and understand the Traditional Micro Nano machiningtechniques	Understand
CO3.	Demonstrate and Understand different mechanisms in Advanced Micro Nano machining	Analyze
CO4.	Understand the importance of Abrasives in Micro Nano Machining	Apply
CO5.	Understand the need of MEMS in Micro Nano Machining	Analyze
CO6.	To develop and exploit ì-/Nano machining capabilities in order to diversify and improve manufacturing technology in the region.	Create

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	S	M	L	-	-	-	-	-	-	-	-	-	M	-	-
CO4	S	M	L	-	-	-	-	-	-	-	-	-	-	-	-
CO5	S	M	L	-	-	-	-	-	-	-	-	-	-	-	-
CO6	S	S	S	S	S	M	M	-	S	S	-	-	S	M	S

S- Strong; M-Medium; L-Low

SYLLABUS				
INTRODUCTION TO NANO MACHINING				
Need-evolution- fundamentals and trends in micro and nano technologies-Consequences of the technology and society-challenges to manufacturing technology-evolution of precision in manufacturing, tooling and current scenario- Micro Nano materials, fabrication tools, requirements and applications.				
TRADITIONAL NANO MACHINING				
Theory of micromachining – Chip formation – Size effect in micromachining – Microturning-Micromilling-Microdrilling-Micromachining tool design – Precision Grinding – Partial ductile mode grinding – Ultraprecision grinding.				
ADVANCED MICRO NANO MACHINING				
Introduction-Classification- Mechanical Micromachining (AJM, USM)- Thermal Micromachining (EDM, LBM, EBM)-Electrochemical and Chemical Micromachining-Ion Beam Machining-Photochemical Etching				
ABRASIVE BASED MICRO NANO MACHINING				
Abrasive Flow Finishing (AFF)-Magnetic Abrasive Finishing (MAF)-Magnetorheological Finishing-Magnetorheological Abrasive Flow Finishing-Elastic Emission Machining (EEM) and Magnetic Float Polishing				
MEMS				
Introduction to MEMS, Definitions and classifications-History-applications-MEMS Market-Bulk Micromachining- Wet and Dry Etching-Surface Micromachining-Chemical-Vapor Deposition-Lithography-Wafer Bonding.				
Text Books:				
1	V.K.Jain, Introduction to Micromachining, Narosa publishing House, New Delhi.			
2	Tai-Ran Hsu, “MEMS and Microsystems: Design and Manufacture,” McGraw- Hill, 2008.			
Reference Books:				
1	J. Paulo Davim, Mark J. Jackson (2009) Nano and Micromachining, John Wiley & Sons.			
2	V. K. Jain (2012), Micromanufacturing Processes, CRC Press.			
3	Mohamed Gad-el-Hak (2010) MEMS Introduction and Fundamentals, CRC Press.			
Course Designers				
Sl.No	**Faculty Name**	**Designation**	**Department/Name of the College**	**Email id**
1	B.SELVA BABU	Assistant Professor	Mech / AVIT	selvababu@avit.ac.in

ELECTIVE COURSES

SPECIALIZATION – MATERIALS ENGINEERING

17MESE32	COMPOSITE MATERIALS	Category	L	T	P	C
		EC(SE)	3	0	0	3

PREAMBLE

This course reviews the various composite materials their processing techniques and their behaviors , and to develop models and their applications in aerospace, automotive and medical fields

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To study about Fibre reinforced Plastics
2	To study the manufacturing processes of the composite materials
3	To study about macro mechanical behavior of FRP
4	To study about micromechanical behavior of composite materials
5	To study about material models of composites

COURSE OUTCOMES

On the successful completion of the course, students will be able to

Know the types of reinforcements and fibers used in composite materials	Understand
CO2. Know the various manufacturing techniques in composite manufacturing	Understand
CO3. Able to test the macro mechanical behavior of Fiber Reinforced Plastics	Analyze
CO4. Able to test the Micro mechanical behavior of Fiber reinforced plastics	Analyze
CO5. Make models for solving the composite material manufacturing	Apply

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**S**	-	**L**	-	-	**M**	**S**	-	-	-	-	-	**L**		
CO2	**S**	-	**L**	-	-	**L**	**S**	-	-	-	-	-	**L**		
CO3	**S**	**S**	**S**	**S**	**L**	**L**	**S**	-	-	-	-	-	**L**		
CO4	**S**	**S**	**S**	**S**	**L**	**L**	**S**	-	-	-	-	-	**L**		
CO5	**S**	**S**	**S**	**S**	**S**	**L**	-	-	-	-	-	-	**L**		

S- Strong M-Medium L- Low

Syllabus

FIBRE REINFORCED PLASTICS (FRP)

Definition; Types; General properties and characteristics; Reinforcing materials – particles, fibers, whiskers; Properties of reinforcing materials; Matrix materials; Additives; Properties of FRP materials; Applications

MANUFACTURING PROCESSES

Open mold processes – Hand layup, Spray up, Vacuum bag, Pressure bag & autoclave, Centrifugal casting,Filament winding; Closed mold processes – Compression molding, Resin transfer molding (RTM), Injection molding, Pultrusion; SMC & DMC products, etc.

MACROMECHANICAL BEHAVIOR OF FIBRE REINFORCED PLASTICS

Design variables; Selection of fiber-matrix and manufacturing process; Effects of mechanical, thermal, electrical and environmental properties, Fiber orientation, Symmetric and asymmetric structure; Effects of unidirectional continuous and short fibers; Lamination theory; Failure theories.

MICROMECHANICAL BEHAVIOR OF FIBRE REINFORCED PLASTICS

Strengthening methods, Elasticity of fibre composites, Plasticity and fracture of composites, Crack propagation in fibre composites, Failure under compressive loads.

MATERIAL MODELS

Law of Mixtures, Shear lag model,Laminated plate model, Eshelby's models, Other models.

Text Books:

1. Haslehurst.S.E., "Manufacturing Technology ", ELBS, London.
2. Krishnan K. Chawle. "Composite Material: Science and Engineering" Second Edition, Springer.

Reference:

1.. T.W.Clyne, P.J. Withers, "An Introduction to metal matrix composites", Cambridge University Press.
2. F.C. Campbell "Structural Composite Materials", Materials Park,ASM International,2010

Course Designers

S. No.	Name of the Faculty	Designation	Department / Name of the College	Mail ID
1	Dr.D.Bubesh Kumar	Associate Professor	Mechanical/ AVIT	bubeshkumarmech@gmail.com

17MESE33	EMERGING MATERIALS	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble
The aim of the subject is to make students understand the properties, processing, manufacturing of various emerging materials and their applications

Prerequisite - NIL

Course Objective

1	To understand the classification of Engineering Materials and their relevant applications.
2	To understand the powder metallurgy concepts, process techniques, applications.
3	To understand the basics in composites, fabrication methods, types and applications.
4	To understand the various forms of Smart Materials, applications.
5	To understand the various types of Nano-material's, production & applications.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	To understand classification of Materials and its applications.
CO2.	Know the concepts of powder Metallurgy and its techniques.
CO3.	To know the different types of composites.
CO4.	To understand the concepts of Smart Materials
CO5.	To obtain the knowledge of Nano Materials and its applications

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO 1	PSO 2	PSO 3
CO1	S	L	L	L	M	M							L		
CO2	S	L	L	L	M	M							L		
CO3	S	L	M	M	M	L							L		
CO4	S	L	M	L	M	M							L		
CO5	S	L	S	M	M	M							L		

S- Strong; M-Medium; L-Low

SYLLABUS

ENGINEERING MATERIALS – CONVENTIONAL Classification of engineering materials- Metallic materials-ferrous materials-steel & cast iron and non ferrous materials – aluminium and copper. Non-Metallic materials – glasses , ceramics ,Polymer and plastics – their characteristics and unique properties- Material for structural applications - Light weight structural materials for automobiles and aero plane applications .

POWDER METALLURGY – POWDER SYNTHESIS
Powder Metallurgy – Near net shaping process methods and principles - chemical methods – electro-chemical methods - atomization – mechanical alloying – rapid solidification – processing – Nano size powders. Powder physical and chemical characterization – process characteristics - Applications.

COMPOSITE MATERIALS
Composites – Types of composites - Naturally occurring, synthetic & engineered composites - MMC – CMC – PMC - Fibre and whisker reinforced composites (continuous and discontinuous) - particulate composites layered or sheet composites, composite coating or thin fibre, inter metallic composites - properties and characteristics of composites

SMART MATERIALS
Introduction to intelligent/smart materials, shape memory alloys-types, NiTiNol-origin, properties, martensitic transformation, Memorization process- applications-medical, satellite etc

NANO MATERIALS
Nanomaterials-Definition, Classification of Nanostructured materials, causes of interest in nanomaterials, applications of nanomaterials. Processes for producing ultrafine powders-mechanical grinding, wet chemical synthesis of nanomaterials. Gas phase synthesis of Nano materials, gas condensation processes, chemical vapour condensation, laser ablation

TEXT BOOKS

1. 11. Budinski, Kenneth G, Budinski, Michael K, Engineering Materials: Properties and Selection, 9th Edition, PHI.
2. M.V.Gandhi., Thomson - Smart Materials and Structures- Chapman and Hall.
3. A.K.Bandhopadyay-Nanomaterials-New Age

Reference Books

1. 1. 1. Srinivasan.K, Composite Materials, Narosa Publishing House.
2. Ramesh, Nanomaterials: Mechanics and Mechanisms, Springer Verlag, EPZ, Paperback edition.
3. Angelo P.C., Subramanian R., Powder Metallurgy, Science, Technology and Applications, Prentice Hall of India

Course Designers

S.No	Faculty Name	Designation	Department/ Name of the College	Email id
1	C.THIAGARAJAN	ASSISTANT PROFESSOR (GRADE-II)	Mechanical/AVIT	cthiagarajan@avit.acc.in

17MESE34	FAILURE ANALYSIS OF MATERIALS	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

This course covers failures of materials and causes of failure, topics include types of failure in components and equipments for failure analysis.

Prerequisite

NIL

Course Objective

1	To study the fundamentals of failure analysis
2	To study introduction to failure analysis
3	To study the causes of failure in components
4	To study the types of failure in components
5	To study the methods and equipments for failure analysis

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Apply the importance of failure analysis for automotive components and Determination of failure mode.	Apply
CO2.	Identify the failure mode identification methods andCorrosion failures.	Understand
CO3.	Describe thecauses of failure in components.	Understand
CO4.	Discuss the types of failures in components.	Understand
CO5.	Indentify the methods and equipments for failure analysis.	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO 1	PSO 2	PSO 3
CO1	S	M	M	-	-	M	-	-	-	-	-	-	L	-	-
CO2	S	M	M	-	-	L	-	-	-	-	-	-	L	-	-
CO3	S	M	M	-	-	M	-	-	-	-	-	-	L	-	-
CO4	S	L	L	-	-	L	-	-	-	-	-	-	L	-	-
CO5	S	M	M	-	-	L	-	-	-	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS				
FUNDAMENTALS OF FAILURE ANALYSIS				
Importance of failure analysis for automotive components, Steps in typical failure analysis: Collection ofbackground data (review documentation and speak with appropriate individuals), Selection of failed andunfailed samples for examination, Preliminary examination of the failed part, Non-destructive evaluation, Mechanical testing, Macroscopic examination and analysis, Microscopic examination and analysis,Determination of failure mode, Chemical analysis, Fracture mechanics considerations, Full scale testing under service conditions, Analysis of the evidence, Formulation of conclusions, Recommendations toprevent reoccurrence, Sample preparation methods for failure analysis, Selection of locations/samples forfailure analysis.				
INTRODUCTION TO FAILURE ANALYSIS				
Failure mode identification methods, Failure mechanisms: Fatigue failures, fractography, effect of variables: part shape, type of loading, stress concentration, metallurgical factors, etc. Wear failures, adhesive, abrasive, erosive, corrosive wear. Corrosion failures, types of corrosion: uniform, pitting, selective leaching, intergranular, crevice, etc. Elevated temperature failures, creep, thermal fatigue, micro structural instability, and oxidation.				
CAUSES OF FAILURE IN COMPONENTS				
Misuse or Abuse, Assembly errors, Manufacturing defects, Improper maintenance, Fastener failure, Design errors, Improper material, Improper heat treatments, Unforeseen operating conditions, Inadequate quality assurance, Inadequate environmental protection/control, Casting discontinuities. Data compilation and identification of root cause.				
TYPES OF FAILURES IN COMPONENTS				
Fatigue failures, Corrosion failures, Stress corrosion cracking, Ductile and brittle fractures, Hydrogen embrittlement, Liquid metal embrittlement, Creep and stress rupture.				
METHODS AND EQUIPMENTS FOR FAILURE A NALYSIS				
Selection of suitable testing methods for failure analysis, Selection of metallurgical equipments for failureAnalysis, SEM-EDAX.				
Text Books				
1	"Understanding How Components Fail" by Donald J. Wulpi; ASM International Publication.			
2	"Analysis of Metallurgical Failures: by Vito J. Colangelo; Francis A. Heiser Wiley Publication			
3	ASM Handbook Vol.11 - Failure Analysis and Prevention, ASM International Publication, 1995.			
Reference Books				
1	"Metallurgy of Failure Analysis" by A K. Das; by McGraw-Hill Professional Publication.			
2	Metallurgical Failure Analysis by Charlie R. Brooks; Ashok Choudury; McGraw-Hill Publication.			
3	ɔgraphy Principles and Practice by Voort, George F. Vander; ASM International Publication			
Course Designers				
S.No	**Faculty Name**	**Designation**	**Department/ Name of the College**	**Email id**
1	C.THIAGARAJAN	ASSISTANT PROFESSOR (GRADE-II)	Mechanical/AVIT	cthiagarajan@avit.acc.in

17MESE35	NANO STRUCTURED MATERIALS AND ITS APPLICATIONS	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble
To develop the knowledge of students in nano-structured materials.

Prerequisite
NIL

Course Objective

1	The objective of this course is to make the students familiar with the different methods of synthesis for nano-materials.
2	To motivate the students to understand the evolution of nano-materials in the scientific era.
3	To understand different processing methods and properties of nano-materials.
4	To explore knowledge about the different nanoporus materials.
5	To provide the various applications of nano-materials for future engineering applications

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Understand the basics of nano materials, types, various structures of nano materials and its applications	Understand
CO2.	Understand the various synthesis process of nano-materials, methods and various chemical approaches.	Understand
CO3.	Understand the various physical approach methods and techniques involved in the process of nano-materials.	Understand
CO4.	Applications and types of various nano porus materials.	Apply
CO5.	Analyze the various nano-materials and its principle and design.	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO 1	PSO 2	PSO 3
CO1	M				L	S									
CO2	S				M	M									
CO3	S				M	M									
CO4	S				M	M							L		
CO5	S		M		L	M							M		M

S- Strong; M-Medium; L-Low

Syllabus

INTRODUCTION TO NANO STRUCTURED MATERIALS

0D, 1D, 2D structures –Size Effects –Fraction of Surface Atoms –specific Surface Energy and Surface Stress –Effect on the Lattice Parameter –Phonon Density of States–the General Methods available for the Synthesis of Nanostrutures –precipitative –reactive –hydrothermal/solvothermal methods –suitability of such methods for scaling –potential Uses.
BULK SYNTHESIS AND CHEMICAL APPROACHES
Top down and bottom up approaches–Mechanical alloying and mechanical ball milling- Mechano chemical process, Inert gas condensation technique – Arc plasma and laser ablation, Sol gel processing-Solvo thermal, hydrothermal, precipitation, Spray pyrolysis, Electro spraying and spin coating routes, Self-assembly, self-assembled monolayers (SAMs). Langmuir-Blodgett (LB) films, micro emulsion polymerization- templated synthesis, pulsed electrochemical deposition.
PHYSICAL APPROACHES
Vapor deposition and different types of epitaxial growth techniques (CVD,MOCVD, MBE,ALD)- pulsed laser deposition, Magnetron sputtering - lithography :Photo/UV/EB/FIB techniques, Dip pen nanolithography, Etching process :Dry and Wet etching, micro contact printing.
NANOPOROUS MATERIALS
Zeolites, mesoporous materials, nanomembranes - Carbon nanotubes and graphene - Core shell and hybrid nanocomposites.
APPLICATION OF NANOMATERIALS
Overview of nanomaterials properties and their applications, Molecular Electronics and Nanoelectronics – Nanobots- Biological Applications – Quantum Devices – Nanomechanics - Photonics- Nano structures as single electron transistor –principle and design.

Text Books

1	Guozhong Cao ,"Nanostructures and Nanomaterials , synthesis , properties and applications" ,Imperial College Press ,2004.
2	Carl C. Koch (ed.), " Nanostructured Materials", Processing, Properties and Potential Applications, Noyes Publications, Norwich, New York, U.S.A.
3	Bhusan, Bharat (Ed), "Springer Handbook of Nanotechnology", 2nd Edition, 2007.

Reference Books

1	Modern Physics – Beiser 6th edition 2009.
2	Quantum Mechanics - Bransden and Joachen 2nd edition 2000.
3	Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, 2nd Edition by Eisberg, Robert; Resnick, Robert, 1985.
4	Quantum Physics – Theory and application, Ajoy Ghatak, Springer 2004.
5	Principles of Quantum Mechanics 2nd ed. - R. Shankar 2000.
6	Quantum Mechanics - Vol 1&2 - Cohen-Tannoudji,1997.

Course Designer

S.No	**Faculty Name**	**Designation**	**Department/Name of the College**	**Email id**
1.	A.SENTHILKUMAR	AP-II	MECH/AVIT	senthilkumar@avit.ac.in

17MESE36	STRUCTURAL PROPERTY OF ENGINEERING MATERIALS	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

To study the structural Property and correlation on Engineering Materials

Prerequisite – NIL

Course Objective

1	To study the mechanical behavior of the material
2	To study the elasticity of the material
3	To study the continuum mechanics of materials
4	To study the fracture of materials
5	To study the continuum mechanics of materials

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	To understand the mechanical behavior of the material	Understand
CO2.	To apply the stress and strain concepts in elasticity of the materials	Apply
CO3.	To obtained the knowledge about continuum mechanics of materials	Understand
CO4.	To know the fracture of materials	Apply
CO5.	To Analyze the continuum mechanics of materials	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	M	L	S	L	S	L							M		
CO2	M	L	S	L	S	L							M		
CO3	M	L	S	L	S	L							S		
CO4	M	L	S	L	S	L							S		
CO5	M	L	S	L	S	L							S		

S- Strong; M-Medium; L-Low

SYLLABUS

Introduction

Stiffness, Strength, and Toughness, Types of mechanical behavior, Relevance, Measurement, data,Macroscopic, continuum behavior, Physical mechanisms controlling behavior.

Elasticity

Introduction, Stress, strain, compliance and stiffness tensors, Physical origin of elastic moduli, Generalized Hooke's law and its application to crystals, Designing for modulus and Composites

Continuum Plasticity

True stress-true strain, Necking and Considere's Criterion, Yield Criteria and yield locus, Normality,

Isotropic and kinematic hardening, Plastic stress-strain relations.
Fracture
Importance of Fracture Mechanics, Griffith Fracture Theory, Crack Driving Force & Energy Release Rate,Modes of fracture, Stress intensity factors, Similitude, Role of Crack-tip Plasticity--Plastic Zone Size & Shape, K-dominance, Fracture Toughness-Microstructural Issues.
Fatigue
Total life approaches, Fatigue design approaches, HCF and LCF, Fatigue crack inhibition, Fatigue crack growth, Paris law and models, Threshold, Damage tolerant approach, Striations, Different stages of fatigue crack growth, Examples.

Text Books

1	GE Dieter, Mechanical Metallurgy, McGraw-Hill
2	RW Hertzberg, Deformation and Fracture Mechanics of Engineering Materials, John Wiley &Sons
3	MF Ashby and DRH Jones, Engineering Materials 1, Butterworth-Heinemann
4	D Hull and DJ Bacon, Introduction to Dislocations, Pergamon
5	Fracture Mechanics – T.L. Anderson, CRC Press.

Reference Books

1	MA Meyers and K Chawla, Mechanical Behavior of Materials, Prentice Hall
2	S Suresh, Fatigue of Materials, Cambridge University Press
3	.JP Hirth and J Lothe, Theory of Dislocations, John Wiley & Sons

Course Designers

S.No	**Faculty Name**	**Designation**	**Department/ Name of the College**	**Email id**
1	J.SENTHIL	Associate Professor	Mech / AVIT	jsenthil@avit.ac.in

17MESE37	THEORIES OF ELASTICITY	**Category**	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

This course covers surface body forces, principle stresses and also covers 2D problems of materials, torsion and curved beams

Prerequisite - NIL

Course Objective

1	To know the forces acting on body and surfaces
2	To learn stress, strain and the relation between them
3	To analyze the problemson materials in 2D
4	To learn the Torsion acting on materials of circular and non - circular sections
5	To study the thermal stresses and analyze the problems on Curved beams

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Identify the forces acting on objects	Understand
CO2.	Understand the principle of stresses, stress- strain relationship	Understand
CO3.	Solve Two Dimensional problems on materials	Apply
CO4.	Determine the torsion on various sections and apply it for safer design	Apply
CO5.	Estimate the thermal stresses and to apply it to solve problems on curved beams and thick cylinders	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	L	L	L	L	-	-	-			L		
CO2	S	M	M	L	L	L	-	-	-	-			L		
CO3	S	S	S	S	M	-	-	-	-	-			L		
CO4	S	S	S	S	S	-	-	-	M	L			L		
CO5	S	S	S	S	S	-	-	-	M	L			L		

S- Strong; M-Medium; L-Low

SYLLABUS

Surface and Body forces	
Surface and Body forces, Stress and Strain Tensor, Transformation Laws, Lagrangian and EulerianDescription, Equation of Elasticity (Equilibrium, Constitutive law and Boundary Conditions), Cauchy's Formula	
Stresses and Strains	
Principle of Stresses, Lami's stress Ellipsoid, Cauchy stress quadratic, octahedral stress, Stress –strain relationship, Uniqueness of Solutions, St. Venant's Principle, Strain Energy functions,	
Two dimensional problems on materials	
Two dimensional problems in rectangular coordinates (polynomial solution, bending of beam, Fourier series solution). Two-dimensional problems in polar coordinates (axisymmetric problems – rotating discs, Cylindrical shells, plate with a hole, infinite plate with point load, curved beams). Two-dimensional problems in curvilinear coordinates using stress functions.	
Torsion on materials	
Torsion (circular and non-circular cross section, membrane analogy, thin walled members, hydrodynamic analogy). Scalar and Vector potentials, Strain potentials. Plane state of stress and strain (Two & Three Dimensional), Airy's stress function for problems, Representation of bi harmonic function using complex variables, kolosoff-Mushkelishvili method.	
Thermal stresses and Curved beams	
Thermal stresses and its Applications to problems of curved beam, thick cylinder and rotating disc, stress concentration	
Text Books	
1	S. Timoshenko and J.N. Goodier, Theory of Elasticity, McGraw – Hill International Publication.
2	Vitor Dias da Silva, Mechanics and Strength of Materials, Springer.
3	I. S. Sokolnikoff, Mathematical Theory of Elasticity, McGraw-Hill International Publication
Reference Books	
1	A. E. Green and W. Zerna, Theoretical Elasticity, Dover Publications
2	L. D. Landau and E. M. Lifschitz, Theory of Elasticity, Pergamon Press
3	F. P. Beer, E. R. Johnston and J. T. DeWolf, Mechanics of Materials, McGraw – Hill International Publication.

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	J.SENTHIL	Associate Professor	Mech / AVIT	jsenthil@avit.ac.in

ELECTIVE COURSES

SPECIALIZATION – PRODUCT LIFE CYCLE

17MESE08	PRODUCT DESIGN AND DEVELOPMENT	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

The focus of Product Design and Development is integration of the marketing, design, and manufacturing functions of the firm in creating a new product.

Prerequisite

NIL

Course Objective

1	Understanding the aspects of product planning and development
2	To understand the customer needs
3	Concept generation and industrial needs
4	Concept selection and method of selection
5	Intellectual property

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Understand the basic concept of product planning and development	Understand
CO2.	Understand the customer requirements and specification of the product	Apply
CO3.	Apply the concept of design and manufacturing to develop new product	Apply
CO4.	Apply the appropriate concept required for new product development	Apply
CO5.	Analyze the product elements, scope, operating procedure and outline for patenting procedure	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO 1	PSO 2	PSO 3
CO1	S				L	L	M						L		
CO2	S	M	L	L	M	M							L		
CO3	S	L	M										L		
CO4	S	M	S	M	M	M							L		
CO5	S	M	S	S									L		

S- Strong; M-Medium; L-Low

SYLLABUS
INTRODUCTION AND PRODUCT PLANNING AND PROJECT SELECTION
Significance of product design, product design and development process, sequential engineering design method, the challenges of product development, Identifying opportunities evaluate and prioritize projects, allocation of resources
IDENTIFYING CUSTOMER NEEDS AND PRODUCT SPECIFICATIONS
Interpret raw data in terms of customers need, organize needs in hierarchy and establish the relative importance of needs., Establish target specifications, setting final specifications
CONCEPT GENERATION AND INDUSTRIAL DESIGN
Activities of concept generation, clarifying problem, search both internally and externally, explore the output, Assessing need for industrial design, industrial design process, management, assessing quality of industrial design
CONCEPT SELECTION
Overview, concept screening and concept scoring, Concept and Idea generation - methods of selection. - Activities of concept generation, clarifying problem, search both internally and externally
INTELLECTUAL PROPERTY
Elements and outline, patenting procedures, claim procedure, Design for Environment: Impact, regulations from government, ISO system and IPR.

Text Books

1	Ulrich K. T, Eppinger S.D and Anita Goyal , "Product Design and Development", Tata McGraw Hill, 2009.

Reference Books

1	Otto K, and Wood K, "Product Design", Pearson Education, 2001.

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	P.KUMARAN	ASST. PROF –GR-II	Mech / AVIT	Kumaranp@avit.ac.in
2	R.PRAVEEN	ASST. PROF –GR-II	Mech / AVIT	praveen@avit.ac.in

17MESE09	NEW PRODUCT DEVELOPMENT	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

This course introduces students to the methods that companies use to develop and release new products. New product development is a challenging, rewarding activity that requires multifunctional cooperation and inter-disciplinary skills. For technology companies, successful product development is critical to success.

Prerequisite

NIL

Course Objective

1	To understand the new product process
2	To learn how to integrate the customer and end-consumer into this process.
3	To learn and apply the concepts and tools necessary through case examples and assignments.
4	To actually use the new product development process by conceiving your own new product or service and an introductory launch plan.
5	To participate in group work sessions and teams to become acquainted with the importance of teamwork and collaboration that is critical to new product success.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Understand the concept of designing a new product and importance of design	Understand
CO2.	Understand the end user needs and define the design parameters of the products	Understand
CO3.	Apply the concept of new product design to clarify the problems occurring in the design stage	Apply
CO4.	Understand the market demand and prepare for the launch of the product	Understand
CO5.	Analyze the product elements, scope, operating procedure and outline for patenting procedure	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L			M	M	M						L		
CO2	S	M	M	L	M	S							L		
CO3	S		S				M						L		
CO4	S	M	S	S	M	M							L		
CO5	S	M	S	S	M								L		

S- Strong; M-Medium; L-Low

SYLLABUS
INTRODUCTION TO NEW PRODUCT DESIGN
Introduction to New Product Design – Importance – Objectives – The New Product Development Process Principles of Success - Factors influencing product design – Characteristics of a good product design
IDENTIFYING CUSTOMER NEEDS AND PRODUCT SPECIFICATIONS
Interpret raw data in terms of customers need, organize needs in hierarchy and establish the relative importance of needs., Establish target specifications, setting final specifications
CONCEPT AND PRODUCT DESIGN AND DEVELOPMENT
Concept and Idea generation -Activities of concept generation, clarifying problem, search both internally and externally, explore the output, Assessing need for industrial design, industrial design process, management, assessing quality of industrial design - Testing and forecasting
NEW PRODUCT LAUNCH AND MARKET ENTRY
Preparing a Launch Plan - Market Testing - Pricing, Packaging - Integrated Marketing - Customer and Channel Marketing - Innovation Marketing -
INTELLECTUAL PROPERTY
Elements and outline, patenting procedures, claim procedure, Design for Environment: Impact, regulations from government, ISO system and IPR.

Text Books	
1	Otto K, and Wood K, "Product Design", Pearson Education, 2001.
2	Ulrich K. T, Eppinger S.D and Anita Goyal, "Product Design and Development", Tata McGraw Hill, 2009.

Reference Books	
1	New Products Management,9th ed., by Merle Crawford and Anthony DiBendetto

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	R.PRAVEEN	ASST. PROF –GR-II	Mech / AVIT	praveen@avit.ac.in
2	P.KUMARAN	ASST. PROF –GR-II	Mech / AVIT	Kumaranp@avit.ac.in

17MESE10	DESIGN FOR MANUFACTURING AND ASSEMBLY	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble
To study how a design can be made suitable for various manufacturing and assembly process requirements.

Prerequisite
NIL

Course Objective

1	To understand the factors for Design for Manufacture
2	To know about the basics of Form Design of casting and welding
3	To know about the basics of Form design of forged and machined components
4	To study about design for assembly
5	To study about the various assembly methods and processes and design for assembly guidelines

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Understand the factors to be considered for design and manufacturability	Understand
CO2.	Understand the requirements and design consideration for casting & welding	Understand
CO3.	Understand the requirements and design consideration for forging & machining	Understand
CO4.	Apply the various types of approaches followed in Design for assembly methods	Apply
CO5.	Analyze the various methods for assembly procedure depending on the process	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO 1	PSO 2	PSO 3
CO1	S	L					L						L		
CO2	S	S	L				L						L		
CO3	S	L	M		S								L		
CO4	S	M	S	M	S								L		
CO5	S	M	S	S	S								L		

S- Strong; M-Medium; L-Low

SYLLABUS
INTRODUCTION TO DESIGN FOR MANUFACTURE
Qualities of a designer - Systematic working plan - Factors influencing choice of materials - Manufacturing methods. Process capability. Tolerances - Relevant to manufacturing, assembly. Tolerance stack - effects on assembly- Methods of eliminating tolerance stack.
FORM DESIGN - CASTING AND WELDING
Influence of loading, materials, production methods on form design. Casting considerations - Requirements and rules. Welding considerations - Requirements and rules. Redesign of components for castings. Redesign of components for welding. Case studies.
FORM DESIGN - FORGING AND MACHINING
Forging considerations - Requirements and rules. Choice between casting, forging and welding. Machining considerations - Requirements and rules. Redesign of components for forging. Redesign of components for machining. Case studies.
INTRODUCTION TO DESIGN FOR ASSEMBLY
Distinction between assembly methods and processes. Factors determining assembly methods and processes. Design factors independent of methods and processes. Design factors dependent on methods. Design factors dependent on processes.
DESIGN FOR ASSEMBLY METHODS
Approaches to design for assembly - Approaches based on design principles and rules - Qualitativeevaluation procedures, knowledge based approach, Computer aided DFA methods. Assemblability measures. Boothroyd Dewhurst DFA method, Redesign of a simple product. Case studies.

Text Books	
1	Alan Redford and chal, Design for Assembly-Principles and Procedures, McGraw Hill International Europe, London, 1994.
2	Swift. K.G.,Knowledge Based Design for Manufacture,Kogan Page Ltd.,1987

Reference Books	
1	James G. Bralla, Hand Book ofProduct Design for Manufacturing, McGraw Hill Co., 1986

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	R.PRAVEEN	ASST. PROF –GR-II	Mech / AVIT	praveen@avit.ac.in
2	P.KUMARAN	ASST. PROF –GR-II	Mech / AVIT	Kumaranp@avit.ac.in

17MESE11	FAILURE MODE AND EFFECTS ANALYSIS	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

This course provides to learn the FMEA is to take actions to eliminate or reduce failures, starting with the highest-priority ones. Failure modes and effects analysis also documents current knowledge and actions about the risks of failures, for use in continuous improvement. FMEA is used during design to prevent failures.

Prerequisite

Nil

Course Objective

1	To identify potential failure modes for a product or process
2	To assess for reducing risk and improving reliability of a system, design or process
3	To rank the issues in terms of importance
4	To identify and carry out corrective actions to address the most serious concerns
5	To critically analyze the failure mode effects

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Understanding the value and versatility of amethodical approach to systematic designevaluation	Understand
CO2.	Knowing the different types of FMEA andrecognizing when each is to be used and whenFMEA is not appropriate or effective	Understand
CO3.	Relating FMEA to other continuous improvement tools	Apply
CO4.	Performing an Failure Mode And Effects Analysis	Analyze
CO5.	Knowing current trends and application techniques for various industries	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO 1	PSO 2	PSO 3
CO1	S	M	M	L	-	-							-		
CO2	**S**	M	L	L	L	-							L		
CO3	**S**	S	S	S	S	L							M		
CO4	S	S	S	M	M	L							S		
CO5	S	M	L	M	M	-							L		

S- Strong; M-Medium; L-Low

SYLLABUS
INTRODUCTION TO FMEA
FMEA : A General Overview- significant characteristics – The four types of FMEA's – Relationships of FMEA and other Tools- Quantitative Techniques – Qualitative Techniques.
TEAMS AND TEAM MECHANICS OF FMEA
Team – Use of a Team- Team process Check – Handling of difficult individuals – planning the meeting – In process meeting management
FMEA APPLIED
Typical Tools Used in FMEA - Teams and Team Mechanics of FMEA - Concept FMEA - System FMEA - Design FMEA - Process FMEA - Service FMEA - Machine FMEA
FMEA CASE STUDIES
FMEA Flow and its Role In Failure Mode Avoidance - Automotive Industry - Electromechanical Industry - Hardware and Software - Semiconductor Industry - Medical Device Industry – Healthcare – Pharmaceutical – Utilities - Oil and Gas - Green Industry
FAILURE MODE EFFECTS AND CRITICALLY ANALYSIS (FMECA)
Introduction to FMECA – Types of FMECA – Quantitative criticality analysis – Qualitative criticality analysis – FMECA criticality matrix – FMECA worksheet – Summary output of FMECA

Text Books	
1	Failure Mode and Effect Analysis: FMEA from Theory to Execution, D. H. Stamatis, ASQ Quality Press, 2003
2	Failure Modes and Effects Analysis for Design by Michael A. Anleitner (August 2010)
3	Failure Mode and Effect Analysis: FMEA from Theory to Execution by D. H. Stamatis (June 2003)

Reference Books	
1	The FMEA Pocket Handbook: by Kenneth W. Dailey (2004)
2	Root Cause Analysis: Simplified Tools and Techniques by Bjorn Andersen (June 2006)

Course Designers

S.No.	Faculty Name	Designation	Department/Name of the College	Email id
1	K.Vijayakumar	Assistant Professor	Mech / AVIT	vijayakumar@avit.ac.in

17MESE12	PRODUCT LIFE CYCLE MANAGEMENT	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

To enable the students to understand the various product life management tools & PLM concepts

Prerequisite NIL

Course Objective

1	To understand the product life cycle management of a product
2	To understand the process flow, work flow, & product data management
3	To Understand the concepts of new product development
4	To Understand the concepts of new product development
5	Product life cycle management strategy and PLM assessment.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Understand product data, information, structures and PLM concepts.	Understand
CO2.	Measure benefits of PLM implementation in daily operations, material costs, productivity of labor and quality costs.	Understand
CO3.	Apply PLM concepts for service industry and E-Business.	Apply
CO4.	Recognize tools and standards in PLM.	Understand
CO5.	Apply PLM systems in organization verticals including production, after sales, sales and marketing, and subcontracting	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	S												L		
CO2	S	S	S	S						S			L		
CO3	S	M	L												
CO4	S	M	L												
CO5	S	S	M	L								L	L		

S- Strong; M-Medium; L-Low

SYLLABUS
INTRODUCTION TO PRODUCT LIFE CYCLE MANAGEMENT
Definition - PLM Lifecycle model - Threads of PLM - Need for PLM - Opportunities and benefits of PLM - Views - Components and Phases of PLM - PLM feasibility study - PLM visioning - Characteristics of PLM - Environment driving PLM - PLM Elements - Drivers of PLM - Conceptualization - Design - Development - Validation - Production - Support of PLM
PRODUCT DATA MANAGEMENT (PDM) PROCESS AND WORKFLOW
Engineering vaulting - product reuse - smart parts - engineering change management - Bill of materials and process consistency - Digital mock-up and prototype development - design for environment - virtual testing and validation - marketing collateral.
COLLABORATIVE PRODUCT DEVELOPMENT
Steady one-dimensional convection and diffusion – Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes.
DIGITAL MANUFACTURING – PLM
Digital manufacturing - benefits manufacturing - Manufacturing the first-one - Ramp up - virtual learning curve - manufacturing the rest - production planning.
DEVELOPING A PLM STRATEGY AND CONDUCTING A PLM ASSESSMENT
Strategy - Impact of strategy - implementing a PLM strategy - PLM initiatives to support corporate objectives - Infrastructure assessment - assessment of current systems and applications.

Text Books	
1	Stark, John. Product Lifecycle Management: Paradigm for 21st Century Product Realisation, Springer-Verlag, 2004.
2	Product Lifecycle Management, Michael Grieves, Tata McGraw Hill 2012

Reference Books	
1	Fabio Giudice, Guido La Rosa, Product Design for the environment-A life cycle approach, Taylor & Francis 2006

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	M.SARAVANA KUMAR	ASST. PROF GRII	MECH./ AVIT	saravanakumar@avit.ac.in

17MESE13	GEOMETRIC MODELLING	**Category**	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

This course introduces material on the mathematics, algorithms, and techniques for the creation, manipulation, representation, and display of geometric objects. Discuss the modeling and design of curves, surfaces, and solids.

Prerequisite

Nil

Course Objective

1	To learn the modeling of curves using Bezier and B-spline approximations;
2	To study2 D and 3 D transformations to surfaces;
3	To learn surface subdivision and reconstruction techniques;
4	To master object construction and manipulation, including its applications to CAD systems;
5	To conduct research in advanced computer graphics topics in geometry, including mesh generation, shape analysis, parameterization, differential geometry, computational topology, and others.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Understanding various Algorithms in modeling	Understand
CO2.	Know the concepts of geometric transformations	Understand
CO3.	Design the complex curved structures of objects	Apply
CO4.	Design the various complex surfaces and solids	Apply
CO5.	Animate the various graphical structures	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	S	L	L	L	L	M	-	-	-	-	-	-	L	-	-
CO2	S	M	M	L	L	-	-	-	-	-	-	-	L	-	-
CO3	S	S	S	S	L	-	-	-	-	-	-	-	L	-	-
CO4	S	S	S	S	L	-	-	-	-	-	-	-	L	-	-
CO5	S	|M	S	S	S	-	-	-	M	L	-	-	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS				
MATHEMATICAL REPRESENTATION OF GRPAHICS PRIMITIVES				
Points and lines. Line algorithms – DDA algorithm, Bresenham's algorithm and parallel line algorithms. Circle and Ellipse generation algorithms. Character generation, fill area functions.				
2D & 3D TRANSFORMATIONS OF GEOMETRY AND PROJECTIONS				
2D Translation, 2D Scaling, 2D Reflection, 2D Rotation, Homogeneous representation of transformation, Concatenation of transformations 3D Translation, 3D Scaling, 3D Reflection, 3D Rotation, Homogeneous representation of transformation, Concatenation of transformations, Perspective, Axonometric projections, Orthographic and Oblique projections				
DESIGN OF CURVES				
Analytic Curves, PC curve, Ferguson, Composite Ferguson, curve Trimming and Blending, Bezier segments, de Casteljau's algorithm, Bernstein polynomials, Bezier- subdivision, Degree elevation, Composite Bezier, Splines, Polynomial Splines, B-spline basis functions, Properties of basic functions, Knot Vector generation, NURBS.				
DESIGN OF SURFACES AND SOLIDS				
Design of Surfaces: Differential geometry, Parametric representation, Curves on surface, Classification of points, Curvatures, Developable surfaces, Surfaces of revolution, Intersection of surfaces, Surface modelling, 16-point form, Coons patch, B-spline surfaces. Design of Solids: Solid entities, Boolean operations, B-rep of Solid Modelling, CSG approach of solid modelling, Advanced modelling methods				
COMPUTER ANIMATION				
Computer animation, animation systems, types and technique, design applications, Computer Graphics Standard				
Text Books				
1	Michael E Mortenson, "Geometric modeling". John Wiley & Sons Inc., Second edition, 2010			
2	Ibrahim Zeid and Sivasubramanian**,** R., CAD/CAM Theory and Practice, Tata McGraw Hill Publications, New Delhi, 2009.			
Reference Books				
1	. David F. Rogers, J. A. Adams, Mathematical Elements for Computer Graphics, TMH, 2008.			
2	Radhakrishnan P &Kothandaraman C P, "Computer Graphics and Design", DhanpatRai and Sons,2008			
Course Designers				
S.No	**Faculty Name**	**Designation**	**Department/Name of the College**	**Email id**
1	M.SARAVANA KUMAR	ASST. PROF GRII	MECH./ AVIT	saravanakumar@avit.ac.in

17MESE14	REVERSE ENGINEERING	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

PREAMBLE

This course reviews the various steps involved in reverse engineering, design of a product as per customer's requirements, a suitable reverse engineering system for inspection and manufacturing & reverse engineering applications in aerospace, automotive and medical fields

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To introduce the various steps involved in reverse engineering
2	To understand the design of a product based on customer requirements
3	To introduce a suitable reverse engineering system for inspection and manufacturing
4	To know the RE applications in aerospace, automotive and medical sectors.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Identify the steps involved in reverse engineering of a given component.	Understand
CO2. Design and fabricate an existing component with suitable modifications as per Customer's requirements.	Apply
CO3. Select and configure a suitable re-engineering system for inspection and manufacturing.	Apply
CO4.Apply the re-engineering techniques in aerospace, automobile and medical sectors.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	M	M	M	--	--	--	--	L	--	--	--	--	--
CO2	S	M	S	M	S	M	--	--	--	S	--	--	--	--	--
CO3	S	S	S	M	S	--	M	--	M	M	--	--	--	--	--
CO4	S	S	S	S	S	M	M	--	S	S	M	M	--	--	--

S- Strong; M-Medium; L-Low

SYLLABUS

GEOMETRIC MODELLING USING POINT CLOUD DATA: Point Cloud acquisition, Surface Modelling from a point clouds, Meshed or Faceted Models, Planar Contour Models, Points to Contour Models, Surface Models, Segmentation and Surface Fitting for Prismatic objects and Free Form Shapes.

METHODOLOGIES AND TECHNIQUES FOR RE-ENGINEERING: The Potential for Automation with 3-D Laser Scanners, What Is Not Re-Engineering, What is Computer-aided (Forward)Engineering, What Is Computer-aided Reverse Engineering, Computer Vision and Re-Engineering.

SELECTING A RE-ENGINEERING SYSTEM: The Selection Process, Some Additional Complexities,Point Capture Devices, Triangulation Approaches, “Time-of-flight” or Ranging Systems,Structured-light and Stereoscopic Imaging Systems, issues with Light-based Approaches,Tracking Systems, Internal Measurement Systems, X-ray Tomography, Destructive Systems,Some Comments on Accuracy, Positioning the Probe, Post processing the Captured Data,Handling Data Points, Curve and Surface Creation, Inspection Applications, ManufacturingApproaches.

INTEGRATION BETWEEN RE-ENGINEERING AND ADDITIVE MANUFACTURING: Modeling Cloud Data in Re -Engineering, Data Processing for Rapid Prototyping, Integration of RE and RP for Layer-based Model Generation, Adaptive Slicing Approach for Cloud Data Modeling, Planar Polygon Curve Construction for a Layer, Determination of Adaptive Layer Thickness.

RE-ENGINEERING IN AUTOMOTIVE, AEROSPACE, MEDICAL SECTORS: Legal Aspects of Re-Engineering: Copyright Law, Re-Engineering, Recent Case Law, Barriers to Adopting Re-Engineering. A discussion on a few benchmark case studies.

TEXT BOOKS:

1. Reverse Engineering: An Industrial Perspective by Raja and Fernandes, Springer-Verlag 2008.

REFERENCES:

1. K. Otto and K. Wood, Product Design: Techniques in Reverse Engineering and New Product Development, Prentice Hall, 2001.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department / Name of the College	Mail ID
1	SHIVAKUMAR N	Asst. Prof. - II	Mechanical, AVIT	shiva.thermal@gmail.com

17MESE15	SUPPLY CHAIN MANAGEMENT	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

PREAMBLE

The student will understand in detail about the basics in supply chain and the inventory control models available in the industry.

PREREQUISITE: NIL

COURSE OBJECTIVES

1	To understand the basic issues in Supply Chain Management
2	To understand the various strategic sourcing and decisions
3	To understand the various inventory control models
4	To understand the various information tools
5	To understand the various supply chain integration processes

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1.	Understand the working principle and Development chain-Global optimization-Managing uncertainty and risk.	Understand
CO2.	Identifying core processes - Market Vs Hierarchy - Make Vsbuy continuum	Understand
CO3.	Understand the working principle of inventory control-Economic lot size model.	Understand
CO4.	Understand the working principle of Supply chain coordination structures.	Apply
CO5.	Understand the Strategies Distribution Strategies-Direct shipment distribution	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	L	--	--	--	L	--	--	--	M	L	--	--
CO2	S	M	M	L	--	--	--	M	--	--	--	M	L	--	--
CO3	S	M	M	L	--	--	--	L	--	--	--	M	L	--	--
CO4	S	S	S	M	L	--	--	M	--	--	--	M	L	--	--
CO5	S	S	S	M	M	--	--	M	--	--	--	M	L	--	--

S- Strong; M-Medium; L-Low

Syllabus
Introduction to SCM Development chain-Global optimization-Managing uncertainty and risk-Evolution of SCM- Complexity of SCM-Why SCM?-Key Issues in SCM
Strategic Sourcing Outsourcing – Make Vs buy - Identifying core processes - Market Vs Hierarchy - Make Vsbuycontinuum - ourcing strategy - Supplier Selection and Contract Negotiation. Creating a worldclass supply base- Supplier Development - World Wide Sourcing.
Inventory Management & Risk Pooling Introduction and forms of inventory-Single stage inventory control-Economic lot size model- Effect of demand uncertainty-Single period models-Initial inventory-Multiple order opportunities-Periodic review policy-ontinuous review policy
The Value of Information The bullwhip effect-Supply chain coordination structures-Information sharing & incentives Information and supply chain trade-offs-Centralized and decentralized decision making and performance impacts-Learning organization principles -Structure-process-event dependencies- Functional Products-Innovative products-Efficient supply chains-Responsive supply chains-Agile supply chains
Supply Chain Integration Push, pull, and push-pull systems-Demand-driven strategies-Impact of lead time-Impact of the Internet on supply chain-strategiesDistribution Strategies-Direct shipment distribution- Intermediate inventory storage pointstrategies-Transhipment
Text Books:
1. Janat Shah, Supply Chain Management – Text and Cases, Pearson Education. 2. Sunil Chopra and Peter Meindl, Supply Chain Management-Strategy Planning and Operation, PHI Learning / Pearson Education.
Reference:
1. Ballou Ronald H, Business Logistics and Supply Chain Management, Pearson Education, 2. David Simchi-Levi, Philip Kaminsky, Edith Simchi-Levi, Designing and Managing the SupplyChain: Concepts, Strategies, and Cases, Tata McGraw-Hill

S.No	Name of the Faculty	Designation	Department / Name of the College	Mail ID
1	SAMUVEL MICHAEL	Asso.Prof Gr-II	MECH/AVIT	samuvelmichael@avit.ac.in

ELECTIVE COURSES

SPECIALIZATION – THERMAL ENGINEERING

17MESE24	COMBUSTION ENGINEERING	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

On completion of this course, the students are able to understand the concepts of combustion of fuel and flames. Also students are able to get the knowledge on consequence of various combustions.

Prerequisite

ENGINEERING THERMODYNAMICS

Course Objective

1	To Acquire the fundamental knowledge of combustion.
2	To Understand the thermodynamics of combustion.
3	To Understand the kinetics of combustion.
4	To Understand the types of flames.
5	To Understand the combustion aspects in SI and CI Engines.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Formulate combustion equations to determine A/F, adiabatic flame temperature and pollutant concentration.	Apply
CO2.	Relate the thermo chemistry and kinetics of combustion to evolve mathematical models for combustion.	Analyze
CO3.	Rate of physical mixing and its effects on ignition, propagation and extinction, and rate of chemical reaction once mixed.	Understand
CO4.	Identify factors responsible for laminar and turbulent flame propagation. Apply the different principles of flame stabilization and ignition to design combustor.	Apply
CO5.	Summarize emission associated with combustion and identify their control techniques	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO 1	PSO 2	PSO 3
CO1	S	S	M	M	-	-	L	-	-	-	L	-	L		
CO2	S	S	M	-	-	-	-	-	-	-	L	-	L		
CO3	S	M	M	M	-	-	-	-	-	-	L	-	L		
CO4	S	S	M	L	-	-	M	-	-	-	M	-	L		
CO5	L	M	M	S	-	M	S	-	-	-	M	-	L		

S- Strong; M-Medium; L-Low

SYLLABUS

COMBUSTION OF FUEL				
Introduction - Combustion equations - Theoretical air - Excess air - Air fuel ratio - Equivalence ratio - Exhaust gas composition - Air fuel ratio from exhaust gas composition - Heating value of fuels.				
COMPRESSION IGNITION ENGINES				
Thermo-chemistry, first law analysis of reacting systems - Adiabatic combustion temperature - Second law analysis of reacting systems - Criterion for chemical equilibrium - Equilibrium constant for gaseous mixtures - Evaluation of equilibrium composition - Chemical availability				
KINETICS OF COMBUSTION				
Rates of reaction - Reaction order and complex reactions - Chain Reactions, Arrhenius rate equation, collection theory - Activated complex theory - Explosive and general oxidative characteristics of fuels.				
FLAMES				
Laminar and turbulent flames - Premixed and diffusion flames - Burning velocity and its determination - Factors affecting burning velocity - Quenching, flammability and ignition - Flame stabilization in open burners				
ENGINE COMBUSTION				
Combustion in SI and CI engines - Stages of combustion in SI and CI engines - Normal combustion and abnormal combustion - Emissions from premixed combustion - Emission from non-premixed combustion - Control of emissions				
Text Books				
1	Ganesan.V, “Internal Combustion Engines”, Tata McGraw-Hill, New Delhi.			
2	Ramalingam.K.K, “Internal Combustion Engines - Theory and practice”, SciTech Publications India Pvt. Ltd., Chennai, 2010.			
3	Stephen.R.Turns, “An Introduction to Combustion concepts and applications”, McGraw Hill Book Company, Boston, 3rd Edition, 2011.			
Reference Books				
1	Thipse.S.S, “Internal Combustion Engines”, Jaico Publication House.			
2	Thipse.S.S, “Alternate Fuels”, Jaico Publication House.			
3	Heywood.J.B, “Internal Combustion Engine Fundamentals”, McGraw Hill International, New York.			
4	Mathur. R.B. and R.P. Sharma, “Internal Combustion Engines”., Dhanpat Rai & Sons.			
5	Domkundwar.V.M, “A course in Internal Combustion Engines”, Dhanpat Rai & Sons.			
Course Designers				
S.No	**Faculty Name**	**Designation**	**Department/ Name of the College**	**Email id**
1	S.PRAKASH	Assistant Professor (Gr-II)	Mech / AVIT	prakash@avit.ac.in

17MESE25	COMPUTATIONAL FLUID DYNAMICS	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

This course introduces the finite difference methods as a means of solving different type of differential equations that arise in fluid dynamics. Fundamentals of numerical analysis, ordinary differential equations and partial differential equations related to fluid mechanics and heat transfer will be reviewed. Error control and stability considerations are discussed and demonstrated.

Prerequisite

1. Engineering Thermodynamics
2. Fluid Mechanics And Machinery

Course Objective

1	To understand basic properties of computational methods
2	To introduce Governing Equations of viscous fluid flows
3	To learn computational solution techniques for time integration of ordinary differential equations
4	To introduce numerical modeling and its role in the field of fluid flow and heat transfer
5	To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Discuss the basic properties of computational methods	Understand
CO2.	Discuss the Governing Equations of viscous fluid flows	Understand
CO3.	Solve problems in computational solution techniques for time integration of ordinary differential equations	Analyze
CO4.	Solve problems in numerical modeling and its role in the field of fluid flow and heat transfer	Analyze
CO5.	Determine the various discretization methods, solution procedures and turbulence modeling.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	L	M	L	-	-	-	-	-	L	L	-	-
CO2	S	M	M	L	L	L	-	-	-	-	-	-	L	-	L
CO3	S	M	M	L	L	L	-	-	-	-	-	L	L	-	L
CO4	S	S	S	M	L	L	-	-	-	-	-	-	L	-	L
CO5	M	M	M	L	L	M	-	-	-	-	-	-	L	-	L

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION				
Computational Fluid Dynamics, Advantages, Applications, Future of CFD. Problem set up-pre-process, Numerical solution – CFD solver				
GOVERNING EQUATIONS FOR CFD				
Introduction, the continuity equation, the momentum equation, the energy equation, the additional equations for turbulent flows, generic form of the governing equations for CFD, boundary conditions.				
CFD TECHNIQUES				
Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy- Finite volume formulation for steady state One, Two and Three -dimensional diffusion problems				
FLOW FIELD ANALYSIS				
Finite volume methods -Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms.				
TURBULENCE MODELS AND MESH GENERATION				
Turbulence models, mixing length model, Two equation (k-Є) models – High and low Reynolds number models – Structured Grid generation – Unstructured Grid generation – Mesh refinement – Adaptive mesh – Software tools.				
Text Books				
1	Versteeg, H.K., and Malalasekera, W.,"An Introduction to Computational Fluid Dynamics": The finite volume Method, Pearson Education Ltd. Third Edition – 2014.			
2	Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw Hill Publishing Company Ltd.,			
Reference Books				
1	John D. Anderson "Computational Fluid Dynamics - The basics with Applications", McGrawHill International Editions.			
2	Anil W. Date, "Introduction to Computational Fluid Dynamics", Cambridge University Press, Reprinted 2010.			
3	Yogesh Jaluria & Kenneth E. Torrance, "Computational Heat Transfer", CRC press, 2nd Edition.			
4	John. F. Wendt, "Computational Fluid Dynamics – An Introduction", Springer, Third Edition, 2013.			
Course Designers				
S.No	**Faculty Name**	**Designation**	**Department/Name of the College**	**Email id**
1	S.PRAKASH	Assistant Professor (Gr-II)	Mech / AVIT	prakash@avit.ac.in
2				

17MESE26	CRYOGENIC ENGINEERING	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

This course provides basic knowledge of cryogenic refrigeration systems, cryogenic instrumentation and cryogenic heat exchangers

Prerequisite

ENGINEERING THERMODYNAMICS

Course Objective

1	To provide the knowledge of evolution of low temperature science
2	To provide knowledge on the properties of materials and gas separation systems
3	To familiarize with various vacuum techniques systems
4	To provide design aspects of cryogenic storage and transfer lines
5	To provide the knowledge of advances in cryogenics

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Understand properties of material at cryogenic temperatures	Understand
CO2.	To understand the properties of materials and gas separation systems	Understand
CO3.	Know about various vacuum techniques systems	Apply
CO4.	To understand the cryogenic refrigeration systems	Understand
CO5.	Understand the cryogenic instrumentation and cryogenic heat exchangers	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L		M			L					L	L		
CO2	S	M									L	L	L		
CO3	S	M					M					M	L		
CO4	S	M		M			L				S	M	L		
CO5	S	M		S	M		L				S	M	L		S

S- Strong; M-Medium; L-Low
SYLLABUS
INTRODUCTION TO CRYOGENIC SYSTEMS
Properties of materials at low temperature, Properties of Cryogenic Fluids - Air and Gas Liquefaction Systems: Thermodynamically ideal system, Production of low temperatures Liquefaction systems for gases other than Neon, Hydrogen and Helium, liquefaction systems for Neon, Hydrogen and Helium - Cryogenic Refrigeration System
GAS SEPARATION AND GAS PURIFICATION SYSTEMS
The thermodynamically ideal separation system properties of mixtures, Principles of gas separation, air separation systems, Hydrogen, Argon, Helium air separation systems, Gas purification methods.
VACUUM TECHNIQUES
System for production of high vacuum such as mechanical, diffusion, ion and cryopumps - Cryogenics measurement systems - Temperature pressure, flow rate, liquid level measurement, Introduction to Cryo-coolers.
CRYOGENIC FLUID STORAGE SYSTEMS
Introduction, Basic Storage vessels, inner vessel, outer vessel design, piping, access manways, safety device.Cryogenic insulations Vacuum insulation, gas filled powders and fibrous materials, solid foam, selection and comparison of insulations. Cryogenic fluid transfer systems. Transfer through uninsulated lines, vacuum insulated lines, porous insulated lines etc.
ADVANCES IN CRYOGENICS
Vortex tube and applications, Pulse tube refrigerator, Cryogenic Engine for space vehicles. Cryogenic Applications in gas industry, cryogenic fluids, space research, Cryobiology, food processing, electronics, nuclear and high energy physics, chemical processing, metal manufacturing, cryogenic power generation, medicine, analytical physics and chemistry.

Text Books

1	Cryogenic Systems – R.F. Barron
2	Cryogenic Engineering – R.B. Scott – D.Van Nostrand Company, 1959

Reference Books

1	Cryogenic Process Engineering – K.D. Timmerhaus and T.M. Flynn, Plenum Press, New York, 1989
2	High Vacuum Technology – A. Guthree – New Age International Publication
3	Experimental Techniques in Low Temperature Physics – G.K. White – Oxford University Press, England, 1959

Course Designers

S.No	**Faculty Name**	**Designation**	**Department/Name of the College**	**Email id**
1	Dr.M.Prabhahar	Asso Prof	Mech / AVIT	mprabhahar@avit.ac.in

17MESE27	POWER PLANT ENGINEERING	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

Power Plant Engineering is the subject involving study of applying the thermal engineering concepts and machineries in the process of power generation. Power Plants are the backbone of a country involving in the generation of electric power.

Prerequisite - Thermal Engineering

Course Objective

1	To understand the objectives of power plants in a country's electrical power requirement.
2	To understand the operational methods of power generation using different energy sources.
3	To provide the knowledge of instrumentation involved in the operation and control of power plants
4	To estimate the cost and economics of power generation in different types of power plants.
5	To inculcate the knowledge of environmental impact of power plants on the society.

Course Outcomes: On the successful completion of the course, students will be able to

CO 1.	Understand the methods of power generation using different energy sources	Understand
CO 2.	To state the instrumentation and control systems for a power plant	Understand
CO 3.	To calculate the cost of power generation for a typical power plant	Apply
CO 4.	To infer the environmental impacts of power plants on the society	Apply
CO 5.	Prepare a layout for different power plants	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO12	PSO 1	PSO 2	PSO3
CO1	M	M	S	-	-	-	-						M	M	M
CO2	S	M	M	M	M	-	-						M	S	M
CO3	M	S	S	S	-	-	-						M	M	S
CO4	M	S	S	S	M	M	S						M	M	S
CO5	S	S	S	S	S	S	-						M	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Power Generation: Global Scenario, Present status of power generation in India, Role of private and governmental organizations, Load shedding, Carbon credits, Power reforms, concept of cascade efficiency.

General layout of modern power plant with different circuits, working of thermal power plant, coal classification, coal, ash and dust handling, selection of coal for Thermal Power Plant, FBC boilers, high pressure boiler, cogeneration power plant (with numerical)

Steam Condenser: Necessity of steam condenser, Classification, Cooling water requirements, Condenser efficiency, Vacuum efficiency, Cooling towers, air Leakage, Effects of Air Leakage on condenser performance, (Numerical Treatment)

HYDROELECTRIC AND NUCLEAR POWER PLANTS

HEPP : Introduction, Plant Layout, Site Selection, Advantages and Disadvantages of HEPP, Hydrograph , Flow duration curve ,Mass Curve, Classification of HEPP with layout.

NPP : Elements of NPP, Nuclear reactor & its types, fuels moderators, coolants, control rod, classification of NPP, N-waste disposal

DIESEL & GAS TURBINE POWER PLANT

DEPP : Plant Layout, Diesel Engine Power Plant Performance Analysis, application, selection of engine size, advantages & disadvantages of diesel power plant.

GTPP : Introduction, fuels, materials selection for GTPP, Brayton Cycle analysis, Thermal Efficiency, Work ratio, maximum & optimum pressure ratio, Actual cycle effect of operating variables on thermal efficiency, inter-cooling reheating, & regeneration cycle, Open, Closed & Semi Closed cycles Gas Turbine Plant , combined cycle plant (Numerical Treatment).

NON-CONVENTIONAL POWER PLANTS

Wind Power plant : Introduction, wind availability measurement, types of wind machines, site selection, and wind power generation.

Solar Power Plant : Introduction, components ,Types of Collectors & Solar Ponds, Low & High Temperature Solar Power Plant. Photovoltaic Power System, Heliostat

Tidal, OTEC, geothermal, magneto hydrodynamics, fuel cell, hybrid power plants, Challenges in commercialization of Non-Conventional Power Plants.

INSTRUMENTATION , ECONOMICS AND ENVIRONMENTAL IMPACT

Power Plant Instrumentation Layout of electrical equipment, generator, exciter, short circuits & limiting methods, switch gear, circuit breaker, power transformers, methods of earthing, protective devices & Control system used in power plants, Control Room.

Economics of Power Generation: Introduction, Cost of electric energy, Fixed and operating cost, (with numerical treatment), Selection and Type of generation, Selection of generation equipment, Performance and operation characteristics of power plants and Tariff methods.

Environmental impact due to power plants. Environmental aspects, introduction, constituents of atmosphere, different pollutants due to thermal power plants and their effects of human health, Environmental control of different pollutant such as particulate matter, Oxides of sulphur, nitrogen, global warming & green house effect, thermal pollution of water & its control. Noise pollution by power plants.

Text Books	
1	E.I.Wakil, —Power Plant Engineering‖ , McGraw Hill Publications New Delhi
2	P.K.Nag, —Power Plant Engineering‖ , McGraw Hill Publications New Delhi
3	K K Ramalingam ,‖ Power Plant Engineering, SCITECH Publications Pvt Ltd.
4	Domkundwar & Arora, —Power Plant Engineering‖ , Dhanpat Rai & Sons, New Delhi
Reference Books	
1	R.K.Rajput, —Power Plant Engineering‖ , Laxmi Publications New Delhi
2	R.Yadav , —Steam and Gas Turbines‖ ,Central Publishing House, Allahabad
3	G.D.Rai, — Non-Conventional Energy Sources‖ Khanna Publishers,Delhi
4	S.P.Sukhatme, —Solar Energy‖ Tata McGraw-Hill Publications, New Delhi

Course Designers

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1	N.Lakshminarayanan	Associate Professor	MECH / AVIT	nlakshminarayanan@avit.ac.in
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17MESE28	REFRIGERATION AND AIR CONDITIONING	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble
This course provides the underlying principles of operation in different Refrigeration & Air conditioning systems and components.

Prerequisite
NIL

Course Objective

1	To impart knowledge on refrigeration cycles and methods to improve performance
2	To familiarize the components of refrigeration systems
3	To Perform psychrometric calculations
4	To introduce air conditioning systems
5	To know the applications of refrigeration and air conditioning systems

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Carry out analysis of refrigeration cycles	Understand
CO2.	Understand the principles refrigeration of air-conditioning and basic design considerations.	Understand
CO3.	Perform psychrometric calculations, humidity control and analysis of air-conditioning processes	Apply
CO4.	Apply the concepts of indoor environmental comfort.	Apply
CO5.	Know the various applications of Refrigeration and air conditioning	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO 1	PSO 2	PSO 3
CO1	S	L		L			L					L	L		
CO2	S	M										L	L		
CO3	S	S	M	M									M		
CO4	S	S	M	M									M		
CO5	S	M		M	M		L					M	L		

S- Strong; M-Medium; L-Low

SYLLABUS

REFRIGERATION CYCLE

Review of thermodynamic principles of refrigeration. Carnot refrigeration cycle – Vapour compression refrigeration cycle – use of P.H. charts – multistage and multiple evaporator Systems – cascade system – COP comparison. Air Refrigeration cycles.

REFRIGERANTS AND SYSTEM COMPONENTS

Compressors – reciprocating and rotary (elementary treatment), Types of condensers, vaporators, cooling towers – Functional aspects. Refrigerants – properties – selection of refrigerants, Alternate Refrigerants, Cycling controls.

PSYCHROMETRY

Psychrometric processes use of psychrometric charts – Grand and Room Sensible Heat Factors – bypass factor – air washers, requirements of comfort air conditioning, summer and Winter Air conditioning.

AIR CONDITIONING SYSTEMS

Cooling load calculation working principles of – Centralized Air conditioning systems, Split, Ductable split, Packaged Air conditioning, VAV & VRV Systems. Duct Design by equal friction method, Indoor Air quality concepts.

UNCONVENTIONAL REFRIGERATION CYCLES

Vapor Absorption system – Ejector jet, Steam jet refrigeration, thermo electric refrigeration. APPLICATIONS – ice plant – food storage plants – milk – chilling plants.

Text Books

1	Manohar Prasad, “Refrigeration and Air Conditioning”, Wiley Eastern Ltd., 1983.
2	Arora C.P., “Refrigeration and Air Conditioning”, Tata McGraw Hill, New Delhi, 1988.

Reference Books

1	Roy. J. Dossat, “Principles of Refrigeration”, Pearson Education 1997.
2	Jordon and Priester, “Refrigeration and Air Conditioning”, Prentice Hall of India Pvt.Ltd., New Delhi, 1985.
3	Stoecker N.F. and Jones, “Refrigeration and Air Conditioning”, TMH, New Delhi,1981.

Course Designers

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1	Dr.M.Prabhahar	Assoc Prof	Mech / AVIT	mprabhahar@avit.ac.in
2				

17MESE29	TURBOMACHINERY	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble
This course is to explore the strategies in Machineries and its dynamic analysis

Prerequisite
Engineering Thermodynamics, Fluid Mechanics and Machinery

Course Objective

1	To learn the principles of fluid machinery.
2	To understand various fans and blowers.
3	To understand the concept of compressors.
4	To learn the concept of axial flow compressors.
5	To understand the concept of various turbines.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Know about the fundamental of fluid mechanics concepts, and energy transfer from fluid and machineries	Remember
CO2.	To understand the design concepts and importance of dynamic machineries	Understand
CO3.	To understand about constructional details of compressors and performance analysis from graphs	Understand
CO4.	To know about bench marking and to utilize velocity diagrams for work done, efficiency and performance characteristics	Apply
CO5.	To know about bench marking and to utilize velocity diagrams for blade design, testing and analysis	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M								M				M		
CO2	M			L					M				L		
CO3	M				L			L	M				L		
CO4	M	M		L	S				M				M		
CO5	M								M				M		

S- Strong; M-Medium; L-Low

SYLLABUS				
BASIC PRINCIPLES				
Energy transfer between fluid and rotor-classification of fluid machinery,-dimensionless Parameters-specific speed-applications-stage velocity triangles-work and efficiency				
CENTRIFUGAL FANS AND BLOWERS				
Types- stage and design parameters-flow analysis in impeller blades-volute and Diffusers, losses, characteristic curves and selection, fan drives and fan noise.				
CENTRIFUGAL COMPRESSOR				
Construction details, impeller flow losses, slip factor, diffuser analysis, losses and Performance curves				
AXIAL FLOW COMPRESSOR				
Stage velocity diagrams, enthalpy-entropy diagrams, stage losses and efficiency, work Done simple stage design problems and performance characteristics.				
AXIAL AND RADIAL FLOW TURBINES				
Stage velocity diagrams, reaction stages, losses and coefficients, blade design Principles, testing and performance characteristics				
Text Books				
1	Yahya, S.M., Turbines, Compressors and Fans, Tata McGraw-Hill Publishing Company, 1996.			
2	Ganesan, V., Gas Turbines, Tata McGraw Hill Pub. Co., 1999.			
Reference Books				
1	Bruneck, Fans, Pergamom Press, 1973.			
2	Shepherd, D.G., Principles of Turbo machinery, Macmillan, 1969.			
Course Designers				
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1	Mr.R.Mahesh	Asst.Prof Gr-II	Mech / AVIT	Mahesh@avit.ac.in

17MESE30	DESIGN OF THERMAL POWER EQUIPMENTS	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

This course provides knowledge of design and analysis of the heat exchangers.

Prerequisite

NIL

Course Objective

1	To provide the knowledge of heat transfer equipment.
2	To provide knowledge on design and analysis of the Shell and tube heat exchanger
3	Enable to carry out the performance of heat exchanger with the extended surfaces.
4	To provide design and analysis of cooling towers.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Design and analysis of the parallel flow, counter flow heat exchangers.	Understand
CO2.	To understand the multi-pass and cross flow heat exchangers.	Understand
CO3.	To develop the Shell and tube heat exchanger.	Apply
CO4.	To optimize the performance of heat exchanger	Understand
CO5.	To design and analyze the cooling towers	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L		M			L						L		
CO2	S	M											L		
CO3	S	M					M						L		
CO4	S	M		M			L						L		
CO5	S	M		S	M		L						L		S

S- Strong; M-Medium; L-Low

SYLLABUS	
CLASSIFICATION OF HEAT EXCHANGERS	
Introduction, Recuperation & Regeneration – Tubular heat exchangers: double pipe, shell & tube heat exchanger, Plate heat exchangers.	
BASIC DESIGN METHODS OF HEAT EXCHANGER	
Introduction, Basic equations in design, Overall heat transfer coefficient – LMTD method for heat exchanger analysis – parallel flow, counter flow, multi-pass, cross flow heat exchanger design calculations.	
SHELL & TUBE HEAT EXCHANGERS	
Tube layouts for exchangers, baffle Heat exchangers, calculation of shell and tube heat exchangers – shell side film coefficients, Shell side equivalent diameter, the true temperature difference in a 1-2 heat exchanger, shell side pressure drop, tube side pressure drop, Analysis of performance of 1-2 heat exchanger, and design calculation of shell & tube heat exchangers.	
CONDENSATION OF SINGLE VAPORS AND EXTENDED SURFACES	
Evaporators and Reboilers, Vaporizing processes, forced circulation vaporizing exchangers, natural circulation vaporizing exchangers, calculations of a reboiler. Longitudinal fins, calculation of a double pipe fin efficiency curve, calculation of a double pipe finned exchanger.	
DIRECT CONTACT HEAT EXCHANGER	
Cooling towers, relation between wet bulb & dew point temperatures, classification of cooling towers, cooling tower internals, Heat balance, heat transfer by simultaneous diffusion and convection. Analysis of cooling tower requirements. Calculation of cooling tower performance.	
Text Books	
1	Process Heat Transfer – D.Q. Kern, TMH.
2	Heat Exchanger Design – A.P.Fraas and M.N. Ozisick. John Wiely & sons, New York.
Reference Books	
1	W.F. Stoecker, Design of Thermal Systems - McGraw-Hill
2	Bejan, G. Tsatsaronis, M.J. Moran, Thermal Design and Optimization – Wiley
3	N.V. Suryanarayana, Design & Simulation of Thermal Systems – MGH.

Course Designers

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1	Mr. N. Fedal Castro	Asst Prof - II	Mech / AVIT	fedal@avit.ac.in

17MESE31	**Advanced Ceramic Technology**	**Category**	**L**	**T**	**P**	**Credit**
		EC(SE)	**3**	**0**	**0**	**3**

Preamble :

Advanced Ceramic Technology constitute the methods of developing a group of materials other than the clay minerals based "traditional ceramics" particularly for advanced technology applications replacing, in many cases, conventional metals and alloys. Advanced ceramics use mostly synthetic or specially prepared raw materials. Therefore, preparation of synthetic raw material constitutes an important part of this course. Advanced ceramic materials are used in the bulk shapes, form of thick or thin films, single crystals as well as in the fiber form. The materials cover a very wide spectrum of compounds e.g. oxides, carbides, nitrides, oxy-nitrides, silicides as well as their combinations.

Prerequisite: Nil

Course Objective

1	To inculcate methods of preparation of ceramic material powders.
2	To inculcate methods of preparation of ceramic crystals.
3	To provide the knowledge of properties of ceramics.
4	To understand the different applications of ceramics.
5	To enable students to learn about various types advanced ceramics.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Understand the different methods of development of ceramic materials in different required forms.	Understand
CO2.	State the methods of formation of ceramic in powder and crystal forms	Understand
CO3.	Understand the different properties of ceramics	Understand
CO4.	Apply ceramics for different applications	Apply
CO5.	Apply ceramics for advanced applications	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	M	M	S	-	-	-	-	-	-	-	-	-	-	S	-
CO2	S	M	M	M	M	-	-	-	-	-	-	-	-	-	-
CO3	M	S	S	S	-	-	-	-	-	-	-	-	-	-	-
CO4	M	S	S	S	M	M	S	-	-	-	-	-	-	S	-
CO5	S	S	S	S	S	S	-	-	-	-	-	-	-	-	M

S- Strong; M-Medium; L-Low

Syllabus	
Introduction to Ceramics	
Introduction: oxide and non-oxide ceramics, their chemical formulae, crystal and defect structures, non-stoichiometry and typical properties. **PREPARATION METHODS OF CERAMIC POWDERS** Powder Preparation: Physical methods (different techniques of grinding), chemical routes - coprecipitation, sol-gel, hydrothermal, combustion synthesis, high temperature reaction (solid state reaction).	
PREPARATION METHODS OF CERAMIC CRYSTALS	
Basic principles and techniques of consolidation and shaping of ceramics: powder pressing-uniaxial, biaxial and cold isostatic and hot isostatic, injection moulding, slip casting, tape-casting, calendaring, multilayering. Sintering: different mechanisms and development of microstructure (including microwave sintering). Preparation of single crystal, thick and thin film ceramics. Preparation of single crystal, thick and thin film ceramics.	
PROPERTIES OF CERAMICS	
Mechanical behavior: fracture mechanics and tribology. Electrical behaviour: insulating (dielectric, ferroelectric, piezoelectric, pyroelectric) semiconducting, conducting, superconducting and ionically conducting, specific materials and their applications. Magnetic behaviour: basic principles, materials and their applications. Transparent ceramics, coatings and films: preparation and applications. Porous ceramics and ceramic membrane: fabrication techniques and applications in separation technology	
APPLICATIONS OF CERAMICS	
Bio-medical applications of ceramic materials , Ceramics for energy and environment technologies (fuel cell, lithium battery, gas sensor and catalytic support), Ceramics matrix composites: different types, their preparation and properties (including Nano composites) Exotic ceramics: functionally graded, smart/ Intelligent, bio-mimetic.	
ADVANCED APPLICATIONS OF CERAMICS	
Gas turbine blades - Abrasives – Aerospace - Diesel engines – Heat Exchangers - Cutting Tools Applications. Spinel Ferrites - Hexagonal Ferrites - Garnet - Processing -Single crystal ferrite –Applications. High Temperature Superconductors - Structure of Y-Ba-Cu oxide system - Powder synthesis - Theory of Superconductivity - Nano- ceramics - basic principles, preparation and applications.	
Text Books	
1	Bansal, N.P. ed., 2006. *Handbook of ceramic composites* (Vol. 200). Springer Science & Business Media.
2	Fundamental of Ceramics by Michel W. Barsoum, McGraw Hill International edition, 1997
3	1. Modern Ceramic Engineering by David. W. Richerson, Mercel Dekker, NY 1992.

4	Ceramic Processing and Sintering by M. N. Rahman, Mercel Dekker, 2003			
Reference Books				
1	Pugh, R.J. and Bergstrom, L. eds., 1993. *Surface and colloid chemistry in advanced ceramics processing* (Vol. 51). CRC Press.			
2	Lakshmanan, A. ed., 2012. *Sintering of ceramics: new emerging techniques*. BoD–Books on Demand.			
Course Designers				
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4				

ELECTIVE COURSES - GENERAL ELECTIVES

17MEEC01	HYDRAULICS AND PNEUMATIC SYSTEMS	Category	L	T	P	Credit
		EC(PS)	3	0	0	3

PREAMBLE

Today, Industries are increasingly demanding process automation in all sectors. Automation results into better quality, increased production and reduced costs. The controlling parameters like motion , Speed, Position and torque are paramount in raising productivity and quality and reducing energy and equipment costs in all industries. Electric drives share most of industrial machine control applications. The variable speed drives which controls speed of a.c/d.c motors are indispensable controlling elements in automation systems. Such drives contains various high performance motors, power electronic converters and digital control systems. With wide options which are open to engineers for selecting proper drive system, one can look forward for a highly efficient and reliable drive for every application in industry.

PREREQUISITE-NIL

COURSE OBJECTIVES

1	To understand about basics of fluid power systems fundamentals
2	To acquire knowledge about components used in hydraulic and pneumatic systems
3	To familiarize about the various types of valves and actuators
4	To design hydraulic circuits for different applications
5	To design pneumatic circuits for different applications

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Understand the different drive systems and identify which is suitable for specific application.	Understand
CO2. Understand the working of different components in fluid power system.	Understand
CO3. Understand about the utilization of cylinders, accumulators, valves and various control components.	Understand
CO4. Design a feasible hydraulic circuit for a given application.	Apply
CO5. Design a feasible pneumatic circuit for a given application.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO 3
CO1	S	M	M	L	M	-							L		
CO2	S	M	M	L	M	-							L		
CO3	S	M	M	L	M	-							L		
CO4	S	S	S	M	L	M							L		
CO5	S	S	S	M	L	M							L		

S- Strong; M-Medium; L-Low

SYLLABUS

FLUID POWER SYSTEMS AND FUNDAMENTALS

Introduction to fluid power, Advantages and Applications of fluid power system. Basic Laws in Fluid power system, Types of fluid power systems, Properties of fluids – General types of fluids – Fluid power symbols. Basic Laws in Fluid power system. Low cost automation.

HYDRAULIC SYSTEM & PNEUMATIC SYSTEMS COMPONENTS

Pump classification – Gear pump, Vane Pump, Piston pump, construction and working of pumps– Variable displacement pumps. Pneumatic Components: Compressors-types. Filter, Regulator, Lubricator Unit, Muffler

VALVES AND ACTUATORS

Construction of Control Components: Director control valve – 3/2 way valve ,4/2 way valve, Shuttle valve ,check valve – pressure control valve –pressure reducing valve, sequence valve-Flow control valve.. Fluid Power Actuators: Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, Double acting special cylinders like Telescopic, Cushioning mechanism, Construction of single acting and double acting cylinder.

DESIGN OF HYDRAULIC CIRCUITS

Accumulators and Intensifiers: Types of accumulators – Accumulators circuits, intensifier – Intensifier circuit. Circuits: Reciprocating- Regenerative - Quick return – Sequencing – Synchronizing - Safety circuits - Press – Planer.

DESIGN OF PNEUMATIC CIRCUITS

Fluid Power Circuit Design: Speed control circuits, synchronizing circuit, Sequential circuit design for two and three cylinder using cascade method. Pneumo-hydraulic circuit. Electro pneumatic circuit, Fluid power circuits- failure and troubleshooting.

Text Books:

1. Anthony Esposito - "Fluid Power with Applications"- Pearson Education - 2013
2. Srinivasan - "Hydraulic and Pneumatic Controls"- TMH - 2011.
3. Andrew Parr - "Hydraulics and Pneumatics "- Jaico Publishing House

Reference:

1. Thomson, "Introduction to Fluid power"- Prentice Hall - 2004.
2. Majumdar S.R. - "Oil Hydraulics – Principles and maintenance"- Tata McGraw-Hill.
3. Majumdar S.R. - "Pneumatic systems – Principles and maintenance"- Tata McGraw Hill.

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17MEEC02	FUNDAMENTALS OF PIPING ENGINEERING	Category	L	T	P	Credit
		EC(PS)	3	0	0	3

Preamble :
The students completing this course are expected to gain knowledge on fundamentals of piping engineering, pipe hydraulics, piping supports and design.

Prerequisite: Nil

Course Objective

1	To understand the importance of piping engineering
2	To enable student to learn the application of flanges and valves
3	To understand about process mechanical equipments
4	To gain knowledge about various pipe supports
5	To enable students to learn about various types of stress analysis

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Discuss the basic concepts of piping engineering	Understand
CO2.	Discuss the application of flanges and valves	Understand
CO3.	Apply the concept of various process mechanical equipments	Apply
CO4.	To gain knowledge about various pipe supports	Apply
CO5.	Apply the concept of Pressure Design of Miter Bends	Apply
CO6	Analyse the different types of stress	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	-	-	-	-	-	-	-	-	-	-	-		
CO2	S	M	L	-	-	-	-	-	-	-	-	-	L		
CO3	S	M	L	-	-	-	-	-	-	-	-	-	M		
CO4	S	S	M	L	-	-	-	-	-	M	-	-	M		
CO5	S	S	S	M	-	-	-	-	-	M	-	-	L		
CO6	S	S	S	M	S	-	-	-	-	S	-	-	L		

S- Strong; M-Medium; L-Low		
Syllabus		
INTRODUCTION		
Introduction to Piping Responsibilities of Piping Engineer and Designer - Scope of Piping Input and Outputs - General: Process Diagrams (PFD, UFD, P&ID, Line List etc) - Piping Fundamentals Definition, Application Codes and Standards.		
FLANGES AND VALVES		
Introduction to Flanges and Valves – Application and advantages of Flanges - Pipe Fittings - Pipe Flanges – Valves -Piping Special Items		
PROCESS MECHANICAL EQUIPMENTS		
Process Mechanical Equipments – Static equipments & Rotary equipments Layouts - Preparation of Plot Plan - Preparation of Equipment Layouts - Preparation of Piping General Arrangement Drawings - Preparation of Cross Sectional Drawings - Piping Isometric Drawings & Material Take off		
PIPE SUPPORTS		
Pipe Supports: Support Types - Support Selection, Support Location, Support Span Calculation - Typical Unit Conversion - Materials: Preparation of Piping Material Specification - Valve Material Specification - Familiarity with ASME B31.3 Pipe Wall thickness Calculations.		
STRESS ANALYSIS		
Preparation of Special Items Datasheets : Pressure Design of Miter Bends – Single & Multiple Miters - Pressure Design of Blanks - Branch reinforcement calculations - Overview of Technical Queries and Technical Bid Evaluations Stress Analysis: Types of stresses, Significance of forces and moments - Introduction to Stress Analysis - Expansion Loop types, BellowsTypes		
Text Books		
1	G.K.Sahu, Fundamentals of piping design, New Age International Publishers	
Reference Books		
1	Peter Smith, R.W.Zappe, Valve Selection Hand Book, Elsevier Science	
2	Peter Smith, The fundamentals of piping design, Elsevier Science	
Course Designers		
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17MEEC03	PETROLEUM PRODUCTION ENGINEERING	Category	L	T	P	Credit
		EC(PS)	3	0	0	3

Preamble : The students completing this course are expected to gain knowledge on oil well drilling engineering and operations and fundamentals equations and calculations used in drilling engineering.
Prerequisite: Nil

Course Objective

1	To understand oil well drilling engineering and operations.
2	To get familiarized with field equipment practices, difficulties and actions to be taken.
3	To learn fundamental equations and calculations used in drilling engineering.
4	To gain knowledge about casing and cementation
5	To enable students to analysis various drilling fluids

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Discuss the basic concepts of well drilling engineering	Understand
CO2.	Discuss the application of field equipment practices	Understand
CO3.	Apply the concept of fundamental equations and calculations used in drilling engineering.	Apply
CO4.	To gain knowledge about Casing and cementation	Apply
CO5.	Apply the concept of using of drilling fluids	Apply
CO6	Analyse the different drilling fluids	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	S	M	L	-	-	-	-	-	-	-	-	-	L	-	L
CO3	S	M	L	-	-	-	-	-	-	-	-	-	M	-	M
CO4	S	S	M	L	-	-	-	-	-	M	-	-	M	-	M
CO5	S	S	S	M	-	-	-	-	-	M	-	-	L	-	L
CO6	S	S	S	M	S	-	-	-	-	S	-	-	L	-	L

S- Strong; M-Medium; L-Low

Syllabus				
Drilling Rig				
Rotary / top drive drilling for oil and natural gas, introduction to hardware system, power generation system, Hoisting, Rotary and drilling fluid circulation system, Rig selection, onshore offshore rigs, onshore and offshore drilling operations, Horse power calculations for draw-works and rotary advantages and disadvantages of top drive system.				
Drilling Operations and Difficulties				
Down hole drilling problems and solutions, factors affecting rate of penetration, drill off test, bit section, IADC classification of bit, dull bit gradation, circulation system, mud pumps, numerical related to mud pumps of circulation system, problems concerned with drilling fluid and drill pipe stuck up, geometry of a stuck pipe. Hole problems (lost circulation, kick etc) well control equipment BOP.				
Drilling Techniques and Fishing				
Introduction to directional, horizontal multilateral drilling techniques. Types of well, coring operations, Fishing tools and operations. Terminology used in directional wells and basic mathematics used in directional wells (DMS to Dec. Deg, co-ordinate system).				
Casing and Cementation				
Casing and Cementation, Functions, types, API grades properties of casing, Threads and couplings, Functions, classification of cement, Strength retrogenion, Cement additives, Methods of cementation, Equipment accessories, Field problems pertaining to cementation job, Cement slurry calculations.				
Drilling Fluids				
Drilling fluid, Functions, Types, compositions, Properties of mud, Field test, Rheology, Additives and contamination, Selection of drilling fluids and mud, Conditioning equipments, Mud calculations, Hydrostatic pressure, Volume, Weight related calculations during drilling.				
Text Books				
1	Gatlin C.; Petroleum Engineering, Drilling and Well Completions, Prentice Hall.			
Reference Books				
1	Rabia H.; Oil Well Drilling Engineering, Graham Trotman Ltd., London.			
2	Azar, J. J., G. Robello Samuel; Drilling Engineering, Penn Well.			
Course Designers				
S.No	**Faculty Name**	**Designation**	**Department / College**	**Email id**
1	V.K.KRISHNAN	Assistant Professor	Mech / VMKVEC	vkkrishnanme@yahoo.com

17MEEC04	**AGRICULTURAL ENGINEERING EQUIPMENTS**	**Category**	L	T	P	Credit
		EC(PS)	3	0	0	3

Preamble

The course introduces the fundamental knowledge in engineering properties of agricultural materials, different Post Harvest operations and processing methods of harvested crops and storage of crops.

Prerequisite

NIL

Course Objective

1	To understand the basic concepts in post harvesting
2	To understand fundamentals and analyze various unit operations of Agricultural Processing
3	To gain the knowledge on different Post Harvest operations and processing methods of harvested crops
4	To gain the knowledge on Material handling equipment's.
5	To understand the basic concepts in processing technologies

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Understand the various post harvesting losses and to evaluate the moisture content of various cereals and pulses	Apply
CO2.	Understand the drying techniques and dryers	Understand
CO3.	Apply the mechanical concepts of cleaning and grading of pulses	Apply
CO4.	Understand the mechanical shelling and handling equipment's	Understand
CO5.	Apply the mechanical concepts of de husking, polishing and milling of pulses and oil seeds	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	S	M	L	M								M		
CO2	M	M	M	M	M								M		
CO3	M	M	M	M	S								S		
CO4	M	M	M	L	S								M		
CO5	M	M	M	M	S								M		

S- Strong; M-Medium; L-Low

SYLLABUS
FUNDAMENTALS OF POST HARVESTING
Post harvest technology – introduction –objectives –post harvest losses of cereals, pulses and oilseeds – importance - optimum stage of harvest. Threshing – traditional methods mechanical threshers – types-principles and operation-moisture content –measurement –direct and indirect methods – moisture meters – equilibrium moisture content.
DRYING
Drying – principles and theory of drying – thin layer and deep bed drying – Hot air drying – methods of producing hot air – Types of grain dryers – selection – construction, operation and maintenance of dryers – Design of dryers
CLEANING AND GRADING
Principles - air screen cleaners – adjustments - cylinder separator - spiral separator – magnetic separator - colour sorter - inclined belt separator – length separators - effectiveness of separation and performance index.
SHELLING AND HANDLING
Principles and operation – maize Sheller, husker Sheller for maize – groundnut decorticator – castor Sheller – material handling – belt conveyor –screw conveyor – chain conveyor – bucket elevators – pneumatic conveying.
PADDY AND CROP PROCESSING
Paddy processing – parboiling of paddy – methods – merits and demerits – dehusking of paddy – methods – merits and demerits – rice polishers –types – constructional details – polishing –layout of modern rice mill - wheat milling – pulse milling methods – oil seed processing.

Text Books

1	Chakraverty, A. Post harvest technology for Cereals, Pulses and oilseeds. Oxford & IBH publication Pvt Ltd, New Delhi, Third Edition.
2	Sahay, K.M., and Singh, K.K. Unit operations of Agricultural Processing. Vikas publishing house Pvt. Ltd., New Delhi.

Reference Books

1	Pande, P.H. Principles of Agriculture Processing. Kalyani Publishers, Ludhiana.
2	Henderson, S.M. and R.L. Perry. Agricultural Process Engineering. John Wiley and Sons, New York.

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	A.IMTHIYAS	AP//MECH	MECH/AVIT	imthiyas@avit.ac.in

17MEEC05	BIOMECHANICS	Category	L	T	P	Credit
		EC(PS)	3	0	0	3

Preamble

The aim of this course to introduces the student to the Basic mechanical concepts. Also anatomical and mechanical bases of physical activity with emphasis on the analysis of sport and exercise skills. This is also bones and its elastic properties.

Prerequisite - NIL

Course Objective

1	Describe force and Torque, well-defined mechanical and anatomical terminology
2	Understand centre of gravity and rotational motions
3	Understand the simple mechanics
4	Understand and quantify the cause and effect relationship between muscle force and linear and angular motion
5	Understand the bone and elasticity

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Explain the concept of forces on the Body and concept of the torques on the rigid bodies.	Understand
CO2.	Explain the centre of gravity and rotational concepts	Understand
CO3.	Evaluate the simple machines	Apply
CO4.	Explain the musical forces	Understand
CO5.	Explain about bones and its properties	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	L	L	-	-	L	-	-	-	-	-	L	-	-
CO2	M	L	L	L	-	-	L	-	-	-	-	-	L	-	-
CO3	S	M	M	M	-	-	L	-	-	-	-	-	L	-	-
CO4	S	S	M	M	-	-	L	-	-	-	-	-	L	-	-
CO5	S	S	M	M	-	-	L	-	-	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

Syllabus	
Forces and Torques	
Concept of Force - Representation of Forces, Diagram of Forces, Resultant or Sum of Force Vectors, Addition of Vectors - Rule of Polygon, Rule of Parallelogram, Method of Components, Algebraic Method. Newton's Laws - Newton's First Law of Motion, Newton's Second Law, Newton's Third Law. Some Specific Forces – Weight, Muscle Forces, Contact Force or of Reaction or Normal Force, Forces of Friction – Pressure. Concept of Torque-Torque Due to Two or More Nonparallel Forces, Resultant of Two Nonparallel Forces Appliedon a Body and Its Line of Action, Rotational Equilibrium.	
Center of Gravity and Rotation	
Weight and Center of Gravity, Practical Method to Locate the Center of Gravity, Analytical Method to Locate the Center of Gravity, Stable, Unstable, and Neutral Equilibrium, Motion of the Center of Gravity, Moment of Inertia- Moment of Inertia of Regularly Shaped Uniform Solids, Radius of Gyration, Parallel Axis Theorem, Moment of Inertia of the Human Body, Angular Momentum and Its Conservation-Angular Impulse, Variation of Angular Momentum.	
Simple Machines	
Simple Machines, Work Done by a Force, Levers- First Class Levers, Second Class Levers, Third Class Levers, Mechanical Advantage. Levers in the Human Body- The Locomotion Equipment, Articulations and Joints, Muscle and Levers, Identification of Levers in the Human Body, Pulleys-Combination of Pulleys, Traction Systems.	
Muscle Force	
Equilibrium Conditions of a Rigid Body, System of Parallel Forces, System of Nonparallel Forces, Forces on the Hip, Forces on the Spinal Column-Forces Involved in the Spinal Column When the Posture Is Incorrect, Forces Involved in the Spinal Column When the Posture Is Correct.	
Bones	
Skeleton and Bones, Composition of Bones, Elastic Properties of Solids, Tensile Stress and Compressive Stress, Modulus of Elasticity, Elastic Properties of Bones, Pressure or Stress on Intervertebral Discs, Pressure on the Vertebrae, Shear Stress in the Lumbosacral Intervertebral Disc, Bone Fractures in Collisions.	
Text Books	
1	Zatsiorsky, Vladimir: Kinematics of Human Motion
2	Zatsiorsky, Vladimir: Kinetics of Human Motion
3	Robertson, D. Gordon E.: Research Methods in Biomechanics
Reference Books	
1	Nigg, B.M., Herzog, W. and Herzog, W., 1999. *Biomechanics of the musculo-skeletal system* (Vol. 192). New York: Wiley.
2	Hall, S.J. and Lysell, D., 1995. *Basic biomechanics* (Vol. 2). St. Louis: Mosby.

Course Designers				
S.No	**Faculty Name**	**Designation**	**Dept / College**	**Email id**
1	Dr. S. Natarajan	Asso. Professor	MECH/ VMKVEC	natarajanshree@gmail.com
2	Prof. N. Rajan	Professor	MECH/ VMKVEC	rajanned@gmail.com

17MEEC06	MEMS AND NEMS	Category	L	T	P	C
		EC(PS)	3	0	0	3

PREAMBLE

The course reviews the various applications of MEMS AND NEMS and its applications in sensors and actuators.

PREREQUISITE : NIL

COURSE OBJECTIVES

1	To study the fundamentals of MEMS and NEMS
2	To gain knowledge on fabrication of MEMS
3	To study on Micro Sensors
4	To study on Micro actuators
5	To study on Nano systems and Quantum Mechanics

COURSE OUTCOMES

On the successful completion of the course, students will be able to

The student will understand the various applications of NEMS and MEMS	Understand
CO2. The student will understand the Various fabrication of MEMS	Understand
CO3. The student will learn the working of various micro sensors	Analyze
CO4. The student will know how to design the working of micro actuators	Apply
CO5. The student will understand the nanosystems and quantum mechanics	Understand

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**S**	-	-	-	-								M		
CO2	**S**	-	-	-	-								M		
CO3	**S**	**S**	**S**	**L**	**L**								S		
CO4	**S**	**S**	**S**	**L**	**L**								M		
CO5	**S**	**M**	**M**	**M**	**S**								M		

S- Strong M-Medium L- Low

SYLLABUS

OVERVIEW AND INTRODUCTION

New trends in Engineering and Science: Micro and Nano scale systems Introduction to Design of MEMS and NEMS, Overview of Nano and Micro electromechanical Systems, Applications of

Micro and Nano electro mechanical systems, Micro electromechanical systems, devices and structures Definitions, Materials for MEMS: Silicon, silicon compounds, polymers, metals
MEMS FABRICATION TECHNOLOGIES
Microsystem fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation.Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching; Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect-Ratio (LIGA and LIGA-like) Technology; Packaging: Microsystems packaging, Essential packaging technologies, Selection of packaging materials
MICRO SENSORS
MEMS Sensors: Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Microsensors. Case study: Piezo-resistive pressure sensor
MICRO ACTUATORS
Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators), Micromechanical Motors and pumps. Case study: Comb drive actuators
NANOSYSTEMS AND QUANTUM MECHANICS
Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: Shrodinger Equation and Wave function Theory, Density Functional Theory, Nanostructures and Molecular Dynamics, Electromagnetic Fields and their quantization, Molecular Wires and Molecular Circuits.
Text Books:
1. Marc Madou, "Fundamentals of Micro fabrication", CRC press. 2. Stephen D. Senturia," Micro system Design", Kluwer Academic Publishers.
Reference:
1. . Tai Ran Hsu ,"MEMS and Microsystems Design and Manufacture" ,Tata McGraw Hill. 2. Chang Liu, "Foundations of MEMS", Pearson education India limited.

Course Designers				
S. No.	**Name of the Faculty**	**Designation**	**Department / Name of the College**	**Mail ID**
1	**Dr.D.Bubesh Kumar**	**Associate Professor**	**Mechanical/ AVIT**	**bubeshkuma@avit.ac.in**

17MEEC07	NAVAL ARCHITECTURE	Category	L	T	P	Credit
		EC(PS)	3	0	0	3

Preamble

To provide an adequate knowledge basic knowledge on Naval Architecture

Prerequisite - NIL

Course Objective

1	To understand historical development of different types of naval vessels
2	To gain the basic knowledge about design of Hull.
3	To enhance the knowledge of main and auxiliary machinery in warships
4	To understand the Structural arrangements in naval ships
5	To enhance the various types of some modern naval ships

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	To know the production of naval vessels, Mission requirements and constraints. Determination of mine dimensions. Space allocation and general arrangement	Understand
CO2.	To enhance the knowledge of Hydrodynamics of naval vessels. Propellers for warships. Design and construction.	Apply
CO3.	To know the Structural design criteria and design procedures, Shock and methods to reduce its effects, Guns torpedoes, depth chargers, mines and missiles. Radar and Sonar weapon control systems.	Understand
CO4.	To know the Structural design criteria and design procedures, Shock and methods to reduce its effects, Guns torpedoes, depth chargers, mines and missiles. Radar and Sonar weapon control systems.	Analyze
CO5.	To analyse pressure hull external structure, diving and surfacing systems. A/C and ventilation systems. Propulsion system. Rudder and hydroplanes. Nuclear submarines.	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	-	-									M		
CO2	M	S	M	L									M		
CO3	S	M	L	M									S		
CO4	S	S	L	S									M		
CO5	L	S	M	S									M		

S- Strong; M-Medium; L-Low

SYLLABUS				
Historical development of different types of naval vessels:				
Distinguishing features of warship types. Indigenous design and production of naval vessels. Mission requirements and constraints. Concept exploration and development of warship criteria. Determination of mine dimensions. Volumes based and weight based criteria. Space allocation and general arrangement.				
Design of Hull Form				
Warship resistance data, Hydrodynamics of naval vessels. Propellers for warships. Design and construction. Propeller data for heavily loaded propellers. Hydrodynamic design methods. Stability criteria for warships. Damage survival considerations.				
Main and auxiliary machinery in warships				
Comparative methods of steam, diesel and gas turbine plants. Combined plants. Requirements of sea keeping and stability platform. Stabilisation systems. Special manoeuvring requirements for naval vessels.				
Structural arrangements in naval ships				
Structural design criteria and design procedures. Shock and methods to reduce its effects. Accommodation. Habitability standards. A/C requirements. Nuclear, bacteriological and chemical defense arrangements. Weapon systems. Guns torpedoes, depth chargers, mines and missiles. Radar and Sonar weapon control systems. Counter Measures.				
Detailed study of some modern naval ships				
Submarine: General description, pressure hull external structure, diving and surfacing systems. A/C and ventilation systems. Stability, equilibrium polygon. Distance when submerged and while on surface. Propulsion system. Rudder and hydroplanes. Nuclear submarines.				
Reference Books				
1	Strength of Ship Structures by W. Muckle			
2	Ship Construction by D.J. Eyers			
3	Principles of Naval Architecture by Ed.V. Lewis			
4	Ship Design and Construction by R.Taggart			
Course Designers				
S.No	**Faculty Name**	**Designation**	**Department/ Name of the College**	**Email id**
1	S. ARUNKUMAR	Associate Professor	Mech / VMKVEC	sarunkumar@vmkvec.edu.in
2				

17MEEC08	SHIP BUILDING	Category	L	T	P	Credit
		EC(PS)	3	0	0	3

Preamble

The students completing this course are expected to gain knowledge on fundamentals of Ships terms and stresses in ships , Primary and Secondary girders used in ships and Fore-end and After-end arrangements.

Prerequisite

NIL

Course Objective

1	To understand various terms used in ship construction and materials use
2	To understand side framing, shell, decks , bulk heads and deep tanks
3	To gain knowledge about fore end arrangement , supporting of rudder, bearing.
4	To get familiarized with field of shipyard practice , constructional details and requirements.
5	To gain knowledge about offshore technology

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Discuss the basic concepts of ship construction and materials use	Understand
CO2.	Discuss the knowledge of side framing, shell, decks , bulk heads and deep tanks	Apply
CO3.	Apply the concept of fore end arrangement , supporting of rudder, bearing	Apply
CO4.	To gain knowledge about field shipyard practice , constructional details and requirements.	Apply
CO5.	Apply the concept of drilling ships and platforms ,special auxiliary service ships.	Apply
CO6.	To gain knowledge about ship surveys	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L													
CO2	S	M	L										L		L
CO3	S	M	L										M		M
CO4	S	S	M	L									M		M

CO5	S	S	M	L									M		M
C06	S	M	L										M		M

S- Strong; M-Medium; L-Low

SHIP TERMS

Various terms used in ship construction with reference to ship's parameter e.g. L.B.P. - Moulded Depth - Moulded draught etc. - General classification of ships.
Stresses in Ship's structure: Hogging – Sagging – Racking – Pounding – Panting etc., and Strength members to counteract the same.
Sections and materials use: Type of sections like angles – Bulb plates flanged beams used in ship construction – Riveting & Welding testing of welds – Fabricated components.

BOTTOM & SIDE FRAMING

Double bottoms, watertight floors solid and bracket floors – Longitudinal framing keels – side framing like tank side brackets – Beam knee – Web frame etc., Shell & Decks: Plating systems for shells – Deck plating & Deck Girders – discontinuities like hatches and other openings – supporting & closing arrangements – mid-ship section of ships.
Bulk heads & Deep Tanks: water tight bulkheads – Arrangement of platings and stiffeners – water tight sliding doors – Water tight openings through bulkheads for electric cables pipes and shafting – Deep tank for oil fuel or oil cargo corrugated bulk heads.

FORE & AFT END ARRANGEMENTS

Fore end arrangement, arrangements to resist pounding bulbous bow – Types of sterns stern frame and rudder – Types of rudder – Supporting of rudder – Locking pintle – Bearing pintle – Pallister bearing shaft tunnel – Tunnel bearings.

FREE BOARD AND TONNAGE

Significance and details of markings various international Regulations.
Shipyard Practice: layout of a shipyard – Mould loft –Optical marking – Automatic plate cutting, Fabrication and assembly etc.,
Ship Types: Tankers – Bulk Carriers – Container ships – L.N.G., L.P.G., and Chemical carriers – Lash ships – Passenger ships – Dredgers – Tugs etc., - Constructional details and requirements.

OFFSHORE TECHNOLOGY

Drilling ships and Platforms – Supply vessels – fire fighting arrangement – Pipe laying ships – special auxiliary service ships.
Ship Surveys: Survey rules – Functions of ship classification – Societies – Surveys during construction – Periodical surveys for retention of class.

Text Books

1	D.J. Eyres, "Ship Construction", 4th Edition, Butter worth – Heinemann, Oxford, 1994.
2	E.A. Stokoe, "Reed's Ship Construction for Marine Engineers", 1st Edition, Thomas Reed Publication, London, 2000.

Reference Books

1	A.J. Young, "Ship Construction sketch & Notes", 1st Edition, Butter worth – Heinemann, London,1980.

2	H.J. Pursey, "Merchant Ship Construction", 7th Edition, Brown Son & Ferguson Ltd. GlasGow Great Britain, 1994.			
Course Designers				
S.No	**Faculty Name**	**Designation**	**Department/Name of the College**	**Email id**
1	R.ANANDAN	ASSO.PROF	MECH/VMKV	rajanand0072000@yahoo.com

17MEEC09	**MARINE AUXILIARY MACHINERY**	**Category**	**L**	**T**	**P**	**Credit**
		EC(PS)	**3**	**0**	**0**	**3**

Preamble

The course aims at giving adequate exposure to engine room layouts and piping system arrangements, the various valves, cocks, pumps, heat exchangers, evaporators and distillers used in marines, steering systems of marines. The course is designed to give basics of marine auxiliary machinery systems in a structured way.

Prerequisite

NIL

Course Objective

1	To study about the basic engine room layouts, piping systems and fitting used in ships.
2	To learn the different valves and cock systems used in ships.
3	To understand the operations and utilization of different pumps used in ships.
4	To study and analyze various heat exchangers, evaporators and distillers used in ships.
5	To understand various types of steering systems used in ships.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Understand the basic engine room layouts, piping systems and fitting used in ships.	Understand
CO2.	Differentiate types of valves and cock systems of ships.	Understand
CO3.	Understand different types of pumps is ships.	Understand
CO4.	Understand different types of heat exchangers, evaporators and distillers and analyze their performances	Apply
CO5.	Understand different types of steering systems used in ships.	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	L	L	L	-	-	-	-	-	-	-	M	-	M
CO2	M	L	L	L	L	-	-	-	-	-	-	-	M	-	M
CO3	S	S	S	S	S	-	-	-	-	-	-	-	S	-	S
CO4	S	M	M	M	M	-	-	-	-	-	-	-	M	-	M
CO5	M	M	M	M	M	-	-	-	-	-	-	-	M	-	S

S- Strong; M-Medium; L-Low

Syllabus

ENGINE ROOM LAYOUT

Layout of main and auxiliary machinery in Engine Rooms in different ships. **Engine Room Piping Arrangements & Fittings:** Steam and condensate system, water hammering in pipes, Expansion joints in pipelines, Bilge – ballast, fuel oil bunkering and transfer system, bunkering procedure, precautions taken, fuel oil service system to main and auxiliary engines, lubricating oil and Engine cooling system to main and auxiliary engines, central cooling and central priming systems, control and service air system, domestic fresh water and sea water (Hydrophore) service system, drinking water system, fire main system.
VALVES AND COCKS
Straight way cocks, right angled cock, 'T' cock, spherical cock, Boiler gauge glass cock (cylindrical cock). **Valves:** Globe valves, SDNR valve, swing check valve (storm valve), gate valves, butterfly valves, relief valves, quick closing valves, pressure reducing valves, control valves, change over valve chests, fuel oil transfer chest, valve actuators, steam traps. Jointings: Packings, Insulation of materials, Types,- Various applications. Seals – purpose of bearing seal, description and application of non rubbing seals and rubbing seals, simple felt seal, seals suitable for various peripheral speeds, V-ring seals, Lip seals. **Filters and strainers:** Filtration, filter elements basket strainers, duplex strainers, edge type strainers, auto-kleen strainers, back flushing strainers, magnetic filter, rotary filters, fine filters.
PUMPS
Types of pumps for various requirements – their characteristics, performance and application in ships – centrifugal pumps – gear pumps – screw pumps and reciprocating pumps – care and maintenance of pumps.
HEAT EXCHANGERS, EVAPORATORS AND DISTILLERS
Principle of surface heat transfer – description, contact heat transfer, construction of shell and tube type – flat plate type, single and double pass – lubricating oil coolers, fueloil heaters, fresh water coolers, compressed air coolers, Main Engine charge air cooler, Fresh water heaters, steam condensers, evaporators and condensers in refrigeration system – materials used in all the above heat exchangers, expansion allowance – temperature controls effect of air in the system – maintenance. **Evaporators and Distillers:** Distillation of water, distilling equipment, problem of scale formation and method of controlling, methods of distillation, single effect and double effect shell type evaporator, low pressure vacuum type evaporator, flash evaporators, salt water leaks and detection, reverse osmosis desalination plant, membranes, drinking water and treatment.
STEERING SYSTEM
Hydraulic Telemotor system (Transmitter and receiver), Bypass valve – charging system, – hydraulic power unit – hunting gear heleshaw pump principle, construction and operation – pawl and ratchet mechanism, 2-ram and 4-ram steering gear – Allelectric steering gear, principle and operation – Hunting gear and emergency steering

gear. Electro-hydraulic steering gear, Raphson and slide Actuators, Rotary vane steering gear – principle – construction – operation – safety features, relief, isolating and bypass valves, steering system regulations and testing – trouble shooting – rectification maintenance. Navigational safety of a ship – case history, cause and /or errors – how to avoid rudder restraining, general requirements – requirements for large tankers and gas carrier, additional requirements (electrical) definitions – controls – automatic system, general arrangement – rudder and pintle, rudder wear down – rudder carrier.				
Text Books				
1	D.W. Smith, "Marine Auxillary Machinery", 6th Edition, Butter worths, London, 1987.			
2	H.D. McGeorge, "Marine Auxillary Machinery", 7th Edition, Butter worth, London, 2001.			
Reference Books				
1	H.D. McGeorge, "General Engineering Knowledge", 3rd edition, Butter worth – Heineman, London, 1991.			
Course Designers				
S.No	**Faculty Name**	**Designation**	**Department/ College**	**Email id**
1	J.SATHEES BABU	Associate Professor	Mech / VMKVEC	jsathees@gmail.com

17MEEC10	MARINE REFRIGERATION AND AIRCONDITIONING	Category	L	T	P	Credit
		EC(PS)	3	0	0	3

Preamble

To develop the knowledge of students in Marine Refrigeration and Air conditioning

Prerequisite

NIL

Course Objective

1	To provide knowledge on performance of compressors.
2	To understand the theoretical aspects of Marine refrigeration and air-conditioning.
3	To provide knowledge on the method of economical and efficient design of Heat Exchangers for Air conditioning and refrigeration plants
4	To understand the various steps involved in heat exchanger design.
5	To explore the knowledge on marine refrigeration plants.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	The performance of Reciprocating Compressors,	Understand
CO2.	The theoretical aspects of Marine refrigeration and air-conditioning	Apply
CO3.	The method of economical and efficient design of Heat Exchangers for Airconditioning and refrigeration plants.	Apply
CO4.	To study the operating principle of various refrigeration plants and components	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	L	L	M	-	-	-	-	-	-	-	-	-
CO2	M	M	M	L	L	M	-	-	-	-	-	-	-	-	-
CO3	S	M	S	L	M	M	-	-	-	-	-	-	-	-	-
CO4	S	M	L	L	L	M	-	-	-	-	-	-	-	-	-

S- Strong; M-Medium; L-Low

RECIPROCATING COMPRESSORS

Ideal cycle for compressors work transfer in a single stage compressors – mass flow – volume flow – free air delivery – effect of clearance and volumetric efficiency in single stage compressors. multi stage compression neglecting clearance volume. condition for minimum work input and perfect inter cooling. tandem in line arrangements in compressors. air motors.

BASIC REFRIGERATION AND AIR CONDITIONING

Reversed Carnot cycle – vapour compression cycle – refrigerating effect – co-efficient of performance – cooling capacity – refrigerants used in marine practice and their justification - rating of refrigeration plant – methods for improving C.O.P. – use of vapour tables – applied problems.
MARINE REFRIGERATING PLANTS
Typical marine refrigerating plants with multiple compression and evaporator system – heat pump cycles – refrigeration in liquefied gas carriers – applied problems.
MARINE AIR CONDITIONING
Principles of air conditioning – Psychrometric properties of air – comfort conditions – control of humidity – airflow and air conditioning capacity – calculation for ships plants
BASIC DESIGN OF HEAT EXCHANGERS
Introduction - types - LMTD and NTU method - double-pipe, shell and tube type, condenser and evaporator – problems.

Text Books

1	C.P., "Refrigeration & Air Conditioning", 13th Edition, Sri Eswar Enterprises, Chennai,2016.
2	Stoecker, Wilbert .F Jones, Jerold. W., "Refrigeration and Air Conditioning", 2nd Edition, Tata McGraw-Hill, Delhi, 1985.
3	Stott, "Refrigeration Machinery And Air Conditioning Plant", Marine Engineering Practice, Vol-1 P Part-04, IMarEST, London.
4	Roy, J. Dossat, "Principles Of Refrigeration", 1st Ed., Pearson, 2006.
5	Kuppan Thulukkanam, "Heat Exchanger Design Handbook", 1st Ed., CRC Press, 2000.

Reference Books

1	D.A. Taylor, "Introduction to Marine Engineering", 2nd Edition, Butter Worth, London,1993.
2	J.R. Stott, "Refrigerating Machinery and Air Conditioning Plant", 1st Edition, The Institute of Marine Engineers, London, 1974, Reprint 1998.
3	Ghoshdastidar, P.S., " Heat transfer", 2nd Edition, Oxford University Press, 2012 .
4	Sukhatme, S.P., " Heat Transfer",4th Ed. Universities Press, 2011.

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	A.SENTHILKUMAR	ASST.PROF	MECH/AVIT	senthilkumar@avit.ac.in

17MEEC11	INDUSTRIAL ROBOTICS	Category	L	T	P	Credit
		EC(PS)	3	0	0	3

PREAMBLE

To study the application of industrial robots and enhance the knowledge of students in industrial applications

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To learn the basics about Robotics and Robot drive system.
2	To understand the controlling of Robots and devices system.
3	The study of latest technology of sensors used in robotics.
4	To understand robot kinematics system.
5	Application of robotics in industry.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1.	Understand the basics of Robot and its drive system.	Understanding
CO2.	To Identify the steps involved in controlling system	Apply
CO3.	Apply the various kinematics system used in robots.	Apply
CO4.	Identity the various sensors used in robots.	Apply
CO5.	Able to learn the applications of robots.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	----	----	----	----	----						---	---	---
CO2	M	M	L	S	L	L	----						---	----	L
CO3	M	S	S	S	M	L	----						M	---	L
CO4	M	M	M	M	S	L	----						L	---	L
CO5	S	S	S	S	S	M	L						M	----	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION :

Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robotics-Simple problems Specifications of Robot-Speed of Robot-Robot joints and links-Robot classifications-Architecture of robotic systems-Robot Drive systems Hydraulic, Pneumatic

and Electric system Functions – Need for Robots – Different Applications.
END EFFECTORS AND ROBOT CONTROLS:
Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, cam type-Magnetic grippers-Vacuum grippers-Air operated grippers-Gripper force analysis-Gripper design-Simple problems-Robot controls-Point to point control, Continuous path control, Intelligent robot-Control system for robot joint-Control actions, Adaptive control.
ROBOT KINEMATICS:
Forward kinematics – Inverse kinematics – Differences: Forward kinematics and Reverse kinematics of manipulators with two and three degrees of freedom (In 2 dimensional), four degrees of freedom (In 3 dimensional) – Deviations and problems.
ROBOT SENSORS:
Sensor -principles and applications of the following types of sensors – Position of sensors (Piezo electric sensor, LVDT, Resolvers, Optical encoders, Pneumatic position sensors) – Range sensors (Triangulation principle, Structured, Lighting approach, Time of flight range finders, Laser range meters) – Proximity sensors (Inductive, Hall effect, Capacitive, Ultrasonic and Optical proximity sensors) – Touch sensors (Binary sensors, Analog sensors) – Wrist Sensors – Compliance Sensors – Slip Sensors.
INDUSTRIAL APPLICATIONS :
Application of robots in machining - Welding - Assembly - Material handling - Loading and unloading - CIM - Hostile and remote environments.

TEXT BOOKS:

1	K.S. Fu, R.C. Gonzalez, C.S.G. Lee, “Robotics – Control Sensing, Vision and Intelligence”, Tata McGraw-Hill Education.
2	Mikell P Groover & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics, Technology programming and Applications, McGraw Hill, 2012

REFERENCES:

1	Kozyrey, Yu. “Industrial Robotics” MIR Publishers Moscow.
2	Richard D.Klafter, Thomas A. Chmielewski and Michael Negin, “Robotic Engineering-An Integrated Approach”,Prentice Hall Inc,Englewoods Cliffs,NJ,USA

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department / Name of the College	Mail ID
1	G.ANTONY CASMIR	Asst. Prof. - II	Mechanical, AVIT	antonycasmir@avit.ac.in

17MEEC12	DESIGN OF EXPERIMENTS	Category	L	T	P	Credit
		EC(PS)	3	0	0	3

Preamble

This course that deals with two of the most important approaches to collecting research data experiments.To enable the students to understand the various statistical tools & Problem solving techniques.

Prerequisite

Nil

Course Objective

1	Know about Design of Experiment
2	Understand the methodology for Design of Experiment
3	Familiarize about concepts of confounding and ANOVA
4	Expose the concepts of response surface design
5	To apply Taguchi method

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Understand the principles and theory of designing experiments	Understand
CO2.	Apply basic principles in the design of simple experiments.	Apply
CO3.	Understand and use the terminology of experimental designs	Understand
CO4.	Select and design an appropriate method of data collection for a research project.	Analyze
CO5.	Apply the concept toproduct design and development for obtain optimum results	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	S	-	-							-		
CO2	S	M	L	S	-	-							S		
CO3	S	S	S	M	S	-							M		
CO4	M	S	M	M	M	L							M		
CO5	M	M	L	M	L	M							L		

S- Strong; M-Medium; L-Low

SYLLABUS
BASICS OF DESIGN OF EXPERIMENTS
Introduction in Design of experiments (DOE) - Fundamental and practical issue in industrial experimentation - Statistical thinking and its role within DOE - Basic principles of DOE and Degrees of freedom - Selection of quality characteristics for industrial experiments - Understanding key interaction in processes - Alternative method for calculating two-order interaction effect - Synergistic interaction versus Antagonistic interaction
METHODOLOGY FOR DESIGN OF EXPERIMENTS
DOE methodology - Barriers in the successful application of DOE - Practical methodology of DOE and Analytical tools for DOE - Confidence interval for the mean response - Introduction of Screening design - Geometric and non-geometric P-B design - Introduction of full factorial design - 2^2 , 2^3 ,2^4 full factorial design
CONFOUNDING
Introduction and uses of confounding - 2^3 factorial experiment with complete confounding - 2^3 factorial experiment with partial confounding - Confounding in the 2^n series and examples - Confounding of 3^2 factorial - Confounding of 3^3 factorial and examples - Mixed series and examples - Introduction on ANOVA Analysis
RESPONSE SURFACE DESIGN
Background of response surface design - Creation of response surface design - Central composite design - Box Behnken design - Contour profile of response surface plot - Design table - Analyze the data - Case studies on response surface design - Experiment with random factor
TAGUCHI METHOD
Taguchi design approach - Orthogonal array, S/N ratio - Smaller is better, Nominal is better and larger is better with simple case studies - Analyze the data, factor effect diagram - Levels of parameters - Confirmation test - Augmented design with simple case studies

Text Books

1	Jijuantony, "Design of Experiments for Engineers and Scientists", Elsevier.
2	Douglas C Montgomery, " Design and Analysis of Experiments" , John Wiley & Sons Ltd.

Reference Books

1	1. M N Das, N C Giri, "Design and Analysis of Experiments", New Age International (P) Limited, Publishers, 1997.
2	Larry B. Barrentine, "An introduction to Design of Experiments A simplified approach", New Age International Publishers, 2010.
3	William G. Cochran, Gertrude M. Cox, "Experimental Design", John Wiley and sons, Inc.
4	Cox C.R, "The theory of Design of Experiments", Chapman and Hall, CRC Press.

Course Designers

S.No.	Faculty Name	Designation	Department/Name of the College	Email id
1	K.Vijayakumar	Assistant Professor	Mech / AVIT	vijayakumar@avit.ac.in

17MEEC13	INDUSTRIAL SAFETY	Category	L	T	P	Credit
		EC(PS)	3	0	0	3

Preamble

To familiarize with safety issues in design, handling and industrial environment

Prerequisite

NIL

Course Objective

1	To study about safety management and understand all the safety aspects thoroughly.
2	To be aware of the various safety procedures and precaution to be followed during the operation of different types of machines.
3	To be thoroughly equipped with sufficient knowledge of handling the different types of equipments and materials used for industrial safety.
4	To be having sufficient knowledge and sharing of expertise for emergency situations arising due to accidents and monitoring of health aspects.
5	To be aware of the various laws regarding health issues and safety of personals.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Identify materials for industrial applications based on microstructure and mechanical property relationship.	Understand
CO2.	Select suitable strengthening mechanism and its effects for a crystalline material.	Understand
CO3.	Identify heat treatment methods and surface treatments to improve mechanical properties of materials for applications in engineering industries.	Apply
CO4.	To makes an analysis of the formation and effects of corrosion on various materials.	Analyze
CO5.	Perform testing and mechanical properties evaluation of materials for real-time applications. Select advanced materials and various fabrication techniques	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	L	L	L								M		
CO2	M	L	L	L	L								M		
CO3	S	S	S	S	S								S		
CO4	S	M	M	M	M								M		
CO5	S	S	S	S	S								M		

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT I - SAFETY MANAGEMENT

Evaluation of modern safety concepts - Safety management functions – safety organization, safety department – safety committee, safety audit - performance measurements and motivation - employee participation in safety - safety and productivity.

UNIT II: OPERATIONAL SAFETY

Hot metal Operation - Boiler, pressure vessels - heat treatment shop - gas furnace operation – electroplating-hot bending pipes -Safety in welding and cutting. Cold-metal Operation – Safety in Machine shop - Cold bending and chamfering of pipes - metal cutting –shot blasting, grinding, painting - power press and other machines

UNIT III: SAFETY MEASURES

Layout design and material handling - Use of electricity - Management of toxic gases and chemicals - Industrial fires and prevention - Road safety - highway and urban safety – Safety of sewage disposal and cleaning - Control of environmental pollution - Managing emergencies in Industries - planning, security and risk assessments, on- site and off site. Control of major industrial hazards.

UNIT IV: ACCIDENT PREVENTION

Human side of safety - personal protective equipment - Causes and cost of accidents. Accident prevention programs -Specific hazard control strategies - HAZOP - Training and development of employees - First Aid- Fire fighting devices - Accident reporting, Investigation.

UNIT V SAFETY, HEALTH, WELFARE & LAWS

Safety and health standards - Industrial hygiene - occupational diseases prevention – Welfare facilities - History of legislations related to Safety-pressure vessel act-Indian Boiler act - The environmental protection act - Electricity act - Explosive act.

Text Books

1	Krishnan N.V. “Safety Management in Industry” Jaico Publishing House
2	John Ridley

Reference Books

1	Accident Prevention Manual for Industrial Operations”,N.S.C.Chicago, 1982

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	S.DURAITHILAGAR	ASSO.PROF	MECH/VMKVEC	duraithilagar@vmkvec.edu.in
2	J.RABI	ASSO.PROF	MECH/VMKVEC	jrabi@vmkvec.edu.in

17MEEC15	CONCURRENT ENGINEERING	Category	L	T	P	Credit
		EC(PS)	3	0	0	3

Preamble

This course reviews the benefits of Concurrent engineering, life cycle product design, design as per customer requirements, different manufacturing methods with computer based approach, importance of quality during product design, reliability, maintainability and economics of product design.

Prerequisite

NIL

Course Objectives

1	Study the benefits of concurrent engineering, life-cycle design of the products, structure and organization and implementation process of the CE.
2	Learn about the design of the product as per the customer requirements and also understand the co-operation/ coordination required between the different departments like marketing, design and the latest softwares available so far.
3	Study the role of design for manufacturing in concurrent engineering, different DFM methods, creative design methods and computer based approach to DFM.
4	Learn about the importance of quality during the product design and methods used to evaluate the quality.
5	Learn about the design of the product for reliability, maintainability and economics.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Know the meaning, objectives and benefits of the concurrent engineering, life-cycle design of the products, structure and organization and implementation process of the CE.	Understand
CO2.	Understand the design of the product as per the customer requirements and also understand the co-operation/ coordination required between the different departments like marketing, design and the latest softwares available so far.	Understand
CO3.	Understand the role of design for manufacturing in concurrent engineering, different DFM methods, creative design methods and computer based approach to DFM.	Understand
CO4.	Know the importance of quality during the product design and methods used to evaluate the quality.	Understand
CO5.	Understand the design of the product for reliability, maintainability and economics.	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	S	L	L	--							L		
CO2	S	M	S	S	S	M							S		
CO3	S	M	S	L	M	M							M		
CO4	S	M	S	S	M	M							M		
CO5	S	L	S	M	L	--							M		

S- Strong; M-Medium; L-Low

SYLLABUS
INTRODUCTION:
Sequential engineering process, Concurrent engineering definition and requirement, meaning of concurrent objectives of CE, benefits of CE, Life cycle design of products, life cycle costs. SUPPORT FOR CE: Classes of support for CE activity, CE organizational, structure CE, team composition and duties, Computer based Support, CE Implementation Process.
DESIGN PRODUCT FOR CUSTOMER
Industrial Design, Quality Function Deployment, house of quality, Translation process of quality function deployment (QFD). Modeling of Concurrent engineering design- Compatibility approach, Compatibility index, implementation of the Compatibility model, integrating the compatibility Concerns
DESIGN FOR MANUFACTURE (DFM)
Introduction, role of DFM in CE, DFM methods, e.g. value engineering, DFM guidelines, design for assembly, creative design methods, product family themes, design axioms, Taguchi design methods, Computer based approach to DFM. Evaluation of manufacturability and assembliability.
QUALITY BY DESIGN
Quality engineering & methodology for robust product design, parameter and Tolerance design, Quality loss function and signal to noise ratio for designing the quality, experimental approach.
DESIGN FOR X-ABILITY
Design for reliability, life cycle serviceability design, design for maintainability, design for economics, decomposition in concurrent design, concurrent design case studies.

Text Books	
1	Concurrent Engineering- Kusiak - John Wiley & Sons
2	Concurrent Engineering- Menon - Chapman & Hall

Reference Books	
1	Integrated Product Development/Anderson MM and Hein, L.Berlin, Springer Verlog,1987.
2	Design for Concurrent Engineering/ Cleetus, J. Concurrent Engg. Research Centre,Morgantown,WV, 1992.

Course Designers

S.No	**Faculty Name**	**Designation**	**Department/Name of the College**	**Email id**
1	B.SELVA BABU	Assistant Professor	MECH/AVIT	selvababu@avit.ac.in

17MEEC16	FLUID POWER SYSTEMS	Category	L	T	P	Credit
		EC(PS)	3	0	0	3

Preamble

Fluid Power is the technology that deals with the generation, control, and transmission of power, using pressurized fluids. Fluid power is called hydraulics when the fluid is a liquid and is called pneumatics when the fluid is a gas. Hydraulic systems use liquids such as petroleum oils, synthetic oils, and water. Pneumatic systems use air as the gas medium because air is very abundant and can be readily exhausted into the atmosphere after completing its assigned task.

Prerequisite

NIL

Course Objective

1	To study about the principles of main hydraulic and pneumatic components.
2	To design and study about the principles of main pneumatic components.
3	To learn the methodology of circuit diagram
4	To design and study about the principles of electro-pneumatic and hydraulic circuits
5	To study and analyze various circuits application ,maintenance and safety aspects

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Explain the principles of main hydraulic and pneumatic components. static and dynamic performance characteristics design of component	Understand
CO2.	Explain the principles of main pneumatic components. static and dynamic performance characteristics design of component	Apply
CO3.	Students are able to read the circuit diagrams methodology and to understand the principles of circuit operation, in relation to the performance of the individual components themselves.	Apply
CO4.	Explain the design of electro-pneumatic and hydraulic circuits.	Apply
CO5.	Students are able to design of hydraulic and pneumatic circuits applied to machine tools. Maintenance and safety aspects .	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	S	S								M		
CO2	M	S	M	M	S								L		
CO3	S	M	M	M	L								M		
CO4	M	L	S	L	S								M		
CO5	S	M	L	M	M								L		

S- Strong; M-Medium; L-Low

Syllabus				
HYDRAULIC COMPONENTS				
Introduction to fluid power system-Pascal's Law-Hydraulic fluids-Hydraulic pumps-Gear, Vane and Piston pumps-Pump Performance-Characteristics and Selection-actuators-valves-pressure control-flow control and direction control valves-Hydraulic accessories-Hydraulic Accumulator.				
PNEUMATIC COMPONENTS				
Introduction to Pneumatics-Compressors-types-Air treatment-FRL unit-Air dryer-Control valves-Logic valves-Time delay valve and quick exhaust valve-Pneumatic Sensors–types-characteristics and applications.				
FLUID POWER CIRCUITS				
Circuit Design Methodology-Sequencing circuits-Overlapping signals-Cascade method-KV Map method-Industrial Hydraulic circuits-Double pump circuits-Speed control Circuits-Regenerative circuits-Safety circuits-Synchronizing circuits-Accumulator circuits.				
ELECTRO - PNUEMATICS AND HYDRAULICS				
Relay, Switches-Solenoid-Solenoid operated valves-Timer-Counter-Servo and proportional control-Microcontroller and PLC based control-Design of electro-pneumatic and hydraulic circuits.				
APPLICATION, MAINTENANCE AND TROUBLE SHOOTING				
Development of hydraulic / pneumatic circuits applied to machine tools-Presses-Material handling systems-Automotive systems-Packaging industries-Manufacturing automation-Maintenance and trouble shooting of Fluid Power circuits-Safety aspects involved.				
Text Books				
1	Anthony "Esposito, Fluid Power with applications", Prentice Hall international–1997.			
2	Majumdar.S.R, "Oil Hydraulics", Tata McGraw Hill, 2002.			
3	Majumdar S.R, "Pneumatic systems-principles and maintenance", Tata McGraw Hill 1995.			
Reference Books				
1	John Pippenger, Tyler "Hicks, Industrial Hydraulics", McGraw Hill International Edition, 1980.			
2	Andrew Parr, "Hydraulics and pneumatics", Jaico Publishing House, 2003.			
3	FESTO, "Fundamentals of Pneumatics", Vol I, II, III.			
Course Designers				
S.No	**Faculty Name**	**Designation**	**Department / College**	**Email id**
1	S. ASHOK KUAMR	Assistant Professor	Mech / AVIT	ashokkumar@avit.ac.in

17MEEC17	ENGINEERING PRODUCT DESIGN	Category	L	T	P	Credit
		EC(PS)	3	0	0	3

Preamble

Engineering Product Design is a challenging, rewarding activity that requires multifunctional cooperation and inter-disciplinary skills.

Prerequisite

NIL

Course Objective

1	To understand the models in developing new engineering products.
2	To learn how to identify the customer needs and integrate the end-consumer into process.
3	To learn and apply the concepts and tools necessary for concept generation and evaluation.
4	To apply embodiment design concept in the process of new product development.
5	To Understand the concept of manufacturing process and design the product accordingly.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Understand the conceptual development techniques to find solution for a critical design issue.	Understand
CO2.	Apply embodiment principles to translate the conceptual ideas to engineering design.	Understand
CO3.	Apply environmental, ethical and social issues during innovative design process.	Apply
CO4.	Design and develop innovative engineering products for industrial needs using robust design philosophy.	Apply
CO5.	Apply the concept of Design for Manufacture and to understand the different modes of Failure of the product.	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	L	L	L								M		
CO2	M	L	L	L	L								M		
CO3	S	S	S	S	S								S		
CO4	S	M	M	M	M								M		
CO5	S	S	S	S	S								M		

S- Strong; M-Medium; L-Low

SYLLABUS
Introduction
Innovations in Design, Engineering Design Process, Prescriptive and integrative models of design, Design Review and societal considerations.
Identification of Customer Need
Evaluating Customer requirements and survey on customer needs, Conversion of customer needs into technical Specifications, Information sources.
Concept Generation and Evaluation
Creativity and Problem solving, Brainstorming, Theory of Inventive Problem solving (TRIZ), Functional Decomposition of the problem for innovative concept development, Morphological design, Introduction to Axiomatic Design, Concept evaluation and decision making.
Embodiment Design
Introduction, Product Architecture, Configuration and Parametric design Concepts, Industrial Design.
Design for Manufacturing
Design for Manufacturing, Design for Assembly, Design for Environment, Design for Reliability and Robustness, Introduction to FMEA.

Text Books

L	Nigel Cross, Engineering Design Methods, John Wiley, 2009.

Reference Books

L	George E. Dieter, Engineering Design, McGraw-Hill, 2009.
2	Genrich Altshuller, The Innovation Algorithm, Technical Innovation Centre, 20LL.

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1.	PRAVEEN R	Asst. Prof – II	Mechanical / AVIT	praveen@avit.ac.in

17MEEC18	ADVANCED IC ENGINES	Category	L	T	P	Credit
		EC(PS)	3	0	0	3

Preamble

On completion of this course, the students would be able to understand the operation, combustion, performance and emissions of internal combustion engines.

Prerequisite

ENGINEERING THERMODYNAMICS

Course Objective

1	To study the construction and working of Spark Ignition Engines
2	To study about the Compression Ignition Engines and Turbocharger
3	To understand the different pollutants and its control techniques
4	To study the different Alternative fuels available
5	To study the various recent trends adopted in the field of automobiles

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Acquire the knowledge of engine operation and performance	Understand
CO2.	Understand the working of engine auxiliary systems	Understand
CO3.	Understand the combustion aspects of SI Engines	Understand
CO4.	Understand the combustion aspects of CI Engines	Apply
CO5.	Know the various alternate fuels, engine emissions, Measuring and Control techniques	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	L	L									L		
CO2	S	S	M	S						S			L		
CO3	S	L	M										L		
CO4	S	M	L										L		
CO5	S	S	M	L								L	L		

S- Strong; M-Medium; L-Low

SYLLABUS
SPARK IGNITION ENGINES
Mixture requirements – Fuel injection systems – Monopoint, Multipoint & Direct injection – Stages of combustion – Normal and Abnormal combustion – Knock – Factors affecting knock – Combustion chambers.
COMPRESSION IGNITION ENGINES
Diesel Fuel Injection Systems – Stages of combustion – Knocking – Factors affecting knock – Direct and Indirect injection systems – Combustion chambers – Fuel Spray behaviour – Spray structure and spray penetration – Air motion – Introduction to Turbocharging.
POLLUTANT FORMATION AND CONTROL
Pollutant – Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters, Selective Catalytic Reduction and Particulate Traps – Methods of measurement – Emission norms and Driving cycles.
ALTERNATIVE FUELS
Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel – Properties, Suitability, Merits and Demerits – Engine Modifications.
RECENT TRENDS
Air assisted Combustion, Homogeneous charge compression ignition engines – Variable Geometry turbochargers – Common Rail Direct Injection Systems – Hybrid Electric Vehicles – NOx Adsorbers – Onboard Diagnostics.

Text Books	
1	Ramalingam. K.K., "Internal Combustion Engine Fundamentals", Scitech Publications, 2002.
2	Ganesan, "Internal Combustion Engines", II Edition, TMH, 2002.
Reference Books	
1	Mathur. R.B. and R.P. Sharma, "Internal Combustion Engines"., Dhanpat Rai & Sons 2007.
2	Duffy Smith, "Auto Fuel Systems", The Good Heart Willcox Company, Inc., 1987. 3. Eric Chowenitz, "Automobile Electronics", SAE Publications, 1995

Course Designers

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1	SANGEETHA.S	ASSOC. PROF	MECH./ AVIT	sangeethas@avit.ac.in

AERONAUTICAL ENGINEERING - OPEN ELECTIVE

17AREC03	UNMANNED AIRCRAFT SYSTEMS	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

Preamble

To enrich the student with additional value based knowledge and skills on sport based Unmanned Aerial Vehicle systems.

Prerequisite

NIL

Course Objectives

1	To know briefly the History of unmanned aerial vehicles and its types.
2	To understand the basic aspects involved in development of UAV.
3	To apply the knowledge in modeling and control of small unmanned vehicles.
4	To modify the existing flight control systems for rotorcraft UAV.
5	To design a new system for efficient operation.

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	Define principles of operation and label components of unmanned aerial vehicles.	Remember
CO2.	Explain working of vehicles used as aerial vehicles.	Understand
CO3.	Employ analytical skills to design a new system.	Apply
CO4.	Categorise the structure and estimate reliability of operations.	Analyze
CO5.	Evaluate and modify the system with up gradation of performance.	Evaluate
CO6.	Formulate and design a new modified vehicle with optimum resources.	Create

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO2.	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO3.	S	S	S	S	-	-	-	-	-	-	-	-	M	M	M
CO4.	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S
CO5.	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S
CO6.	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S

S- Strong; M-Medium; L-Low

Syllabus

UNIT – I	INTRODUCTION TO UNMANNED AIRCRAFT SYSTEMS	9
History of unmanned aerial vehicles- types- Introduction to Unmanned aircraft systems-Unmanned aerial vehicles –Micro aerial vehicles definitions, history, classification- applications-recent research and development in civil and defense applications – autonomous vehicles -future research in autonomous vehicles – design standards and		

regulatory aspects introduction to design and selection of systems.		
UNIT – II	**ASPECTS OF UNMANNED AIRCRAFT SYSTEMS**	**9**
Involvement of different aspects in the development of UAV-aerodynamic configurations -Aspects of airframe design- Stealth design, payload types, communication, navigations & guidance systems, control & stability, launch, recovery and support systems, reliability design.		
UNIT – III	**MODELING AND CONTROL HELICOPTER MODEL**	**9**
Modeling and control of small and miniature unmanned helicopters –single rotor helicopter design – coaxial rotor helicopter design - autonomous control of a mini quad-rotor vehicle using LQG controllers – linearization and identification of helicopter model.		
UNIT – IV	**UNMANNED AERIAL VEHICLE DESIGN MODELING & CONTROL**	**9**
Development of autonomous quad tilt wing – advanced flight control systems for rotorcraft UAV and MAV – mathematical modeling and non- linear control of VTOL aerial vehicles.		
UNIT – V	**DEPLOYMENT OF UAS/UAV SYSTEMS**	**9**
Only application point of view of various UAS roles played in civil, defense applications -vision based navigation company trails- certification of UAS/UAV/MAV systems.		
TEXT BOOK:		
1. Reg Austin, *Unmanned Aircraft Systems*: UAVS Design, Development and Deployment John Wiley, UK,2010 2. KenzoNonami, FaridKendoul, Satoshi Suzuki, Wei Wang, Daisuke Nakazawa, *Modeling and Control of Unmanned Small Scale Rotorcraft* UAVs & MAVs, Springer, New York, 2010 3. Laurence R. Newcome, *Unmanned Aviation: A Brief History of Unmanned Aerial Vehicles*, American Institute of Aeronautics and Astronautics, New York, 2004		
REFERENCES:		
1. KimonValavanis, *Advances in Unmanned Aerial Vehicles*, Springer, Netherlands, 2007 2. Elizabeth Bone, Christopher Bolkcom, *Unmanned Aerial Vehicles*, Novinka Books, United Kingdom 2004 3. Rogelio Lozano, *Unmanned Aerial Vehicles Embedded Control*, John Wiley & Sons, 2010 4. Pedro Castillo, Rogelio Lozano, Alejandro E. Dzul, *Modelling and Control of Mini-Flying Machines*, *Advances in Industrial Control (Aic)*, Springer-Verlag, London,2005 5. Bernard Mettler, *Identification Modeling and Characteristics of Miniature Rotorcraft*, Kluwer Publishers, USA, 2003.		

Course Designers:

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17ARSE21	ROCKETS AND MISSILES	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

Preamble

This course provides and creates a base for the students to develop concepts of rocket propulsion.

Prerequisite

NIL

Course Objectives

1	To understand the basic concepts of rockets.
2	To provide an in-depth study of propulsion.
3	To develop analytical skills for selection of precise method.
4	To develop criticizing skills for modification and designing components.
5	To develop entrepreneurial skills.

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	Define principles of operation and label components of a rocket.	Remember
CO2.	Explain working of internal combustion engines.	Understand
CO3.	Employ analytical skills.	Apply
CO4.	Categorise the structure and estimate reliability.	Analyze
CO5.	Evaluate and modify the system.	Evaluate
CO6.	Formulate and design a new modified structure.	Create

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO2.	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO3.	S	S	S	S	-	-	-	-	-	-	-	-	M	M	M
CO4.	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S
CO5.	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S
CO6.	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S

S- Strong; M-Medium; L-Low

Syllabus

CLASSIFICATION OF ROCKETS AND MISSILES

Various methods of classification of missiles and rockets – Basic aerodynamic characteristics of surface to surface, surface to air, air to surface and air to air missiles – Examples of various Indian space launch vehicles and missiles – Current status of Indian rocket programme with respect to international scenario

AERODYNAMICS OF ROCKETS AND MISSILES

Airframe components of rockets and missiles – forces acting on a missile while passing through atmosphere – classification of missiles – slender body aerodynamics – method of describing forces and moments – lift force and lateral moment –lateral aerodynamic damping moment – longitudinal moment – drag estimation – upwash and downwash in missile bodies – rocket dispersion.

ROCKET MOTION IN FREE SPACE AND GRAVITATIONAL FIELD

One dimensional and two-dimensional rocket motions in free space and homogeneous gravitational fields – description of vertical, inclined and gravity turn trajectories – determination of range and altitude – simple approximations to determine burn out velocity and altitude – estimation of culmination time and altitude.

STAGING OF ROCKETS AND MISSILES

Design philosophy behind multi staging of launch vehicles and ballistic missiles – optimization of multistage vehicles – stage separation techniques in atmosphere and in space – stage separation dynamics and lateral separation characteristics.

CONTROL OF ROCKETS AND MISSILES

Introduction to aerodynamic and jet control methods – various types of aerodynamic control methods for tactical and short range missiles- aerodynamic characteristics - various types of thrust vector control methods including secondary injection thrust vector control for launch vehicles and ballistic missiles

TEXT BOOK:

TEXT BOOKS:

1. Cornelisse, J.W., "Rocket Propulsion and Space Dynamics", J.W. Freeman & Co., Ltd, London,1982
2. Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 5th Edition, 1993.

REFERENCES:

1. Parker, E.R., "Materials for Missiles and Spacecraft", McGraw Hill Book Co. Inc. 1982.
2. Mathur, M.L., and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers and Distributors, Delhi, 1988.

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17ARSE32	AIRCRAFT MAINTENANCE AND REPAIR	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

Preamble

This subject provides the knowledge and maintenance aspect of airframe systems and rectification of snags. Similarly it gives the in depth knowledge of various technologies behind those systems. It also provides the knowledge of hydraulic and pneumatic system along with aircraft jacking, assembly and rigging

Prerequisite

NIL

Course Objectives

1.	To understand the basic concepts welding in aircraft structural components
2.	To Study the plastics and composites in aircraft
3.	To Study the aircraft jacking, assembly and rigging
4.	To Study the review of hydraulic and pneumatic system
5.	To Study the safety practices

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	Gather the knowledge of fundamental principles of welding in aircraft	Remember
CO2.	Explain the function and operations of various systems in aircraft	Understand
CO3.	Explain the function and operations of aircraft jacking, assembly and rigging	Understand
CO4.	Utilize the concept and finding out the parameters of hydraulic and pneumatic system	Apply
CO5.	Formulate the performance of safety practices and its instruments.	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1.	L	L	L	-	-	-	-	-	-	-	-	L	L	L	L
CO2.	M	L	-	L	M	-	-	-	-	-	-	-	L	M	L
CO3.	S	L	M	S	M	-	-	-	L	-	-	L	M	M	M
CO4.	S	M	M	S	M	-	-	-	-	-	-	-	S	S	S
CO5.	M	S	S	M	S	-	-	-	-	--	-	M	S	S	S

S- Strong; M-Medium; L-Low

Syllabus

UNIT – I	WELDING IN AIRCRAFT STRUCTURAL COMPONENTS	10
Equipments used in welding shop and their maintenance – Ensuring quality welds – Welding jigs and fixtures – Soldering and brazing - Sheet Metal Repair And Maintenance - Inspection of damage – Classification – Repair or replacement – Sheet metal inspection – N.D.T. Testing – Riveted repair design, Damage investigation – reverse technology		
UNIT – II	**PLASTICS AND COMPOSITES IN AIRCRAFT**	**10**
Review of types of plastics used in airplanes – Maintenance and repair of plastic components – Repair of cracks, holes etc., various repair schemes – Scopes. Inspection and Repair of composite components – Special precautions – Autoclaves		

UNIT – III	AIRCRAFT JACKING, ASSEMBLY AND RIGGING	8
Airplane jacking and weighing and C.G. Location. Balancing of control surfaces – Inspection maintenance. Helicopter flight controls. Tracking and balancing of main rotor		
UNIT – IV	**REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM**	**10**
Trouble shooting and maintenance practices – Service and inspection. – Inspection and maintenance of landing gear systems. – Inspection and maintenance of air-conditioning and pressurization system, water and waste system. Installation and maintenance of Instruments – handling – Testing – Inspection. Inspection and maintenance of auxiliary systems – Fire protection systems – Ice protection system – Rain removal system – Position and warning system – Auxiliary Power Units (APUs)		
UNIT – V	**SAFETY PRACTICES**	**7**
Hazardous materials storage and handling, Aircraft furnishing practices – Equipments. Trouble shooting - Theory and practices		
TEXT BOOK:		
1. KROES, WATKINS, DELP, “Aircraft Maintenance and Repair”, McGraw-Hill, New York, 1992		
REFERENCES:		
1. LARRY REITHMEIR, “Aircraft Repair Manual”, Palamar Books, Marquette, 1992. 2. BRIMM D.J. BOGGES H.E., “Aircraft Maintenance”, Pitman Publishing corp. New York, 1940		

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17ARSE35	ADVANCED MATERIALS AND NDT FOR AEROSPACE APPLICATIONS	Category	L	T	P	Credit
		EC(OE)	**3**	**0**	**0**	**3**

Preamble

This course provides knowledge about advanced materials and creates a base for the students to develop good concepts in metallurgy.

Prerequisite

NIL

Course Objectives

1	To understand the basics of metallurgy.
2	To develop skills for selection of materials.
3	To develop analytical skills for selection of precise method.
4	To develop criticizing skills for modification and designing components.
5	To develop entrepreneurial skills.

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	Understand principles of operation of metallurgical processes involved.	Remember
CO2.	Identify best material for its precise applications.	Understand
CO3.	Employ analytical skills for trouble shooting and further provide solutions.	Apply
CO4.	Categorise the materials depending on reliability.	Analyze
CO5.	Evaluate and modify the parts and components.	Evaluate
CO6.	Formulate and design a new component.	Create

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO2.	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO3.	S	S	S	S	-	-	-	-	-	-	-	-	M	M	M
CO4.	S	S	S	S	-	-	-	-	-	-	-	S	S	S	S
CO5.	S	S	S	S	-	-	-	-	-	-	S	-	S	S	S
CO6.	S	S	S	S	-	-	-	-	-	-	S	S	S	S	S

S- Strong; M-Medium; L-Low

Syllabus

UNIT I SUPERALLOYS 9

Iron base, Nickel base and Cobalt base super alloys, composition control, solid solution strengthening, precipitation hardening by gamma prime, grain boundary strengthening, TCP phase, Embrittlement, solidification of single crystals, Inter-metallics, high temperature ceramics.

UNIT II CERAMICS 9

Introduction – powder metallurgy - modern ceramic materials – cermets - cutting tools – glass ceramic – production of semi fabricated forms - plastics and rubber – carbon/carbon composites, fabrication processes involved in metal matrix composites - shape memory alloys – applications in aerospace vehicle design, open and close mould processes.

UNIT III HIGH TEMPERATURE MATERIALS CHARACTERIZATION 9

Classification, production and characteristics – determination of mechanical and thermal properties of materials at elevated temperatures – heat treatment of carbon steels – aluminium alloys, magnesium alloys and titanium alloys – effect of alloying treatment, heat resistance alloys – tool and die steels, magnetic alloys,application of these materials in thermal protection systems of aerospace vehicles – super alloys – high temperature material characterization.

UNIT IV CREEP AND FRACTURE RESISTANCE 9

Design of transient creep time, hardening, strain hardening, expressions of rupture life of creep, ductile and brittle materials, types of fracture, brittle to ductile from low temperature to high temperature, cleavage fracture, ductile fracture due to micro void coalescence-diffusion controlled void growth; fracture maps for different alloys and oxides.

UNIT V NON DESTRUCTIVE TESTING 9

Principle of NDT, types of cracks and their growth, Red Dye Penetrant method, Fluorescent Penetrant method, X-Ray, Magnetic Particle Inspection method, Ultra sonic method, Eddy Current Inspection method of crack detection.

TEXT BOOK:

TEXT BOOKS:

1. Titterton.G., ”Aircraft Materials and Processes", V Edition, Pitman Publishing Co., 1995.
2. Hertzberg R. W., “Deformation and Fracture Mechanics of Engineering materials”, 4th Edition, John Wiley, USA, 1996.
3. Courtney T.H, “Mechanical Behavior of Materials”, McGraw-Hill, USA, 1990.

REFERENCES:

1. Martin, J.W., "Engineering Materials, Their properties and Applications", Wykedham Publications (London) Ltd., 1987.
2. Van Vlack. L.H., "Materials Science for Engineers", Addison Wesley, 1985.
3. Raghavan.V., "Materials Science and Engineering", Prentice Hall of India, New Delhi, 1993.
4. Bressers. J., “Creep and Fatigue in High Temperature Alloys”, Applied Science, 1981.
5. McLean D., “Directionally Solidified Materials for High Temperature Service”, The Metals Society, USA, 1985.

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AUTOMOBILE ENGINEERING - OPEN ELECTIVE

17ATEC02	NEW GENERATION AND HYBRID VEHICLES	Category	L	T	P	Credit
		EC (OE)	3	0	0	3

PREAMBLE

To teach the students about the new generation and hybrid vehicles

PREREQUISITE: NIL

COURSE OBJECTIVES

1	*To understand the hybrid vehicles.*
2	*To understand the power system and new generation vehicles.*
3	*To understands the vehicle operation and control.*
4	*To study about vehicle automated tracks*
5	*To study automotive suspension, brakes, aerodynamics and safety*

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1.	Ability to understand the importance of Hybrid vehicle	Understand
CO2.	Student Should be able to understand about GBS	Understand
CO3.	Student should get knowledge of vehicle speed control by EGM	Understand
CO4.	One should be able to identify the vehicle how to control by satellite	Apply
CO5.	How to measure the vehicle safety and its components	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
CO1	S	M	L	L	--	--	--	L	--	--	--	M	L	--	--
CO2	S	M	M	L	--	--	--	M	--	--	--	M	L	--	--
CO3	S	M	M	L	--	--	--	L	--	--	--	M	L	--	--
CO4	S	S	S	M	L	--	--	M	--	--	--	M	L	--	--
CO5	S	S	S	M	M	--	--	M	--	--	--	M	L	--	--

S- Strong; M-Medium; L-Low

UNIT-I NTRODUCTION

Electric and hybrid vehicles, flexible fuel vehicles (FFV), solar powered vehicles, magnetic track vehicles, fuel cells vehicles.

INTROD

UNIT-II POWER SYSTRM AND NEW GENERATION VEHICLES

Hybrid Vehicle engines, Stratified charge engines, learn burn engines, low heat rejection engines, hydrogen engines, HCCI engine, VCR engine, surface ignition engines, VVTI engines. High energy and power density batteries, fuel cells, solar panels, flexible fuel systems

UNIT-III VEHICLE OPERATION AND CONTROL

Computer Control for pollution and noise control and for fuel economy – Transducers and actuators - Information technology for receiving proper information and operation of the vehicle like optimum speed .

UNIT-IV VEHICLE AUTOMATED TRACKS

Preparation and maintenance of proper road network - National highway network with automated roads and vehicles - Satellite control of vehicle operation for safe and fast travel, GPS.
.

UNIT-V SUSPENSION, BRAKES, AERODYNAMICS AND SAFETY

Air suspension – Closed loop suspension, compensated suspension, anti-skid braking system, retarders, regenerative braking, safety gauge air backs- crash resistance. Aerodynamics for modern vehicles, safety systems, materials and standards.

TEXT BOOKS:

Heinz, "Modern Vehicle Technology" Second Edition, Bu

Bosch Hand Book, SAE Publication, 2000

Reference:

Light weight electric for hybrid vehicle design.

Advance hybrid vehicle power transmission, SAE.

Noise reduction, Branek L.L., McGraw Hill Book company, New York, 1993.

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17ATEC03	MODERN AUTOMOBILE ACCESSORIES	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

PREAMBLE

To teach the students about the various Automobile accessories in Modern Vehicles

PREREQUISITE: NIL

COURSE OBJECTIVES

1	*To understand the Engine Management Systems*
2	*To understand the Chassis.*
3	*To understand the Heating and Air Conditioning*
4	*To impart the various Comfort and Convenience*
5	*To understand the various Safety and Security Systems*

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1.	Understand the working principle and Development EGM	Understand
CO2.	Understand the working principle and Development Suspension System	Understand
CO3.	Understand the working principle of Air Condition System.	Understand
CO4.	Understand the working principle of vehicle comfort	Apply
CO5.	Understand thevehicle safety	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	L	--	--	--	L	--	--	--	M	L	--	--
CO2	S	M	M	L	--	--	--	M	--	--	--	M	L	--	--
CO3	S	M	M	L	--	--	--	L	--	--	--	M	L	--	--
CO4	S	S	S	M	L	--	--	M	--	--	--	M	L	--	--
CO5	S	S	S	M	M	--	--	M	--	--	--	M	L	--	--

S- Strong; M-Medium; L-Low

ENGINE MANAGEMENT
Electronically controlled SI and CI engine fuel injection systems, related hardware and software. Closed loop ignition system. Catalytic converters and particulate traps.

CHASSIS
Active suspension control, Pneumatic suspensions

HEATING AND AIR CONDITIONING
Principles of vehicle air conditioning and heating.

COMFORT AND CONVENIENCE
Adaptive cruise control, car entertainment, power windows, navigation system, adaptive noise control, electric seats, driver information system. Power windows, power steering.

SAFETY AND SECURITY SYSTEMS
Airbags, seat belt tightening system, collapsible and tilt able steering column, Anti-theft system, anti-lock braking system, electronic stability control system/traction control system, roll over protection system.

Text Books:

1 Bosch Automotive Hand Book - 5th Edition - SAE Publication, USA - 2000.

Reference:

1 Tom Denton - "Automobile Electrical and Electronic Systems" - Edward Arnold, London - 1995.

2. Eric Chowanietz - „Automotive Electronics‟ - SAE International USA - 1995.

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17ATEC05	POLYMER COMPONENTS AND RUBBER MATERIALS IN AUTOMOBILE APPLICATIONS	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

Preamble

To teach the students about the Polymers and rubbers in Automobile applications.

Prerequisite NIL

Course Objective

1	To understand the plastics
2	To understand the structure-property relationship of rubber
3	To understands the vibration and rubber spring
4	To study about fluid sealing's.
5	To study compounding and manufacture.

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Gain knowledge about various rubber components used in automobiles.	Understand
CO2.	Gain the knowledge of various structure properties of Rubber materials.	Understand
CO3.	Evaluate the various vibration characteristics of Rubber spring.	Apply
CO4.	Impart the knowledge of various Fluid sealings & Flexible hoses	Understand
CO5.	To gain the knowledge of compounding and manufacture of couplings.	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	L	L	L	S	S	S	M	S	L	S			
CO2	S	M	L	L	L	M	M	M	M	M	L	M			
CO3	S	M	M	M	L	S	S	S	M	S	L	S			
CO4	S	M	M	M	L	M	M	M	M	M	L	M			
CO5	S	M	L	L	L	M	M	M	M	M	L	M			

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Identification of plastics / rubber components in automobiles - function - selection criteria.

STRUCTURE-PROPERTY RELATIONSHIP OF RUBBER

Resilience, creep, hysteresis and damping, stability, set and stress relaxation, behavior in dynamic applications.

VIBRATION AND RUBBER SPRING

Principle of vibration isolation - Rubber mounts - spring design - comparison with metallic springs - shape factor and its effect - forced and free vibrations with damping - typical mounts, compounding .

FLUID SEALINGS AND FLEXIBLE COUPLING AND HOSES

Seals for static and dynamic applications - effect of heat/ oil ageing - frictional behavior - fundamental of sealability.

COMPOUNDING AND MANUFACTURE

Types of couplings - specification and selection- torque Vs deflection relationships - brake fluid /hydraulic hoses, materials and manufacture

Text Books

1	Freakley.P.K., and Payne A.R., Theory and Practice of Engineering with Rubber., Applied Science Publishers Ltd.

Reference Books

1	Hobel,E.F., Rubber Springs Design
2	Blow,C.M. and Hepburn.C, Rubber Technology and Manufacture

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17ATEC12	FUEL CELL TECHNOLOGY	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

PREAMBLE

To study and understand the substitute for conventional automobile fuels and energy source

PREREQUISITE: NIL

COURSE OBJECTIVES

1	*To impart the knowledge of various alternate fuels in vehicles.*
2	*To understand the entire properties of alcohols.*
3	*To understand the various fuels like natural gas, LPG, hydrogen and biogas*
4	*To impart the knowledge of vegetable oils..*
5	*To impart the knowledge of electric and solar vehicles*

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1.	To learn the detailed study ofalternate fuel	Understand
CO2.	To learn the detailed study of alternate fuel's properties	Understand
CO3.	To learn the detailed study LPG and Hydrogen fuels	Understand
CO4.	To learn about how to use the bio feul in ic engine	Apply
CO5.	To learn how to design the electric drive vehicle	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	L	--	--	--	L	--	--	--	M	L	--	--
CO2	S	M	M	L	--	--	--	M	--	--	--	M	L	--	--
CO3	S	M	M	L	--	--	--	L	--	--	--	M	L	--	--
CO4	S	S	S	M	L	--	--	M	--	--	--	M	L	--	--
CO5	S	S	S	M	M	--	--	M	--	--	--	M	L	--	--

S- Strong; M-Medium; L-Low

FUELCELL TECHNOLOGY

Structures, Operations and properties of Fuel cells – (Phosphoric Acid Fuel cell, Proton Exchange membrane Fuel cell, Direct Methanol fuel cell Alkaline Fuel Cells, Solid Oxide Fuel Cell, Molten Carbonate Fuel Cell) -Characteristics. Electrochemical energy conversion – Theoretical efficiency – Factors affecting electrochemical energy conversion- Helmholtz double layer model.

INTRODU

FUEL CELL BASED VEHICLES STRUCTURE

PEMFC: Operating principle (membranes, electrodes and electrolysis, optimization of membrane and electrode assembly, impurities) – Technology development (single cell and stacks, composite plates) – Fuel processing – Modeling studies (membrane, electrode, membrane-electrode assembly, fuel cell, stack and system) – Technology development and applications.

DMFC: Operating principle – Noble metal issue – Electro-oxidation of methanol (Catalysts, oxygen electroreduction, electrolyte, non catalytic aspects) - Methanol crossover.

HYBRID ELECTRIC TECHNOLOGY AND ELECTRIC DRIVETRAIN

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental impartance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT IV - HYBRID ELECTRIC VEHICLES

Principles of Hybrid Electric Drivetrains, Architectures – Electrical distribution, Hybrid control Strategies – Parallel Hybrid, Series Hybrid - (Charge Sustaining, Charge Depleting), Practical Models – Toyota Prius, Honda Insight. Hybridization Effects. 42 V System for Traction Applications - Lightly Hybridized vehicles, Low –Voltage Storage System, Low – Voltage main system with High voltage bus for propulsion. Heavy Vehicles Hybrid Electric Heavy Duty Vehicles, Fuel cell Heavy duty vehicles.

UNIT V - HYBRID VEHICLE TECHNOLOGY

Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems. Energy Management Strategies in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

TEXT BOOKS:

1. Basu .S, “Recent Trends in Fuel cell Science and Technology”, Anamaya Publishers, New Delhi.,2007.
2. Viswanathan, B. and Aulice Scibioh, M., “Fuel Cells Principles and Applications”, Universities Press (India) Pvt. Ltd., Hyderabad, 2006.
3. Hoogers, G., Edr. “Fuel Cell Technology Handbook”, CRC Press, Washington D. C,2003.

Reference:

1) Larminie, J. and Dicks, A., “Fuel Cell Systems Explained” John Wiley & Sons, Ltd., New York,2001.
2) Ali Emadi, Mehrdad Ehsani, John M. Muller, “Vehicular Electric Power Systems”, Marcel Dekker,Inc., 2004.

S.No	Name of the Faculty	Designation	Department / Name of the College	Mail ID
1	SAMUVEL MICHAEL	Asso.Prof Gr-II	MECH/AVIT	samuvelmichael@avit.ac.in

17ATEC13	COMPUTER SIMULATION OF IC ENGINE PROCESSOR	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

Preamble

This course includes the study of adiabatic flame temperature, analysis of actual and ideal cycles and simulation of S.I, and C.I engine performance

Prerequisite

NIL

Course Objective

1	To know the measurement of HRR and calculation of Adiabatic flame temperature of IC engines
2	To study I.C engine simulation with Adiabatic combustion
3	To learn the simulation of IC engines with gas exchange processes and engine performance simulation
4	To know the Simulation of S.I engine with intake and exhaust charging
5	To study the simulation of C.I engine performance

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Analyze the measurement of HRR and calculation of Adiabatic flame temperature	Analyze
CO2.	Apply the I.C engine simulation with Adiabatic combustion	Apply
CO3.	Apply the simulation of IC engines with gas exchange processes and engine performance simulation	Apply
CO4.	Apply the Simulation of S.I engine with intake and exhaust charging	Apply
CO5.	Apply the simulation of C.I engine performance	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	L	M										
CO2	S	M	L	L	L										
CO3	S	M	L	L	M										
CO4	S	M	L	L	M		L								
CO5	S	M	L	L	M		L								

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Introduction – Heat of reaction – Measurement of URP – Measurement of HRR – Adiabatic flame temperature: Complete combustion in C/H/O/N Systems, Constant volume adiabatic combustion, constant pressure adiabatic combustion. Calculation of adiabatic flame temperature – Isentropic changes

ENGINE SIMULATION WITH AIR AS WORKING MEDIUM

Deviation between actual and ideal cycle – problems, SI engine simulation with adiabatic combustion, temperature drop due to fuel vaporization, full throttle operation – efficiency calculation, part – throttle operation, super charged operation.

PROGRESSIVE COMBUSTION

SI Engines simulation with progressive combustion with gas exchange process, Heat transfer process, friction calculation, compression of simulated values, validation of the computer code, engine performance simulation, pressure crank angle diagram and other engine performance.

SIMULATION OF SI ENGINE

Intake – Exhaust - Charging and Combustion Simulation for two stroke and four stroke spark ignition Engine

DIESEL ENGINE SIMULATION

Zero, one and multi zone model for combustion, different heat release and heat transfer models, equilibrium calculations, simulation of engine performance.

Text Books

1	Ganesan. V - “InternalCombustion Engines” - Tata McGraw-Hill, 2003.
2	Ganesan.V. – Computer Simulation of compression ignition engines – Orcent

Reference Books

1	Ramoss A.L. Modeling of Internal Combustion Engines process, McGraw Hill Publishing Co., 1992
2	Ashley Cambel, Thermodynamics analysis of combustion engines, John Wiley & Son, New York, 1986.
3	Benson, R.S., Whitehouse, N.D., Internal Combustion Engines, Pergamon Press, Oxford, 1979.

Course Designers

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1	A.IMITH YAS	ASST PROF G1	AVIT	imthicyr@gmail.com

17ATEC14	COMPUTER CONTROLLED VEHICLE SYSTEM	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

Preamble

This course introduces the role of sensors and actuators for controlling the engine, drive line. It also provide knowledge about the transportation and safety devices controlled by computer

Prerequisite

NIL

Course Objective

1	To know thecontrol Autonomy of vehicles
2	To study computer controlled fuel, Ignition , Speed and knock system of IC engine
3	To learn the computer controlled drive line system of Automobile
4	To study about the computer control transportation system
5	To learn about the smart safety devices of Automobile

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Understand the role of sensors and actuators used in vehicle control system	Understand
CO2.	Control fuel,Ignition , speed and knock in IC engine	Apply
CO3.	Control Drive line system, Steering and suspension systems	Apply
CO4.	Understand intelligent transportation system	Understand
CO5.	Analyze the smart safety Devices used in Automobiles	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	M	L	M	L									
CO2	S	L			M	L									
CO3	S	L				L									
CO4	S	L	M	M	M	M	M		L	L		L			
CO5	S	M			M	M	M								

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Understanding autonomy – Review of the role of control in autonomy (speed control, suspension control & integrated vehicle dynamics) - Role of sensors and actuators. Examples of autonomy cruise control
ENGINE CONTROL SYSTEM
Fuel control-Ignition control in SI engines- Lambda control- idle speed control- Knock control- cylinder balancing
DRIVE LINE CONTROL SYSTEM
Speed control – gear shifting control – traction /braking- steering- suspension – vehicle handling and ride characteristics of road vehicles- adaptive cruise control
INTELLIGENT TRANSPORTATION SYSTEM
Overview – control architecture – collision avoidance, pitch, yaw, bounce control – traffic routing system- automated high way systems- lane warning system- driver information system-data
SAFETY IMPACTING DEVICES
Vision enhancement- driver conditioning warming- anti-lock braking systems – route guidance and navigation systems – in-vehicle computing – commercial vehicle diagnostic/ prognostics – hybrid/ electric and future cars- case study.

Text Books	
1	Automotive control systems, U.Kienckeand L. Nielson, SAE and springer-Verlag, 2000
Reference Books	
1	Crouse, W.H. & Anglin, D.L., Automotive Mechanics, Intl. Student edition, TMH, New Delhi.
2	Artamonov, M.D., Harionov, V.A. & Morin, M.M. Motor Vehicle, Mir Publishers, Moscow 1978
3	Heitner, J., Automotive Mechanics, CBS Publishers, New Delhi 1987.
4	Stockel Martin W and Stocker Martin T., Auto Mechanics Fundamentals, Goodheart Wilcox,

Course Designers

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1	A.IMITHYAS	ASST PROF G1	AVIT	imthicyr@gmail.com

17ATEC17	VEHICLE AIR-CONDITIONING	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

Preamble

To teach the students about the vehicle air-conditioning

Prerequisite NIL

Course Objective

1	Understand the principles and applications of Air conditioning systems.
2	To understand the air conditioner – heating system.
3	To understands the properties of air conditioning coolant.
4	To study about air routing and temperature control
5	To study heater- air conditioner trouble shooting &service

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Gain knowledge about various air conditioning systems	Understand
CO2.	Gain the knowledge of cooling and heating loads in an air-conditioning system	Understand
CO3.	Evalute the diagonostic characteristics of Refrigeration system	Apply
CO4.	Evalute the various testing of air control and handling systems.	Apply
CO5.	Learn the various methods of Trouble shooting in air conditioning systems.	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	L	L	L	S	S	S	M	S	L	S			
CO2	S	M	L	L	L	M	M	M	M	M	L	M			
CO3	S	M	M	M	L	S	S	S	M	S	L	S			
CO4	S	M	M	M	L	M	M	M	M	M	L	M			
CO5	S	M	L	L	L	M	M	M	M	M	L	M			

S- Strong; M-Medium; L-Low

SYLLABUS

AUTOMOTIVE AIR-CONDITIONING FUNDAMENTALS

Basic Air conditioning system- Location of Air conditioning components in a car – schematic layout of a Refrigeration system. Compressor components- condenser and high-pressure service ports. Thermostatic expansion valve and Orifice tube – expansion valve calibration – evaporator temperature controls for air conditioning systems

AIRCONDITIONER – HEATING SYSTEM

Manually controlled air conditioner- Heater system- ford automatically controlled air conditioner- Heater systems- Chrysler automatically controlled air conditioner- heater system, general motors automatically controlled Air conditioner- heater system- Flushing and evacuating

REFRIGERANT

Containers- handling refrigerant – discharging, charging and leak detection – refrigeration system Diagnosis – Diagnostic procedure – Ambient conditions affecting system pressures

AIR ROUTING AND TEMPERATURE CONTROL

Objectives – Evaporators case air flow through the Dash recalculating unit – Automatic Temperature control – Duct system- Controlling flow – vacuum reserve – testing the air control and handling systems.

HEATER- AIR CONDITIONER TROUBLE SHOOTING

Air conditioner maintenance and service- servicing heater system. Removing and replacing components. trouble shooting of air conditioner- heating system- compressor service

Text Books

1	William H Crouse and Donald L Anglin, Automotive Air Conditioning McGraw Hill inc; 1990. .

Reference Books

1	Mitchell information services, Inc., Mitchell Automotive Heating and Air conditioning systems, prentice Hall Inc, 1989.
2	Paul Weisler, Paul Weisler, Automotive Air conditioning, Restone Publishing Co. Inc., 1990. Automotive Air conditioning, Reston Publishing Co. Inc., 1990
3.	McDonald K.L., Automotive Air conditioning., Theodore Audel series., 1978
4.	Goings.L.F., Automotive Air conditioning., American Technical services, 1974

Course Designers

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1	C.THIAGARAJAN	ASST. PROF GRII	MECH./ AVIT	cthiagarajan@avit.ac.in

BIO MEDICAL ENGINEERING - OPEN ELECTIVE

17BMSE13	BIOMECHANICS	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

Biomechanics is the study of how the systems and structures of biological organisms, from the smallest plants to the largest animals, react to various forces and external stimuli. In humans, biomechanics often refers to the study of how the skeletal and musculature systems work under different conditions. Scientists often try to apply physics and other mathematically based forms of analysis to discover the limits and capabilities of biological systems.

PREREQUISITE : Nil

COURSE OBJECTIVES

1	Explain the principles of mechanics.
2	To study the fluid biomechanics of physiological systems.
3	Discuss the solidbiomechanics of physiological systems.
4	Explain the mechanics of joints.
5	Illustrate the mathematical models used in the analysis of biomechanical systems

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1.Understand the principles of mechanics	Understand
CO2. Outline the principles of bio fluid dynamics.	Understand
CO3. Explain the fundamentals of biosolid mechanics.	Understand
CO4. Apply the knowledge of joint mechanics	Apply
CO5. Design computational mathematical modelling applied in biomechanics.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	M	--	M	--	--	--	--	--	--	M	--	M
CO2	S	M	M	M	--	--	--	--	--	--	--	--	M	--	L
CO3	S	M	M	--	--	--	--	--	--	--	--	--	M	--	L
CO4	M	M	M	M	M	L	--	--	--	--	--	--	M	--	--
CO5	S	M	M	M	M	--	--	--	--	--	--	--	M	--	L

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO MECHANICS

Introduction – Scalars and vectors, Statics – Force types, Resolution and composition of forces, Moments of force and couple, Resultant force determination, parallel forces in space, equilibrium of coplanar forces, Dynamics, Basic principles – Linear motion, Newton's laws of motion, Impulse and Momentum, Work and Energy Kinetics – Velocity and acceleration, Kinematics – Link segment models, Force transducers, Force plates, Introduction to Constitutive equations – Constitutive equations of Non-viscous fluid, Newtonian Viscous fluid and Hookean Elastic solid.

INTRODUCTION TO BIOFLUID MECHANICS
Intrinsic fluid properties – Density, Viscosity, Compressibility and Surface Tension, Viscometers Capillary, Coaxial cylinder and cone and plate, Rheological properties of blood, Pressure-flow relationship for Non-Newtonian Fluids, Fluid mechanics in straight tube – Steady Laminar flow, Turbulent flow, Flow development, Viscous and Turbulent Sheer Stress, Effect of pulsatility, Boundary Layer Separation, Structure of blood vessels, Material properties and modeling of Blood vessels, Heart – Cardiac muscle characterization, Native heart valves – Mechanical properties and valve dynamics, Prosthetic heart valve fluid dynamics.

BIOSOLID MECHANICS
Constitutive equation of viscoelasticity – Maxwell & Voight models, anisotropy, Hard Tissues – Structure, blood circulation, elasticity and strength, viscoelastic properties, functional adaptation, Soft Tissues – Structure, functions, material properties and modeling of Soft Tissues – Cartilage, Tendons and Ligaments Skeletal Muscle – Muscle action, Hill‘s models, mathematical modeling, Bone fracture mechanics, Implants for bone fractures.

BIOMECHANICS OF JOINTS
Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium,Free body diagrams, Structure of joints, Types of joints, Biomechanical analysis of elbow, shoulder, spinal column, hip, knee and ankle, Lubrication of synovial joints, Gait analysis, Motion analysis using video.

MODELING AND ERGONOMICS
Introduction to Finite Element Analysis, finite element analysis of lumbar spine; Ergonomics-Musculoskeletal disorders, Ergonomic principles contributing to good workplace design, Design of a Computer work station, Whole body vibrations, Hand transmitted vibrations.

TEXT BOOKS:

1. Y.C. Fung, **“Bio-Mechanics-Mechanical Properties of Tissues”**, Springer-Verlag, 1998.
2. Subrata Pal, **“Text book of Biomechanics”**, Viva Books Private Limited, 2009.

REFERENCES:

1. Krishna B. Chandran, Ajit P. Yoganathan and Stanley E. Rittgers, **“Biofluid Mechanics: The Human Circulation”**, Taylor and Francis, 2007.
2. Sheraz S. Malik and Shahbaz S. Malik, **“Orthopaedic Biomechanics Made Easy”**, Cambridge University Press, 2015.
3. Jay D. Humphrey, Sherry De Lange, **“An Introduction to Biomechanics: Solids and Fluids, Analysis and Design”**, Springer Science Business Media, 2004.
4. Shrawan Kumar, **“Biomechanics in Ergonomics”**, Second Edition, CRC Press 2007.
5. Neil J. Mansfeild, **“Human Response to Vibration”**, CRC Press, 2005.
6. Carl J. Payton, **“Biomechanical Evaluation of movement in sports and Exercise”**, 2008.

COURSE DESIGNERS

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3	Mrs. R.Indumathi	Assistant Professor (Gr-II)	BME	indhumr@avit.ac.in

17BMSE15	BIOMATERIALS AND ARTIFICIAL ORGANS	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

Biomaterials can be derived either from nature or synthesized in the laboratory using a variety of chemical approaches utilizing metallic components, polymers, ceramics or composite materials. It can be used every day in orthopaedic application, dental applications, surgery, and drug delivery. The primary objective of this course is to impart the knowledge on biomaterials needed to solve challenges in the biomedical engineering.

PRERQUISITE : NIL

COURSE OBJECTIVES

1	To understand about the classes of biomaterials used in medicine and material characterization.
2	To illustrate the properties, manufacturing methods and applications of various biomaterial.
3	To illustrate the materials used in soft tissue replacement and implants in hard tissue replacements.
4	To outline the host response to the biomaterial and degradation of implant materials.
5	To examinethe testing of material and various artificial organs.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Describe the different classes of biomaterials and material characterization.	Understand
CO2. Identify the suitable material and Manufacturing methods for bio implant applications.	Apply
CO3. Apply the knowledge to select suitable materials for tissue replacements.	Apply
CO4. Analyze the mechanism of host-tissue interaction and failure of materials.	Analyze
CO5. Apply the knowledge to test the biomaterials and predict the mechanism artificial organs.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	--	--	--	--	--	--	--	L	--	--	S	--	M	L
CO2	S	--	--	--	--	L	--	--	M	--	--	S	--	M	M
CO3	S	--	--	--	--	L	--	--	M	--	--	S	--	S	M
CO4	L	S	M	--	M	M	--	--	M	--	--	S	S	L	M
CO5	S	--	--	--	S	L	--	--	M	--	M	S	--	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO BIOMATERIALS: Biomaterials – Definition, Classification of biomaterials, Structure of solids, Material characterization – Mechanical, thermal, Phase diagrams, Surface properties, Electrical, Optical, X-ray absorption, Acoustic and Ultrasonic, Density and porosity, Diffusion properties. Engineered natural materials, Technologies of biomaterials processing, Surface Coatings Methods, Surface modification of materials.

CLASSES OF BIOMATERIALS: Metals: Stainless steel, Cobalt-Chromium alloy, Titanium alloys. Polymers: Classification and Synthesis, Polyesters, Polyamides, Polyacrylates, Silicones, Hydrogels, Fluorocarbon polymers. Ceramics: Alumina, Zirconia, Hydroxyapatites. Composites as biomaterials.

SOFT AND HARD TISSUE APPLICATIONS: Sutures, Adhesives, Wound dressings, Maxillofacial and other Soft-tissue augmentation, Heart valve implant, Cardiovascular Grafts and Stents, Orthopedic fixation devices: Internal fixation devices - Wires, Pins, Screws, Fracture Plates and Intramedullary Devices. Joint replacement - Hip joint replacements, Knee joint replacements, Ankle joint replacement, Upper Extremity joint replacements, Dental implants.

HOST RESPONSE AND MATERIAL FAILURE: Host Reaction to Biomaterials - Inflammation, Wound healing, Foreign-body reaction, Blood–Materials Interactions. Degradation of Implanted Materials - Deterioration of polymers, Biodegradation of biostable and biodegradable polymers, Metal corrosion, Ceramic degradation. Device failure mode analysis.

BIOMATERIAL TESTING AND ARTIFICIAL ORGANS: Testing of biomaterials: In-vitro, In-vivo preclinical tests, Sterilization of implants and devices, Artificial Blood, Artificial skin, Artificial Heart, Artificial Kidney, Artificial lung (oxygenator), Artificial Pancreas, Eye and Ear implants.

TEXT BOOKS:

1. Joon park, R.S. Lakes, **"Biomaterials and introduction"**, 3rd Edition, Springer Science Business Media LLC, 2007.
2. BD Ratner, AS Hoffmann, FJ Schoen, JE Lemmons, **"An introduction to Materials in Medicine"**, 3rd Edition, Academic Press, 2013.

REFERENCES:

1. Sujata V. Bhatt, **"Biomaterials"**, Second Edition, Narosa Publishing House, 2005.
2. Joseph D. Bronzino, **"The Biomedical Engineering Hand Book"**, Second Edition, CRC Press LLC, 2000. "

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Mr.K.Natarajan	Associate Professor	BME	natarajank@vmkvec.edu.in
2	Mrs. R.Indumathi	Assistant Professor (Gr-II)	BME	indhumr@avit.ac.in

17BMSE18	ROBOTICS & AUTOMATION IN MEDICINE	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

The purpose of learning this course on automation and robotics in medicine to acquire knowledge and understand the basic function and to create new application of robotic and automation system in medical field especially in surgery.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To understand the basics of Robotics, Kinematics.
2	To understand the basics of Inverse Kinematics.
3	To explore various kinematic motion planning solutions for various Robotic configurations.
4	To study the basic inverse Kinematic motion planning solutions.
5	To explore various applications of Robots in Medicine.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Understand the basics of robotic systems.	Understand
CO2. Outline the basics of automation and robotics in medicine.	Evaluate
CO3. Design basic Robotics system and formulate Kinematics.	Create
CO4. Construct Inverse Kinematic motion planning solutions for various Robotic configurations.	Create
CO5. Design Robotic systems for Medical application.	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	L	--	--	--	S	L	--	--	M	--	--	--
CO2	S	S	L	L	--	--	--	M	M	--	--	L	M	--	--
CO3	M	M	L	L	--	--	--	M	L	--	--	M	M	--	L
CO4	M	M	L	L	--	--	--	L	M	--	--	L	M	--	M
CO5	M	L	L	L	--	--	--	L	L	--	--	M	L	--	--

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Introduction Automation and Robots, Classification, Application, Specification, Notations, Direct Kinematics Dot and cross products, Coordinate frames, Rotations, Homogeneous coordinates Link coordination arm equation – Five-axis robot, Four-axis robot, Six-axis robot.

KINEMATICS
Inverse Kinematics – General properties of solutions tool configuration, Five axis robots, Three Four axis, Six axis Robot, Workspace analysis and trajectory planning work envelope and examples, workspace fixtures, Pick and place operations, Continuous path motion, Interpolated motion, Straight-line motion.

ROBOT VISION
Robot Vision Image representation, Template matching, Polyhedral objects, Shane analysis, Segmentation – Thresholding, region labeling, Shrink operators, Swell operators, Euler numbers, Perspective transformation, Structured illumination, Camera calibration.

PLANNING
Task Planning Task level programming, Uncertainty, Configuration, Space, Gross motion, Planning, Grasp Planning, Fine-motion planning, Simulation of planar motion, Source and Goal scenes, Task Planner simulation.

APPLICATIONS
Applications in Biomedical Engineering – Bio Engineering, Biologically Inspired Robots, Neural Engineering, Application in Rehabilitation – Interactive Therapy, Bionic Arm, Clinical and Surgical – Gynaecology, Orthopaedics, Neurosurgery.

TEXT BOOKS:

1. Robert Schilling, "**Fundamentals of Robotics-Analysis and control"**, Prentice Hall, 2003.
2. J.J.Craig, **"Introduction to Robotics"**, Pearson Education, 2005.

REFERENCES:

1. Staugaard, Andrew C, **"Robotics and Artificial Intelligence: An Introduction to Applied Machine Learning"**, Prentice Hall Of India, 1987
2. Grover, Wiess, Nagel, Oderey, **"Industrial Robotics: Technology, Programming and Applications"**, McGraw Hill, 1986.
3. Wolfram Stadler, **"Analytical Robotics and Mechatronics"**, McGraw Hill, 1995.
4. Saeed B. Niku, **"Introduction to Robotics: Analysis, Systems, Applications"**, Prentice Hall, 2001.
5. K. S. Fu, R. C. Gonzales and C. S. G. Lee, **"Robotics"**, McGraw Hill, 2008.

COURSE DESIGNERS

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3	Mr. S.Kannan	Assistant Professor	BME	kannan@vmkvec.edu.in

17BMSE22	CRITICAL CARE INSTRUMENTS AND THERAPEUTIC EQUIPMENT	Category	L	T	P	Credit
		EC - SE	3	0	0	3

PREAMBLE

This course is designed to enable students to understand the principles of monitoring of respiratory, cardiovascular and other systems of the patients in ICU. Many diagnostic and therapeutic devices such as ventilators, hemodialysis, pacemakers, infusion pumps, and deep-brain or spinal stimulators attempt to augment or, in some cases, replace certain critical physiological functionalities.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To describe the basic principles of monitoring system.
2	To identify the benefits and risks of ICU monitoring techniques.
3	To describe the functions of Pacemaker and defibrillator.
4	To understand the functions of therapeutic equipment.
5	To study ventilators and drug delivery systems.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Operate the critical care instruments.	Apply
CO2. Know how to tackle the critical situation.	Understand
CO3. Apply the diathermy systems.	Apply
CO4. Use hemodialysis and lithotripter techniques.	Analyze
CO5. Know ventilator and drug delivery systems.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	--	L	L	M	--	L	--	--	--	--	--	M	--	--
CO2	S	--	M	L	M	--	--	--	--	--	--	--	M	--	L
CO3	S	--	M	L	M	--	L	--	--	--	--	--	M	--	--
CO4	S	--	M	L	M	--		--	--	--	--	--	M	--	L
CO5	S	--	M	L	M	--		--	--	--	--	--	M	--	--

S- Strong; M-Medium; L-Low

SYLLABUS

CRITICAL CARE MONITORING SYSTEM

Objective of critical care monitoring system, cardiac monitor, Bed side monitoring system, Central monitors, Cardiac arrhythmia, Arrhythmia monitor, ST/AR arrhythmia algorithm, Ambulatory monitoring instruments, Fetal monitoring.

CARDIAC PACEMAKER AND DEFIBRILLATOR

Need for pacemaker. External pacemaker, Implantable pacemaker. Types of implantable pacemaker, Pacing modes, ventricular synchronous demand pacemaker, Power sources for implantable pacemaker.

Defibrillator- Need for defibrillator, Dc defibrillator, Implantable defibrillator, Pacer – cardioverter defibrillator, Defibrillator analyser.

ELECTRO THERAPHY AND SURGICAL DIATHERMY
Short wave diathermy, Microwave diathermy, Ultrasonic theraphy Unit, Electrotherapy, Pain Relief through electrical stimulation. Principles of surgical diathermy, Types of electro surgery techniques, Surgical diathermy machine, Coagulation modes, Mono polar and bipolar technique, Electrodes used with surgical diathermy, Surgical diathermy analyzers.

HAEMODIALYSIS AND LITHOTRIPTOR
Function of kidney, Artificial kidney, Types of dialyzers, Performance analysis of dialyzer, Hemodialysis machine, Portable Kidney Machine. Lithotripter- Stone disease problem, First lithotripter machine, Modern lithotripter systems.

VENTILATORS AND DRUG DELIVERY SYSTEMS
Mechanics of Respiration, Ventilators, Ventilator terms, Classification of ventilators, Modern ventilator. Humidifier, Nebulizers and Aspirator. Drug delivery systems- infusion pomp, components of infusion pump, implantable infusion systems, Examples of typical infusion pumps.

TEXT BOOKS:

1. Khandpur R.S, **"Hand book of Biomedical Instrumentation"**, Tata McGraw Hill, 2nd Edition, 2003.
2. Leslie Cromwell, Fred Weibell J, Erich Pfeiffer. A, **"Biomedical Instrumentation and Measurements"**, Prentice-Hall India, 2nd Edition, 1997.

REFERENCES:

1. Arumugam, M, **"Biomedical instrumentation"**, Anuradha publications, 2008.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. N.Babu	Professor	BME	babu@vmkvec.edu.in
2	Mrs. R.Indumathi	Assistant Professor (Gr-II)	BME	indhumr@avit.ac.in
3	Mrs.S.Vaishnodevi	Assistant Professor	BME	vaishnodevi@vmkvec.edu.in

BIO TECHNOLOGY - OPEN ELECTIVE

17BTCC15	FOOD PROCESSING TECHNOLOGY	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

PREAMBLE

Food Processing Technology deals with the study of food production, processing, packaging, preservation and the use of technology and Engineering techniques in aiding the above-mentioned stages. It also deals with artificial food, artificial edible items, nutrition science and its Chemistry. It allows students to learn about food and nutrients, role of functional foods and the strategies to produce specific food ingredients.

PRERQUISITE - NIL

COURSE OBJECTIVES

1	To explain different types of foods, factors affecting food & food products and the micro-organisms which cause food borne diseases
2	To explain the concepts of food spoilage and different food preservation methods, and their impact on the shelf life, quality, and other physical and sensory characteristics of foods
3	To discuss the different food processing methods and its applicability in food product preparations
4	To choose appropriate modern methods of food preservation for industrialization
5	To Choose the materials and types of packaging for foods and its quality testing

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Identify different microbes associated with foods, and food borne diseases.	Understand
CO2. Describe the role of microbes in food spoilage and food preservation	Understand
CO3. Summarize all food processing methods and demonstrate its application in food product preparation	Understand
CO4. Illustrate the modern methods to modify foods using biotechnology.	Apply
CO5. Demonstrate packing methods, materials and factors affecting food packing.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	M	L	M	L	M	L	-	-	-	-	-	-	-	-
CO2	L	S	L	M	L	L	L	-	-	-	-	-	-	-	-
CO3	S	M	M	L	M	M	M	-	-	-	-	-	M	-	-
CO4	M	S	S	S	S	M	L	-	-	-	-	-	-	M	M
CO5	S	M	M	M	M	L	M	-	-	-	-	-	-	--	-

S- Strong; M-Medium; L-Low

SYLLABUS

FUNDAMENTALS OF FOOD MICROBIOLOGY

Microbiology of different types of foods-Vegetables, fruits, milk and milk products, meat and meat products. Factors affecting the food products. Food borne diseases and causative organisms.

FOOD SPOILAGE AND PRESERVATION

Spoilage of foods and Shelf –life-Milk and milk products, meat and meat products. Factors influencing food spoilage. Methods of food preservation-Pickling, salting, drying, freezing, refrigeration, use of food additives and irradiation.

PROCESSING OF FOODS

Heating, boiling, oxidation, toxic inhibition, dehydration, drying-Yeast based products, Milk products, Jams and jellies, Pickles, Meat and meat products. Labelling Instructions.

INDUSTRIALIZATION/ MODERN FOOD PRESEVERVATION

Pasteurization, Vacuum packing, food additives, irradiation, bio preservation, Modified atmosphere packing, cryopreservation.

PACKAGING AND QUALITY TESTING

Methods of packaging of foods-Solid, liquid, semi solids, Modified atmosphere packing. Factors affecting packaging. Packaging materials.

TEXT BOOKS

1. Frazier. Food Microbiology. McGraw Hill Publication.4th Edition.2001
2. Sivashankar.B.Food processing Preservation, Prenlice Hall of India.Pvt.Ltd.2002

REFERENCE BOOKS

1. James M Jay, Martin J, Loessner and David A Golden. Food Microbiology, Springer Publication, 7th Edition. 2005
2. Shetty K, Paliyath, Food Microbiology, 2nd Edition, Taylor and Francis, 2006

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Mrs.C.Nirmala	Assistant Professor	Biotechnology	nirmala@vmkvec.edu.in
2	Dr.M.Sridevi	Professor& Head	Biotechnology	sridevi@vmkvec.edu.in

17BTEC24	BIOFERTILIZER TECHNOLOGY	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

PREAMBLE

This course will provide knowledge of comprehensive understanding of the biofertilizer technology and its current trends. It develops the entrepreneurship to catch with the current trends as well as creating the industry ready professionals.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To state the basic knowledge on biofertilizer in agriculture.
2	To discuss about the role of biofertilizer in crop production
3	To implement the production and application of biofertilizer technology
4	To outline the marketing strategies of biofertilizer.

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Recall the types and importance of biofertilizer.	Remember
CO2. Describe in detail about the different chemical fertilizer, green manuring and its role in crop production	Understand
CO3. Illustrate the functions of microorganism from various sources and their mass production	Apply
CO4. Appraise in detail about the application and limitation of biofertilizer in crop field	Analyze
CO5. Estimate the promotion and strategies improvement in distribution system.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	-	L	-	-	L	-	-	-	L	L	-	L	-
CO2	S	M	S	-	-	-	S	-	-	-	L	L	L	L	-
CO3	M	-	M	M	-	-	M	-	-	-	L	-	-	-	-
CO4	L	-	-	L	-	-	S	-	-	-	-	-	-	-	-
CO5	S	M	L	L	-	-	-	-	-	-	L	S	-	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

BIOFERTILIZER

Definition and types, importance of biofertlizers in agriculture, Characteristics of biofertilizers- *Rhizobium, Azotobactor, Azospirillum*, Phosphate solubilizing microorganisms, cyanobacteria, *Azolla,* Mycorrhizae. Symbiosis- Physiology, biochemistry and molecular genetics of symbiosis, Enzymes and their regulation: Nitrogenase, hydrogenase

BIOFERTILIZER AND ITS ROLE IN CROP PRODUCTION SYSTEM

Different chemical fertilizer, its function and effect on agriculture. Role of organic matter on crop production and soil health. Various type of bio-inocula and techniques application and keep soil environment free from pollution. Green manuring, its sources, use and role in cropping system.

FUNCTION AND MASS SCALE PRODUCTION

Total and differential count of microorganisms from soil, water and carrier material. Nitrogen cycle andnitrogen fixation technology. Isolation, purification, screening, selection, mass scale production and preservation of *Rhizobia/Bradyrhizobia, Azotobacter, Azospirillum*, PSB and KSB. General biology, function, use and important of green manuring, particularly Sesbania and Azolla.

APPLICATION TECHNOLOGY

Strain selection, sterilization, growth and fermentation, mass production of various biofertilizers.Application technology: Standards and quality control, application for field and tree crops, nursery plants and seedlings. Limitation of bio-fertilizer and bio-pesticide application in agriculture.

EXTENSION, PROMOTION AND MARKETING

Extension strategies, diagnosis for the effectiveness of inoculation, improvement in distribution system.

TEXT BOOKS:

1. Dr. HLS Tomdon, Fertilizers, organic manures, recyclable water and biofertilizer, Fertilizer development and consultation organization 204-204 A New Delhi.
2. S.L. Tisdale, J.D. Beaton, W.L. Nelson, J.L. Havling, Soil fertility and fertilizers, fifth edition, Mc millan publishing company 866 third avenue new yark.
3. R. Serraj, Symbiotic nitrogen fixation prospects for enhanced application in tropical agriculture, Oxford & IBH publishing Co Pvt. Ltd New Delhi.

REFERENCES:

1. HLS. Tandan, Biofertilizer technology marketing and uses, Fertilizer development.
2. N.S. Subba Rao, Biofertilizer in Agriculture, Oxford & IBH Publishing co.pot ltd.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	R. Deepa Priya	Assistant professor	Biotechnology	deepapriya.biotech@avit.ac.in
2	Dr M.Sridevi	Professor & Head	Biotechnology	sridevi@vkvec.edu.in

17BTEC25	BIOLOGY FOR NON BIOLOGISTS	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

PREAMBLE

The purpose of this course is to provide a basic understanding of biological mechanisms of living organisms from the perspective of engineers. In addition, the course is expected to encourage engineering students to think about solving biological problems with engineering tools.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To list out the students with the basic organization of organisms and subsequent building to a living being
2	To summarize about the machinery of the cell functions that is ultimately responsible for various daily activities.
3	To implement the knowledge about biological problems that requires engineering expertise to solve them.

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1: Recall the structure and cell theory of living organism.	Remember
CO2: Discuss about the biological diversity of life.	Understand
CO3: Classify the application of enzymes in industrial level.	Apply
CO4: Detect the uses of Bioremediation and Biosensors using molecular machines.	Analyse
CO5: Appraise in detail about the principles of cell signalling in nervous system and immune system.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	-	-	-	-	-	-	-	-	-	-	L	L	L	-
CO2	S	M	S	-	-	M	S	-	L	L	-	L	L	L	-
CO3	-	L	M	-	L	S	M	-	M	M	L	L	M	L	L
CO4	L	L	L	L	-	L	S	M	S	L	-	M	L	M	M
CO5	S	M	L	L	-	-	-	-	-	S	L	S	S	M	L

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO BIOLOGY – CELL AND CELL STRUCTURE AND FUNCTION

Introduction, Scope, Disciplines of biology –An over View of plants, animal, Microorganism.

INTRODUTION TO BIOLOGY – BIO CHEMISTRY, ENZYME, INDUSTRIAL USE

Prokaryotes – Eukaryotes, Cell, Cell structure, Organelles and their functions, Yeast, Bacteria –Friends and Foe.

FOOD DIET NUTRITION

Major constituents of food – carbohydrate, protein, lipids, vitamins and minerals. Balanced diet-BI-Junk food, Fermented food, nutritional values.

ENVIRONMENT

Clean environment-Reduce, Recycle and Reuse-Renewable energy-Waste management –water-waste water management – personal hygiene, Global Climatic Changes -Tsunami, global warming, storms, vardha, Okhi. Recycled products -Paper, No to plastic, go green.

HEALTH, IMMUNE SYSTEM AND MEDICINE

Immunology- Blood Grouping – Antigen- Antibody. Antibiotics, Vaccines their significance. Diagnosis –Parameters in Urine and Blood. Instruments – ECG, ECHO, MRI, X-ray. Prophylaxis, Chemotherapy and Allergy.

TEXT BOOKS:

1. J.M.Berg, J.L.Tymosczko and L.Sryer. Biochemistry, W.H Freeman publication.
2. Student Companion to accompany Biochemistry, Fifth Edition-Richard I. Gum port.
3. Frank H.Deis, Nancy Count Gerber, Roger E.Koeppe, 2 Molecular motors

REFERENCE BOOKS:

1. Albert's, 2003, Molecular Biology of the cell
2. Lodish, 2004, Molecular cell Biology

COURSE DESIGNERS

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1	Dr. R. Deepapriya	Assistant Professor	Biotechnology	deepapriya21@gmail.com
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17BTEC30	NATURAL RESOURCES MANAGEMENT	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

PREAMBLE

Bioresource management showers the knowledge on importance of various resource available in the world and its economic importance. Students will gain the knowledge in wide spectrum of bioresource availability and its culturing method. This paper also deals with the conservation of wild resource and cultivation of valuable products for the sophistication of human life.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To state about the kinds and importance of bioresource management.
2	To describe about the various types of aquaculture and its breeding types.
3	To construct the characteristics of vermiculture and its scope and importance.
4	To categorise and preserve the afforestation process with certain conservation policies.
5	To develop the economic importance of value-added products.

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Recognize the basic concepts and importance of Bioresource management	Remember
CO2. Explain the culturing process and various types of aquaculture.	Understand
CO3. Demonstrate the scope and economic importance of vermiculture and sericulture.	Understand
CO4. Develop the strategies on conservation and management of forest resource.	Analyze
CO5. Measure the crop improvement technologies in the production of bioresource products.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	-	L	L	-	-	L	-	-	-	-	M	L	L	-
CO2	L	-	M	L	L	-	M	-	S	-	L	M	S	M	M
CO3	S	S	-	-	-	-	M	L	-	-	L	-	-	L	-
CO4	L	-	L	L	-	L	S	L	-	-	-	-	-	-	L
CO5	L	L	-	L	-	-	L	-	-	-	-	S	M	L	M

S- Strong; M-Medium; L-Low

SYLLABUS

BASICS OF BIORESOURCE MANAGEMENT

Basics of Bioresources - Concept, kinds, importance. Human Resource: Management, scope and importance of human resource management (HRM) and personnel management; human development index (HDI). Animal Resources Conservation and Management: Concept on livestock and livestock production management; role in livelihood and nutritional securities; sustainable livestock production, problems and opportunities

AQUACULTURE

Introduction to aquaculture; Prawn culture, Methods of prawn fishing, Preservation and processing of prawn; Pearl culture and status of pearl culture in India; Economically important of fishes. Setting up of a fish farm, Monoculture and composite fish culture, Bundh breeding, Induced breeding, methods of fishing, Fish preservation and processing; Identification of fish diseases and their control.

VERIMICULTURE AND SERICULTURE

Introduction and scope, Species of earthworm, Characteristics features of earthworm. Overview of methods of vermicomposting, Role of earthworm in solid waste management. Vermiwash- its importance, Vermicompost as bio-fertilizer. Overview of scope, economic importance and the product of Sericulture.

FOREST MANAGEMENT AND PLANTS CULTIVATION

Classification and distribution of forests, current strategies of conservation and management of forest resource; agro-forestry, social forestry; Joint Forest Management; National Forest Policy; Forest (conservation) Act, 1980. A brief account of Harlan and Hawkes theories; practices of floriculture, agroforestry, BT crops (brief account).

VALUE ADDED BIORESOURCE PRODUCTS

Economic uses of important cereals, legumes (pulses and fodders), fruits and vegetables, spices and condiments, beverages, oils and fats, essential oils, medicinal plants, hallucinogens (psychotropic drugs), timber plants, fibre plants, natural rubber, resins, raw materials for paper. A brief account of crop improvement technologies, biosafety considerations, natural products.

TEXT BOOKS:

1. Manju Yadav. 2010. "Economic Zoology" Discovery publishing housePvt.Ltd., New Delhi
2. Trivedi, T, R. (2011) "Forest Management"Discovery Publishing Pvt.Ltd. New Delhi
3. Milton Fingerman, RachakondaNagabhushanam 2000. "Recent Advances in Marine Biotechnology" I[st]Edition Science Pub Inc.

REFERENCES:

1. Peter Bettinger Kevin Boston Jacek Siry Donald Grebner 2017. Forest Management and Planning 2nd Edition. Academic press.

COURSE DESIGNERS

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1	Dr.Chozhavendhan. S	Associate professor	Biotechnology	chozhavendhan@avit.ac.in
2	Mrs.R.Subashini	Assistant Professor	Biotechnology	subashini@vmkvec.edu.in

17BTEC31	APPLICATIONS OF ENZYME IN WASTE MANAGEMENT	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

PREAMBLE

This course explains about different waste generation in environment, management of waste, general characters of enzymes, their immobilization process, makes an attempt to bring students in direct contact with nature, to find the environmental problems and possible solutions. To empower the students to enrich their knowledge on waste treatment using biocatalyst to solve the environmental pollution.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To state the basic knowledge on different wastes
2	To discuss about the waste management methods
3	To perform the waste treatment using enzymes
4	To implement the basics of enzyme immobilization process
5	Tooutline the students to basic knowledge concerning biodegradation with the usage of enzymes

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. List and classify the different wastes in environment	Remember
CO2. Describe about the general waste management methods	Understand
CO3. Illustrate the waste treatment using enzymes	Apply
CO4. Demonstrate the basics of enzyme immobilization process	Apply
CO5.Appraise different method of biodegradation of waste using enzymes	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P	PO11	PO12	PS	PSO	PSO3
CO1	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	M	M	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	M	M	-		L	-	-	-	-	-	-	L	L	-	-
CO4	M	M	-	-	S	-	L	-	-	-	-	-	-	M	-
CO5	M	M	L	L	S	S	-	L	-	-	-	-	-	L	L

S- Strong; M-Medium; L-Low

SYLLABUS

CLASSIFICATION AND TECHNOLOGIES IN REDUCING WASTE

Definition of waste, and its classification, Waste treatment technologies including waste incineration and energy from waste, advanced conversion technologies of pyrolysis and gasification, anaerobic digestion, composting and biological treatment of wastes.

WASTE AND RESOURCE MANAGEMENT

3 RS, Advances in waste recycling and recovery technologies to deliver added value products; Landfill

engineering, Sustainability and resource efficiency with consideration for materials flow through the economy, steps towards designing out waste and maximizing the value of outputs from waste treatment processes.

ENZYME IN WASTE TREATMENT

Enzymes in enhanced oil recovery; treatment of wastewater of brewery, pharmaceutical, textile dyeing, metal processing, petrochemical, pulp and paper industry; role of natural/stimulated, dead/spent microbial cultures, GMOs, phytoremediation. Biological indicators of waste by enzyme.

ENZYME ACTION AND IMMOBILIZATION

Action of enzyme on xenobiotic compound, phenolic compounds, pesticides (organo chlorinated, organo phosphorous and carbonated) immobilization techniques.

BIOSENSOR AND OPTICAL INSTRUMENTS

Birth of biosensors, advantages and disadvantages, construction of biosensors- enzyme and microbial biosensor. Transducers- piezoelectric, potentiometric, amperometric and fiber optics.

TEXTBOOKS:

1. Instant Notes in Ecology by A. Mackenzie, A.S. Ball and S.R. Virdee, Bios Scientific Publishers Ltd., UK, 1999.
2. Biotechnology-Applications to Environmental Protection by M.M. Pandey, Himalaya Publishing House, 1993.
3. Pesticide Properties in the Environment by A.G. Hornsky, R.D. Wauchope and A.E. Herner, Springer-Verlag, New York Inc., 1996.
4. Basic Environmental Science by G.S.P. Iyer, Educational Publishers and Distributers, New Delhi, 1997.

REFERENCES:

1. Popular Biotechnology Lecture Series Focus: Bioremediation by Division of Biotechnology, PSCST, 2013.
2. Pesticide Properties in the Environment by A.G. Hornsky, R.D. Wauchope and A.E. Herner, Springer-Verlag, New York Inc., 1996.
3. Introduction to Environmental Technology by A.K. Chatterji, Prentice Hall of India Pvt. Ltd., New Delhi, 2002.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
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2	Ms.R.Subashini	Assistant Professor	Biotechnology	subashini@vmkvec.ac.in

CIVIL ENGINEERING - OPEN ELECTIVE

<table>
<tr><td rowspan="2">17CVSE28</td><td rowspan="2">URBAN TRANSPORTATION INFRASTRUCTURE– PLANNING AND DESIGN</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td></tr>
<tr><td>EC(OE)</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
</table>

PREAMBLE

Helps in Design of Intersections, Interchanges, Parking and Terminal Facilities to be provided inan urban area

PREREQUISITE

NIL

COURSE OBJECTIVES

1	Helps in Design of Intersections, Interchanges, Parking and Terminal Facilities to be provided inan urban area
2	The students would have gained knowledge on Rail Infrastructure Management
3	The students would have gained knowledge on Design of Grade Separators and intersections
4	The students would have gained knowledge on Design of Multi-Storey and Surface Parking facility
5	The students would have gained knowledge on Design and Case Studies of Inter Modal Transfer Facilities

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. The students would have gained knowledge on Rail Infrastructure Planning, Operation and Management.	Apply
CO2. The students would have gained knowledge on Rail Infrastructure Management.	Understand
CO3. The students would have gained knowledge on Design of Grade Separators and intersections	Apply
CO4. The students would have gained knowledge on Design of Multi Storied and Surface Parking facility	Apply
CO5. The students would have gained knowledge on Design and Case Studies of Inter Modal Transfer Facilities	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	-	-	-	-	-	-	-	-	-			
CO2	S	-	L	S	-	-	-	-	-	-	-	-			
CO3	S	-	M	S	-	-	-	-	-	-	-	-			
CO4	S	M	-	-	-	-	-	-	-	-	-	-			
CO5	S	M	M	-	-	-	-	-	-	-	-	L			

S- Strong; M-Medium; L-Low

SYLLABUS

PRINCIPLES OF INTERSECTION DESIGN: Basic considerations – simplicity – uniformity – Manoeuvre Elements – Separation of conflict points – Design Elements – Design Speed – Intersection Curves – Super elevation for curves at Intersection – Intersection Sight Distance

DESIGN OF AT-GRADE INTERSECTIONS: Capacity and LOS, Design of Rotary and Signalised Intersections, Vehicle Actuated Signals, Signal Co-ordination, Area Traffic Control System (ATCS), Pedestrian Planning at Grade Intersections

DESIGN OF GRADE SEPARATED INTERSECTIONS: Design of Grade Separators – Principles , Design Criteria – Layout Design, GAD Preparation – Pedestrian Foot Over-bridge and Subway Design – Pedestrian Planning for Grade Separated Intersections

PARKING FACILITIES : Parking – Demand – Characteristics – Space Inventory – Accumulation – Duration – Turn over – Index – Design of Multi Storey and Surface Parking facility

DESIGN OF TERMINAL FACILITIES: Bus Terminus – Design Principles – Design Elements – Design and Case Studies of Inter Modal Transfer Facilities – Design – Case Studies of Bus and Rail Terminals.

TEXT BOOKS:

1. Robert F Baker, (Edition) "Hand Book of Highway Engineering, Van Nostrand Reinhold Company, New York, 1975
2. Kanna, S.K. and Justo, C.E.G. "Highway Engineering, Nemchand.

REFERENCES:

1 .New Jersy, "Transportation and Traffic Engineering Hand Book, Institute of Transportation Engineers, Prentice Hall, INC, 1982

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COURSE DESIGNERS

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17CVSE35	QUALITY CONTROL AND ASSURANCE IN REAL ESTATE	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

PREAMBLE

To introduce the students to understand about the quality, strategic planning, and competitive advantage in real estate, principles of total quality management, customer relationship management techniques, quality control and quality assurance and benefits of control charts and applications

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To study about the concept of quality, planning and quality and market share
2	To learn about the elements and benefits of total quality management
3	To understand about the customer satisfaction measurement techniques and customer relationship management techniques.
4	To learn about the quality control and quality assurance
5	To know about the benefits of control charts and applications

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Understand the concept of quality, planning and quality and market share	Understand
CO2. Remember the elements and benefits of total quality management	Remember
CO3. Understand the customer satisfaction measurement techniques and customer relationship management techniques.	Understand
CO4. Remember the quality control and quality assurance	Remember
CO5. Understand the benefits of control charts and applications	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO1 2	PS O1	PS O2	PSO3
CO1	S	M	L	-	-	-	-	-	-	-	-	-			

CO2	S	M	L	S	-	-	-	-	-	-	-	-			
CO3	S	M	M	S	-	-	-	-	-	-	-	-			
CO4	S	M	M	M	-	-	-	-	-	-	-	-			
CO5	S	M	M	-	-	-	-	-	-	-	-	L			

S- Strong; M-Medium; L-Low

SYLLABUS

QUALITY, STRATEGIC PLANNING, AND COMPETITIVE ADVANTAGE: Brief History - Definitions of Quality. Quality in Manufacturing and Service Systems. Quality and Price - Quality and Market Share - Quality and Cost - Quality & Competitive Advantage.

PRINCIPLES OF TOTAL QUALITY MANAGEMENT: Introduction - Elements of Total Quality Management - Malcolm Baldrige National Quality Award Criteria. Benefits of Total Quality Management. The Deming Management Philosophy – The Juran Philosophy – The Crosby Philosophy.

CUSTOMER FOCUS: The Customer-Driven Quality Cycle - Quality Function Deployment –Customer Satisfaction Measurement Techniques – Customer Relationship Management Techniques.

QUALITY CONTROL AND QUALITY ASSURANCE Concept of Quality Control – Concept of Process Variation – Acceptance Sampling – Sampling Inspection Vs. 100% Inspection – Attributes and variable sampling plans – OC Curves – Producer and Consumer Risk – AQL, RQL, TQL, AOQL and AOL. (10%)

STATISTICAL PROCESS CONTROL : Control Charts – X-R, P, np and C Charts – Benefits of Control Charts and Applications

TEXT BOOKS:

1. Quality Control - Dale H Besterfield – Pearson Education
2. Total Quality Management – S. Sundarrajan
3. Quality Control & Total Quality Management – Jain

REFERENCES:

1. The essence of Total Quality Management – Hansen & Ghare
2. Managing for Total Quality – Logothetic
3. Quality Problem Solving – Smith

4. ISO 9000 – Kairon

5. Manuals of various standards

COURSE DESIGNERS

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17CVSE41	INFRASTRUCTURE PROJECT DEVELOPMENT	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

PREAMBLE

To study the elements of construction planning and scheduling and to apply appropriate tools and techniques like networks and coding systems. To study the elements of quality control and safety of construction projects. To study the monitoring of projects through cost control.

PREREQUISITE

Nil.

COURSE OBJECTIVES

1	To study about the Concepts environment relationship with focus on issues of population
2	To learn about the Application of ecological principles in sustainability.
3	To study about the Land capability and suitability analysis in location and planning of urban.
4	To gain the knowledge about Urban interference in hydrological cycle.
5	To study about the Concepts of effects of air pollution and solid wasted is posalin cavities.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Understand infrastructure organizations	Apply
CO2. Prepare infrastructure master plan	Analyze
CO3. Schedule infrastructure project activities	Analyze
CO4. Prepare project development plan	Apply
CO5. Prepare tender documents for infrastructure project contract	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	-	-	-	-	-	-	-	-	-			
CO2	S	M	L	S	-	-	-	-	-	-	-	-			

CO3	S	M	M	S	-	-	-	-	-	-	-	-			
CO4	S	M	M	M	-	-	-	-	-	-	-	-			
CO5	S	M	M	-	-	-	-	-	-	-	-	L			

S- Strong; M-Medium; L-Low

SYLLABUS

INFRASTRUCTURE: Definitions of infrastructure, Governing Features, Historical overview of Infrastructure development in India, Infrastructure Organizations & Systems.

INFRASTRUCTURE PLANNING: Typical infrastructure planning steps, Planning and appraisal of major infrastructure projects, Screening of project ideas, Life cycle analysis, Multi-criteria analysis for comparison of infrastructure alternatives, Procurement strategies, Scheduling and management of planning activities, Infrastructure Project Budgeting and Funding, Regulatory Framework, Sources of Funding.

PROJECT MANAGEMENT IN CONSTRUCTION: Introduction to project management processes - Initiating, Planning, Executing, Controlling, and Closing processes; Project Integration Management - Project plan development, Project plan execution, and Overall change control; Project Scope Management - Initiation, Scope planning, Scope definition, Scope verification, and Scope change control.

CONTRACTS AND MANAGEMENT OF CONTRACTS: Engineering contracts and its formulation, Definition and essentials of a contract, Indian Contract Act 1872, types of contracts and clauses for contracts, Preparation of tender documents, Issues related to tendering process, Awarding contract.

AIR QUALITY & SOLID WASTE MANAGEMENT: Sources, types and effects of air pollution and solid wasted is posalinc activities, urban industrial processes and land use and transportation implications in air and solid waste pollution; norms, standards, laws, organizations and policies in urban air quality control and solid waste management; example stabilized organic fraction best practices.

TEXT BOOKS:

1. A. S. Goodman and M. Hastak, Infrastructure planning handbook: Planning, engineering, and economics, McGraw-Hill, New York, 2006.
2. J. Parkin and D. Sharma, Infrastructure planning, Thomas Telford, London, 1999.
3. P. Chandra, Projects: Planning, analysis, selection, financing, implementation, and review, Tata McGraw-Hill, New Delhi, 2009.

REFERENCES:

1. J. Kelly, S. Male and D. Graham, Value management of construction projects, Blackwell Publishing, Oxford, 2003.
2. Vasant Desai, “Project Management”, Himalaya Publishing , 1st Edition, 2010
3. James C. Van Horne, John M. Wachowicz, “Fundamentals of Financial Management”,
4. PHI, 2nd Edition, 2000 Ronald W Hudson, “Infrastructure Management: integrating design, Construction, maintenance, rehabilitation and renovation”, MGH, 1st Edition, 1997.

COURSE DESIGNERS

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17CVSE42	GREEN BUILDING AND ENERGY EFFICIENT BUILDING	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

PREAMBLE

Before starting with this course one must get a clear knowledge on the basics of green building, learning the plan details of HVAC for a building, energy efficient modeling.

PREREQUISITE

Nil.

COURSE OBJECTIVES

1	To study about the Development & Plan Implementation.
2	To learn about the fundamentals of electric power systems and building electric wiring.
3	To study about the Bioclimatic design and concepts.
4	To gain the knowledge about Water conservation & water management systems.
5	To learn about the Key components of remodelling project.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Describe what green building	Apply
CO2. Understand the benefits and advantages of green building practices	Apply
CO3. Identify and describe green systems and features in residential and commercial buildings	Analyze
CO4. Define what makes up a healthy building	Apply
CO5. Describe green and sustainable materials and practices	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	-	-	-	-	-	-	-	-	-			
CO2	S	M	L	M	-	-	-	-	-	-	-	-			
CO3	S	M	M	L	-	-	-	-	-	-	-	-			
CO4	S	M	M	M	-	-	-	-	-	-	-	-			

CO5	S	M	L	-	-	-	-	-	-	-	-	L			

S- Strong; M-Medium; L-Low

SYLLABUS

GREEN BUILDING BASICS AND PRACTICES: Site Design / Development & Plan Implementation, Resource Efficiency, Energy Efficiency, Water Efficiency, Indoor Environmental Quality and Homeowner Education, Operation, Maintenance & Practices. Assessment of building design and construction, emission of CO_2, SO_2, and NO_2 of building materials, elements, and construction process.

ENERGY MANAGEMENT SYSTEM OF BUILDINGS: The objective of the course is to provide students the necessary tools to control, monitor and optimize the building's facilities, mechanical and electrical equipment for comfort, safety, and efficiency. It starts with the fundamentals of electric power systems and building electric wiring and then works through building automation systems (BAS) principles. The course allows students to acquaint applying BAS to commercial HVAC equipment, lighting systems, fire systems and security/observation systems.

LOW ENERGY ARCHITECTURE, PASSIVE BUILDING DESIGN: Solar geometry, climate/regional limitations, natural lighting, passive design and sustainability initiatives, insulating and energy storing material. Bioclimatic design and concepts. Case studies will be used extensively as a vehicle to discuss the success/failure of ideas and their physical applications.

WATER MANAGEMENT, BUILDING METHODS & MATERIALS : Water conservation, water management systems, water efficient landscaping, green roofing, rainwater harvesting, sanitary fixtures and plumbing systems, wastewater treatment and reuse, and process water strategies. AAC (Aerated Auto clave Concrete), ICF (Insulated Concrete Forms), new Advanced Framing & Insulation Techniques, SIPs (Structural Insulated Panels), Straw Bale and Pumice-crete Rammed Earth, Timber Frame, Straw Clay, and Earth ship buildings.

ENERGY EFFICIENT REMODELING : Key components of remodeling projects-windows, walls, roofs, heating and ventilation, insulation, tighten up the building envelope, Advances in building technology and materials, Incorporate active and passive solar into the home or commercial building, Mistakes to avoid, various improvements cost

TEXT BOOKS:

1. Kibert, C. J. "Sustainable Construction: Green Building Design and Delivery," Second Edition, New York: John Wiley & Sons, Inc., 2008.
2. Thermal analysis and design of passive solar buildings by A. K. Athienitis and Mat Santamouris.
3. Passive building design by N.K. Bansal, G. Hauser, and G. Minke

REFERENCES:

1. McDonough, W. and Braungart, M. "Cradle to Cradle: Remaking the Way We Make Things," New York: Farrar, Straus and Giroux, 2002

COURSE DESIGNERS

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COMPUTER SCIENCE AND ENGINEERING - OPEN ELECTIVE

17CSEC09	ETHICAL HACKING	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

To analyze the basic concepts of security and hacking process

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To understand the basic concepts in ethical hacking
2	To identify vulnerabilities using ethical hacking techniques
3	To understand security in web applications
4	To understand various types of vulnerabilities in wireless networks
5	To discuss about security tools and its applications

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1: To Understand basics in ethical hacking	Understand
CO2: To apply hacking techniques in real time problems	Apply
CO3: To apply Security Features in web applications	Apply
CO4: To understand and apply security features in wireless networks	Understand and Apply
CO5: To apply information security features in real time	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**			
CO1	M	M									L	L			
CO2	M	M		L								L			
CO3	M	M	L	L		M									
CO4	M	S	L			L				L		M			
CO5	M	L				M					M	L			

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION **9 - hours**

Introduction to Hacking, Types of Hacking, Hacking Process, Security – Basics of Security- Elements of Security, Penetration Testing, Scanning, Exploitation- Web Based Exploitation. Simple encryption and decryption techniques implementation.

HACKING TECHNIQUES **9 – hours**

Building the foundation for Ethical Hacking, Hacking Methodology, Social Engineering, Physical Security, Hacking Windows, Password Hacking, and Privacy Attacks, Hacking the Network, Hacking Operating Systems- Windows & Linux, Application Hacking, Footprinting, Scanning, and Enumeration. Implementing System Level Hacking- Hacking Windows & Linux.

WEB SECURITY **9 - hours**

Evolution of Web applications, Web application security, Web Application Technologies- Web Hacking, Web functionality, How to block content on the Internet, Web pages through Email, Web Messengers, Unblocking applications, Injecting Code- Injecting into SQL, Attacking Application Logic. Check authentication mechanisms in simple web applications. Implementation of Web Data Extractor and Web site watcher. Implementation of SQL Injection attacks in ASP.NET.

WIRELESS NETWORK HACKING **9 - hours**

Introduction to Wireless LAN Overview, Wireless Network Sniffing, Wireless Spoofing, Port Scanning using Netcat, Wireless Network Probing, Session Hijacking, Monitor Denial of Service (DoS) UDP flood attack, Man-in-the-Middle Attacks, War Driving, Wireless Security Best Practices, Software Tools, Cracking WEP, Cracking WPA & WPA-II. Implementation- Locate Unsecured Wireless using Net-Stumbler/ Mini-Stumbler.

APPLICATIONS **9 - hours**

Safer tools and services, Firewalls, Filtering services, Firewall engineering, Secure communications over insecure networks, Case Study: Mobile Hacking- Bluetooth-3G network weaknesses, Case study: DNS Poisoning, Hacking Laws. Working with Trojans using NetBus.

TEXT BOOKS

1. Stuart McClure, Joel Scambray, George Kurtz, "Hacking Exposed 6: Network Security Secrets & Solutions", Seventh edition, McGraw-Hill Publisher, 2012.
2. Kevin Beaver, "Hacking for Dummies" Second Edition, Wiley Publishing, 2007.
3. Dafydd Stuttard and Marcus Pinto, "The Web Application Hacker's Handbook: Discovering and Exploiting Security Flaws" Wiley Publications, 2007.
4. Ankit Fadia, "An Unofficial Guide to Ethical Hacking" Second Edition, Macmillan publishers India Ltd, 2006.

REFERENCES

1. Hossein Bidgoli, "The Handbook of Information Security" John Wiley & Sons, Inc., 2005.

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17CSEC11	GREEN COMPUTING	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

To acquire knowledge to adopt green computing practices and To learn about energy saving practices

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To acquire knowledge to adopt green computing practices
2	To minimize negative impacts on the environment
3	To learn about energy saving practices and To understand the impact of e-waste and carbon waste
4	To learn about green compliance. And implementation using IT

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1: To acquire knowledge to adopt green computing practices	Understand
CO2: To minimize negative impacts on the environment	Apply
CO3: To learn about energy saving practices and To understand the impact of e-waste and carbon waste	Understand
CO4: To learn about green compliance. And implementation using IT	Understand and Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**			
CO1	M		S			M			S		L	L			
CO2	M	S	M		S					L		L			
CO3	M	M		M			M		L						
CO4	M	S						L		M		M			

S- Strong; M-Medium; L-Low

SYLLABUS

FUNDAMENTALS **9 - hours**

Green IT Fundamentals: Business, IT, and the Environment – Benefits of a Green Data Centre - Green Computing:Carbon Foot Print, Scoop on Power–GreenITStrategies: Drivers, Dimensions, and Goals – Environmentally Responsible Business: Policies, Practices, and Metrics.

GREEN ASSETS AND MODELING **9 – hours**

Green Assets: Buildings, Data Centres, Networks, Devices, Computer and Earth Friendly peripherals, Greening Mobile devices – Green Business Process Management: Modelling, Optimization, and Collaboration – Green Enterprise Architecture – Environmental Intelligence – Green Supply Chains – Green Information Systems: Design and Development Models.

GRID FRAMEWORK **9 - hours**

Virtualizing of IT Systems – Role of Electric Utilities, Telecommuting, Teleconferencing and Teleporting – Materials Recycling – Best Ways for Green PC – Green Data Center – Green Grid Framework. Optimizing Computer Power Management, Seamless Sharing Across Systems. Collaborating and Cloud Computing, Virtual Presence.

GREEN COMPLIANCE **9 - hours**

Socio-Cultural Aspects of Green IT – Green Enterprise Transformation Roadmap – Green Compliance: Protocols, Standards, And Audits – Emergent Carbon Issues: Technologies and Future. Best Ways to Make Computer Greener.

GREEN INITIATIVES WITH IT and CASE STUDIES **9 - hours**

Green Initiative Drivers and Benefits with IT - Resources and Offerings to Assist Green Initiatives. - Green Initiative Strategy with IT - Green Initiative Planning with IT - Green Initiative Implementation with IT - Green Initiative Assessment with IT. The Environmentally Responsible Business Strategies (ERBS) – Case Study Scenarios for Trial Runs – Case Studies – Applying Green IT Strategies and Applications to a Home, Hospital, Packaging Industry and Telecom Sector.

TEXT BOOKS

1.Bhuvan Unhelkar, ―Green IT Strategies and Applications-Using Environmental Intelligence‖,CRC Press, June 2011
2.Carl Speshocky, ―Empowering Green Initiatives with IT‖, John Wiley and Sons, 2010.

REFERENCES

1. Alin Gales, Michael Schaefer, Mike Ebbers, ―Green Data Center: Steps for the Journey‖, Shoff/IBM rebook, 2011.
2. John Lamb, ―The Greening of IT‖, Pearson Education, 2009.
3. Jason Harris, ―Green Computing and Green IT- Best Practices on Regulations and Industry‖, Lulu.com, 2008.

COURSE DESIGNERS

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17CSEC24	OPEN SOURCE SYSTEMS	Category	L	T	P	Credit
		PC	3	0	0	3

PREAMBLE

The purpose of an open standard is to increase the market for a technology by enabling potential consumers or suppliers of that technology to invest in it without having to either pay monopoly rent or fear litigation on trade secret, copyright, patent, or trademark causes of action. No standard can properly be described as "open" except to the extent it achieves these goals.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	Students will study common open source software licenses, open source project structure
2	To understand distributed team software development, and current events in the open source world
3	To learn free and open source components & tools
4	Students will also work on an open source project and will be expected to make a significant contribution

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1: explain common open source licenses and the impact of choosing a license	Understand
CO2: explain open source project structure and how to successfully setup a project	Analyze
CO3: be competent with distributed software engineering tools and processes such as test-driven development, issues tracking, unit testing, code review, distributed version control, and continuous integration	Understand
CO4: Knowledge of free and open source tools like libre office ,open office	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S		L			L		S			M				
CO2		S		M					M	S		M			
CO3	L		S		S				L		S				
CO4		S			S		M				L				

S- Strong; M-Medium; L-Low

SYLLABUS

OPEN SOURCE LICENSING **9 - hours**

Open Source Licensing, Contract, and Copyright Law-The MIT, BSD, Apache, and Academic Free Licenses-The GPL, LGPL, and Mozilla Licenses-Qt, Artistic, and Creative Commons Licenses-Non-Open Source Licenses.

OPEN SOURCE OPERATING SYSTEM **9 – hours**

Linux history-distributions-licensing-installing Linux-working with directories-working with files-working with file contents-the Linux file tree. shell expansion: commands and arguments-control operators-shell variables-file globing. Pipes and commands: I/O redirection-filters -regular expressions. Introduction to vi – scripting: scripting introduction-scripting loops-scripting parameters

LINUX USER MANAGEMENT **9 - hours**

local user management- introduction to users-user management-user passwords-user profiles -groups. file security: standard file permissions-advanced file permissions-access control lists-file links.

LIBRE OFFICE –WORD, SPREAD SHEET **9 - hours**

Introduction of libre office- WRITER — THE WORD PROCESSOR: Opening a Document -Laying Out the Page-Setting paper size, margins, and orientation -Creating headers and footers -Numbering pages -Entering and Editing Text-Modifying text-Moving and copying text.

CALC — THE SPREADSHEET: Creating a Spreadsheet -Inputting Your Data -Entering your data -Editing your data -Filling cells automatically -Managing Columns and Rows-Copying, pasting, cutting, dragging, and dropping your cells -Adding the Art -Formula Basics.

LIBRE OFFICE- PRESENTATION **9 - hours**

IMPRESS — THE PRESENTATION Creating a Presentation -Opening an existing presentation -Adding Slides -Adding text to a slide -Saving Your Presentation for Posterity - Making Presentations Picture Perfect -Adding Images -Clipping art -Drawing objects -Coloring Backgrounds - Creating a plain-colored background -Creating a gradient background.

TEXT BOOKS

1. Understanding Open Source and Free Software Licensing By Andrew M. St. Lauren , August 2004 , Pages: 207. (Unit I)
2. Linux study link : https://itsfoss.com/learn-linux-for-free/ (Unit II & Unit III).
3. https://www.libreoffice.org/assets/Uploads/Documentation/en/GS51-GettingStartedLO.pdf (Unit IV & V)

REFERENCES

1. Andy channelle (2009), "Beginning OpenOffice 3", Aprèss.
2. Ellen Siever, Stephen Figgins, Robert Love, Arnold Robbins, "Linux in a Nutshell", Sixth Edition, OReilly Media, 2009.
3. N. B. Venkateshwarlu (Ed); Introduction to Linux: Installation and Programming, B S Publishers; 2005.
4. Matt Welsh, Matthias Kalle Dalheimer, Terry Dawson, and Lar Kaufman, Running Linux, Fourth Edition, O'Reilly Publishers, 2002.
5. Carla Schroder, Linux Cookbook, First Edition, O'Reilly Cookbooks Series, 2004.

COURSE DESIGNERS

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17CSEC30	**UNIX INTERNALS**	Category	L	T	P	Credit
		PC	3	0	0	3

PREAMBLE

This talk is a brief guide to UNIX programming languages, tools and concepts.It is aimed at programming novices or programmers migrating from a Windows system. The aim is to introduce you to the concepts, the possibilities and the tools used in Unix programming.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To understand the design of the UNIX operating system
2	To become familiar with the various data structures used

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1: To learn The basic Unix operating systems and its basic commands	Understand
CO2: To analyze the buffers and kernel representation	Analysis
CO3: To understand the UNIX system structure, system calls	Remember
CO4: To understand UNIX segmentation, scheduling, paging	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**			
CO1	S			L					L			S			
CO2		S					M			S	M				
CO3			M		S							S			
CO4	L						L		S		M				

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION **9 - hours**

General Review of the System-History-System structure-User Perspective-OperatingSystem Services- Assumptions About Hardware. Introduction to the Kernel-ArchitectureSystem Concepts-Data Structures- System Administration

DISK BLOCKS **9 – hours**

The Buffer Cache-Headers-Buffer Pool-Buffer Retrieval-Reading and Writing Disk Blocks - Advantages and Disadvantages. Internal Representation of Files-Inodes- Structure-Directories-Path Name to Inode- Super Block-Inode Assignment-Allocation of Disk Blocks -Other File Types

FILE SYSTEM **9 - hours**

System Calls for the File System-Open-Read-Write-Lseek-Close-Create-Special files Creation -Change Directory and Change Root-Change Owner and Change Mode-Stat- Fstat-Pipes-Dup-Mount-Unmount-Link-Unlink-File System Abstraction-Maintenance.

PROCESS MANAGEMENT **9 - hours**

The System Representation of Processes-States-Transitions-System Memory-Context of a Process-Saving the Context-Manipulation of a Process Address Space-Sleep Process Control-signals-Process Termination-Awaiting-Invoking other Programs-The Shell-System Boot and the INIT Process.

MEMORY MANAGEMENT **9 - hours**

Memory Management Policies-Swapping-Demand Paging-a Hybrid System-I/O Subsystem-Driver Interfaces-Disk Drivers-Terminal Drivers.

TEXT BOOKS

1. Maurice J. Bach, "The Design of the Unix Operating System", Pearson Education 2002.

REFERENCES

1. UreshVahalia, "UNIX Internals: The New Frontiers", Prentice Hall, 2000.
2. John Lion, "Lion's Commentary on UNIX", 6th edition, Peer-to-Peer Communications, 2004.
3. Daniel P. Bovet & Marco Cesati, “Understanding the Linux Kernel”, O’REILLY, Shroff Publishers &Distributors Pvt. Ltd, 2000.
4. M. Beck et al, “Linux Kernel Programming

COURSE DESIGNERS

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17CSEC32	VIRTUAL REALITY	Category	L	T	P	Credit
		PC	3	0	0	3

PREAMBLE

This course provides a detailed understanding of the concepts of Virtual Reality and its application.

PREREQUISITE

Basis of Network

COURSE OBJECTIVES

1	To Learn Geometric modelling and Virtual environment
2	To Learn Virtual Hardware and Software
3	To Learn Virtual Reality applications

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1: To understand the basics of virtual reality, virtual environment, and computer graphics	Understand & Apply
CO2: To understand and learn the concept of geometric modelling and transformations	Understand & Apply
CO3: To understand and learn the concept of content creation and interaction issues	Understand
CO4: To understand the concept of VR hardware and software	Understand & Apply
CO5: To understand the VR applications	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**			
CO1	S	S	M	S	S	M	M	S	S	M	M				
CO2	S	S	M	S	S	S	M	S	M	M	M				
CO3	M	M	M	M	S	M	L	M	L	M	L				
CO4	M	M	M	M	M	M	M	M	M	M	M				
CO5	M	M	M	M	M	M	M	M	L	M	M				

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION **9 - hours**

Virtual Reality & Virtual Environment : Introduction – Computer graphics – Real time computer graphics – Flight Simulation – Virtual environments –requirement – benefits of virtual reality- **3D Computer Graphics** : Introduction – The Virtual world space – positioning the virtual observer – the perspective projection – human vision – stereo perspective projection – 3D clipping – Colour theory – Simple 3D modelling – Illumination models – Reflection models – Shading algorithms

GEOMETRIC MODELLING **9 – hours**

Geometric Modelling: Introduction – From 2D to 3D – 3D space curves – 3D boundary representation - **Geometrical Transformations**: Introduction – Frames of reference – Modelling transformations – Instances – Picking – Flying – Scaling the VE – Collision detection - **A Generic VR system**: Introduction – The virtual environment – the Computer environment – VR Technology – Model of interaction – VR System

CONTENT CREATION AND INTERACTION ISSUES **9 - hours**

Gestalt perceptual organization - real world content - field of view - paradigm shift from real environment to virtual environment - reusing existing content - transition to VR content Human factors : Direct Vs Indirect Interaction - Modes and flow - Input device characteristics - viewpoint and control patterns.

DESIGN ISSUES **9 - hours**

Optimizing performance - optimizing target hardware and software - **VR Hardware** : Introduction – sensor hardware – Head-coupled displays –Aquatic hardware – Integrated VR systems-**VR Software**: Introduction – Modelling virtual world –Physical simulation- VR toolkits - multiplayer environment - multiplayer networking architecture.

APPLICATION **9 - hours**

Engineering – Entertainment – Science – Training – classroom.

TEXT BOOKS

1. John Vince, “Virtual Reality Systems “, Pearson Education Asia, 2002
2. Jason Jerald, "The VR book: Human centered design for virtual reality", CRC Press, 2015

REFERENCES

1. Adams, “Visualizations of Virtual Reality”, Tata McGraw Hill, 2000.
2. Grigore C. Burdea, Philippe Coiffet, “Virtual Reality Technology” , WileyInterscience,1 Edition,1994.
3. William R. Sherman, Alan B. Craig, “Understanding Virtual Reality: Interface, Application, and Design”, Morgan Kaufmann, 1st Edition,2002.
4. Jonathan Linowes, "Unity Virtual Reality Projects- Explore the world of virtual reality by building immersive and fun VR Projects using Unity 3D", Packt Publishing, 2015.

COURSE DESIGNERS

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ELECTRICAL AND ELECTRONICS ENGINEERING - OPEN ELECTIVE

17EECC14	**ELECTRICAL MACHINES AND DRIVES**	Category	L	T	P	Credit
		CC	3	0	0	3

Preamble

In a modern world the electric drives are essential for all the applications especially in mechanical engineering the Electrical drives represent a dominant source of mechanical power in various applications in production, material handling, and process industries etc. hence the course provides the magnificent knowledgeabout basic concepts, performance analysis of conventional and solid state control of electric drives which can help the mechanical engineer to understand and implement the concepts to various applications in engineering sector.

Prerequisite

xxx: Basics Electrical and Electronics Engineering A. Basic Electrical Engineering

Course Objectives

1. To select appropriate electrical drive system based on their thermal factors.
2. To interpret the characteristics of DC motors and perform appropriate conventional control techniques for desired applications.
3. To interpret the characteristics of AC motors and perform appropriate conventional control techniques for desired applications.
4. To employ the solid state speed control techniques for DC drives for efficient control.
5. To employ solid state speed control techniques for AC drives for proficient and loss less control.

Course Outcomes

On the successful completion of the course, students will be able to

CO1. Define the conceptsof an electrical drive system and choose a suitable motor drive for different applications.	Remember
CO2. Explain the working principle with their characteristics and Predetermine the performance of DC drives with various load and unload conditions.	Understand
CO3.Interpret the conventional speed control methods of DC motors with starting, braking Methods.	Apply
CO4.Identify the parts of AC motors,Predetermine the performance of AC motors with their characteristics and Interpret the conventional speed control methods of AC motors with starting and braking methods.	Analyse
CO5. Evaluate the proficient control of AC and DC drives by utilize the power electronics concepts.	Evaluate

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	S	M	--	--	L										
CO2.	S	S	M	--	--										
CO3.	M	L	M	S	--										
CO4.	S	S	--	M	--										
CO5.	S	M	S	M	M						M	M			

S- Strong; M-Medium; L-Low

Syllabus

UNIT - I **INTRODUCTION** **9 - hours**

Electrical Drives - Basic Elements of a drive system – Types of Electrical Drives –Multi quadrant operation of Electric Drive -Classes of duty – Selection of power rating for drive motors -Factors influencing the choice of electrical drives – Heating and cooling curves – Applications .

UNIT - II **DC Drives** **9 - hours**

Constructional details of DC Motor – Principle of operation DC Motor – Back EMF and torque equations – Types of DC Motors – Characteristics of DC Motors – Starting of DC Motors – Types of Braking – Conventional Speed Control of DC Motors: Armature Voltage Control, Field Flux Control, Ward Leonard Control. Stepper motor: Permanent magnet stepper motor – Principle of operation – Applications.

UNIT - III **AC Drives** **9 - hours**

Construction and operational details of Single and Three Phase Induction Motors – Types – Slip – Torque Equations – Speed-Torque Characteristics – Types of Starters – Types of Braking – Conventional Speed Control of Induction Motors – Construction and operational details of synchronous motor – Starting methods- types of Excitation -V curve and inverted V curve-Servomotor- Applications.

UNIT - IV **Solid State Drives and Speed Control of DC Drives** **9 - hours**

Introduction of Solid state Drives- Functional block diagram and advantages of Solid state Drives – Converter – Phase control- Single Phase and Three Phase Fully controlled Converter: Principle of operation and waveforms of single phase and three phase fully controlled converter fed DC drive – Chopper - Control strategies- Choppers Fed DC Motor Drive – Applications.

UNIT - V **Solid State Speed Control of AC Drives** **9 - hours**

Inverter, AC voltage controller and Cycloconverter - Voltage Source Inverter and Current Source Inverter – VSI fed Three Phase Induction Motors – CSI Fed Three Phase Induction Motors- Cycloconverter Fed Induction Motor Control - Voltage/Frequency Control of induction motor, Static Rotor Resistance Control – Static Scherbius and static Kramer Drives block diagram and explanation – Applications.

TEXTBOOKS

1 Gopal.K.Dubey,"Fundamentals of Electrical Drives" Narosa Publishing House, 2001

2 Theraja,B.L and Theraja, A.K., "A text book of Electrical Technology – Volume II (AC & DC Machines)" S.Chand& Company Ltd., New Delhi, 2009.

REFERENCES

1 VedamSubrahmanyam, "Electric Drives Concepts and Applications" Tata McGraw Hill Publishing Company Ltd., New Delhi, 1998.

2 M.D.Singh and K.B. Khanchandani, "Power Electronics", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2008

Course Designer

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17EECC04	MEASUREMENTS AND INSTRUMENTATION	Category	L	T	P	C
	Total Contact Hours – 45	CC	3	0	0	3
	Prerequisite – Basic Electrical & Electronics Engineering					
	Co-requisite - NIL					

Preamble

This course introduces principle of operation of basic analog and digital measuring instruments for measurement of current, voltage, power, energy etc. Measurement of resistance, inductance and capacitance by using bridge circuits will be discussed in detail.

COURSE OBJECTIVES

1	To introduce the fundamentals of electrical and electronic instruments
2	To understand the working principles of the electrical and electronic meters
3	To Understand the working principle of AC, DC bridges.
4	To introduce various data storage and display devices.
5	To introduce various transducers and the data acquisition systems.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO 1	Explain the functional elements, characteristics, standards and calibration of measuring instruments.	Apply
CO 2	Describe the working of various electrical and electronic meters	Understand
CO 3	Determine unknown values using bridges.	Understand
CO 4	Describe the operation of storage and display devices.	Understand
C0 5	Explain the working of various transducers, ADC and DAC.	Apply

Mapping with Programme outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	M	-	-	-	-	S	-	M	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	S	M	S	-	S	-	-	S	M	-	-	-	-	-	-
CO4	M	M	L	-	L	-	-	M	-	-	M	M	-	-	-
CO5	S	S	-	-	-	-	-	-	S	-	-	M	-	-	-

SYLLABUS

UNIT - I	INTRODUCTION 9
Functional elements of an instrument - static and dynamic characteristics – errors in measurement - statistical evaluation of measurement data - standard and calibration	
UNIT - II	**ELECTRICAL AND ELECTRONICS INSTRUMENTS 9**
Principle and types analog and digital ammeters and voltmeters – single and three phase Wattmeters and Energy meter– instrument transformers – instruments for measurement of frequency and phase.	
UNIT - III	**COMPARISON METHODS OF MEASUREMENTS 9**
D.C & A.C potentiometers, D.C & A.C bridges, transformer ratio bridges, self-balancing bridges. Interference & screening – Multiple earth and earth loops – Electrostatic and electromagnetic interference – Grounding techniques.	
UNIT - IV	**STORAGE AND DISPLAY DEVICES 9**
Magnetic disc and tape recorders – digital plotters and printers – CRT displays – digital CRO – LED, LCD and Dot matrix displays. Data Logger	
UNIT - V	**TRANSDUCERS 9**
Classification of transducers – selection of transducers – resistive, capacitive and inductive transducers – piezo electric transducers – optical and digital transducers- Elements of data acquisition system – A/D, D/A converters – Smart sensors.	

TEXTBOOK

1. A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2004.
2. Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd., 2007.

REFERENCES

1. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw Hill, II Edition 2004.
2. A.J. Bouwens, 'Digital Instrumentation', Tata McGraw Hill, 1997.
3. D.V.S. Moorthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt Ltd, 2007.
4. John P. Bentley, 'Principles of Measurement Systems', III Edition, Pearson Education, 2000.

COURSE DESIGNERS				
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17EECC16	POWER ELECTRONICS AND DRIVES	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Power electronics deals with the processing and control of 'raw' electrical power from an electrical source such as an AC mains supply, a battery bank, a photovoltaic array, or a wind turbine into a form and quality suitable for a particular electrical load. It is an enabling technology with a very wide range of applications, such as a cell phone charger, a personal computer, a microwave oven, an MRI system, a hybrid electric car, or even the electrical grid. As can be noted, the power levels handled can vary from a few watts to several hundreds of megawatts. In this course, we will study the basic principles behind the power electronic circuits used in most such power processing applications. These circuits include power converters for DC to DC, DC to AC and AC to DC applications.

PREREQUISITE

Electronic Devices and Circuits

COURSE OBJECTIVES

1	To get an overview of different types of power semiconductor devices and their switching characteristics.
2	To understand the operation, characteristics and performance parameters of controlled rectifiers.
3	To study the operation, switching techniques and basics topologies of DC-DC switching regulators.
4	To learn the different modulation techniques inverters and to understand harmonic reduction methods.
5	To study the operation of AC voltage controller.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1:The basic semiconductor physics to the properties of real power semiconductordevices and differentiate from low power devices.	Remember
CO2:The concepts of operation of AC-DC converters in steady state and transient state of both continuous and discontinuous modes.	Understand
CO3:Classify and design choppers for simple electrical application	Apply
CO4:Identify the proper gating sequence and control circuit in operating the single phase and three phase inverter circuits.	Analyze
CO5:Analyze the performance parameter, various techniques for analysis and design of AC voltage controller and also list the various control schemes in cycloconverter.	Analyze
CO6:Describe the concepts of electric machines .	Understand
CO7:implement the power electronics concepts to AC & DC drives to made the effective control .	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES															
COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M													
CO2	S	S	M												
CO3	S														
CO4	S		S		S										
CO5					S										
CO6		S	M												
CO7		M	M		M										
S- Strong; M-Medium; L-Low															

UNIT - I :POWER SEMI-CONDUCTOR DEVICES 9

Overview of switching devices – Driver and snubber circuit of SCR TRIAC, GTO, IGBT, MOSFET – Computer simulation of PE circuits.

UNIT - II : RECTIFIERS & CHOPPERS 9

Introduction-2 pulse / 3 pulse and 6 pulse converters – Dual converters. Basic Principles of Choppers - Stepdown and stepup chopper – Time ratio control and current limit control – Buck, Boost, Buck-Boost converters.

UNIT - III :INVERTERS & AC - AC CONVERTERS 9

Single phase and three phase [120^o& 180^o mode] inverters – PWM techniques – Sinusoidal PWM, Modified sinusoidal PWM and multiple PWM.

Single phase AC voltage controllers – Multistage sequence control – single phase and three phase cycloconverter.

UNIT - IV :ELECTRICAL DRIVES 9

Type of Electrical Drives – Selection & factors influencing the selection – heating and cooling curves – loading condition and classes of duty – determination of power rating – simple problems.

UNIT - V :SOLID STATE DRIVES(QUALITATIVE TREATMENT ONLY) 9

Advantages of solid state drives – D.C. motor control using rectifiers and choppers – control of induction motor by V, V/f and slip power recovery scheme using inverters and A.C. power regulators.

Total Hours : 45

TEXT BOOKS:

1. Rashid M.H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India, 3rd Edition, New Delhi, 2004.
2. G.K. Dubey “Fundamental Electrical Drives” second edition 2002, Narosa Publications,

Second edition, 2002.

REFERENCES:

1. Cyril.W.Lander, "Power Electronics", McGraw Hill International, Third Edition, 1993.
2. P.S.Bimbra "Power Electronics", Khanna Publishers, third Edition 2003.
3. Philip T.Krein, "Elements of Power Electronics" OxfordUniversity Press, 2004Edition.
4. N.K.De.,P.K.Sen "Electric Drives", Prentice Hall, First edition 1999.
5. Pillai, S.K., " A First course on Electrical Drives", Wiley Eastern Ltd., New Delhi, 1982

COURSE DESIGNERS

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ELECTRONICS AND COMMUNICATION ENGINEERING - OPEN ELECTIVE

17ECCC07	MICROCONTROLLERS & ITS APPLICATIONS	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Microcontroller is used as the main controller in most of the embedded systems nowadays. Due to the development in VLSI technology, microcontrollers evolve which function similar to microprocessors but they have most of the peripherals built on-chip. This course makes the students to be familiar with the architecture and programming of Microcontrollers. This course also introduces the architecture and hardware features of PIC 16F877 and ARM7 (LPC2148) microcontrollers.

PREREQUISITE -

COURSE OBJECTIVES

1	To learn the concepts of microprocessors and knowledge of interfacing devices.
2	To study the Architecture of 8051 microcontroller
3	To develop skill in simple program writing of microcontroller
4	To study the interfacing and applications of microcontroller
5	To study the advanced microcontrollers.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Explain the concept of microprocessor and interfacing devices.	Understand
CO2. Explain the architecture and function of 8051 microcontroller	Apply
CO3. Design and implement programs on 8051 Microcontroller	Analyze
CO4. Design and implement applications using 8051 Microcontroller	Analyze
CO5. Explain the advanced Microcontrollers used in different applications.	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO0 6	PO0 7	PO0 8	PO0 9	PO 10	PO1 1	PO 12	PS O1	PS O2	PS O3
CO1	S	L	L	-	L	-	-	-	-	-	-	M	-	-	-
CO2	L	S	S	-	M	-	-	-	-	-	-	M	-	-	-
CO3	S	M	M	-	L	M	-	-	-	-	-	M	-	-	-
CO4	S	L	L	-	L	S	-	-	-	-	-	M	-	-	-
CO5	M	M	S	-	M	L	-	-	-	-	-	M	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTEL 8086 MICROPROCESSOR & I/O INTERFACING
Introduction to 8086 - Architecture of 8086 - Register organization – Signal Description of 8086 - Addressing modes – Data Transfer Instruction – Arithmetic Instruction - Branching Instruction - Program Transfer Instruction – simple programs- Programmable Peripheral Interface 8255 – Programmable Communication Interface 8251 USART – Programmable Interrupt Controller 8259A – Direct Memory Access Controller 8257- Programmable Interval Timer 8253 – Keyboard/Display Controller 8279.

INTEL 8051 MICROCONTROLLER
Introduction to 8 bit microcontroller – architecture of 8051- Signal descriptions of 8051- Role of PC and DPTR- Flags and PSW- CPU registers- Internal RAM & ROM- Special Function Register-Counter & Timers- Serial Communication.

ASSEMBLY LANGUAGE PROGRAM OF INTEL 8051
Interrupt- Addressing Mode- Data Transfer Instruction- Arithmetic Instruction- Logical Instruction- Jump Loop & Call Instruction- I/O Port Programming.

INTERFACING AND APPLICATION OF INTEL 8051
LCD Interfacing - A/D and D/A Interfacing- Sensor Interfacing- Relays and Optoisolators- Stepper Motor Interfacing- DC Motor Interfacing.

ADVANCED MICROCONTROLLERS
PIC 16F877 microcontroller – Architecture On chip ADC, I^2C – SPI – Watchdog timer – ARM7 (LPC2148) microcontroller – Architecture and applications.

TEXTBOOKS

1. Muhammad Ali Mazidi and Janica Gilli Mazidi, The 8051 microcontroller and embedded systems, Pearson Education, 5th Indian reprint, 2003.
2. Frank D. Petruzella. “Programmable Logic Controllers”, McGraw–Hill Book, Company, 1989

REFERENCE BOOKS

1. B.P. Singh, Microprocessors and Microcontrollers, Galcotia Publications (P) Ltd, First edition, New Delhi, 1997.
2. Embedded Controller Hand book, Intel Corporation, USA.
3. Microcontroller Hand Book, INTEL, 1984.
4. Ajay V.Deshmukh, “Microcontrollers- Theory and applications”, Tata McGraw-Hill, publisher,2005.

COURSE DESIGNERS

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17ECCC18	INTERNET OF THINGS FOR ELECTRONICS	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

The purpose of this course is to impart knowledge on Internet of Things (IoT), which relates to the study of sensors, actuators, and controllers, among other Things, IoT applications and examples overview (building automation, transportation, healthcare, industry, etc.) with a focus on wearable electronics

PREREQUISITE -

COURSE OBJECTIVES

1	Understanding of IoT value chain structure (device, data cloud), application areas and technologies involved
2	Understand IoT sensors and technological challenges faced by IoT devices, with a focus on wireless, energy, power, RF and sensing modules
3	Market forecast for IoT devices with a focus on sensors
4	Explore and learn about Internet of Things with the help of preparing projects designed for Raspberry Pi
5	To study the advanced internet of things for electronics

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Explain the concept of Internet of Things.	Understand
CO2. Explain the IOT Sensors To Appear	Apply
CO3. Design and implement of technological sensors	Analyze
CO4. Design and implement applications using internet of things	Analyze
CO5. Explain the advanced internet of things used in different applications.	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO06	PO07	PO08	PO09	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	L	-	L	-	-	-	-	-	-	M	-	-	-
CO2	L	S	S	-	M	-	-	-	-	-	-	M	-	-	-
CO3	S	M	M	-	L	M	-	-	-	-	-	M	-	-	-
CO4	S	L	L	-	L	S	-	-	-	-	-	M	-	-	-
CO5	M	M	S	-	M	L	-	-	-	-	-	M	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Internet of Things Promises–Definition–Scope–Sensors for IoT Applications–Structure of IoT–IoT Map Device

SEVEN GENERATIONS OF IOT SENSORS TO APPEAR

Industrial sensors –Description & Characteristics–First Generation –Description & Characteristics–Advanced Generation –Description & Characteristics–Integrated IoT Sensors –Description & Characteristics–Polytronics Systems –Description & Characteristics–Sensors' Swarm –Description & Characteristics–Printed Electronics –Description & Characteristics–IoT Generation Roadmap

TECHNOLOGICAL ANALYSIS

Wireless Sensor Structure–Energy Storage Module–Power Management Module–RF Module–Sensing Module

IOT DEVELOPMENT EXAMPLES

ACOEM Eagle –EnOcean Push Button –NEST Sensor –Ninja Blocks -Focus on Wearable Electronics

PREPARING IOT PROJECTS

Creating the sensor project -Preparing Raspberry Pi -Clayster libraries -Hardware-Interacting with the hardware -Interfacing the hardware-Internal representation of sensor values -Persisting data -External representation of sensor values -Exporting sensor data -Creating the actuator project-Hardware -Interfacing the hardware -Creating a controller -Representing sensor values -Parsing sensor data -Calculating control states -Creating a camera -Hardware -Accessing the serial port on Raspberry Pi -Interfacing the hardware -Creating persistent default settings -Adding configurable properties -Persisting the settings -Working with the current settings -Initializing the camera

REFERENCE BOOKS

1. Dr. Guillaume Girardin , Antoine Bonnabel, Dr. Eric Mounier, 'Technologies & Sensors for the Internet of Things Businesses & Market Trends 2014 -2024',Yole Développement Copyrights ,2014
2. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015
3. Editors OvidiuVermesan Peter Friess,'Internet of Things –From Research and Innovation to Market
4. Deployment', River Publishers, 2014
5. N. Ida, Sensors, Actuators and Their Interfaces, Scitech Publishers, 2014.

COURSE DESIGNERS

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17ECEC06	MEMS & SENSORS	Category	L	T	P	Credit
		EC	3	0	0	3

PREAMBLE

In recent years, MEMS have revolutionized the semiconductor industry, with sensors being a particularly buoyant sector. Smart MEMS and Sensor Systems presents readers with the means to understand, evaluate, appreciate and participate in the development of the field, from a unique systems perspective.The combination of MEMS and integrated intelligence has been put forward as a disruptive technology. The full potential of this technology is only evident when it is used to construct very large pervasive sensing systems.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	Understand the fundamental concept of MEMS and their relevance to current industry/scientific needs
2	Gain the physical knowledge underlying the operation principles and design of microsystems;
3	Build an understanding of microscale physics for use in designing MEMS applications
4	Understand the basic principles of MEMS sensors and actuators (mechanical, electrical, piezoresistive, piezoelectric, thermal, microfluidic)
5	Design the process flow of a basic MEMS device, such as an inertia sensor (accelerometer), given a fabrication process description.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Knowledge on the basics of MEMS and mechanics for MEMS Design	Understand
CO2. Ability to apply the basic knowledge of MEMS in different fields	Apply
CO3. Apply the MEMS for different applications.	Apply
CO4. Use concepts in common methods for converting a physical parameter into an electrical quantity	Apply
CO5. Locate different type of sensors used in real life applications and paraphrase their importance	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO06	PO07	PO08	PO09	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	L	-	L	-	-	-	-	-	-	M	L	-	-
CO2	S	S	M	M	M	-	-	-	-	-	-	M	M	-	-
CO3	S	S	M	M	L	M	-	-	-	-	-	M	M	-	-
CO4	S	S	S	-	L	S	-	-	-	-	-	M	L	M	-

CO5	S	M	S	S	S	S	M	-	-	-	-	M	M	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

OVERVIEW AND INTRODUCTION Introduction to Design of MEMS, Overview of Micro electromechanical Systems, Materials for MEMS: Silicon, silicon compounds, polymers, metals ,Micro fabrication, Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect-Ratio (LIGA and LIGA-like) Technology; Packaging: Microsystems packaging, Essential packaging technologies, **S**election of packaging materials

MECHANICS FOR MEMS DESIGN Elasticity, Stress, strain and material properties, Bending of thin plates, Spring configurations, torsional deflection, Mechanical vibration, Resonance, Thermo mechanics – actuators, force and response time, Fracture and thin film mechanics.

MEMS APPLICATION Case studies – Capacitive accelerometer, Peizo electric pressure sensor, Microfluidics application, Modeling of MEMS systems, CAD for MEMS.

INTRODUCTION AND DISPLACEMENT MEASUREMENT Sensors - Basic requirements of a sensors- Classification of sensors- Static and Dynamic characteristics of sensors- Displacement Sensors- Linear and Rotary displacement sensors-Potentiometer, Capacitive and Inductive type displacement sensor-position sensors- Optical encoder, Photoelectric sensor, Hall Effect Sensor.

MICRO SENSORS AND ACTUATORS Micro Sensors: Principles and examples, Force and pressure micro sensors,position and speed micro sensors, acceleration micro sensors, chemical sensors,biosensors, temperature micro sensors and flow micro sensors. Micro Actuators: Actuation principle, shape memory effects-one way, two way and pseudo elasticity. Types of micro actuators- Electrostatic, Magnetic, Fluidic, Inverse piezo effect, other principles.

Text Books

1.N. P. Mahalik, "MEMS",Tata McGraw hill, Sixth reprint, 2012.
2.Stephen Santeria," Microsystems Design", Kluwer publishers, 2000.

3.Sensor & transducers, D.Patranabis, 2nd edition, PHI

Reference Books

1. Nadim Maluf," An introduction to Micro electro mechanical system design", ArtechHouse, 2000.
2. Mohamed Gad-el-Hak, editor," The MEMS Handbook", CRC press Baco Raton,2000.
3.. Tai Ran Hsu," MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002. Liu,"MEMS", Pearson education, 2007
4. Instrument transducers, H.K.P. Neubert, Oxford University press.

COURSE DESIGNERS

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INDUSTRIAL ELECTIVES

17MEP103	NOISE VIBRATION & HARSHNESS	Category	L	T	P	Credit
		PI	3	0	0	3

PREAMBLE

This course reviews the fundamental concepts of acoustics, noise propagation and vibrations. Focus is given to the theory and equipments pertaining to the measurement of automotive acoustics, sound quality and vibrations.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To introduce source of noise and vibration
2	To broaden the understanding of sound measurement and human sensitivity
3	To underline the importance of simulation, anechoic chamber and acoustic holography
4	To broaden the importance of statistical and frequency analysis
5	To introduce active control techniques

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Identify sources of noise and vibration

CO2. Measure sound intensity and human sensitivity

CO3. Apply methods to model the advanced acquisition techniques

CO4.Evaluate active control techniques

CO5. Identify and evaluate the automotive noise sources

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO 1	PO 2	PO 3	PO4	PO 5	PO6	PO7	PO8	PO 9	PO1 0	PO1 1	PO12	PS O1	PSO 2	PSO3
CO1	S	M	M	L	--	L	L	--	--	--	--		M	--	--
CO2	S	M	M	M	M	L	L	--	--	--	--		M	--	--
CO3	S	S	S	S	S	M	M	--	--	--		--	M	--	--
CO4	S	S	S	S	S	M	M	--	--	--		--	M	--	--
CO5	S	S	S	S	S	S	S	--	--	--	--	--	M	--	--

S- Strong; M-Medium; L-Low

SYLLABUS

BASICS OF VIBRATION ANALYSIS: Basic Concepts, Formulating the Equations of Motion, Free Undamped Vibrations- Free Damped Vibrations - Logarithmic Decrement, Forced Vibrations, Magnification Factor - Torsional System Characteristics, Single Disc And Two Disc- Two Degree of Freedom Systems under Harmonic Force, Modal Analysis- Coordinate Coupling.

NVH IN THE AUTOMOTIVE INDUSTRY: Sources of noise and vibration. Design features. Common problems. Marque values. Noise quality. Pass-by noise requirements. Target vehicles and objective targets. Development stages in a new vehicle programme and the altering role of NVH engineers.

SOUND AND VIBRATION THEORY: Sound measurement. Human sensitivity and weighting factors. Combining sound sources. Acoustical resonances. Properties of acoustic materials. Transient and steady state response of one degree of freedom system applied to vehicle systems. Transmissibility. Modes of vibration.

NVH MEASUREMENTS: Vibration and Noise Standards – Pass/Drive by Noise-Test Site- Meteorological Condition-Constant Speed Test- Wide Open Throttle Test - Interior Noise Test- Standards – Test Track Condition – Vehicle Operating Condition –Steady Speed – Full Throttle Test –Stationery Test- Microphone Positions.- Stationery Vehicle Test- Standards- Test Site- Preparation of The Vehicle-Vehicle Operating Condition.- NVH Measurement Tools And Techniques- Vibration and Noise Measurement Transducers.- Advanced Acquisition Techniques.

AUTOMOTIVE NOISE SOURCES AND CONTROL TECHNIQUES: Methods for Control of Engine Noise-Control Measures- Mufflers, Transmission Noise- Control Methods.- Intake And Exhaust Noise – Attenuation Of Intake and Exhaust Noise- Dissipative Silencers – Reactive Silencers – Resonators - Aerodynamic Noise, Its Sources And Control Methods- Tire Noise And Their Control Methods, Brake Noise.- Noise Control Strategy, Noise Control At Source.- Noise Control Along The Transmission Path- Barriers, Enclosures, Resonators.

TEXT BOOKS:

1. Singiresu S. Rao, "*Mechanical Vibrations*" 5th Edition, Pearson, September , 2010
2. Ambekar, A. G., "*Mechanical Vibrations and Noise Engineering*", Prentice Hall of India, New Delhi, 2006
3. Manasi P. Joshi, "*Noise &Vibration Measurement Techniquesin Automotive NVH*"2012

REFERENCES:

1. Beranek, L. L. and Ver, I, L., "*Noise and Vibration Control Engineering –Principles and Application*", John Wiley & Sons, Inc, 1992.
2. Malcolm J. Crocker, *"Handbook of Noise and Vibration Control"* John Wiley & Sons, Inc 2007

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department / Name of the College	Mail ID
1	SHIVAKUMAR N	Asst. Prof. - II	Mechanical, AVIT	shiva.thermal@gmail.com

17MEP104	NON-DESTRUCTIVE TESTING	Category	L	T	P	Credit
		PI	3	0	0	3

Preamble

To study and understand the various Non Destructive Evaluation and Testing methods, theory and their industrial applications.

Prerequisite

NIL

Course Objective

1	To expose to the concept of overview of NDT
2	To familiarize with the applicationsof differential equations, surface NDE Methods
3	To understand the concept of thermography and Eddy current testing
4	To understand the concept of ultrasonic testing and acoustic emission
5	To understand the concept of Radiography (RT)

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Classify the concept of overview of NDT	Apply
CO2.	To familiarize with the applications of differential equations, surface NDE Methods	Understand
CO3.	Explain the concept of thermography and Eddy current testing	Understand
CO4.	Explain the concept of ultrasonic testing and acoustic emission	Understand
CO5.	Explain the concept of Radiography (RT)	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO 1	PSO 2	PSO 3
CO1	S	L	L	S	S	M							L		
CO2	S	M	L	S	S	M							L		
CO3	S	S	L	M	S	M							L		
CO4	S	M	L	M	S	M							M		
CO5	S	M	M	M	S	M							M		

S- Strong; M-Medium; L-Low

SYLLABUS
OVERVIEW OF NDT
NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterization. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT., Visual inspection – Unaided and aided
SURFACE NDE METHODS
Liquid Penetrants Testing – Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetisation methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.
THERMOGRAPHY AND EDDY CURRENT TESTING
Thermography- Principles, Contact and non contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation – infrared radiation and infrared detectors, Instrumentations and methods, applications.Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.
ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION (AE)
Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique –Principle, AE parameters, Applications
RADIOGRAPHY (RT)
Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films – graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography
Text Books
1. Baldev Raj, T.Jayakumar, M.Thavasimuthu “Practical Non-Destructive Testing”, NarosaPublishing House. 2.RaviPrakash, “Non-Destructive Testing Techniques”, 1st revised edition, New Age International Publishers.
Reference Books
1.ASM Metals Handbook,”Non-Destructive Evaluation and Quality Control”, American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17. 2.Paul E Mix, “Introduction to Non-destructive testing: a training guide”, Wiley, 2nd Edition New Jersey 3.Charles, J. Hellier,“ Handbook of Nondestructive evaluation”, McGraw Hill, New York.
Course Designers

S.No	Faculty Name	Designation	Department/ Name of the College	Email id
1	S.ASHOKKUMAR	Asst.Professor G-II	Mech / Avit	Ashokkumar@avit.ac.in

17MEP105	COAL MINING AND MECHANIZATION	Category	L	T	P	Credit
		PI	**3**	**0**	**0**	**3**

Preamble

This course enable the students to understand the various mining methods, methods of gasification and design of various machineries.

Prerequisite

NIL

Course Objective

1	To introduce the recent trends of level of mechanisation for coal face
2	To understand the various advanced methods of coal mining
3	To understand basic mining using hydraulics
4	To understand the concept of different conditions of mining
5	To understand the gasification of underground coal mines

Course Outcomes: On the successful completion of the course, students will be able to

CO1.	Understand the basic concept of coal mining and types	Understand
CO2.	Understand the problems faced during mining operation from past experiences	Understand
CO3.	Understand the basic requirements, equipments and machinery for mining operation	Understand
CO4.	Apply the Concepts, Methodology, Mining techniques appropriate for the field	Apply
CO5.	Analyze the failure modes, Process, safety and criticality in design of underground mines	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO 1	PSO 2	PSO 3
CO1	S	L											M		
CO2	S	S	M	S		S							M		
CO3	S	L	L										M		
CO4	S	M		L			M						M		
CO5	S	S	S	M	L	S	S						M		

S- Strong; M-Medium; L-Low

SYLLABUS
COAL FACE MECHANISATION
Introduction to Coal mining - Recent Trends, mechanised board and pillar mining, case studies.
MINING OF THICK SEAMS
Problems, past experiences in India, current methods, mining of thick, contiguous, and steep seams
HYDRAULIC MINING
Applicability, operating parameters, equipment, layouts, Indian experience. Computer applications such as remote control and environmental monitoring in hydraulic mining.
LONGWALL MINING
Powered supports, development of powered supports, their types and designs, selection for different conditions, last drivages for longwall panelling, remotely operated powered support and longwall faces, Indian experiments, salvaging in longwall.
UNDERGROUND COAL GASSIFICATION
Scope, application, methods of gasification, design of gasification plants, coal bed methane. Environmental monitoring techniques and computer applications in coal gasification techniques.

Text Books

1	Das S.K., Modern Coal Mining Technology, Lovely Prakashan, Dhanbad,
2	Singh, T.N., and Dhar, B.B. Thick Seam Mining, Problems and Issues, Oxford & IBH Publishers,

Reference Books

1	Mathur, S.P., Mining Planning for Coal, M G Consultants, Bilaspur, Peng S.S. and Chiang,
2	H.S., Longwall Mining, John Willey and Sons, New York,
3	T.N. Singh, Underground Winning of Coal, Oxford IBH Publishers.
4	R.D. Singh, Principles and Practices of Modern Coal Mining, New Age International,

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	P.KUMARAN	ASST. PROF –GR-II	Mech / AVIT	Kumaranp@avit.ac.in
2	R.PRAVEEN	ASST. PROF –GR-II	Mech / AVIT	praveen@avit.ac.in

17ARPI03	INTRODUCTION TO AIRCRAFT INDUSTRY AND AIRCRAFT SYSTEMS	Category	L	T	P	Credit
		INDUSTRY ELECTIVE (INFOSYS)	3	0	0	3

Preamble

To provide knowledge about stakeholders in aviation industries and employment skills required by companies.

Prerequisite

NIL

Course Objectives

1	To provide an understanding of the basics of aircrafts.
2	To provide a deep knowledge of stakeholders in aviation industries.
3	To develop analytical skills for taking decisions.
4	To develop criticizing skills and compare for better and best.
5	To develop entrepreneurial skills.

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	Define principles of operation and label components of an aircraft.	Remember
CO2.	Explain working of components of aircraft and its systems.	Understand
CO3.	Employ analytical skills for judgement of best.	Apply
CO4.	Categorise knowledge gained and will be able to apply suitably.	Analyze
CO5.	Evaluate and balanced approach towards employment in industries.	Evaluate
CO6.	Create benchmarks by advising juniors about opportunities.	Create

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO2.	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO3.	S	S	S	S	-	-	-	-	-	-	-	-	M	M	M
CO4.	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S
CO5.	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S
CO6.	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S

S- Strong; M-Medium; L-Low

Syllabus		
UNIT – I	**AIRCRAFT INDUSTRY OVERVIEW**	**8**
Evolution and History of Flight, Types Of Aerospace Industry, Key Players in Aerospace Industry, Aerospace Manufacturing, Industry Supply Chain, Prime contractors, Tier 1 Suppliers, Key challenges in Industry Supply Chain, OEM Supply Chain Strategies, Mergers and Acquisitions, Aerospace Industry Trends, Advances in Engineering/CAD/CAM/CAE Tools and Materials technology, Global and Indian Aircraft Scenario.		

UNIT – II	**INTRODUCTION TO AIRCRAFTS**	**8**
Basic components of an Aircraft, Structural members, Aircraft Axis System, Aircraft Motions, Control surfaces and High lift Devices. Types of Aircrafts - Lighter than Air/Heavier than Air Aircrafts Conventional Design Configurations based on Power Plant Location, Wing vertical location, intake location, Tail Unit Arrangements, Landing Gear Arrangements. Unconventional Configurations-Biplane, Variable Sweep, Canard Layout, Twin Boom Layouts, Span loaders, Blended Body Wing Layout, STOL and STOVL Aircraft, Stealth Aircraft. Advantages and disadvantages of these Configurations.		
UNIT – III	**INTRODUCTION TO AIRCRAFT SYSTEMS**	**9**
Types of Aircraft Systems, Mechanical Systems, Electrical and Electronic Systems, Auxiliary systems, Mechanical Systems: Environmental control systems (ECS), Pneumatic systems, Hydraulic systems, Fuel systems, Landing gear systems, Engine Control Systems, Ice and rain protection systems, Cabin Pressurization and Air Conditioning Systems, Steering and Brakes Systems Auxiliary Power Unit, Electrical systems: Avionics, Flight controls, Autopilot and Flight Management Systems, Navigation Systems, Communication, Information systems, Radar System.		
UNIT – IV	**BASIC PRINCIPLES OF FLIGHT**	**10**
Significance of speed of Sound, Air speed and Ground Speed, Properties of Atmosphere, Bernoulli's Equation, Forces on the airplane, Airflow over wing section, Pressure Distribution over a wing section, Generation of Lift, Drag, Pitching moments, Types of Drag, Lift curve, Drag Curve, Lift/Drag Ratio Curve, Factors affecting Lift and Drag, Center of Pressure and its effects. Aerofoil Nomenclature, Types of Aerofoil, Wing Section- Aerodynamic Center, Aspect Ratio, Effects of lift, Drag, speed, Air density on drag.		
UNIT – V	**BASICS OF FLIGHT MECHANICS**	**10**
Mach Waves, Mach Angles, Sonic and Supersonic Flight and its effects **Stability and Control** Degree of Stability- Lateral, Longitudinal and Directional Stability and controls of Aircraft. Effects of Flaps and Slats on Lift Coefficients, Control Tabs, Stalling, Landing, Gliding Turning, Speed of Sound, Mach Numbers, Shock Waves **Aircraft Performance and Maneuvers** Power Curves, Maximum and minimum speeds of horizontal flight, Effects of Changes of Engine Power, Effects of Altitude on Power Curves, Forces acting on an Aeroplane during a Turn, Loads during a Turn, Correct and incorrect Angles of Bank, Aerobatics, Inverted Maneuvers, Maneuverability.		
TEXT BOOK:		
1. Flight without Formulae by A.C Kermode, Pearson Education,10th Edition. 2. Mechanics of Flight by A.C Kermode, Pearson Education,5th Edition. 3. Fundamentals of Flight, Shevell, Pearson Education, 2nd Edition.		
REFERENCES:		
1. Introduction to Flight by Dave Anderson. 2. Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration by Ian Moir, Allan Seabridge 3. An Introduction to Aircraft Certification; A Guide to Understanding JAA, EASA and FAA by Filippo De Florio, Butterworth-Heinemann.		

Course Designers:

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17ARPI04	DESIGN OF AIRCRAFT STRUCTURES	Category	L	T	P	Credit
		INDUSTRY ELECTIVE (INFOSYS)	3	0	0	3

Preamble

To study about load taking capabilities of components of aircraft structures.

Prerequisite

NIL

Course Objectives

1	To understand the basic concepts of strengthening components of aircrafts.
2	To develop an understanding of applications of basic theories of strength of materials.
3	To develop analytical skills for selection of suitable and precise method.
4	To design and suggest modification in existing load carrying members.
5	To develop entrepreneurial skills.

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	Define principles of operation and label components of aircraft structures.	Remember
CO2.	Explain working of load carrying members.	Understand
CO3.	Employ analytical skills to calculate stresses at different points.	Apply
CO4.	Categorise the structure and estimate reliable performance.	Analyze
CO5.	Evaluate and modify the system for meeting suitable requirement.	Evaluate
CO6.	Formulate and design a new modified structure for new applications.	Create

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO2.	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO3.	S	S	S	S	-	-	-	-	-	S	-	-	M	M	M
CO4.	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S
CO5.	S	S	S	S	-	-	-	-	-	-	S	-	S	S	S
CO6.	S	S	S	S	-	-	-	-	-	-	-	S	S	S	S

S- Strong; M-Medium; L-Low

Syllabus		
UNIT – I	**FUNDAMENTALS OF AIRCRAFT DESIGN PROCESS AND STRUCTURAL ANALYSIS**	**8**
Introduction, Phases of Aircraft Design, Aircraft Conceptual Design Process, Conceptual Stage, Preliminary Design, Detailed Design, Design Methodologies, Review of Hooke's Law, Principal stresses, Equilibrium and Compatibility, Determinate Structures, St. Venant's Principle, Conservation of Energy, Stress Transformation, Stress Strain Relations.		

UNIT – II	**INTRODUCTION TO AIRCRAFT STRUCTURES AND AIRCRAFT LOADS**	**9**
Types of Structural members of Fuselage and wing section Ribs, Spars, Frames, Stringers, Longeron, Splices, Sectional Properties of structural members and their loads, Types of structural joints, Type of Loads on structural joints, Aerodynamic Loads, Inertial Loads, Loads due to engine, Actuator Loads, Maneuver Loads, VN diagrams, Gust Loads, Ground Loads, Ground conditions, Miscellaneous Loads.		
UNIT – III	**AIRCRAFT MATERIALS AND MANUFACTURING PROCESSES**	**8**
Material selection criteria, Aluminum Alloys, Titanium Alloys, Steel Alloys, Magnesium Alloys, copper Alloys, Nimonic Alloys, Non Metallic Materials, Composite Materials, Use of Advanced materials Smart materials, Manufacturing of A/C structural members, Overview of Types of manufacturing processes for Composites, Sheet metal Fabrication ,Machining, Welding, Super-plastic Forming And Diffusion Bonding		
UNIT – IV	**STRUCTURAL ANALYSIS OF AIRCRAFT STRUCTURES**	**12**
Theory of Plates- Analysis of plates for bending, stresses due to bending, Plate deflection under different end conditions, Strain energy due to bending of circular, rectangular plates, Plate buckling, Compression buckling, shear buckling, Buckling due to in plane bending moments, Analysis of stiffened panels in buckling, Rectangular plate buckling, Analysis of Stiffened panels in Post buckling, Post buckling under shear. **Sample Exercises**. Theory of Shells-Analysis of Shell Panels for Buckling, Compression loading, Shear Loading / Shell Shear Factor, Circumferential Buckling Stress, **Sample exercises** Theory of Beams-Symmetric Beams in Pure Bending, Deflection of beams, Unsymmetrical Beams in Bending, Plastic Bending of beams, Shear Stresses due to Bending in Thin Walled Beams, Bending of Open Section Beams, Bending of Closed Section Beams, Shear Stresses due to Torsion in Thin Walled Beams. **Sample Exercises**. Theory of Torsion - Shafts of Non-Circular Sections, Torsion in Closed Section Beams, Torsion in Open Section Beams, Multi Cell Sections, **Sample Exercises**.		
UNIT – V	**AIRCRAFT STRUCTURAL REPAIR, AIRWORTHINESS AND AIRCRAFT CERTIFICATION**	**8**
Definition, Airworthiness Regulations, Regulatory Bodies, Type certification, General Requirements, Requirements Related to Aircraft Design Covers, Performance and Flight Requirements, Airframe Requirements, Landing Requirements, Fatigue and Failsafe requirements, Emergency Provisions, Emergency Landing requirements. Types of Structural damage, Nonconformance, Rework, Repair, Allowable damage Limit, Repairable Damage Limit, Overview of ADL Analysis, Types of Repair, Repair Considerations and best practices.		
TEXT BOOK:		
1. Aircraft Design-A Conceptual Approach by Daniel P.Raymer, AIAA education series,6th Edition 2. Airframe Structural Design by Michael Niu, Conmilit Press, 1988,2nd Edition 3. Airframe Stress Analysis and Sizing by Michael Niu, Conmilit Press, 1999,3rd Edition.		
REFERENCES:		
1. The Elements of Aircraft Preliminary Design – Roger D. Schaufele, Aries Publications, 2000 2. Aircraft Structural Maintenance by Dale Hurst, Avotek publishers, 2nd Edition, 2006 3. Aircraft Maintenance & Repair by Frank Delp, Michael J. Kroes & William A. Watkins, Glencoe &McGraw-Hill,6th Edition, 1993		

Course Designers:

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