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 Part Time (3 1/2 Years)

STRUCTURED CHOICE BASED CREDIT SYSTEM (SCBCS)

Curriculum & Syllabus

(Semester I to VII)

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

Department of Mechanical Engineering

PROGRAM OUTCOMES

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: 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.

4. **Conduct investigations of complex problems**: 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.

5. **Modern tool usage**: 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.

6. **The engineer and society**: 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.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: 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.

11. **Project management and finance**: 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.

12. **Life-long learning**: 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 to be earned Min – Max.
01	**A. Foundation Courses (FC)**	**12 - 18**
	i. Humanities and Sciences (English and Management Courses)	3 – 6
	ii. Basic Sciences (Maths, Physics and Chemistry Courses)	9– 12
02	**B. Core courses (CC)**	**77**
03	**C. Elective Courses (EC)**	**12 - 18**
	i. Programme Specific (Class Room or Online)	9 – 12
	ii. Open Elective (Class Room or Online)	3 - 6
04	**D. Project**	**6**
Minimum Credits to be earned for awarding of Degree		**107**
Credits earned in categories A to D would be mentioned in Mark sheets and will be used for overall CGPA Calculations.		

B.E/B.TECH. – MECHANICAL ENGINEERING - SEMESTER I TO VIII

CATEGORY A – FOUNDATION COURSES - HSS, BS AND ES COURSES - CREDITS (12 - 18)

(i) HUMANITIES AND SCIENCES (ENGLISH AND MANAGEMENT SUBJECTS) - CREDITS (3 – 6)

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	17MBHS04	TOTAL QUALITY MANAGEMENT	MANAGEMENT	FC (HSS)	3	0	0	3	NIL
4	17MBHS01	ENGINEERING STARTUPS AND ENTREPRENEURIAL MANAGEMENT	MANAGEMENT	FC (HSS)	3	0	0	3	NIL
5	17MBHS07	PROFESSIONAL ETHICS AND HUMAN VALUES	MANAGEMENT	FC (HSS)	3	0	0	3	NIL
6	17MBHS08	PROJECT MANAGEMENT FOR ENGINEERING BUSINESS AND TECHNOLOGY	MANAGEMENT	FC (HSS)	3	0	0	3	NIL
7	17MBHS09	INTELLECTUAL PROPERTY RIGHTS & ALTERNATE DISPUTES RESOLUTIONS	MANAGEMENT	FC (HSS)	3	0	0	3	NIL

(ii) BASIC SCIENCES (MATHS, PHYSICS AND CHEMISTRY SUBJECTS) - CREDITS (9 – 12)

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

B.E/B.TECH. – MECHANICAL ENGINEERING - SEMESTER I TO VII

CATEGORY B – CORE COURSES RELEVANT TO THE PROGRAMME - CREDITS (77)

S.No	CODE	COURSE	OFFERING	CATEGORY	L	T	P	C	PREREQUISITE
1	17MECC02	ENGINEERING THERMODYNAMICS	MECH	CC	2	1	0	3	NIL
2	17MECC03	ENGINEERING MECHANICS	MECH	CC	2	1	0	3	NIL
3	17CVCC34	FLUID MECHANICS AND MACHINERY	CIVIL	CC	3	0	0	3	NIL
4	17CVCC33	STRENGTH OF MATERIALS	CIVIL	CC	3	0	0	3	ENGINEERING MECHANICS
5	17MECC05	MECHANICAL BEHAVIOUR OF MATERIALS AND METALLURGY	MECH	CC	3	0	0	3	NIL
6	17MECC06	KINEMATICS OF MACHINES	MECH	CC	3	0	0	3	ENGINEERING MECHANICS
7	17MECC07	THERMAL ENGINEERING	MECH	CC	2	1	0	3	ENGINEERING THERMODYNAMICS
8	17MECC08	DYNAMICS OF MACHINES	MECH	CC	2	1	0	3	KINEMATICS OF MACHINES
9	17MECC09	DESIGN OF MACHINE ELEMENTS	MECH	CC	2	1	0	3	STRENGTH OF MATERIALS
10	17MECC10	ENGINEERING METROLOGY AND MEASUREMENTS	MECH	CC	3	0	0	3	NIL
11	17MECC11	GAS DYNAMICS AND JET PROPULSION	MECH	CC	2	1	0	3	ENGINEERING THERMODYNAMICS
12	17MECC12	COMPUTER INTEGRATED MANUFACTURING	MECH	CC	3	0	0	3	NIL
13	17MECC13	DESIGN OF TRANSMISSION SYSTEMS	MECH	CC	2	1	0	3	DESIGN OF MACHINE ELEMENTS
14	17MECC14	HEAT AND MASS TRANSFER	MECH	CC	2	1	0	3	ENGINEERING THERMODYNAMICS
15	17MECC15	FINITE ELEMENT ANALYSIS	MECH	CC	2	1	0	3	STRENGTH OF MATERIALS
16	17MECC16	INDUSTRIAL AUTOMATION	MECH	CC	3	0	0	3	NIL
17	17MECC17	AUTOMOTIVE ENGINEERING	MECH	CC	3	0	0	3	NIL

18	17MECC18	MANUFACTURING ENGINEERING	MECH	CC	3	0	0	3	NIL
19	17MECC20	UNCONVENTIONAL MANUFACTURING PROCESS	MECH	CC	3	0	0	3	NIL
20	17MECC82	MACHINE DRAWING LAB	MECH	CC	1	0	4	2	NIL
21	17MECC84	METALLURGY LAB	MECH	CC	0	0	4	2	NIL
22	17MECC85	ENGINE TESTING LAB	MECH	CC	0	0	4	2	NIL
23	17MECC86	DYNAMICS & METROLOGY LAB	MECH	CC	0	0	4	2	NIL
24	17MECC87	AUTOMOBILE ENGINEERING LAB	MECH	CC	0	0	4	2	NIL
25	17MECC88	COMPUTER INTEGRATED MANUFACTURING LAB	MECH	CC	0	0	4	2	NIL
26	17MECC89	HEAT TRANSFER LAB	MECH	CC	0	0	4	2	NIL
27	17MECC90	FINITE ELEMENT ANALYSIS LAB	MECH	CC	0	0	4	2	NIL
28	17MECC91	INDUSTRIAL AUTOMATION LAB	MECH	CC	0	0	4	2	NIL
29	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 (12 - 18)

(i) PROGRAMME SPECIFIC (CLASS ROOM OR ONLINE) - CREDITS (9 - 12)

S.No	CODE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1	17ATCC10	AUTOMOTIVE POLLUTION CONTROL	AUTO	EC - PS	3	0	0	3	NIL
2	17MESE04	RENEWABLE SOURCES OF ENERGY	MECHANICAL	EC - PS	3	0	0	3	NIL
3	17MESE05	WASTE ENERGY CONVERSION TECHNOLOGIES	MECHANICAL	EC - PS	3	0	0	3	NIL
4	17MESE07	NUCLEAR POWER ENGINEERING	MECHANICAL	EC - PS	3	0	0	3	NIL
5	17MESE12	PRODUCT LIFE CYCLE MANAGEMENT	MECHANICAL	EC - PS	3	0	0	3	NIL
6	17MESE14	REVERSE ENGINEERING	MECHANICAL	EC - PS	3	0	0	3	NIL
7	17MESE15	SUPPLY CHAIN MANAGEMENT	MECHANICAL	EC - PS	3	0	0	3	NIL
8	17MESE01	ENERGY CONSERVATION IN THERMAL SYSTEMS	MECHANICAL	EC - PS	3	0	0	3	NIL
9	17MESE19	PROCESS PLANNING AND COST ESTIMATION	MECHANICAL	EC - PS	3	0	0	3	NIL
10	17MESE20	RAPID PROTOTYPING AND TOOLING	MECHANICAL	EC - PS	3	0	0	3	NIL
11	17MESE38	INDUSTRIAL ENGINEERING	MECHANICAL	EC - PS	3	0	0	3	NIL
12	17MESE39	LEAN MANUFACTURING SYSTEMS	MECHANICAL	EC - PS	3	0	0	3	NIL
13	17MESE41	MAINTENANCE MANAGEMENT	MECHANICAL	EC - PS	3	0	0	3	NIL
14	17MESE44	SIX SIGMA QUALITY MANAGEMENT	MECHANICAL	EC - PS	3	0	0	3	NIL

15	17MEEC01	HYDRAULICS AND PNEUMATIC SYSTEMS	MECHANICAL	EC - PS	3	0	0	3	NIL
16	17MEEC11	INDUSTRIAL ROBOTICS	MECHANICAL	EC - PS	3	0	0	3	NIL
17	17MEEC13	INDUSTRIAL SAFETY	MECHANICAL	EC - PS	3	0	0	3	NIL
18	17MEEC18	ADVANCED IC ENGINES	MECHANICAL	EC - PS	3	0	0	3	ENGINEERING THERMODYNAMICS
19	17MESE32	COMPOSITE MATERIALS	MECHANICAL	EC - PS	3	0	0	3	NIL
20	17MESE40	INSPECTION AND STATISTICAL QUALITY CONTROL	MECHANICAL	EC - PS	3	0	0	3	NIL
21	17MESE02	ENERGY CONSERVATION AND MANAGEMENT	MECHANICAL	EC - PS	3	0	0	3	NIL
22	17MESE03	HYDROGEN AND FUEL CELL TECHNOLOGY	MECHANICAL	EC - PS	3	0	0	3	NIL
23	17MESE46	WORK DESIGN AND ERGONOMICS	MECHANICAL	EC - PS	3	0	0	3	NIL
24	17MESE18	METAL FORMING AND JOINING PROCESS	MECHANICAL	EC - PS	3	0	0	3	NIL
25	17MESE42	DESIGN FOR QUALITY	MECHANICAL	EC - PS	3	0	0	3	NIL

B.E/B.TECH. – MECHANICAL ENGINEERING - SEMESTER I TO VIII									
ii. OPEN ELECTIVE (CLASS ROOM OR ONLINE) - CREDITS (3 - 6)									
S.No	**CODE**	**COURSE**	**OFFERING**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1	17ATEC12	FUEL CELL TECHNOLOGY	AUTO	EC - OE	3	0	0	3	NIL
2	17ATEC03	MODERN AUTOMOBILE ACCESSORIES	AUTO	EC - OE	3	0	0	3	NIL
3	17ATEC02	NEW GENERATION AND HYBRID VEHICLES	AUTO	EC - OE	3	0	0	3	NIL
4	17BTEC15	FOOD PROCESSING TECHNOLOGY	BIOTECH	EC - OE	3	0	0	3	NIL
5	17BTEC24	BIOFERTILIZER TECHNOLOGY	BIOTECH	EC - OE	3	0	0	3	NIL
6	17BTEC25	BIOLOGY FOR NON BIOLIGISTS	BIOTECH	EC - OE	3	0	0	3	NIL
7	17BTEC30	NATURAL RESOURCE MANAGEMENT	BIOTECH	EC - OE	3	0	0	3	NIL
8	17BTEC31	APPLICATION OF ENZYME IN WASTE MANAGEMENT	BIOTECH	EC - OE	3	0	0	3	NIL
9	17CVSE35	QUALITY CONTROL ASSURANCE IN REAL ESTATE	CIVIL	EC - OE	3	0	0	3	NIL
10	17CVSE42	GREEN AND ENERGY EFFICIENT BUILDING	CIVIL	EC - OE	3	0	0	3	NIL
11	17CVSE41	INFRASTRUCTURE PROJECT DEVELOPMENT	CIVIL	EC - OE	3	0	0	3	NIL
12	17CVSE28	URBAN TRANSPORTATION INFRASTRUCTURE-PLANNING AND DESIGN	CIVIL	EC - OE	3	0	0	3	NIL
13	17EECC14	ELECTRICAL MACHINES AND DRIVES	EEE	EC - OE	3	0	0	3	NIL
14	17EECC16	POWER ELECTRONICS AND DRIVES	EEE	EC - OE	3	0	0	3	NIL
15	17ECCC07	MICROCONTROLLER AND ITS APPLICATIONS	ECE	EC - OE	3	0	0	3	NIL

16	17ECCC18	INTERNET OF THINGS FOR ELECTRONICS	ECE	EC - OE	3	0	0	3	NIL
17	17ECEV06	MEMS AND SENSORS	ECE	EC - OE	3	0	0	3	NIL
18	17CSEC09	ETHICAL HACKING	CSE	EC - OE	3	0	0	3	NIL
19	17CSEC11	GREEN COMPUTING	CSE	EC - OE	3	0	0	3	NIL
20	17CSEC24	OPEN SOURCE SYSTEMS	CSE	EC - OE	3	0	0	3	NIL
21	17CSEC32	VIRTUAL REALITY	CSE	EC - OE	3	0	0	3	NIL
22	17CSEC30	UNIX INTERNALS	CSE	EC - OE	3	0	0	3	NIL

B.E/B.TECH. – MECHANICAL ENGINEERING - SEMESTER I TO VIII									
CATEGORY D									
PROJECT - CREDITS (6)									
S.No	**CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1	17MEPI01	PROJECT WORK	MECHANICAL	PI	0	0	12	6	NIL

VMRF-DU-AVIT& VMKVEC
SCHEDULINGOFCOURSES - B.E., -MECHANICAL ENGINEERING (PART TIME – REGULAR)

SEMESTER	THEORY				PRACTICAL		CREDITS
	1	2	3	4	5	6	
I	**ENGINEERING MATHEMATICS (FC-BS)** (3)	**ENVIRONMENTAL SCIENCE AND ENGINEERING (FC-BS)** (3)	ENGINEERING MECHANICS (CC) (3)	MANUFACTURING ENGINEERING (CC) (3)	MANUFACURING ENGINEERING (CC) (2)		**14**
II	**MATHEMATICS FOR MECHANICAL SCIENCES (FC-BS)** (3)	ENGINEERING THERMODYNAMICS (CC) (3)	KINEMATICS OF MACHINES (CC) (3)	FLUID MECHANICS AND MACHINERY (CC) (3)	MACHINE DRAWING LAB (CC) (2)		**14**
III	**TOTAL QUALITY MANAGEMENT (FC-HS)** (3)	DYNAMICS OF MACHINES (CC) (3)	THERMAL ENGINEERING (CC) (3)	STRENGTH OF MATERIALS (CC) (3)	ENGINE TESTING LAB (CC) (2)	DYNAMICS AND METROLOGY LAB (CC) (2)	**16**
IV	DESIGN OF MACHINE ELEMENTS (CC) (3)	COMPUTER INTEGRATED MANUFACTURING (CC) (3)	MECHAICAL BEHAVIOUR OF MATERIALS AND METALLURGY (CC) (3)	ENGINEERING METROLOGY AND MEASUREMENTS (CC) (3)	COMPUTER INTEGRATED MANUFACTURING LAB (CC) (2)	METALLURGY LAB (CC) (2)	**16**
V	DESIGN OF TRANSMISSION SYSTEM (CC) (3)	HEAT AND MASS TRANSFER (CC) (3)	INDUSTRIAL AUTOMATION (CC) (3)	**PROGRAMME ELECTIVE I (EC-PS)** (3)	HEAT TRANSFER LAB (CC) (2)	INDUSTRIAL AUTOMATION LAB (CC) (2)	**16**
VI	AUTOMOTIVE ENGINEERING (CC) (3)	FINITE ELEMENT ANALYSIS (CC) (3)	GAS DYNAMICS AND JET PROPULSION (CC) (3)	**OPEN ELECTIVE-I (EC-0E)** (3)	AUTOMOBILE ENGINEERING LAB (CC) (2)	FINITE ELEMENT ANALYSIS LAB (CC) (2)	**16**
VII	UNCONVENTIONAL MANUFACTURING PROCESS (CC) (3)	**PROGRAMME ELECTIVE II (EC-PS)** (3)	**PROGRAMME ELECTIVE III (EC-PS)** (3)		PROJECT WORK (CC) (6)		**15**
TOTAL CREDITS TO BE EARNED							**107**

SYLLABUS

FOUNDATION COURSES

HUMANITIES AND SCIENCES AND MANAGEMENT

17EGHS01	TECHNICAL ENGLISH	Category	L	T	P	Credit
		HSS	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, remember and respond to others in different scenario	Remember
CO2. Understand and speak fluently and correctly with correct pronunciation in different situation.	Understand
CO3. To make the students experts in professional writing	Apply
CO4. . To make the students in proficient technical communicator	Apply
CO5. To make the students good communicators at the work place and to be theoretically strong.	Apply
CO6 To make the students recognize the role of technical writing in their careers in business, technical and scientific field	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	**M**	**M**	**-**	**-**	**M**	**M**	**S**	**-**	**L**	**S**	**L**	**S**		**M**	**M**
CO2	**L**	**M**	**-**	**L**	**M**	**M**	**S**	**-**	**L**	**S**	**S**	**S**		**M**	**S**
CO3	**M**	**L**	**L**	**M**	**-**	**-**	**L**	**L**	**L**	**M**	**S**	**S**	**S**	**M**	
CO4	**-**	**M**	**-**	**-**	**-**	**M**	**M**	**-**	**L**	**S**	**-**	**S**		**M**	
CO5	**M**	**M**	**-**	**M**	**M**	**M**	**S**	**M**	**L**	**S**	**M**	**S**	**S**		**M**
CO6	**M**	**-**	**M**	**-**	**-**	**M**	**-**	**-**	**-**	**-**	**S**	**M**	**M**	**M**	

S- Strong; M-Medium; L-Low

SYLLABUS

SELF INTRODUCTION

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.

ARTICLES

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.

TENSE FORMS

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.

IMPERSONAL PASSIVE VOICE

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.

SENTENCE PATTERN

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 – VMKV Engineering College, Salem and AVIT, Chennai

REFERENCES

1. 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 Cambridge University 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	Mail ID
1	Dr.P.Saradha	Associate Professor	English	saradhap@vmkvec.edu.in
2	Mr.S.K.Prem Kishor	Assistant Professor	English	Prem.english@avit.ac.in

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

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

On the successful completion of the course, 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	Apply
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	**M**	**-**	**L**	**-**	**L**	**S**	**S**	**-**	**M**	**S**	**-**	**S**	**S**	**-**	**-**
CO2	**-**	**M**	**S**	**M**	**-**	**M**	**M**	**-**	**L**	**S**	**-**	**S**	**M**	**-**	
CO3	**L**	**M**	**-**	**-**	**-**	**M**	**-**	**L**	**-**	**S**	**L**	**M**	**-**	**M**	**-**
CO4	**-**	**L**	**M**	**M**	**-**	**-**	**L**	**M**	**M**	**S**	**L**	**M**	**M**	**-**	**M**
CO5	**-**	**-**	**-**	**M**	**-**	**-**	**-**	**M**	**L**	**S**	**-**	**L**	**-**	**-**	**-**
CO6	**-**	**L**	**-**	**M**	**-**	**L**	**L**	**-**	**-**	**S**	**-**	**S**	**M**	**M**	**S**

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT – I: 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.

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

UNIT – III 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.

UNIT IV - 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

UNIT V - 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.

TEXTBOOK

1. 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:

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

PREAMBLE:

Quality is the mantra for success or even for the survival of any organization in this competitive global market. Total Quality Management (TQM) is an enhancement to the traditional way of doing business. TQM integrates fundamental management techniques, existing improvement efforts, and technical tools under a disciplined approach for providing quality of products and processes. It becomes essential to survive and grow in global markets, organizations will be required to develop customer focus and involve employees to continually improve Quality and keep sustainable growth.

PREREQUISITE: Not Required

COURSE OBJECTIVES:

1. To understand the Total Quality Management concepts.
2. To practice the TQM principles.
3. To apply the statistical process control
4. To analyze the various TQM tools
5. To adopt 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: Practice the relevant quality improvement tools to implement TQM.	Apply
CO3: Analyse various TQM parameters with help of statistical tools.	Analysing
CO4: Assess various TQM Techniques.	Evaluate
CO5: Practice the Quality Management Systems in a different organization Environment.	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	L	M	L	M	L	-	L
CO2	M	-	-	-	L	L	-	L	M	M	-	L	M	L	-
CO3	S	S	M	S	S	-	-	L	-	L	-	L	M	L	M
CO4	L	M	S	L	M	-	L	-	L	M	L	M	M	M	L
CO5	L	L	M	-	L	M	S	S	M	L	L	M	-	M	M

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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17MBHS01	ENGINEERING STARTUPS AND ENTREPRENEURIAL MANAGEMENT	Category	L	T	P	Credit
		HSS	3	0	0	3

PREAMBLE:

A startup means company initiated by individual innovator 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 basics of Startups Management and components.
2. To analyze the startups fund management practices
3. To practice the various kinds of stocks and employment considerations in startups.
4. To apply the importance of intellectual property rights and its procedures.
5. To explore the entrepreneurial mindset and culture.

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.	Analyse
CO3: Analyze the various kinds of stocks and employment opportunities and consideration in startups business.	Analyse
CO4: Compare and contrast the various forms of intellectual property protection and practice.	Analyse
CO5: Explore the entrepreneurial mindset and culture that has been developing in companies of all sizes and industries.	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	-	-	-	-	M	M	S	-	M	-	M	L	L	L
CO2	S	S	M	M	M	L	-	-	-	-	-	M	L	M	-
CO3	S	S	S	M	M	M	-	-	-	-	-	M	-	-	L
CO4	S	S	S	M	M	M	-	-	-	-	-	M	L	L	M
CO5	S	S	-	M	M	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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17MBHS07	PROFESSIONAL ETHICSAND HUMAN VALUES	Category	L	T	P	Credit
		HSS	3	0	0	3

PREAMBLE: Ethics is a system of moral principles governing the appropriate conduct of a person or a group. Good Ethics is a fundamental requirement of any profession. Regardless of profession, ethics is an important part of work. The success depend on how the workers and their dealing with the situations ethically or unethically. Professional ethics are as important as personal ethics. Professional ethics encompass the personal and corporate standards of behavior expected by professional. Human values are the features that guide people to take into account the human element when one interacts with other human. They have many positive characters and positive feelings that create bonds of humanity between people and thus have value for all human beings and have the effect of bonding, comforting, reassuring and procuring serenity. They build space for a drive, a movement towards one another, which leads to peace.

PREREQUISITE: Not Required

COURSE OBJECTIVES:

1. To understand the basic concept of Human Values and Ethics.
2. To analyse the common ethical practice in the engineering professionals.
3. To Practice various code of ethics in Engineering.
4. To apply the rights, legal, ethical issues.
5. To practice ethical responsibilities of a professional engineer.

COURSE OUTCOMES:

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

CO1: Understand the moral values that ought to be practiced in engineering profession	Understand
CO2: Analyse the role of ethics in the field of engineering.	Analyse
CO3: Practice the code of ethics and Industrial standards	Apply
CO4: Assess the Safety, Quality Management and Risk analysis	Evaluate
CO5: Apply the skills and knowledge to handle the contemporary issues.	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	-	L	M	M	L	M	M	-	-
CO2	M	-	-	-	-	S	L	M	L	M	L	M	L	-	-
CO3	M	-	M	L	L	M	-	M	-	-	M	M	M	M	L
CO4	M	M	M	-	M	L	-	M	L	L	L	M	M	L	M
CO5	M	M	M	L	L	-	-	M	L	M	M	M	M	M	M

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",WadsworthThompsonLeatning, United States,2000
3. John R Boatright, "Ethicsandthe ConductofBusiness", PearsonEducation,NewDelhi,2003.
4. EdmundGSeebauerandRobertLBarry,"FundamentalsofEthicsforScientistsandEngineers", Oxford Press, 2000
5. R.Subramanian,"ProfessionalEthics",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: Engineering Project Management is a type of Project Management, focuses solely on engineering and Management. Similar to other Project Management it posses standard methodologies and processes with engineering background. It enables to get into the field of Project Management. These skills can provide critical benefits such as improved efficiency, enhanced effectiveness, success replication, perfect leadership and communication, and complete view of the project in the aspect of time and cost.

PREREQUISITE: Not Required

COURSE OBJECTIVES:

1. To understand the importance of Project Management.
2. To understand the Project management Techniques.
3. To understand the statistical process control.
4. To impart the various Project management tools and software.
5. To understand the Project management and resource utilization.

COURSE OUTCOMES:

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

CO1: Understand the importance of Project Management and Business.	Understand
CO2: Explain the required tools to implement Project Techniques.	Apply
CO3: Analyze various Project constraints with help of project tools.	Analyze
CO4: Evaluating various Project Techniques.	Analyze
CO5: Put forward the Project management in a different organization milieu.	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	-	-	-	M	-	-	M	S	-	M	L	L	M
CO2	S	S	M	-	M	M	S	M	S	S	-	-	-	M	L
CO3	S	M	M	M	S	-	M	M	-	M	-	M	M	M	L
CO4	M	-	S	-	M			S	S			M	M	-	M
CO5	M	M	-	-	M	M	M	S		S	M	S	-	-	S

S- Strong; M-Medium; L-Low

SYLLABUS:

UNIT I INTRODUCTION

Project Management concept-Attributes as a project-Project life cycle-The Project Management process-Benefits of Project Management- Needs, Identification-Project selection-preparing a request for proposal-Soliciting proposals-Proposed solutions- Proposal Marketing-Bid/No-Bid Decision-Developing Winning Proposal-Proposal preparation-Proposal contents-Pricing Consideration-Proposal Submission and Follow-up - Customer evaluation as proposals-Types of contracts-Contract provisions.

UNIT-II- PROJECT PLANNING

Project Planning-Project Planning Objective-Work Break-down structure-Responsibility Matrix-Defining activities-Developing the network plan-Planning for Information system development- -Scheduling-activity duration estimates-project start and finish times-Schedule calculation-Scheduling for information systems development.

UNIT-III- PROJECT CONTROL PROCESS

Schedule control-Project control process-Effects of actual schedule performance - Incorporating project changes into schedule-Updating the project schedule-Approaches to schedule control-Schedule control for information system development – Resource consideration-Constrained Planning-Planned resources utilization – Resources levelling- Limited scheduling-Project Management software – Cost Planning and Performance - Project cost Estimates-Project Budgeting-Determining actual cost-Determining the value of work performed-Cost performance analysis-Cost forecasting-Cost control-Managing Cash Flow.

UNIT IV RISK AND FEASIBILITY

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.

UNIT V PROJECT MANAGER SKILLS AND ABILITIES

Project Manager-Responsibilities of the Project Manager-Skills at the Project Manager - Developing the skill needed to be a Project Manager-Delegation-Managing Change – Project Team-Project Team development and Effectiveness- Ethical Behaviour conflict on project-problem solving-Time Management-Project Communication and Personal Communication-Effective listening-Meetings-Presentation-Report-Project documentation and Controlling changes-Types of project organization- Matrix organization.

TEXT BOOKS:

1. Samuel J.Mantel JR., Jack R.Meredith, Project Management, Wiley India, Edition 2006.
2. Santakki.V.C., Project Management, Himalaya Publishing House, Edition 2006.

REFERENCES:

1. Project Management, Jack Gido and James P Clements, (Edition 2009) Cenage Learning India pvt Ltd., New Delhi.

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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 the most essential for any kind of business development. IPR helps to set the business to show individuality from market competitors. It prevents duplication and provide authentication as a unique selling point to compete in the market and built confidence over the product among the customers. ADR is a new legal mechanism to sort out disputes among industries and helps to get easily solved through mediation and counselling. It provides instant solutions to both the parties with meagre loss in a faster way and less expensive through arbitrator.

PREREQUISITE: Not Required

COURSE OBJECTIVES:

6. To understand and practice the basic concept of IPR and Patent filing procedure.
7. To describe the various procedure for getting grants of patent, trademark and trade secrets.
8. To apply various legal aspects in patent ownership and transfer.
9. To implement the best practices and laws relating to the Intellectual property rights.
10. To examine the practices of ADR mechanism in the technological advancement contexts.

COURSE OUTCOMES:

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

CO1: Understand the concept and development 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.	Understand
CO3: Solve the various issues of transfer of patent ownership with reference to International Patent Law.	Apply
CO4: Analyse the present system of Patent Act in India and changes aligned with international standards.	Analyse
CO5: Criticise the present dispute mechanism and how ADR supports and solution to business issues.	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	L	M	M	-	-	S	L	M	L	M	-	L	L	-	-
CO2	-	-	M	L	M	M	S	L	M	L	L	L	M	M	-
CO3	-	-	M	M	-	L	M	-	M	L	L	M	-	L	L
CO4	M	-	-	L	M	-	L	-	-	L	L	M	L	-	L
CO5	-	L	-	L	M	L	-	M	L	-	M	L	-	L	-

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:

4. 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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BASIC SCIENCES

17MABS01	Subject Title **ENGINEERING MATHEMATICS**	Category	L	T	P	Credit
		BS	2	2	0	3

PREAMBLE

The driving force in Engineering Mathematics is the rapid growth of technology and is designed to provide the basic tools of calculus mainly for the purpose of modelling the engineering problems mathematically and obtaining solutions. This is a foundation course which mainly deals with topics such as single variable and multivariable calculus and plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

PRE REQUISITE --

COURSE OBJECTIVES

1	To identify the characteristics of a linear system with Eigen values and Eigen vectors.
2	To improve their ability in solving geometrical applications of differential calculus
3	To find a maximum or minimum value for a function of several variables subject to a given constraint.
4	To understand the integration techniques for evaluating surface and volume integrals.
5	Incorporate the knowledge of vector calculus to support their concurrent and subsequent engineering studies

COURSE OUTCOMES

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

CO1. Able to understand the system of linear equations arising in all engineering fields using matrix methods.	Understand
CO2. Determine the evolute and envelope for a given family of curves	Apply
CO3. Apply differentiation to solve maxima and minima problems.	Apply
CO4. Compute the area and volume of plane using integration	Apply
CO5. Evaluate the surface and volume integral using Green's, Stokes and Gauss Divergence theorems	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	S	M	M
CO2	S	M	M	M	M	--	--	--	--	--	--	M	S	M	M
CO3	S	M	M	M	M	--	--	--	--	--	--	M	S	M	M
CO4	S	M	M	M	M	--	--	--	--	--	--	M	S	M	M
CO5	S	M	M	M	M	--	--	--	--	--	--	M	S	M	M

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	Name of the College	Mail ID
1	Dr.G.Selvam	Asso.Prof	VMKVEC	selvam@vmkvec.edu.in
2	Ms.S.Gayathri	Asst.Prof.Grade I	AVIT	gayathri@avit.ac.in

17PCBS02	PHYSICAL SCIENCES PART A - ENGINEERING PHYSICS	Category	L	T	P	Credit
		CC	2	0	0	2

PREAMBLE

Engineering Physics is the study of advanced physics concepts and their applications in various technological and engineering domains. Understanding the concepts of laser, types of lasers, thepropagation of light through fibers, applications of optical fibers in communication and different types of non-destructive techniques will help an engineer to analyze, design and to fabricate various conceptual based devices.

PREREQUISITE : NIL

COURSE OBJECTIVES

1	To recall the properties of laser and to explain principles of laser
2	To assess the applications of laser
3	To detail the principles of fiber optics
4	To study the applications of fiber 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. Understand the principles laser, fiber optics and non-destructive testing	Understand
CO2. Understand the construction of laser, fiber optic and Non-Destructive testing equipments	Understand
CO3. Demonstrate the working of laser, fiber optic and Non-Destructive testing based components and devices	Apply
CO4. Interpret the potential applications of laser, fiber optics and Non-Destructive testing in various fields.	Apply
CO5. Differentiate the working modes of various types of laser, fiber optic and Non-Destructive testing based devices.	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
CO2	S		L									M	M		
CO3	S			M			M					M	M		
CO4	S	M		M	M	S	M					M	S		M
CO5	S	M	M									M	M		

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT-I

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

UNIT-II

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

UNIT-III

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

1. Engineering Physics, compiled by Department of Physics, Vinayaka Mission's Research Foundation (Deemed to be University), Salem.

2. P.K. Palanisamy, Engineering Physics, Scientific Publishers, 2011.

3. Dr.M. N. Avadhanulu, Engineering Physics, S.Chand & Co, 2010.

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. Avadhanulu.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	Mail ID
1	Dr. C. SENTHIL KUMAR	PROFESSOR	PHYSICS	senthilkumarc@vmkvec.edu.in
2	Dr. R. SETHUPATHI	ASSOCIATE PROFESSSOR	PHYSICS	sethupathi@vmkvec.edu.in
3	Dr. G. SURESH	ASSOCIATE PROFESSSOR	PHYSICS	suresh.physics@avit.ac.in
4	Dr. B.DHANALAKSHMI	ASSOCIATE PROFESSSOR	PHYSICS	dhanalakshmi.phy@avit.ac.in

17PCBS02	PHYSICAL SCIENCES PART B -ENGINEERING CHEMISTRY Semester I (Common to All Branches)	Category	L	T	P	C
		BS	2	0	0	2

Preamble

Objective of this course is to present a better understanding of basic concepts of chemistry and its applications on different engineering domains. It also imparts knowledge on fundamentals of Electrochemistry, Energy storage technologies, properties of water and its treatment methods, classification of fuels, Non conventional sources of Energy and various advanced Engineering materials.

Prerequisite

Not required

Course Objectives

1	To impart basic knowledge in Chemistry so that the student will understand the engineering concept
2	To familiar with electrochemistry and Battery and fuel Cells
3	To lay foundation for practical applications of water softening methods and its treatment methods in engineering aspects.
4	To inculcate the knowledge of fuels and advanced material.

Course Outcomes

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

CO1.	Describe the electrochemistry, batteries and working principle of energy storage devices	Understand
CO2.	Estimate the hardness of water	Apply
CO3.	Identify suitable water treatment methods	Analyze
CO4.	Outline the important features of fuels and advanced materials	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	PS O1	PS O2	PS O3
CO6.	S	M	-	M	-	S	S	S	-	-	L	M	M	-	M
CO7.	S	S	M	-	-	M	M	M	-	-	-	M	M	M	M
CO8.	S	S	M	-	-	M	S	M	-	-	-	M	M	M	M
CO9.	S	-	-	-	L	L	M	L	-	-	-	S	-	-	M

S- Strong; M-Medium; L-Low

SYLLABUS

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)
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 & Reverse Osmosis).
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)

TEXT BOOKS

1. Engineering Chemistry by prepared by Vinayaka Mission's Research Foundation, Salem.

REFERENCE BOOKS

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 Shashi Chawla, 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	Mail ID
1.	Dr. V. Anbazhagan	Professor	Chemistry	anbu80@gmail.com
2.	Mr. A. Gilbert Sunderraj	Assistant Professor	Chemistry	asmgill80@gmail.com
3.	Dr. R. Nagalakshmi	Professor	Chemistry	nagalakshmi.chemistry@avit.ac.in
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17PHBS05	SMART MATERIALS	Category	L	T	P	Credit
		Basic Sciences	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.

PREREQUISITE : NIL

COURSE OBJECTIVES

1	To explain the fundamental properties and classification of smart materials, crystalline materials, Nano materials, Magnetic materials and Super conducting materials.
2	To paraphrase the basic crystalline structure and its properties.
3	To illustrate the synthesis and fabrication of Nano materials.
4	To predict the application of smart materials, crystalline materials, Nano materials, Magnetic materials and Super conducting materials.
5	To analyze the various parameters of crystalline materials.

COURSE OUTCOMES

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

CO1. Restate the properties of various materials.	Understand
CO2. Summarize the various structures of materials.	Understand
CO3. Predict the applications of various materials to designing equipments.	Apply
CO4. Illustrate the properties of materials to designing equipments.	Apply
CO5. Calculate the crystalline parameters of the 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			S	S		
CO2	S	M	S	M	S				M			M	S	M	
CO3	S	S	S	S	S				S			M	S	S	M
CO4	S	M	S	M	S				M			M	S	S	M
CO5	M	S	S	M	M				S			M	M	M	

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, 2018.

REFERENCES:

1. Pillai S.O., Solid State Physics, New Age International (P) Ltd., publishers, 2018.

2. Senthilkumar G. Engineering Physics II. VRB Publishers, 2018.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. S. MOHAMMED HARSHULKHAN	Asst.Prof	Physics	harshulkhan@vmkvec.edu.in
2	Mr. R. SAKTHI GANAPATHY	Asst.Prof	Physics	sakthiganapthy@vmkvec.edu.in
3	Dr .G. LATHA	Professor	Physics	latha.physics@avit.ac.in
4	Dr. R. N. VISWANATH	Professor	Physics	viswanath.physics@avit.ac.in

17CHBS01	Environmental Science & Engineering (Common to All Branches)	Category	L	T	P	C
		BS	3	0	0	3

Preamble

Environmental science and Engineering is an interdisciplinary field that integrates physical, chemical, biological, information sciences and provides the basic knowledge of structure and function of ecosystem and better understanding of natural resources, biodiversity and their conservation practices. The course helps to create a concern for our environment that will generate pro-environmental action, including activities we can do in our daily life to protect it. Furthermore, it deals the social issues and ethics to develop quality engineer in our country.

Prerequisite

Not required

Course Objectives

1	Applying Science and Engineering knowledge to protect environment
2	To provide comprehensive insight in natural resources and protect natural resources
3	To create awareness on the various pollutions and their impact.
4	To educate the ways and means to manage natural calamities
5	To impart fundamental knowledge on human welfare measures

Course Outcomes:

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

CO1.	Comprehend the impact of engineering solutions in a global and societal context	Understand
CO2.	Illustrate the contemporary issues that results in environmental degradation and would attempt to provide solutions to overcome those problems	Understand
CO3.	Illustrate the importance of ecosystem and biodiversity	Apply
CO4.	Practice to improve the environment and sustainablity	Apply
CO5.	Conclude the importance of conservation of resources.	Analyze
CO6.	Estimate the important role of IT in healthy environment for future generations	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	PSO 1	PSO 2	PSO 3
CO10.	S	M	-	-	-	M	S	S	M	M	-	S	M	S	M
CO11.	S	-	-	-	-	S	S	S	-	-	-	S	M	S	M
CO12.	S	-	-	-	-	M	S	M	L	-	-	S	-	S	-

CO13.	S	-	-	-	-	M	S	S	M	M	-	S	M	S	M
CO14.	S	-	-	-	-	M	S	S	M	M	-	S	M	S	M
CO15.	S	-	-	-	-	M	S	S	M	M	-	S	M	S	M

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.
TEXTBOOK
1. Environmental Science and Engineering by Dr.A. Ravikrishnan, Sri Krishna Publications, Chennai.
REFERENCES

1. Wager K.D. "Environmental Management", W.B. Saunders Co. Philadelphia, USA, 1998.
2. Bharucha Erach "The Biodiversity of India" Mapin Publishing Pvt Ltd, Ahmedabad, India
3. Trivedi R.K. “Handbook of Environmental Laws", Rules, Guidelines, Compliances and tandards Vol I & II, Enviro media.
4. Dr. J. Meenambal, Environmental Science and Engineering, MJP Publication, Chennai
5. Gilbert M. Masters : Introduction to Environmental Engineering and Science, Pearson Education Pvt Ltd., II Edition, ISBN 81-297-0277-0, 2004

Course Designers:

S. No	Name of the Faculty	Designation	Department	Mail ID
1.	Dr. V. Anbazhagan	Professor	Chemistry	anbu80@gmail.com
2.	Mr. A. Gilbert Sunderraj	Assistant Professor	Chemistry	asmgill80@gmail.com
3.	Dr. R. Nagalakshmi	Professor	Chemistry	nagalakshmi.chemistry@avit.ac.in
4.	Dr.K.Sanghamitra	Associate Professor	Chemistry	sanghamitra.chemistry@avit.ac.in

17PCBS81	PHYSICAL SCIENCES LAB: PART A – REAL AND VIRTUAL LAB IN PHYSICS	Category	L	T	P	Credit
		CC	0	0	2	1

PREAMBLE

In this laboratory, experiments are based on the calculation of physical parameters like young's modulus, rigidity modulus, viscosity of water, wavelength of spectral lines, thermal conductivity and band gap. Some of the experiments involve the determination of the dimension of objects like the size of a microparticle and thickness of a thin wire. In addition to the above real lab experiments, students gain hands-on experience in 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

CO16.	Recognize the importance of units while performing the experiments, calculating the physical parameters and obtaining results	Understand
CO17.	Operate the equipments with precision	Apply
CO18.	Practice to handle the equipments in a systematic manner	Apply
CO19.	Demonstrate the experiments through virtual laboratory	Apply
CO20.	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													
CO2	S	S	M	M	S				M			M	M		M
CO3	S														
CO4	S	S	M	M	S							S	M		M
CO5	S	S													

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 compiled by Department of Physics, Vinayaka Missions Research Foundation (Deemed to be University), Salem.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. C. SENTHIL KUMAR	PROFESSOR	PHYSICS	senthilkumarc@vmkvec.edu.in
2	Dr. R. SETHUPATHI	ASSOCIATE PROFESSSOR	PHYSICS	sethupathi@vmkvec.edu.in
3	Dr. G. SURESH	ASSOCIATE PROFESSSOR	PHYSICS	suresh.physics@avit.ac.in
4	Dr. B.DHANALAKSHMI	ASSOCIATE PROFESSSOR	PHYSICS	dhanalakshmi.phy@avit.ac.in

17PCBS81	PHYSICAL SCIENCES PART B - ENGINEERING CHEMISTRY LAB Semester I (Common to All Branches)	Category	L	T	P	C
		BS	0	0	2	1

Preamble

The main objective of this course is to develop the intellectual and psychomotor skills of the students by imparting knowledge in water technology and quantitative analysis.

Prerequisite

Not required

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

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

CO1.	Estimate the chemical properties of water	Apply
CO2.	Determine the presence of various elements in the water	Analyze
CO3.	Calculate the strength of acids, oxidizing and reducing agents	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
CO21.	S	M	M	-	L	M	M	S	-	-	-	M	S	M	M
CO22.	S	M	M	-	L	M	M	L	-	-	-	M	S	M	M
CO23.	S	S	M	-	L	M	M	M	-	-	-	M	S	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

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 BOOKS

2. Laboratory Manual on Engineering Chemistry prepared by Vinayaka Mission's Research Foundation, Salem.

REFERENCE BOOKS

1. Laboratory Manual on Engineering Chemistry, K. Bhasin S, Dhanpat Rai Publishing Co Pvt Ltd

Course Designers:

S. No	Name of the Faculty	Designation	Department	Mail ID
1.	Dr. V. Anbazhagan	Professor	Chemistry	anbu80@gmail.com
2.	Mr. A. Gilbert Sunderraj	Assistant Professor	Chemistry	asmgill80@gmail.com
3.	Dr. R. Nagalakshmi	Professor	Chemistry	nagalakshmi.chemistry@avit.ac.in
4.	Dr.K.Sanghamitra	Associate Professor	Chemistry	sanghamitra.chemistry@avit.ac.in

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	PS01	PS02	PS03
CO24.	S	S	S	M	-	-	-	-	-	-		-	M	L	S
CO25.	S	S	M	L	-	-	-	-	-	-	-	-	L	-	S
CO26.	S	S	M	L	-	-	-	-	-	-	-	-	M	-	-
CO27.	S	M	M	L	-	-	-	-	-	-	-	-	M	-	S
CO28.	M	S	S	S	L	-	-	-	-	-	-	-	M	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

Selection of materials:

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

Metallic materials:

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

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).

Smart materials:

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

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	Designation	Department/College	Mail ID
1	Dr. R. Nagalakshmi	Professor	Chemistry/AVIT	nagalakshmi.chemistry@avit.ac.in
2	A. Gilbert Sunderraj	Asst Professor	Chemistry /VMKVEC	asmgill80@gmail.com

17MABS04	MATHEMATICS FOR MECHANICAL SCIENCES	Category	L	T	P	Credit
		BS	2	2	0	3

PREAMBLE

Partial Differential Equations frequently arise in the field of science and engineering, which emphasizes the development of rigorous logical thinking and analytical skills of the student for solving different kinds of problems such as Heat flow equations of one dimension and two dimensions. Statistical methods are important tool, which provide the engineer with both descriptive and analytical methods for dealing with the variability in observed data.

PREREQUISITE

Engineering Mathematics (17MABS01)

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 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.	Apply
CO2. Demonstrate periodic functions as Fourier series of sine and cosines and calculate the Fourier coefficients numerically.	Apply
CO3. Solve partial differential equations like wave equations and heat flow equation by Fourier series.	Apply
CO4. Classify the random variables to determine the appropriate distributions.	Analyze
CO5. Apply least square method to fit a curve for the given data and evaluate the correlation coefficient and regression lines for the data.	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	M	--	--	--	--	--	--	M	S	M	--
CO2	S	S	M	M	M	--	--	--	--	--	--	M	S	M	--
CO3	S	S	M	M	M	--	--	--	--	--	--	M	S	M	M
CO4	S	S	M	M	M	--	--	--	--	--	--	M	S	S	--
CO5	S	S	M	M	M	--	--	--	--	--	--	M	S	S	M

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	Name of the College	Mail ID
1	Ms.M.Usha	Assistant professor	VMKVEC	usha@vmkvec.edu.in
2	Ms.S.Sarala	Asst.Prof. grade II	AVIT	sarala@avit.ac.in

17MABS11	NUMERICAL METHODS FOR MECHANICAL SCIENCES	Category	L	T	P	Credit
		BS	2	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 of Engineering student needs to know sufficient numerical methods and techniques for solving engineering problems such as static or steady state problems, vibration or stability problems and initial value or transient problems etc.

PREREQUISITE

1.Engineering Mathematics (17MABS01)

2.Mathematics for Mechanical Sciences(17MABS04)

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
CO2. Apply 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
CO1	S	S	M	M	M	--	--	--	--	--	--	M	S	M	M
CO2	S	S	M	M	M	--	--	--	--	--	--	M	S	M	M
CO3	S	S	M	M	M	--	--	--	--	--	--	M	S	M	M
CO4	S	S	S	S	M	--	--	--	--	--	--	M	S	M	M
CO5	S	S	S	S	M	--	--	--	--	--	--	M	S	M	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)

REFERENCES:

6. Joe D. Hoffman, Steven Frankel, "Numerical Methods for Engineers and Scientists", 3 rd Edition, 2015, Tata Mc-Graw Hill.(New York).
7. 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	Name of the College	Mail ID
1	Dr. M.Vijayarakavan	Asso.Prof	VMKVEC	vijayarakavan@vmkvec.edu.in
2	Dr.A.K.Thamizhsudar	Asso.Prof. grade II	AVIT	thamizhsudar@avit.ac.in

CORE COURSES

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 Objective

1	To provide the basic concepts and laws of thermodynamics.
2	To provide an understanding about the concept of enthalpy and entropy in thermal systems.
3	To discuss the working principle of steam cycles and pure substances.
4	To detail about the properties of gas and vapor mixtures
5	To discuss about fuels and combustion.

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

CO1.	Understand the fundamental concepts and laws of thermodynamics.	Understand
CO2.	Understand the concepts of thermodynamic processes for various working fluids.	Understand
CO3.	Determine the basic properties of working fluid while undergoing processes in thermodynamic systems	Apply
CO4.	Derive the governing equations of behaviour of gases and vapours	Analyze
CO5.	Determine the amount of air required for combustion of fuels and analysis of the products.	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO 2	PO 3	PO	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO 1	PSO 2	PSO 3

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

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 theorem, 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

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

REFERENCES:

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

Course Designers

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1	N.Lakshminarayanan	Associate Professor	Mechanical/AVIT	nlakshiminarayanan@avit.ac.in
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17MECC03	ENGINEERING MECHANICS	Category	L	T	P	Credit
		CC	2	1	0	3

Preamble

This course provides the basic knowledge about the behaviour 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 solve the problems related to properties of surfaces and solids
4	To solve problems involving Friction and Rigid body dynamics.
5	To analyze the dynamics of particles problems.

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	Apply
CO3.	Determine the Centroid, moment of inertia and mass moment of inertia of various sections.	Apply
CO4.	Solve frictional and rigid body application problems.	Apply
CO5.	Analyze engineering systems using the concept of dynamic equilibrium	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	M	L	-	-	L	-	-	-	-	-	-	S	-	L
CO2	S	s	M	M	-	M	-	-	-	-	-	-	S	-	L
CO3	S	M	M	M	-	M	-	-	-	-	-	-	S	-	L
CO4	S	S	M	M	-	L	-	-	-	-	-	-	S	-	L
CO5	S	S	L	S	-	S	-	-	-	-	-	-	S	-	L

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 - 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. Shames and G.Krishna Mohana Rao, Engineering Mechanics - Statics & Dynamics, 4th Edition, Prentice Hall of India Pvt. Ltd., 1997.
3	K.L.Kumar, Engineering Mechanics III Edition, Tata McGraw Hill Publishing Co. Ltd., 1998

Course Designers				
S.No	**Faculty Name**	**Designation**	**Department/Name of the College**	**Email id**
1	N.Rajan	Assoc. Prof.	MECH/VMKVEC	rajan@vmkvec.edu.in
2	A Elanthiraiyan	AP-II	MECH/AVIT	aelanthirayan@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	PSO3
CO 1	S	M	M	L	M	L	-	-	-	-	-	L	L	M	L
CO 2	S	M	M	L	L	L	-	-	-	-	-	M	L	M	L
CO 3	S	M	M	L	L	L	-	-	-	-	-	L	L	M	L
CO 4	S	S	S	M	L	L	-	L	-	-	L	M	L	L	L
CO 5	M	M	M	L	L	M	-	-	-	-	L	M	L	L	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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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	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	M	M	-	-	-	-	S	-	-	L	-	L	-	M
CO2.	S	S	S	-	-	-	-	-	-	-	S	-	L	L	M
CO3.	S	S	S	M	-	-	-	-	-	-	S	-	L	M	L
CO4.	S	S	S	S	-	M	-	S	-	-	S	-	L	L	M
CO5.	S	S	S	S	-	M	-	-	-	-	S	-	L	M	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

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	A.FizoorRahman	Assistant Professor	CIVIL	fizoorr@gmail.com
2	M.Senthilkumar	Assistant Professor	CIVIL	Senthilkumar@vmkvec.edu.in
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17MECC05	MECHANICAL BEHAVIOUR OF MATERIALS AND METALLURGY	Category	L	T	P	Credit
		CC	3	0	0	3

Preamble

This course imparts knowledge on the ferrous and non ferrous materials, strengthening mechanisms in crystalline solid materials, mechanical treatment process, corrosion and advanced materials pertaining to Mechanical Engineers.

Prerequisite - NIL

Course Objective

1	To discuss the classification, properties and application of various Engineering Materials.
2	Describe the failure modes of materials and study of phase diagrams.
3	Select the suitable mechanical treatment and strengthening mechanisms for ferrous and non ferrous materials.
4	Determine the various forms of corrosion and predict suitable protection methods.
5	Discuss the process of powder metallurgy, introduction of composite materials and working of SEM

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

CO1.	Describe to select suitable ferrous, non ferrous and intermetallic materials based on mechanical and metallurgical properties.	Understand
CO2.	Explain the Iron-Iron carbide equilibrium diagram and outline various types of steel and iron. Also study the failure mode of materials.	Understand
CO3.	Apply the knowledge to select suitable heat treatment methods and strengthening mechanism of a crystalline material.	Apply
CO4.	Predict the formation of corrosion, mechanism and to prevent corrosion on various materials including PVD & CVD.	Apply
CO5.	Apply suitable powder metallurgy techniques to manufacture parts and composite materials and its applications. Also understand the working principle of SEM.	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	-	-
CO2	S	M	-	-	-	-	-	-	-	-	-	-	M	-	-
CO3	S	S	-	-	-	-	-	-	-	-	-	S	M	-	M
CO4	S	S	-	-	-	-	-	-	-		-	M	M	-	M
CO5	S	S	-	-	-	-	-	-	-		-	S	M	-	M

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”

Course Designers

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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 role of the kinematics of machinery and its applications.

Prerequisite : Engineering Mechanics

Course Objective

1	To demonstrate about various mechanisms.
2	Solve problems involving velocity and acceleration of various mechanisms.
3	Construct various motions of follower and cam profile
4	To study and apply various types of Gears.
5	To study and apply 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.	Construct cams and followers for specified motion profiles.	Apply
CO4.	Construct gear tooth geometry by select the appropriate gears for the required applications.	Apply
CO5.	Discuss the 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	PSO 2	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 psychometric properties and their effects in various psychometric 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, Combustion process, thermodynamic principles in steam nozzles, steam turbines in steam power plants and Psychometric properties of steam	Understanding
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 psychometric properties and their effect in various psychometric 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							S	M	L
CO2	M	M	L	M		L							S	M	L
CO3	S	M	L	M		L							S	M	L
CO4	S	S	M	S		L				M			S	M	L

CO5	S	S	S	S		L				M			S	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.

Course Designers

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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 of forces acting on different members, application of balancing masses, the different types of vibrations and the effect of governors and gyroscope couples in real time applications.

Prerequisite : KINEMATICS OF MACHINES

Course Objective

1	To demonstrate the concepts of forces acting on machines and its members.
2	To learn about the application of balancing of masses.
3	To determine the concepts of free vibrations.
4	To Understand the concepts of forced vibrations.
5	To apply the knowledge of Governors and Gyroscopic forces in real time applications.

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

CO1.	Illustrate the concepts of forces acting on machines and its members	Understand
CO2.	Identify the application of balancing of masses	Understand
CO3.	Determine the concepts of free vibration	Apply
CO4.	Compute and gain the application of forced vibration	Apply
CO5.	To relate the knowledge of Governors and Gyroscopic forces with real time 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	S	L	L	-	-	-	-	-	-	-	-	M	-	-
CO2	S	S	L	L	-	-	-	-	-	-	-	-	M	-	-
CO3	S	S	M	L	-	-	-	-	-	-	-	-	L	-	-
CO4	S	S	M	L	-	-	-	-	-	-	-	-	L	-	-
CO5	S	S	S	S	-	-	-	-	-	-	-	-	S	-	-

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.,

Reference Books

1	Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors,
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,

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

Preamble

Design is essentially a decision-making process. Design is to formulate a plan to satisfy a particular need and to create something with a physical reality. Every Mechanical Engineer should learn the pre-defined set of processes involved in conversion of raw material into a product. The Core course on Design of Machine Elements exposes the basic concepts and techniques involved in machine design. The Course includes the study about various types of stresses, theories of failure and design of shafts, couplings, fasteners, weld joints, springs ,bearings and flywheel. At the outset, the design and techniques involved during designing stages will be focused.

Prerequisite: Strength of Materials

Course Objective

1	To explain the various steps involved in the Design Process.
2	To categorize the various types of stresses and applications
3	To assess the principles involved in evaluating the shape and dimensions of a Component to satisfy functional and strength requirements.
4	To practice the use of standard procedures and data.
5	To design the various mechanical components for the given loading conditions.

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

CO1.	Assess the different types of stresses and Theories of failure for given set of values.	Understand
CO2.	Design shafts and couplings for a given values by using pre-defined data and procedures.	Apply
CO3.	Design the welded joints and fasteners for given set of conditions and type of joints using Pre-defined values.	Apply
CO4.	Design springs for given loading conditions as per the requirements.	Apply
CO5.	Design bearings and Flywheels for a given statement as per the requirements.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 1	PO 1	PO 1	PSO 1	PSO 2	PSO 3
CO1	M	M	M	L	-	-	-	-	-	-	-	-	S	-	-

CO2	S	S	S	M	-	-	-	-	-	-	-	-	S	-	-
CO3	S	S	S	M	-	-	-	-	-	-	-	-	S	-	-
CO4	S	S	S	M	-	-	-	-	-	-	-	-	S	-	-
CO5	S	S	S	M	-	-	-	-	-	-	-	-	S	-	-
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

2	Design Data Book, compiled by PSG College of Technology
3	Fundamentals of Machine component Design–Robert C.Juvinall, Wiley India Pvt.Ltd,
4	Engineering Design, G.E. Dieter.

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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 understand 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 understand the principle, concepts, applications and advancements of temperature, pressure and flow measurements
5	To use information to 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.	Explain the sensitivity of the instruments by evaluating the error in measurements	Understand
CO2.	Discuss the working principle and usage of various instruments used for linear, angular measurement, form measurement and surface finish	Understand
CO3.	Demonstrate the various setups used for measuring linear, angular measurement, form measurement and surface finish	Apply
CO4.	Determine the appropriate instruments for temperature, pressure and flow measurements	Apply
CO5.	Explain the 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	M	L	--	--	--	--	--	--	--	--	L	--	--
CO2	S	S	M	L	--	--	--	--	--	--	--	--	L	--	--
CO3	M	L	M	L	--	--	--	--	--	--	--	--	L	--	--
CO4	S	S	M	L	--	--	--	--	--	--	--	--	L	--	--
CO5	S	M	S	L	--	--	--	--	--	--	--	--	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 Micro Objective, interference micro Objective, tool makers micro Objective, 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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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 flow parameters and its types. Understand the knowledge about the rocket propulsion and various propellants.	Understand
CO2.	apply the concept of gas dynamics in Space Propulsion.	Apply
CO3.	Know to solve flow through variable area ducts.	analyze
CO4.	Examine the effect of compression and expansion waves in compressible flow.	analyze
CO5.	Solve problems in Rayleigh and Fanno flow.	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	M	L	M	M	M	L							S	M	L
CO2	M	M	L	M	L	L							S	M	L
CO3	S	M	L	M	M	L							S	M	L
CO4	S	S	M	S	M	L							S	M	L
CO5	S	S	S	S	M	L							S	M	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

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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 Design, manufacturing & Business aspects.

Prerequisite: Nil

Course Objective

1	To understand the concepts involved in CAD , CAM and CIM
2	To apply geometric modelling techniques and various graphics standards in CAD
3	To apply Modelling Techniques & graphic standard while designing.
4	To make use of GT and CAPP concepts in processing components.
5	To identify the components of 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 components	Apply
CO3	Develop CNC programs for various mechanical components with different operations.	Apply
CO4	Apply the concepts of Group technology and Computer aided process planning techniques in Manufacturing	Apply
CO5	Identify the functions of various components of Shop Floor Control and Flexible Manufacturing Systems.	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	-	-	L	-	-	-	-	-	-	-	M	-	-
CO2	S	S	S	S	S	-	-	-	M	M	M	-	S	-	L
CO3	S	S	L	S	S	-	-	-	M	M	-	-	S	-	L
CO4	M	L	M	M	S	-	-	-	M	-	M	-	M	-	L
CO5	M	L	S	L	-	-	-	-	-	-	-	-	M	-	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 2016.
2	Radhakrishnan P, Subramanyan.S. and Raju V., "CAD/CAM/CIM", New Age International (P) Ltd., New Delhi.

Reference Books

1	Yorem koren, "Computer Integrated Manufacturing System", McGraw-Hill.
2	Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International.

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.
5	Viswanathan.N, Narahari.Y "Performance Modeling & Automated Manufacturing systems" Prentice hall of india pvt. Ltd.

Course Designers

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

Preamble

Design of Transmission System course is concerned with design of mechanical transmission elements for engineering applications. In an industrial facility, motors and turbines use energy to produce rotational mechanical motion. In order to harness this motion to perform useful work, there must be a way to transmit it to other components and machines. Three common methods of accomplishing this include gear drives, chain drives, and belt drives. The Mechanical Transmission Systems subject area covers these types of transmission systems, including specific applications, how each works, and basic maintenance procedures.

Prerequisite - DESIGN OF MACHINE ELEMENTS

Course Objective

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

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

CO1.	Design a suitable flat belt, V-belt and chain drive for specified loading condition by using pre-defined set of values and procedures.	Apply
CO2.	Determine the number of teeth, bending strength and wear strength for given spur gear and bevel gear by using pre-defined set of values and	Apply
CO3.	Determine the number of teeth, bending strength and wear strength for given worm and bevel gear pair by using pre-defined set of values and procedures.	Apply
CO4.	Design the gearbox and gear shaft dimensions for given speed conditions by using pre-defined set of values and procedures.	Apply
CO5.	Design the single plate clutch, multiple plate clutch and brakes for given specified loading conditions by using pre-defined set of values and procedures.	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	S	S	M	_	_	_	_	_	_	_	S	_	_
CO2.	S	M	S	S	M	_	_	_	_	_	_	_	S	_	_
CO3.	M	S	S	S	M	_	_	_	_	_	_	_	S	_	_
CO4.	S	M	S	S	M	_	_	_	_	_	_	_	S	_	_
CO5.	S	M	S	S	M	_	_	_	_	_	_	_	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

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

Preamble

The purpose of this subject is to be 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 categorize various types of convection and its application.
4	To assess various concepts of radiation 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 assess the basic elements & various modes of heat transfer used in engineering applications.	Understand
CO2.	To solve the engineering problems using various methods of Transient heat conduction technologies.	Apply
CO3.	To apply the concepts of convection systems in an engineering problem using standard values	Apply
CO4.	To choose the various concepts of radiation & types of Heat Exchangers based on the requirements for the given problems.	Apply
CO5.	Apply diffusive and convective mass transfer equations and correlations to solve problems for different 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	PO1 0	PO1 1	PO12	PSO 1	PSO 2	PSO 3
CO1	M	M	M	L	-	-	-	-	-	-	-	-	L	-	-
CO2	S	S	S	M	-	-	-	-	-	-	-	-	M	-	-
CO3	S	S	S	M	-	-	-	-	-	-	-	-	S	-	-
CO4	S	S	M	M	-	-	-	-	-	-	-	-	M	-	-
CO5	S	S	S	M	-	-	-	-	-	-	-	-	M	-	-

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

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

Finite Element Analysis is an advanced computer technique based on numerical methods for solving wide variety of engineering problems. FEA can produce accurate, reliable approximate solutions, at a small fraction of the cost of more rigorous, closed-form analyses. This course provides the basic theoretical knowledge to competently perform finite element analysis for structural and thermal analyses. It also provides an introduction to the finite element analysis from engineering point of view.

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

CO 1.	Solve the physical problem using functional approximation method.	Apply
CO 2.	Derive the shape functions and stiffness matrix for one dimensional structural and thermal problems	Apply
CO 3.	Derive the shape functions and stiffness matrix for two dimensional structural and thermal problems.	Apply
CO 4.	Derive the shape functions and stiffness matrix for Isoparametric elements.	Apply
CO 5.	Perform structural analysis of mechanical components like beams, trusses, corner bracket and plates	Apply
CO 6.	Perform thermal analysis of composite walss, composite cylinders and fins	Apply
CO 7.	Performm model and harmonic analysis of mechanical components like beams and spring-mass damper system	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	M	_	_	_	_	_	_	_	_	S	_	M

CO2.	S	S	S	M	_	_	_	_	_	_	_	_	S	S	S
CO3.	S	S	S	M	_	_	_	_	_	_	_	_	S	S	S
CO4.	S	S	S	M	_	_	_	_	_	_	_	_	S	M	S
CO5.	S	S	S	M	S	_	_	_	_	_	_	_	S	_	S
CO6.	S	S	S	M	S	_	_	_	_	_	_	_	S	S	S
CO7.	S	S	S	M	S	_	_	_	_	_	_	_	S	_	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 residual approaches, Galerkin formulation and Point-collocation – Problems on Galerkin formulation and Point-collocation simple 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 NUMERICAL INTEGRATION

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 DIMENSION PROBLEMS (DYNAMIC CONSIDERATION)

Formulation – Hamilton's Principle – Characteristic polynomial Technique – Element mass matrix formulation for one dimensional Elements (2-node isoparametric and 3-node sup-parametric elements) – Problems for 1-D Problems to find eigenvalues and eigenvectors using 2-node isoparametric and 3-node isoparametric.

STEADY STATE HEAT TRANSFER ANALYSIS

Introduction, straight uniform fin analysis, Derivation 1D Element matrices – Problems on straight uniform fin analysis and Taper fin analysis Heat Flex Boundary Conditions – Analysis of uniform fins using 1D Quadratic Elements – Two Dimensional Steady state Problems using CST Elements – 1-D and 2-D simple Problems using any commercial FEA software.	
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 Ind ia, 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 explain the factory automation and integration
2	To Illustrate about hydraulics and pneumatics circuits
3	To Design the various design of pneumatic and electro-pneumatic circuits
4	To design about PLC and its applications
5	To illustrate the automation in transfer machines & assembly.

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

CO1.	Explain the factory automation, production system and integration technologies in manufacturing sector	Understand
CO2.	Explain the various Hydraulics and Pneumatics Elements used for the industrial applications	Understand
CO3.	Develop the pneumatic and electro-pneumatic circuits for the given applications using standard procedures.	Apply
CO4.	Develop PLC for modern manufacturing applications using standard procedures	Apply
CO5.	Construct the automatic transfer machines & assembly 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	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	-	-	-	-	-	-	-	-	-	-	-	M	-	-
CO2	S	-	-	-	-	-	-	-	-	-	-	-	M	-	-
CO3	S	L	L	L	M	-	-	-	-	-	-	-	M	-	-
CO4	S	L	S	L	M	-	-	-	-	-	-	-	M	-	-
CO5	S	L	M	M	M	-	-	-	-	-	-	-	M	-	-

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 AND PNEUMATICS

Basic elements of hydraulics and 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 and 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., 2000. *Fluid power with applications*. Upper Saddle River: Prentice-Hall International.
2	Majumdar, S.R., 1996. *Pneumatic systems: principles and maintenance*. Tata McGraw-Hill Education.
3	Bolton, W., 2003. *Mechatronics: electronic control systems in mechanical and electrical engineering*. Pearson Education.

Reference Books

1	Auslander, D.M. and Kempf, C.J., 1996. *Mechatronics: mechanical systems interfacing*. Prentice Hall.
2	Deppert, W. and Stoll, K., 1975. *Pneumatic Control*. Vogel.
3	Merritt, H.E., 1991. *Hydraulic control systems*. John Wiley & Sons.

Course Designers

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

Preamble

Upon completion of this course the students will be able to learn the layout and arrangement of principal parts of an automobile, advancement in engine control systems, working of transmission and brake systems along with the alternative fuels available and the emission systems.

Prerequisite : NIL

Course Objective

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

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

CO1.	Describe the basic lay-out of an automobile.	Understand
CO2.	Differentiate between the working principle of petrol and diesel engines.	Understand
CO3.	Explain the principles of transmission systems of the automobile	Apply
CO4.	Identify the different types of suspension and braking systems	Apply
CO5.	Demonstrate the latest developments in the file of 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	-	-	-	-	-	-	-	-	S	-	-
CO2	S	L	L	L	-	-	-	-	-	-	-	-	S	-	-
CO3	S	M	M	M	-	-	-	-	-	-	-	-	S	-	-
CO4	S	M	M	M	-	-	-	-	-	-	-	-	S	-	-
CO5	S	M	M	M	-	-	-	-	-	-	-	-	S	-	-

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

Preamble

This course provides deep knowledge about the various manufacturing processes, which are used in the manufacturing industry to produce mechanical components.

Prerequisite : NIL

Course Objective

1	To understand the manufacturing process of conventional and special casting process of foundry technology.
2	To impart the knowledge of various types welding process in metal joining processes.
3	To know the working principles of the various unconventional, conventional machining operations and also metal forming processes.
4	To impart the basic knowledge and working principle of various forming and the moulding processes in plastics.
5	To impart the knowledge of various metal forming processes and manufacturing process of powder metallurgy.

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

CO1.	Explain the working principles of various metal casting processes and to identify the defects and interpret causes in the product of metal casting processes	understand
CO2.	Discuss the working principles of various metal joining processes and machines/equipments used and Select the suitable joining methods for fabrication/ assembly of products.	understand
CO3.	Examine the working principle of various conventional machine tools, work and unconventional manufacturing processes.	Apply
CO4.	Illustrate the types of plastics, working principle of various moulding process and the characteristics of the forming and shaping processes	Apply
CO5.	Apply the concepts of various metal forming and powder metallurgy.	Apply

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

S- Strong; M-Medium; L-Low

SYLLABUS

Introduction to Casting technology

Casting types, procedure to make sand mould, types of core making, moulding tools, machine moulding, special moulding processes– CO_2 moulding, shell moulding, investment moulding, permanent mould casting, pressure die casting, centrifugal casting, continuous casting and identify casting defects and remedies.

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, and identify defects in welding process - Soldering and brazing.

Machining

General principles (with schematic diagrams only) of working and commonly performed operations in the following machines: Lathe, Shaper, Planner, 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

Types of plastics - Characteristics of the forming and shaping processes – moulding of thermoplastics– working principles and typical applications of- Injection moulding – Plunger and screw machines– Blow moulding – rotational moulding – film blowing – extrusion- typical industrial applications – 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 – Principle steps involved advantages, disadvantages and limitations of powder metallurgy.

Text Books

1	S.K.HajraChoudhury and A.K. HajraChoudhury, '**Elements of Work shop Technology**', Vol – I & II Manufacturing Processes, Media Promoters and Publishers Pvt. Ltd, 1986.
2	Mikell P.Groover, '**Fundamental of Modern Manufacturing**', Wiley India Edition, Third Edition, Reprint, 2012.
3	P.C. Sharma, '**A Text Book of Production Technology (Manufacturing Processes)**', S. Chand & Company Ltd., New Delhi, Seventh Reprint, 2012.

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	E.Paul Degarmo, J.T.Black, and Ronald A. Konser, '**Materials and Processes in Manufacturing**', 5th Edition, Prentice Hall India Ltd., 1997.

Course Designers				
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17MECC20	UNCONVENTIONAL MANUFACTURING PROCESS	Category	L	T	P	Credit
		CC	3	0	0	3

Preamble

This course aims to teach the various advanced manufacturing processes used in industries for making products. The students will get complete knowledge of the unconventional processes in terms of aspects stated above.

Prerequisite – Nil

Course Objective

1	To discuss the basic concepts of various unconventional machining processes
2	To Demonstrate the Mechanical energy based unconventional machining processes.
3	To Demonstrate the Electrical energy based unconventional machining processes.
4	To Demonstrate the Chemical & Electro-Chemical energy based unconventional 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 of various unconventional machining processes	Understand
CO2.	Explain the Mechanical energy based unconventional machining processes	Apply
CO3.	Illustrate the Electrical energy based unconventional machining processes	Apply
CO4.	Explain the Chemical & Electro-Chemical energy based unconventional machining processes	Apply
CO5.	Illustrate the Thermal energy based unconventional machining processes	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	-	S	-	M
CO2	S	-	-	M	M	-	-	-	-	-	M	-	S	-	M
CO3	S	-	-	M	M	-	-	-	-	-	M	-	S	-	M
CO4	S	-	-	M	M	-	-	-	-	-	M	-	S	-	M
CO5	S	-	-	M	M	-	-	-	-	-	M	-	S	-	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"

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17MECC82	MACHINE DRAWING LABORATORY	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	Use limits, fits and tolerances in real world problems.
2	Apply different sectional views in drawings.
3	Recognize the drawing notations of standard machine elements.
4	Draw the assembly drawing.
5	Draw the detailed drawing of given components.

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

CO1.	Associate limits, fits and tolerances in real world problems.	Understand
CO2.	Sketch the sectional views of simple elements.	Understand
CO3.	Model the standard mechanical elements like bolt,nut,screw etc.	Apply
CO4.	Model the assembly drawing of Mechanical components	Apply
CO5.	Modify the real products to Machine drawing	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	-	-
CO2	S	L	S	L	-	-	-	-	-	-	-	-	L	-	-
CO3	S	L	-	L	-	-	-	-	-	-	-	-	L	-	L
CO4	S	M	L	L	-	-	-	-	-	-	-	-	L	-	L
CO5	S	M	L	M	-	-	-	-	-	-	-	-	L	-	M

S- Strong; M-Medium; L-Low

SYLLABUS

LIST OF EXPERIMENTS

UNIT 1 - LIMITS, FITS AND TOLERANCES

Limit System- Tolerance, Limits, Deviation, Actual Deviation, Upper Deviation, Lower Deviation, Allowance, Basic Size, Design Size, Actual Size. Fits- Types, Tolerances of Form and Position- Form and Position Variation, Geometrical Tolerance, Tolerance Zone, Indicating Geometrical Tolerances. Indication of Surface Roughness, Standard Abbreviations and Symbols used in industries.

UNIT II - SECTIONAL VIEWS

Sections- Hatching of Sections, Cutting Planes, Revolved or Removed Section, Sectional Views- Full Section, Half Sections and Auxiliary Sections- Conventional Representation-One-view, Two-view and three view Drawings.

UNIT III - INTRODUCTION TO MACHINE ELEMENT DRAWINGS

Drawing standards and Designation of Bolts, nuts, screws, keys, pins, Rivets, Welded Joints- Dimensioning of Welds, Belt Driven Pulleys, Chain and Gears Drives.

UNIT IV - ASSEMBLY DRAWINGS AND SECTIONAL VIEWS

Preparation of manual parts drawing and assembled sectional views from orthographic part drawings, Automobile components - stuffing box, Machine Tool Parts plummer block, Joints knuckle joints, Couplings Protected type flanged coupling, Bearings swivel bearing, Preparation of Bill of materials and tolerance data sheet.

UNIT V - REAL PRODUCTS TO MACHINE DRAWING CONVERSION

Preparation of manual parts drawing and assembled sectional views from real time products- Internal combustion engine parts, connecting rod, couplings - universal coupling, machine tool parts - tailstock, Automobile components screw jack, stuffing box - Commercial products - Preparation of Bill of materials and tolerance data sheet.

Text Books

Bhatt-N.D.-"Machine Drawing"-Published by R.C.Patel- Chartstar Book Stall- Anand-India- 2003	
P.S.G. Design Data Book	
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	N.D. Bhatt, Machine Drawing, Charotar Publishing House Pvt. Ltd., 2014

2	P.S.Gill, A Textbook of Machine Drawing, Katson books, 2013
3	R.K.Dhawan, A Textbook of Machine Drawing,S.Chand,2012
4	K.C. John, Textbook of Machine Drawing, PHI Learning Pvt. Ltd.,2009

Course Designers

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

Preamble

This course provides to impart knowledge of the preparation of samples of both ferrous and non ferrous materials and also study the microstructure of the materials by using metallurgical microscopy.

Prerequisite - NIL

Course Objective

1	Understand the crystal structures and properties of various materials and also to study the various types of heat treatment methods of engineering materials
2	Practice the methodologies of specimen preparation both ferrous and non ferrous materials.
3	Observe the microstructure of the ferrous and non ferrous material specimens through metallurgical microscope

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

CO1.	Understand the basic knowledge about the ferrous and non ferrous metals and their properties. Also study of heat treatment process.	Understand
CO2.	Experiment for specimen preparation and study the microstructure of ferrous materials	Apply
CO3.	Experiment for specimen preparation and study the microstructure of non ferrous materials.	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	-	-	-
CO2	S	M	-	-	-	-	-	-	M	-	-	M	S	-	-
CO3	S	M	-	-	-	-	-	-	M	-	-	M	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.
5	To provide the students to get exposure in various biofuels.

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	Apply
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	M	L	-	-	-	-	-	-	-	-	-	-	S	-	-
CO2	M	-	-	-	-	-	-	-	-	-	-	-	S	-	-
CO3	L	L	-	-	-	-	-	-	-	-	-	-	S	-	-
CO4	L	L	-	-	-	-	-	-	-	-	-	-	S	-	-
CO5	M	L	L	-	-	-	-	-	-	-	-	-	S	-	-

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

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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 learn 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.	Learn the concepts applied in dymanics and metrology lab	Understand
CO2.	Experiment with capable of conduct the various dynamic and vibrating equipments	Apply
CO3.	Make use of static equipments ,for measure the angle, contour	Apply
CO4.	Experiment with proper equipments for flow,temp,speed	Apply
CO5.	Experiment with dynamic equipments ,for measure the forces, angles	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	S	L	L	L	-	-	-	-	-	-	-	L	-	-
CO2	S	M	M	L	L	-	-	-	-	-	-	-	L	-	-
CO3	S	L	M	M	L	-	-	-	-	-	-	-	L	-	-
CO4	S	S	M	M	M	-	-	-	-	-	-	-	L	-	-
CO5	S	S	L	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

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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 automobile 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.	Demonstrate by Dismantling and Assembling of the constructional arrangements of different Engine Models of different vehicles.	Apply
CO2.	Demonstrate the Dismantling and Assembling of the constructional arrangements of different Chassis of different vehicles.	Apply
CO3.	Evaluate the function of Automotive Electronics components by 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	-		-	S	M	M
CO2	S	L	S	L	M	-	-	-	L	-		-	S	M	M
CO3	S	s	-	L	M	-	-	-	L	-		-	S	M	M

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				
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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 explain the basics of part programming for turning and milling using G & M codes.
2	To construct the CNC program for a given profile in milling.
3	Make use of Canned Cycle, Mirroring and subroutines for machining a given profile
4	To Construct the program for a given profile in turning.
5	To examine the tool path simulation and generation of codes using Software

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

CO1.	To demonstrate the basic knowledge about G and M codes	Understand
CO2.	Apply the programming knowledge to write the program for linear and circular interpolation, circular & rectangular pocketing	Apply
CO3.	Apply the knowledge of mirroring, canned cycle and subroutine concepts to write the CNC program	Apply
CO4.	Apply the knowledge of different types of canned cycles including turning, facing, grooving, drilling, boring and threading etc.,	Apply
CO5	Analyze the tool path simulation and generation of codes using Software	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	PO10	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	M	L	L	-	-	-	-	-	-	-	-	L	M	-	
CO2	S	S	M	-	-	-	-	-	M	-	-	M	M	-	M
CO3	S	S	S	-	-	-	-	-	M	-	-	M	S	-	M
CO4	S	S	S	-	-	-	-	-	M	-	-	M	S	-	M
CO5	S	S	S	-	S	-	-	-	S	-	-	S	S	-	M

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 Standard G and M Code.
3. Machining practice on Trainer Type CNC Machines
4. Simulation of tool path using CAM simulation Software

Part programming for 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 and Taper Turning
3. Grooving
4. Fixed/Canned Cycles
5. Thread cutting Cycles
6. Peck Drilling Cycles

Text Books

1	**CAM LAB Manual**

Course Designers

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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 doing experiments using setups.

Prerequisite

NIL

Course Objective

1	To impart practical concept of conduction heat transfer in experimental setup.
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.	Experiment with conduction systems for given set of requirements.	Apply
CO2.	Conduct experiments based on transient conduction systems.	Apply
CO3.	Conducting the experiments for convection systems based on the given requirements.	Apply
CO4.	To Perform the experiments with Radiation Heat Exchangers for given conditions.	Apply
CO5.	To experiment with Stefan Boltzmann's setup for given conditions	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	M	L	-	-	-	-	-	-	-	S	-	-
CO2	M	M	L	M	L	-	-	-	-	-	-	-	S	-	-
CO3	M	M	L	M	L	-	-	-	-	-	-	-	S	-	-
CO4	M	M	L	M	L	-	-	-	-	-	-	-	S	-	-
CO5	M	M	L	M	L	-	-	-	-	-	-	-	S	-	-

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 Manual , Prepared by C.Thiagarajan,Mech/AVIT

Course Designers

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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
Strength of Materials Lab.

Course Objective

1	Learn basic procedure of finite element analysis
2	Make Use of 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.	Illustrate the basic concepts and procedure of finite element analysis	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	-	-
CO2	S	S	M	L	S	M	-	-	-	L	-		M	-	L
CO3	S	S	S	S	S	M	-	-	M	L	-		S	-	S
CO4	S	S	S	M	S	M	-	-	M	L	-		S	-	S
CO5	S	S	S	S	S	L	-	-	-	L	-		S	-	M

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-Faculty of Engineering and Technology,VMRF-DU

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

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

Preamble

This course aims to teach the hydraulic and pneumatic circuit design using different control devices

Prerequisite NIL

Course Objective

1	To know Hydraulic and Pneumatic circuits
2	To train design and testing of logical pneumatic circuits
3	To train design of electro pneumatic circuits
4	To train design PLC based pneumatic circuits

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

CO1.	Explain the principles, strategies and advantages of industrial automation	Understand
CO2.	Build the handling systems for an automated factory.	Apply
CO3.	Construct the sequence circuit using electro pneumatic principles	Apply
CO4.	Develop PLC based pneumatic circuit for sequencing operations	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													
CO2	S	S	S	L	M				L				L		M
CO3	S	M	M	L	L								L		L
CO4	S	M	M	L	L								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 Continuous reciprocation of double acting cylinder.
3. To design a Sequencing of two cylinder circuits.
4. To design a Cascading circuit for trapped signals-2 groups
5. Implementation of Logic Circuits: AND,OR
6. Design of Basic Electro Pneumatic Circuits: Continuous reciprocation of cylinder (with timer and counter)
7. Design and testing of Force, Velocity calculations in Hydraulic Linear actuation
8. Design and simulation of PLC Control Pneumatic/ Hydraulic linear actuator circuits.

9. To design a PLC Controller based sequencing circuits	
Text Books	
1	Industrial Automation Lab Department Manual
Reference 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.
4	Bolton, W., 2003. Mechatronics: electronic control systems in mechanical and electrical engineering. Pearson Education.

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

Preamble

To impart knowledge and skill in the field of machine tools used in the industries. To increase the level of confidence of students by working individually in various machine tools.

Prerequisite – NIL

Course Objective

1	To study the working principle and understand the basic operations in the lathe machine and various machine tools
2	To apply the knowledge and practical training in drilling machine, shaping machine operations
3	To apply the knowledge and 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.	Explain the basic operations in lathe and Special Machine	Understand
CO2.	Apply the various operations in Drilling and shaping machines.	Apply
CO3.	Apply the various operations in using milling, 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	-	-	-	L	-	-	-	M	-	-	-	-	-	-
CO2	S	M	-	-	L	-	-	-	M	-	-	-	S	-	-
CO3	S	M	-	-	L	-	-	-	M	-	-	-	S	-	-
CO4	S	M	-	-	L	-	-	-	M	-	-	-	S	-	-

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

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ELECTIVE COURSES-
PROGRAMME SPECIFIC

17ATCC10	AUTOMOTIVE POLLUTION CONTROL	Category	L	T	P	C
		EC - SE	3	0	0	3

Preamble

To study and purpose is to understand automotive pollution control.

Prerequisite

NIL

Course Objectives

1	To understand the introduction of pollutions.
2	To understand the pollution formation in SI engines.
3	To understand the pollution formation in CI engines
4	To impart the control of emission in CI engines.
5	To understand the measurement technique and emission standards.

Course Outcomes:

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

CO1.	Summarize the current scenario of Automobile Emissions and standards	Understand
CO2.	Apply the formation of Emissions from SI Engines.	Apply
CO3.	Apply the formation of Emissions from CI Engines.	Apply
CO4.	Examine Emission and control Techniques in SI and CI Engines.	Analyze
CO5.	Inspect measuring techniques of Emission and test procedure	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	--	--
CO2	S	S	S	S	M	--	--	--	--	--	--	M	M	--	--
CO3	S	S	S	S	M	--	--	--	--	--	--	S	M	--	--
CO4	S	S	S	S	M	--	--	--	--	--	--	S	M	--	--
CO5	S	S	S	S	M	--	--	--	--	--	--	S	M	--	--

S- Strong; M-Medium; L-Low

Syllabus

INTRODUCTION
Introduction pollution control act- norms and standards. Vehicle population assessment in metropolitan cities and contribution to pollution, effects on human health and environment, global warming, types of emission, transient operational effects on pollution
POLLUTANT FORMATION IN SI ENGINES
Pollutant formation in SI Engines, mechanism of HC and CO formation in four stroke and two stroke SI engines, NOx formation in SI engines, effects of design and operating variables on emission formation, control of evaporative emission. Two stroke engine pollution
POLLUTANT FORMATION IN CI ENGINES
Pollutant formation in CI engines, smoke and particulate emissions in CI engines, effects of design and operating variables on CI engine emissions. Nox and Sox formation and control. Noise pollution from automobiles, measurement and standards.
CONTROL OF EMISSIONS FROM SI AND CI ENGINES
Design of engine, optimum selection of operating variables for control of emissions, EGR, Thermal reactors, secondary air injection, catalytic converters, catalysts, fuel modifications, fuel cells, Two stroke engine pollution control.
MEASUREMENT TECHNIQUES - EMISSION STANDARDS
NDIR, FID, Chemiluminescent analyzers, Gas Chromatograph, smoke meters, emission standards, driving cycles – USA, Japan, Euro and India. Test procedures – ECE, FTP Tests. SHED Test – chassis dynamometers, dilution tunnels

TEXT BOOK:
1. Paul Degobert – Automobiles and Pollution – SAE International ISBN-1-56091-563-3, 1991.
2. Ganesan, V- “Internal Combustion Engines”- Tata McGraw-Hill Co.- 2013.
3. SAE Transactions- “Vehicle Emission”- 1982 (3 volumes).
REFERENCES:
1. Obert.E.F.- “Internal Combustion Engines”- 1988.
2. Marco Nute- “Emissions from two stroke engines, SAE Publication – 1998

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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.	Study the importance and Economics of renewable Energy	Remember
CO2.	Discuss the method of power generation from Solar Energy	Understand
CO3.	Discuss the method of power generation from Wind Energy	Understand
CO4.	Explain the method of power generation from Bio Energy	Understand
CO5.	Explain the Tidal energy, Wave Energy, OTEC, Hydro energy, Geothermal Energy, Fuel Cells and Hybrid 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	M	M	M	-	-	-	-	-	-	-	-	-	S	M	L
CO2	S	M	M	-	-	-	-	-	-	-	-	-	S	M	L
CO3	S	M	M	-	-	-	-	-	-	-	-	-	S	M	L
CO4	S	M	M	M	-	-	-	-	-	-	-	-	S	M	L

CO5	S	M	M	M	-	-	-	-	-	-	-	-	S	M	L

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”, OxfordUniversityPress, 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 to energy conversion fromwaste.

Prerequisite - NIL

Course Objective

1	To understand the waste and waste processes.
2	To understand waste treatment and disposal.
3	To apply the convert waste to energy from thermo chemical conversion.
4	To apply the 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.	Known thetypes and source of waste	understand
CO2.	Familiarize the various waste treatment technique and disposal methods.	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.	Analyze the environmental and health impacts due to waste with case study.	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	M	M	L	L	-	-	-	-	-	-	-	-	L	-	-
CO2	S	S	M	M	-	-	-	-	-	-	-	-	L	-	-
CO3	S	S	M	M	-	-	-	-	-	-	-	-	L	-	-
CO4	S	S	M	L	-	-	-	-	-	-	-	-	L	-	-
CO5	S	S	S	M	-	-	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 LakePublication, 2009.
2	Velma I Grover and Vaneeta Grover, "Recovering Energy from Waste Various Aspects", Science Pub Inc, 2002.

Course Designers

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17MESE07	NUCLEARPOWER ENGINEERING	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

Nuclearengineeringis thebranchof sciencethatdealswiththeoryofnuclearfissionandfusion,nuclear reactorsand preventive maintenance such as protection from radiation. In order to understand the constructionandoperationofnuclearreactors,itisnecessarytohaveabasicgroundinginatomicphysics. The course provides afundamental knowledge in nuclear power generation and nuclear power plant operation and their applications.

Prerequisite-NIL

CourseObjective

1	Tounderstandthemechanismsofnuclearfissionandfusionreactions.
2	Tounderstand importance of reactor materialsanditscharacteristics.
3	Tounderstand application ofreprocessingmethodsofnuclearspentfuel.
4	Toanalysis the performance ofseparationofreactorproducts
5	Tolearn the application ofwaste disposal and radiation production

CourseOutcomes:Onthesuccessfulcompletionofthecourse,studentswillbeableto

CO1.	To understand thenuclearfissionandfusionprocesses.	Understand
CO2.	To learn and understandthevariousnuclearfuelcyclesanditscharacteristics.	understand
CO3.	To apply the various reprocessingmethodsofnuclearspentfuel.	Apply
CO4.	To learn the applications ofdisposalmethodsofnuclear Wastes and radiation production.	Apply
CO5.	To analysis the concept and performance of theseparationofreactorproducts.	Analyze

MappingwithProgrammeOutcomesandProgrammeSpecificOutcomes

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	M	M	M	M								M		
CO2	S	M	M	L	S								M		
CO3	S	M	M	L	S								M		
CO4	S	M	M	S	M								S		
CO5	S	M	M	S	M								M		

S-Strong;M-Medium;L-Low

SYLLABUS

NUCLEARREACTORS

Mechanismofnuclearfission–Nuclides-Radioactivity–Decaychains-Neutronreactions-Fissionprocess –Reactors-Typesofreactors–Designandconstructionofnuclearreactors-Heattransfertechniquesin nuclearreactors-Reactorshielding.

REACTORMATERIALS

Nuclearfuelcycles–Characteristicsofnuclearfuels–Uranium–Productionandpurificationofuranium– ConversiontoUF4andUF6–OtherfuelslikeZirconium,Thorium,Berylium.

REPROCESSING

Nuclearfuelcycles-Spentfuelcharacteristics-Roleofsolventextractioninreprocessing-Solvent extractionequipment

SEPARATIONOFREACTORPRODUCTS

Processestobeconsidered-Fuelelementdissolution-Precipitationprocess–Ionexchange-Redox-Purex -TTA–Chelation-U235-Hexone-TBPandThoraxprocesses-Oxidativeslaggingandelectro-refining- Isotopes– Principlesofisotopeseparation

WASTEDISPOSALANDRADIATIONPROTECTION

Typesofnuclearwastes–Safetycontrolandpollutioncontrolandabatement-Internationalconventionon safetyaspects–Radiationhazardsprevention

TextBooks

1	ThomasJ.Cannoly,"FundamentalsofnuclearEngineering",JohnWisley,2002
2	CollierJ.G.,andHewittG.F,"IntroductiontoNuclearpower",Hemispherepublishing, NewYork, 2002.

ReferenceBooks

1	A.E.WalterandA.B.Reynolds(1981),FastBreederReactor,PergamonPress.
2	M.M.El-Wakil(1971),NuclearEnergyConversion,IntextEducationalPublish.

CourseDesigners

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17MESE12	PRODUCT LIFE CYCLE MANAGEMENT	Category	L	T	P	Credit
		EC(PS)	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 Explain the product life cycle management of a product
2	To understand the process flow, work flow, & product data management
3	To Apply the concepts of new product development
4	To Modify 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.	Explain the concepts of product data, information, structures and PLM.	Understand
CO2.	Describe the benefits of PLM implementation in daily operations, material costs, productivity of labor and quality costs.	Understand
Co3.	Perform PLM Concepts For Service Industry And E-Business.	Apply
CO4.	Determine the Use of tools and standards in PLM.	Apply
CO5.	Illustrate 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												M		
CO2	S	M	S	S						S			M		
CO3	S	S	L												
CO4	S	M	L												
CO5	S	S	M	L								L	M		

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

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17MESE14	REVERSE ENGINEERING	Category	L	T	P	Credit
		EC(PS)	3	0	0	3

PREAMBLE

Thiscoursereviewsthevariousstepsinvolvedinreverseengineering,designofaproductaspercustomer's requirements,suitablereverseengineeringsystem forinspectionandmanufacturing&reverseengineering applicationsin aerospace, automotive and medicalfields.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	Tointroducethevariousstepsinvolved in reverseengineering
2	To understandthedesign ofaproductbased oncustomerrequirements
3	Tointroduceasuitablereverseengineeringsystemfor inspection and manufacturing
4	To know theRE applications inaerospace, automotiveand medical sectors.

COURSE OUTCOMES

On thesuccessfulcompletion ofthecourse, studentswillbeable to

CO1. Identifythestepsinvolved inreverse engineeringofagiven component.	Understand
CO2. Designandfabricateanexistingcomponentwithsuitablemodificationsasper Customer'srequirements.	Apply
CO3. Select and configurea suitablere-engineeringsystemforinspectionand manufacturing.	Apply
CO4.Applythe re-engineeringtechniquesin aerospace, automobile andmedical sectors.	Apply

MAPPINGWITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFICOUTCOMES

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 1	PO 11	PO 1	PSO 1	PSO 2	PSO 3
CO1	S	L	M	M	M	--	--	--	--	L	--	--	S	--	--
CO2	S	M	S	M	S	M	--	--	--	S	--	--	M	--	M
CO3	S	S	S	M	S	--	M	--	M	M	--	--	S	--	M
CO4	S	S	S	S	S	M	M	--	S	S	M	M	S	--	M

S-Strong;M-Medium;L-Low

SYLLABUS

GEOMETRICMODELLINGUSINGPOINT CLOUDDATA:
Point Cloudacquisition, Surface Modellingfrom apointclouds,MeshedorFacetedModels,PlanarContourModels,PointstoContourModels,Surface Models, Segmentation andSurfaceFittingforPrismaticobjects andFreeFormShapes.

METHODOLOGIESANDTECHNIQUESFORRE-ENGINEERING:
ThePotentialforAutomationwith3-DLaserScanners,Re-Engineering,Computer-aided(Forward)Engineering,Computer-aided ReverseEngineering, ComputerVision and Re-Engineering.

SELECTINGARE-ENGINEERINGSYSTEM:
TheSelectionProcess,SomeAdditionalComplexities,Point CaptureDevices, TriangulationApproaches,"Time-of-flight"orRangingSystems,Structured-lightand StereoscopicImaging Systems,issueswithLight-basedApproaches,Tracking Systems,InternalMeasurement Systems,X-ray Tomography,DestructiveSystems,SomeCommentsonAccuracy,Positioning theProbe, Post processing theCaptured Data,HandlingDataPoints,CurveandSurfaceCreation,InspectionApplications, ManufacturingApproaches.

INTEGRATION BETWEEN RE-ENGINEERING AND ADDITIVE MANUFACTURING:
Modeling CloudDatainRe-Engineering,DataProcessing forRapidPrototyping,IntegrationofREandRPforLayer-based ModelGeneration, AdaptiveSlicing Approach forCloud DataModeling,PlanarPolygonCurve ConstructionforaLayer, Determination ofAdaptiveLayerThickness.

RE-ENGINEERING INAUTOMOTIVE,AEROSPACE, MEDICALSECTORS:
LegalAspectsofRe- Engineering:CopyrightLaw,Re-Engineering,RecentCaseLaw,Barriers to Adopting Re-Engineering.A discussion onafew benchmarkcase studies.

TEXT BOOKS:
1. ReverseEngineering:An IndustrialPerspectivebyRaja and Fernandes, Springer-Verlag2008.

REFERENCES:
1. K. Otto andK. Wood, Product Design: Techniques in Reverse Engineering and New Product Development, PrenticeHall, 2001.

COURSE DESIGNERS

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2	RAJA.S	Asst.Prof.	Mechanical/ VMKVEC	raja@vmkvec.edu.in

17MESE15	SUPPLY CHAIN MANAGEMENT	Category	L	T	P	Credit
		EC(PS)	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 apply the various inventory control models
4	To illustrate the various information toolsof Supply chain
5	To demonstrate the various supply chain integration processes

COURSE OUTCOMES

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

CO1.	Explain the working principle and Development chain-Global optimization-Managing uncertainty and risk.	Understand
CO2.	Discuss the core processes - Market Vs Hierarchy - Make Vsbuy continuum	Understand
CO3.	Apply the working principle of inventory control-Economic lot size model.	Apply
CO4.	Illustrate the working principle of Supply chain coordination structures.	Apply
CO5.	Demonstrate the Strategies Distribution and 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	L	L	L	--	--	--	--	--	--	--	--	L	-	-
CO2	M	L	L	L	--	--	--	--	--	--	--	--	L	-	-
CO3	S	M	L	L	--	--	--	--	--	--	--	--	L	-	-
CO4	S	M	L	M	--	--	--	--	--	--	--	--	L	-	-
CO5	S	M	L	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-continuous review policy
The Value of Information The bullwhip effect-Supply chain coordination structures-Information sharing & incentivesInformation and supply chain trade-offs-Centralized and decentralized decisionmakingand 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-strategies Distribution 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

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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 Objective

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	Understand
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	L	-	-	-	-	-	-	-	-	S	-	-
CO2	S	M	M	M	-	-	-	-	-	-	-	-	S	-	-
CO3	S	M	M	M	-	-	--	-	-	-	-	-	S	-	-
CO4	S	M	M	M	-	-	-	-	-	-	-	-	S	-	-
CO5	S	M	S	M	-	-	-	-	-	-	-	-	S	-	-

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
	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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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 variousproducts after process planning.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To know about Work study, Ergonomics
2	To demonstrate about process planning and its approaches.
3	To illustrate about elements of cost estimation.
4	To calculate the various Cost Estimation methods.
5	To analyze 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	Demonstrate the various steps involved in process planning	Apply
CO3	Illustrate the various elements of cost estimation.	Apply
CO4	Apply the various cost estimation methods in production.	Apply
CO5	Analyze 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	S	L	L	L	-	-	-	-	-	-	L	-	M	-	-
CO2	S	M	M	M	-	-	-	-	-	-	M	-	M	-	-
CO3	S	M	M	M	-	-	-	-	-	-	M	-	S	-	--
CO4	S	M	M	M	-	-	-	-	-	-	S	-	S	-	-
CO5	S	M	M	M	-	-	-	-	-	-	S	-	S	-	-

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 requirementsoperating 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-allowancesin 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

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17MESE20	RAPID PROTOTYPING AND TOOLING	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

PREAMBLE

This course provides to impart knowledge of the Rapid Prototyping and Tooling techniques, which is one of the recent manufacturing technologies.

PREREQUISITE: NIL

COURSE OBJECTIVES

1	To understand the history and development for rapid product development.
2	To discuss the various techniques of solid based process for rapid production.
3	To discuss the various techniques of based process for rapid production.
4	To discuss the various tooling used for Rapid manufacturing tooling techniques.
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 techniques.	Understand
CO2.	Explain the various solid and liquid based methods for RPT techniques used to select suitable process.	Apply
CO3.	Explain the various powder based methods for RPT techniques used to select suitable process.	Apply
CO4.	Apply the tooling and moldingdevices used for RPTmachining operations.	Apply
CO5.	Gain application oriented knowledge related to RPT in Reverse Engineering 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	L	-	-	-	-	-	-	-	-	-	S	-	-
CO2	S	M	L	-	M	-	-	-	-	-	-	-	S	-	-
CO3	S	M	M	-	M	-		-	-	-	-	-	S	-	-
CO4	S	S	S	-	M	-	-	-	-	-	-	-	S	-	-
CO5	S	S	S	-	M	-	-	-		-	-	-	S	-	-

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 (SLA)-Solid Ground Curing (SGC)- products, Advantages, Limitations, Applications and Uses. Solid based system – Fused Deposition Modeling- Laminated Object Manufacturing-Multi Jet Modeling System-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 -Advantages-Applications-Indirect rapid Tooling-silicone Rubber Tooling-Spray metal tooling-RSP Tooling-Reaction Injection Moulding-Direct Rapid Tooling-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. RafiqI. 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 Industrialrevolution 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.

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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 understand PPC and its functions.
4	To apply the skills of purchasing materials and their management.
5	To understand the awareness on various labour acts and management principles.

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

CO1.	Explain the work methods through work measurement	Understand
CO2.	Illustrate the efficient work system	Apply
CO3.	Outline the suitable forecasting techniques for given applications	Analyze
CO4.	Demonstrate the charts, diagrams and production plan.	Apply
CO5.	Examine 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	L	L	L	-	-	-	-	-	-	-	-	L	-	-
CO2	S	L	L	L	-	-	-	-	-	-	-	-	L	-	-
CO3	S	M	M	L	-	-	-	-	-	-	-	-	L	-	-
CO4	S	M	M	L	-	-	-	-	-	-	-	-	L	-	-
CO5	S	M	M	L	-	-	-	-	-	-	-	-	L	-	-

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 HANDLING 9 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

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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. Lean Manufacturing systems afford the practice for streamlining missions in any manufacturing environment.

Prerequisite – NIL

Course Objective

1	To explain the basic concepts of lean manufacturing process
2	To illustrate the various quality improvement methods in lean manufacturing.
3	To assess the JIT and VSM Technologies.
4	To analyse the importance of JIDOKA and its role.
5	To illustrate the importance of employee involvement and systematic planning.

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

CO1.	Explain the lean manufacturing Principles, basic concepts in a manufacturing sector	Understand
CO2.	Choose a suitable method for quality improvement in a manufacturing sector	Apply
CO3.	Experiment with JIT methodology, Kanban rules and VSM applicable to a predefined manufacturing process	Apply
CO4.	Interpret the importance of Jidoka and the implementation in a manufacturing sector	Understand
CO5.	Illustrate the requirement of employee involvement in the implementation of lean culture.	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	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	S	S	L	-	-	-	-	-	-	-	-	M	-	-
CO2	S	L	S	L	-	-	-	-	-	-	-	-	M	-	-
CO3	S	L	S	L	-	-	-	-	-	-	-	-	S	-	-
CO4	M	S	S	S	-	-	-	-	-	-	-	-	S	-	-
CO5	M	S	S	L	-	-	-	-	-	-	-	-	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

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17MESE41	MAINTENANCE MANAGEMENT	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble
On completion this course to provide basic knowledge of Maintenance management concepts and safety in industrial system.

Prerequisite
NIL

Course Objective

1	To understand the maintenance systems
2	To understand the maintenance of planning and control systems
3	To apply the prevention and monitoring of maintenance
4	To apply the safety system in industries
5	To apply the total production maintenance systems .

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

CO1.	Understand fundamental of Maintenance management concepts.	Understand
CO2.	Understand systematic method of maintenance planning and control	Understand
CO3.	Apply the operating and shutdown maintenance of logistics	Apply
CO4.	Apply different types of safety measures and reliability of maintenance	Apply
CO5.	Manage 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	PO 10	PO 11	PO12	PSO 1	PSO 2	PSO 3
CO1	S	L	M	L	-	-	-	-	-	-	-	-	L	L	-
CO2	S	M	M	M	-	-	-	-	-	-	-	-	L	L	-
CO3	S	M	M	M	-	-	-	-	-	-	-	-	L	L	-
CO4	S	S	M	M	-	-	-	-	-	-	-	-	L	L	-
CO5	S	S	M	L	-	-	-	-	-	-	-	-	L	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.
2. 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

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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 related to maintenance of quality used in industries.

Prerequisite : NIL

Course Objective

1	To know about six sigma stories, and methods of improvement of quality
2	To understand basic concept and advanced in belt technologies
3	To apply the implementation and selection of projects idea
4	To application of project tools and design
5	To understand the software technologies in six sigma

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

CO1.	Describe information about the six sigma concept, stories, and methods of quality improvement.	Remember
CO2.	Explain the concepts of six sigma used in industry and belt technologies,	Understand
CO3.	Apply the six sigma methodology concept in used in project selection and to know about the types of mapping.	Apply
CO4.	Implement the different six sigma tools in projects.	Apply
CO5.	Select the software technologies developed in six sigma.	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	**L**	L	L	-	-	-	-	-	-	-	-	L	-	-
CO3	S	**M**	**M**	**M**	-	-	-	-	-	-	-	-	L	-	-
CO4	S	M	**M**	**M**	-	-	-	-	-	-	-	-	L	-	-
CO5	S	**L**	**M**	**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

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1	J.RABI	Asso.Prof	Mech / VMKVEC	rabi@vmkvec.edu.in
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17MEEC01	HYDRAULICS AND PNEUMATIC SYSTEMS	Category	L	T	P	Credit
		EC(PS)	3	0	0	3

PREAMBLE

The students completing this course are expected to understand the concepts of Hydraulic and pneumatic systems and its applications.

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 understand about the various types of valves and actuators
4	To develop hydraulic circuits for different applications
5	To develop pneumatic circuits for different applications

COURSE OUTCOMES

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

CO1. Describe the different drive systems and identify which is suitable for specific application.	Understand
CO2. Discuss the working of different components in fluid power system.	Understand
CO3. Explain about the utilization of cylinders, accumulators, valves and various control components.	Understand
CO4.Develop a feasible hydraulic circuit for a given application.	Apply
CO5. Develop a feasible pneumatic circuit for a given application.	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	PO 10	PO 11	PO 12	PS O1	PSO2	PSO3
CO1	S	L	L			-							M		
CO2	S	L	L			-							M		
CO3	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

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. Parr, A. *Hydraulics and pneumatics: a technician's and engineer's guide*. Elsevier - 2011.

Reference:

1. Thomson, "Introduction to Fluid power"- Prentice Hall - 2004.
2. Majumdar, S.R., *Oil hydraulic systems: principles and maintenance*. McGraw-Hill- 2003.
3. Majumdar, S.R., *Pneumatic systems: principles and maintenance*. Tata McGraw-Hill -1996 Education.

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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 understand the Robotics and Robot drive system.
2	To Identify the controlling of Robots and devices system.
3	The Evaluate the latest technology of sensors used in robotics.
4	To classify the robot kinematics system.
5	To justify 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.	Understand
CO2.	To Identify the steps involved in controlling system	Apply
CO3.	Demonstrate the various kinematics system used in robots.	Apply
CO4.	Demonstrate the various sensors used in robots.	Apply
CO5.	Apply the robot in day to day 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	M	M	M					S	M		M
CO2	S	M	M	S	M	M	M					S	M		S
CO3	S	S	S	S	M	M	M					S	S		S
CO4	S	M	M	M	S	M	M					S	S		S
CO5	S	S	S	S	S	S	S					S	S		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

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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 including the safety aspects and various laws associated with industrial safety.

Prerequisite

NIL

Course Objective

1	To understand about safety management and understand all the safety aspects thoroughly.
2	To understand the various safety procedures and precaution to be followed during the operation of different types of machines.
3	To apply thoroughly equipped with sufficient knowledge of handling the different types of equipments and materials used for industrial safety.
4	To analyze the sufficient knowledge and sharing of expertise for emergency situations arising due to accidents and monitoring of health aspects.
5	To analysis 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.	Explain the safety concepts and role of safety management.	Understand
CO2.	Discuss various safety aspects associated with operational safety of equipments like boilers, pressure vessels and other machineries used in workshop.	Understand
CO3.	Apply various safety measures to be undertaken with respect to industrial safety.	Apply
CO4.	Illustrate the various strategies to prevent accidents and implementation.	Analyze
CO5.	Outline the implementation of safety standards and the various laws related to safety, health and welfare of personnel.	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	L	L	L	-	-	-	-	-	-	-	-	L	-	-
CO3	S	M	M	L	-	-	-	-	-	-	-	-	L	-	-
CO4	S	M	M	L	-	-	-	-	-	-	-	-	L	-	-
CO5	S	M	M	L	-	-	-	-	-	-	-	-	L	-	-

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	Handlin.W, “Industrial Hand Book”, McGraw-Hill, 2000.

Reference Books	
1	Heinrich.H.W, “Industrial Accident Prevention”, McGraw-Hill, 1980.
2	Rudenko.N, “Material Handling Equipments”, Mir Publishers, Moscow, 1981.
3	Lees.F.P, “Loss “Prevention in Process Industries”, Butterworths, New Delhi, 1986.
4	Accident Prevention Manual for Industrial Operations”,N.S.C.Chicago, 1982

Course Designers

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17MEEC18	ADVANCED IC ENGINES	Category	L	T	P	Credit
		EC(PS)	3	0	0	3

Preamble

Upon completion of this course the students can be able to compare the operation of different IC engines and the components and can evaluate the pollutant formation- control and also about the different Alternative fuels available along with the recent trends developed in the Automobile engines.

Prerequisite

THERMAL ENGINEERING (17MECC07)

Course Objective

1	To learn about the combustion phenomenon in spark ignition engines.
2	To learn about the combustion phenomenon in compression ignition engines and Turbocharger.
3	To learn the causes, effects and control of pollutants from an Internal Combustion engine.
4	To provide the knowledge of alternate fuels in Internal Combustion engines.
5	To impart the knowledge on recent developments in Internal Combustion engines.

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

CO1.	Retrieve the knowledge of engine operation and performance	Remember
CO2.	Examine the combustion phenomenon of SI and CI engine and auxiliary systems.	Understand
CO3.	Illustrate the recent developments in Internal Combustion engines	Understand
CO4.	Distinguish the causes, effects and control of pollutants from an IC engine.	Understand
CO5.	Identify the uses of alternate fuels in Internal Combustion engines.	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	-	-	-	-	-	-	-	-	-	-	S	-	-
CO2	S	L	L	-	-	-	-	-	-	-	-	-	S	-	-
CO3	S	L	L	-	-	-	-	-	-	-	-	-	S	-	-
CO4	S	M	L	L	-	-	-	-	-	-	-	-	S	-	-
CO5	S	S	M	L	-	-	-	-	-	-	-	-	S	-	-

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, NOx Adsorbers 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

Lean Burn Engine, Air assisted Combustion, Homogeneous charge compression ignition engines – Variable Geometry turbochargers – Common Rail Direct Injection Systems – Hybrid Electric Vehicles –GDI Engine– Onboard Diagnostics.

Text Books

1	Ramalingam. K.K., "Internal Combustion Engine Fundamentals", Scitech Publications,
2	Ganesan, "Internal Combustion Engines", II Edition, TMH.

Reference Books

1	Mathur. R.B. and R.P. Sharma, "Internal Combustion Engines"., Dhanpat Rai & Sons.
2	Duffy Smith, "Auto Fuel Systems", The Good Heart Willcox Company, Inc., 1987. 3. Eric Chowenitz, "Automobile Electronics", SAE Publications.

Course Designers

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1	S.SANGEETHA	Associate Professor	MECH./ AVIT	sangeethas@avit.ac.in
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17MESE32	COMPOSITE MATERIALS	Category	L	T	P	C
		EC(PS)	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	Understand about Fibre reinforced Plastics
2	Understand the manufacturing processes of the composite materials
3	Analyse about macro mechanical behavior of FRP
4	Analyse about micromechanical behavior of composite materials
5	Understand about material models of composites

COURSE OUTCOMES

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

CO1 .Understand the types of reinforcements and fibers used in composite materials	Understand
CO2. Understand various manufacturing techniques in composite manufacturing	Understand
CO3. Analyse the macro mechanical behavior of Fiber Reinforced Plastics	Analyze
CO4. Analyse the Micro mechanical behavior of Fiber reinforced plastics	Analyze
CO5. Apply models for solving the composite material manufacturing	Apply

COS	PO 1	PO 2	PO 3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	**S**	-	**L**	-	-	**M**	**S**	-	-	-	-	-	**L**	-	
CO2	**S**	-	**L**	-	-	**L**	**S**	-	-	-	-	-	**L**	-	-
CO3	**S**	**S**	**S**	**S**	**L**	**L**	**S**	-	-	-	-	-	S	-	S
CO4	**S**	**S**	**S**	**S**	**L**	**L**	**S**	-	-	-	-	-	S	-	S
CO5	**S**	**S**	**S**	**S**	**S**	**L**	-	-	-	-	-	-	**S**	-	S

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
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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 apply the importance of Quality in industry
3	To apply the fundamentals of statistical concept in quality control
4	To analyze the phenomenon of various control charts
5	To apply 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	PO 1	PO 2	PO 3	PO4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO11	PO1 2	PSO1	PSO2	PSO3
CO1	M	M	L	L	-	-	-	-	-	-	-	-	L	-	-
CO2	M	M	L	L	-	-	-	-	-	-	-	-	L	-	-
CO3	S	L	M	L	-	-	-	-	-	-	-	-	L	-	-
CO4	S	L	L	L	-	-	-	-	-	-	-	-	L	-	-
CO5	S	M	M	L	-	-	-	-	-	-	-	-	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
2	J.Rabi	Associate Professor	Mechanical/VMKVEC	rabi@vmkvec.edu.in

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	Understand
CO2.	To understand the methods of Electric managements, Lightings	Understand
CO3.	To apply the concepts of boiler testing, steam distribution & thermal insulators	Apply
CO4.	To apply the techniques for Energy conservation in pumps, fans and Refrigeration	Apply
CO5.	To analysis the techniques for payback period, energy management & internal rate of Return	Analysis

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	-	-	-	-	-	-	-	-	L	-	-
CO2	S	L	L	L	-	-	-	-	-	-	-	-	L	-	-
CO3	S	M	M	M	-	-	-	-	-	-	-	-	L	-	-
CO4	S	M	M	M	-	-	-	-	-	-	-	-	L	-	-
CO5	S	M	M	M	-	-	-	-	-	-	-	-	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				
1	R.ANANDAN	ASSOCIATE PROFESSOR	Mechanical/ V.M.K.V Engineering College	anandan@vmkvec.edu.in
2	R.MAHESH	ASSISTANT PROFESSOR (GR-II)	Mechanical/AVIT	mahesh@avit.ac.in

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

THERMAL ENGINEERING

COURSE OBJECTIVES

1	To study on the hydrogen production methodologies, possible applications and various storage options.
2	To discuss on the working of a typical fuel cell and to elaborate on its thermodynamics and kinetics.
3	To make students understand the different fuel cells and their applications.
4	To analyze the cost effectiveness and eco-friendliness of Fuel Cells.

COURSE OUTCOMES

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

CO1. Retrieve hydrogen properties and its thermodynamic performance.	Remember
CO2. Known the Hydrogen production and working of fuel cells.	Understand
CO3. Known the different types of fuel cells and their applications.	Understand
CO4. Analyze the cost effectiveness and eco-friendliness of fuel cells.	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	PO1 1	PO1 2	PSO1	PSO 2	PSO3
CO1	S	M	L	L	-	-	-	-	-	-	-	-	L	-	-
CO2	S	M	L	M	-	-	-	-	-	-	-	-	M	-	M
CO3	M	S	M	M	L	-	-	-	-	-	-	-	S	-	M
CO4	S	M	S	M	M	M	S	-	-	-	M	-	S	M	M

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, 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).

3.

COURSE DESIGNERS

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1	R.CHANDRASEKAR	Assistant Professor	MECH / VMKVEC	chandrasekar@vmkvec.edu.in
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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	Identify hazards (ergonomic in nature) which are likely to cause occupational illnesses or injuries.
2	Indicate design and redesign tasks and workstations to fit employees.
3	Apply the knowledge, skills and abilities into an industrial based problem.
4	Develop and use of human factor data
5	Understand about human body structure and functions.

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

CO1.	understand accurately recognizing and evaluating hazards	Understand
CO2.	understand and redesign of tasks and workstations to fit employees	Understand
CO3.	Apply the skills in solving industrial based problems	Apply
CO4.	apply the knowledge and developing to used human factor data	Apply
CO5.	Understand 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		L
CO2	S	M											L		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
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17MESE18	METAL FORMING AND JOINING PROCESS	Category	L	T	P	Credit
		CC	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	Understand
CO2.	Explain the various forming processes and its application	Understand
CO3.	Apply basic knowledge on metal joining processes	Apply
CO4.	Experiment with various metal joining processes and its application	Apply
CO5.	Experiment with the welding of alloy steels and non-ferrous metals	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	S									L		
CO2	S		M										M		
CO3	S	L	L	L									S		
CO4	S		M	M									S		
CO5	S	L	L	M									M		

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 – process variables – 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 characteristic curves, flux covering, different types of electrodes and their applications, gas welding and cutting, 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 and chromium 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, 9th Edition ,ASM International
4. Baldev Raj,Shankar V,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, 7th Edition,AWS.

Course Designers

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1	S.ASHOKKUMAR	Asst.Professor G-II	Mech / Avit	ashokkumar@avit.ac.in

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	Understand about Design principles and analysis of statistical techniques
2	Apply single factor & multi factorial experiments
3	Analyze factorial designs
4	Analyze the Selection of orthogonal arrays
5	Apply the Principles of robust design

COURSE OUTCOMES

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

CO1 Understand the the various statistical techniques	Understand
CO2. Design and apply single factor & multi factorial experiments	Apply
CO3. Analyse the special designs in factorial experiments	Analyze
CO4. Analyse the design of orthogonal experiments	Analyze
CO5. Analyse the robust design and how to optimize those data	Apply

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	**S**	**S**	**S**	**M**	-	-	-	-	-	-	-	-	**S**	L	M
CO2	**S**	**S**	**S**	**M**	-	-	-	-	-	-	-	-	**S**	L	M
CO3	**S**	**S**	**S**	**M**	-	-	-	-	-	-	-	-	**S**	L	S
CO4	**S**	**S**	**S**	**M**	-	-	-	-	-	-	-	-	**S**	L	S
CO5	**S**	**S**	**S**	**M**	-	-	-	-	-	-		-	**S**	L	S

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

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ELECTIVE COURSES-
OPEN ELECTIVE

17ATEC12	FUEL CELL TECHNOLOGY	Category	L	T	P	C
		EC(PS)	3	0	0	3

Preamble

New energy sources being worked out for automotive engines to replace conventional methods of using liquid fuels. Fuel cells are one of the promising sources in the development of electric vehicles in the present scenario.

Prerequisite

Nil

Course Objectives

1	To impart knowledge of various Fuel cell Technology as an option for automotive energy source.
2	To describe the vehicle structure for a fuel cell based energy source.
3	To detail on the various hybrid electric technology.
4	To explain hybrid electric vehicles.

Course Outcomes:

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

CO1.	Summarize on the various modes of fuel cell technology for automotive.	Understand
CO2.	Recommend a suitable structure for a fuel cell vehicle.	Apply
CO3.	Appraise on technology for developing hybrid powered vehicles.	Apply
CO4.	Appraise on the electric vehicle technology and its development.	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	M	--	--	-	--	--	--	-	S	--	--
CO2	S	M	M	M	M	--	--	-	--	--	--	-	S	--	--
CO3	S	S	S	M	M	--	--	-	--	--	--	-	S	--	--
CO4	S	S	S	M	M	--	--	-	--	--	--	-	S	--	--

S- Strong; M-Medium; L-Low

Syllabus

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
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.
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.
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 BOOK:

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

REFERENCES:

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

CourseDesigners:

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17ATEC03	MODERN AUTOMOBILE ACCESSORIES	Category	L	T	P	C
		EC	3	0	0	3

Preamble

Automobile vehicles are being provided with lot of accessories as part of controlled operation and passenger safety and comfort. In that sense, it is mandatory to have an understanding of the different technological options available and its application.

Prerequisite

Nil

Course Objectives

1	To describe electronic engine management systems.
2	To explain the new methods of suspension systems applicable for modern day vehicles.
3	To detail the different options of vehicle air-conditioning.
4	To impart the various systems for accessories of an automobile in the present scenario.
5	To detail on the systems for passenger safety of an automotive

Course Outcomes:

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

CO1.	Elucidate electronic engine management system for an automotive.	Understand
CO2.	Appropriately choose a suspension based on the requirement of a modern day vehicle.	Apply
CO3.	Appraise a suitable air-conditioning system for an automotive	Apply
CO4.	Appropriately choose a perfect accessory for an automotive vehicle's requirement.	Apply
CO5.	Recommend a safety device for an automotive 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	M	M	--	--	--	-	--	--	--	-	S	--	--
CO2	S	M	M	M	--	--	--	-	--	--	--	-	S	--	--
CO3	S	S	S	M	--	--	--	-	--	--	--	-	S	--	--
CO4	S	S	S	M	--	--	--	-	--	--	--	-	S	--	--
CO5	S	S	S	M	--	--	--	-	--	--	--	-	S	--	--

S- Strong; M-Medium; L-Low

Syllabus

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 BOOK:

1. Bosch Hand Book, SAE Publication, 2010

REFERENCES:

1. Tom Denton - "Automobile Electrical and Electronic Systems" - Edward Arnold, London - 1995.
2. Eric Chowanietz - „Automotive Electronics" - SAE International USA - 1995.

CourseDesigners:

S.No	Name of the Faculty	Designation	Department/College	Mail ID
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3	M.Saravana Kumar	Assistant. Professor GRII	Auto / AVIT	saravanakumar@avit.ac.in
4	B. Samuvel Michael	Assistant. Professor GRII	Auto / AVIT	samuvelmichael@avit.ac.in

17ATEC02	NEW GENERATION AND HYBRID VEHICLES	Category	L	T	P	C
		EC	3	0	0	3

Preamble

To teach the students about the new generation and hybrid vehicles

Prerequisite

Nil

Course Objectives

1	To elucidate different modes of hybrid vehicles in current scenario.
2	To describe the different modes of power system for new generation vehicles .
3	To understand the operation and control of modern vehicle.
4	To detail the roads, highways and automated tracks for next generation automotive.
5	To explain the advanced technology in braking systems, suspension, aerodynamics and safety.

Course Outcomes:

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

CO1.	Discuss the various methods of developing hybrid vehicle technology available in the present scenario.	Understand
CO2.	Apply an appropriate power system for a new generation vehicle	Apply
CO3.	Apply a right choice of source of power for a modern vehicle	Apply
CO4.	Appraise about the roads, highways and automated tracks for next generation automotive.	Analyze
CO5.	Analyze and apply the exact method braking, suspension and safety .	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	--	--	--	-	--	--	--	-	S	--	--
CO2	S	M	M	M	--	--	--	-	--	--	--	-	S	--	--
CO3	S	M	M	M	M	--	--	-	--	--	--	-	S	--	--
CO4	S	S	S	S	S	--	--	-	--	--	--	-	S	--	--
CO5	S	S	S	S	S	--	--	-	--	--	--	-	S	--	--

S- Strong; M-Medium; L-Low

Syllabus

INTRODUCTION TO HYBRID ELECTRIC VEHICLES
History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.
HYBRID ELECTRIC DRIVE-TRAINS
Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Electric Drive-trains: 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 hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives
ENERGY STORAGE
Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Hybridization of different energy storage devices
SIZING THE DRIVE SYSTEM
Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power, selecting the energy storage technology,

TEXT BOOK:

1. Bosch Hand Book, SAE Publication, 2010
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003

REFERENCES:

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
2. Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.

CourseDesigners:

S.No	Name of the Faculty	Designation	Department/College	Mail ID
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4	B. Samuvel Michael	Assistant. Professor GRII	Auto / AVIT	samuvelmichael@avit.ac.in

17BTCC15	FOOD PROCESSING TECHNOLOGY	Category	L	T	P	Credit
		CC	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. Infer the role of microbes in food spoilage and food preservation	Apply
CO3. Illustrate all food processing methods and demonstrate its application in food product	Apply
CO4. Utilize the modern methods for foods preservation using biotechnology.	Apply
CO5. Inspect the packing methods, materials and factors affecting food packing.	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	M	-	-	L	M	L	-	-	-	-	-	-	-	-
CO2	M	M	M	M	L	L		-	-	-	-	-	M	-	-
CO3	M	M	M	L	M	S	M	-	-	-	-	-	-	-	M
CO4	S	S	S	S	S	M	L	-	-	-	-	-	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 intoxication.

FOOD SPOILAGE

Food Spoilage types & causes. Spoilage of foods and Shelf –life – Vegetables and fruits, Milk and milk products, meat and meat products, cereals and cereals products, Alcoholic beverages. Factors influencing food spoilage. Control of microbes in foods.

PROCESSING OF FOODS

Heating, boiling, oxidation, toxic inhibition, dehydration, drying-Yeast based products, Milk products, Jams and jellies, Pickles, Meat and meat products. Labeling Instructions.

INDUSTRIALIZATION/ MODERN FOOD PRESEVERVATION

Pasteurization, Vacuum packing, irradiation, bio preservation, Modified atmosphere packing, cryopreservation, Pickling, salting, drying, freezing, refrigeration. Food additives- Intentional and Nonintentional additives, Food colorants- natural and artificial, food flavours.

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	Dr.R.Subbaiya	Associate Professor	Biotechnology	subbaiya@avit.ac.in
2	Dr.M.Sridevi	Professor & Head	Biotechnology	sridevi@vmkvec.edu.in

17BTEC24	BIOFERTILIZER TECHNOLOGY	Category	L	T	P	Credit
		EC (PS)	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. Explain the types and importance of biofertilizer.	Understand
CO2. Outline in detail about the different chemical fertilizer, green manuring and its role in crop production	Understand
CO3. Identify the functions of microorganism from various sources and their mass production	Apply
CO4. Inspect in detail about the application and limitation of biofertilizer in crop field	Analyze
CO5. Examine the promotion and strategies improvement in distribution system.	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	M	L	-	L	-	-	L	-	-	-	L	L	-	-	-
CO2	S	M	S	-	-	-	S	-	-	-	L	L	-	-	-
CO3	M	-	M	M	-	-	M	-	-	-	L	-	-	-	-
CO4	L	-	-	L	-	-	S	-	-	-	-	-	-	-	-
CO5	S	M	L	L	-	-	-	-	-	-	L	S	M	-	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 (PS)	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: Outline the structure and cell theory of living organism.	Understand
CO2: Infer about the biological diversity of life.	Understand
CO3: Utilize the application of enzymes in industrial level.	Apply
CO4: Identify the uses of Bioremediation and Biosensors using molecular machines.	Apply
CO5: Analyse in detail about the principles of cell signalling in nervous system and immune system.	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	M	-	-	-	-	-	-	-	-	-	-	L	-	-	-
CO2	S	M	S	-	-	M	S	-	L	L	-	L	-	-	-
CO3	-	L	M	-	L	S	M	-	M	M	L	L	-	-	-
CO4	L	L	L	L	-	L	S	M	S	L	-	M	M	M	-
CO5	S	M	L	L	-	-	-	-	-	S	L	S	-	-	M

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 (PS)	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. Interpret the basic concepts and importance of Bioresource management	Understand
CO2. Explain the culturing process and various types of aquaculture.	Understand
CO3. Identify the scope and economic importance of vermiculture and sericulture.	Apply
CO4. Categorize the strategies on conservation and management of forest resource.	Analyze
CO5. Analyze the crop improvement technologies in the production of bioresource	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	LM	-	-	L	-	-	-	-	M	-	-	-
CO2	L	-	M	L	L	-	M	-	S	-	L	M	-	-	-
CO3	S	S	-	-	-	-	M	L	-	-	L	-	-	-	-
CO4	L	-	L	L	-	L	S	L	-	-	-	-	-	M	-
CO5	L	L	-	L	-	-	L	-	-	-	-	S	M	-	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" IstEdition 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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2	Mrs.R.Subashini	Assistant Professor	Biotechnology	subashini@vmkvec.edu.in

17BTEC31	APPLICATIONS OF ENZYME IN WASTE MANAGEMENT	Category	L	T	P	Credit
		EC (PS)	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	To outline 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. Illustrate and classify the different wastes in environment	Understand
CO2. Outline about the general waste management methods	Understand
CO3. Develop waste treatment using enzymes	Apply
CO4. Identify the basics of enzyme immobilization process	Apply
CO5.Analyze 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	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	-	-	-	-	-	-	-	-	-	-	-	-	M	-
CO2	M	M	-	-	-	-	M	-	-	-	-	-	-	-	-
CO3	M	M	-		L	-	-	S	-	-	-	S	-	-	-
CO4	M	M	-	-	S	-	L	-	-	-	-	-	M	-	-
CO5	M	M	L	L	S	S	-	L	-	-	-	-	M	-	M

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
1	Dr. A. Nirmala	Assistant professor (Gr-II)	Biotechnology	nimmi_aruna@yahoo.com
2	Ms.R.Subashini	Assistant Professor	Biotechnology	subashini@vmkvec.ac.in

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

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

S.No	Name of the Faculty	Designation	Name of the College	Mail ID
1.	Dr.S.P.Sangeetha	HOD-Civil	AVIT	sangeetha@avit.ac.in
2.	Mrs.Vaidevi	AP Fr II	AVIT	vaidevic@ avit.ac.in

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 the efficiencies of green buildings and construction processes of green buildings	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	-	-	-	-	-	-	-	-	-	-	L	-
CO2	S	M	L	M	-	-	-	-	-	-	-	-	-	L	L
CO3	S	M	M	L	-	-	-	-	-	-	-	-	M	M	L
CO4	S	M	M	M	-	-	-	-	-	-	-	-	-	M	M
CO5	S	M	L	-	-	-	-	-	-	-	-	L	-	M	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 CO2, SO2, and NO2 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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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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	-	-	-	-	-	-	-	-	-	-	-	-
CO2	S	M	L	S	-	-	-	-	-	-	-	-	L	M	-

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

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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17CVSE28	URBAN TRANSPORTATION INFRASTRUCTURE– PLANNING AND DESIGN	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

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 in an 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	-	-	-	-	-	-	-	-	-	-	L	-
CO2	S	-	L	S	-	-	-	-	-	-	-	-	-	L	M
CO3	S	-	M	S	-	-	-	-	-	-	-	-	L	L	M
CO4	S	M	-	-	-	-	-	-	-	-	-	-	L	L	L
CO5	S	M	M	-	-	-	-	-	-	-	-	L	L	L	M

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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2	Dr. D. S. Vijayan	Asso.Prof	AVIT	vijayan@avit.ac.in

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 knowledge about 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

17EEES03 -Basics of Electrical & Electronics EngineeringA. 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
CO29.	S	M	--	--	L								M	M	S
CO30.	S	S	M	--	--								M	M	M
CO31.	M	L	M	S	--								M	M	--
CO32.	S	S	--	M	--								M	M	M
CO33.	S	M	S	M	M						M	M	S	M	M

S- Strong; M-Medium; L-Low

Syllabus

Introduction

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 .

DC Drives

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.

AC Drives

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.

Solid State Drives and Speed Control of DC Drives

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.

Solid State Speed Control of AC Drives

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, 2016.

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 DESIGNERS

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1	Mr.G.Ramakrishnaprabu	Associate Professor	EEE/VMKVEC	ramakrishnaprabu@vmkvec.edu.in
2	Mr.N.P.Gopinath	Assistant Professor	EEE/AVIT	gopinathnp@avit.ac.in

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-NIL

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:Thebasic semiconductor physics to the properties of real power semiconductor devices and differentiate from low power devices.	Remember
CO2:Theconcepts 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**	**M**	**M**	**L**	L	-	L	L	L	L	L	L	S	-
CO2	**S**	**S**	**M**	**M**	**L**	-	M	-	-	-	-	-	M	M	-
CO3	**S**	**S**		**M**	**L**	M	M-	-	M	M	-	-	M	S	-
CO4	**S**	**S**	**S**	**M**	**S**	-	M	-	M	M	-	-	M	M	-
CO5	**M**	**S**	-	**M**	**S**	-	M	-	-	M	-	-	M	M	-
CO6	**M**	**S**	**M**	**S**	-	-	M	-	-	M	-	-	L	M	-
CO7	**M**	**M**	**M**	**S**	**M**	M	-	-	-	-	-	-	M	M	-

S- Strong; M-Medium; L-Low-

POWER SEMI-CONDUCTOR DEVICES

Overview of switching devices – Driver and snubber circuit of SCR TRIAC, GTO, IGBT, MOSFET – Computer simulation of PE circuits.

RECTIFIERS & CHOPPERS

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.

INVERTERS & AC - AC CONVERTERS

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.

ELECTRICAL DRIVES

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.

SOLID STATE DRIVES (QUALITATIVE TREATMENT ONLY)

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" Oxford University 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

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Mr.A.Balamurugan	Assistant Professor	EEE/VMKVEC	balamurugan@vmkvec.edu.in
2	Mr.N.P.Gopinath	Assistant Professor (Gr-II)	EEE/AVIT	Gopinathnp@avit.ac.in

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 - Nil

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. Illustrate various applications using advanced Microcontrollers.	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	-	-	-	-	-	-	M	S	-	-
CO2	S	S	S	-	M	-	-	-	-	-	-	M	-	-	-
CO3	S	M	M	-	M	M	-	-	-	-	-	M	M	-	-
CO4	S	S	M	-	M	M	-	-	-	-	-	M	M	M	-
CO5	S	M	S	-	M	M	-	-	-	-	-	M	S	M	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 - Nil

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.	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	L	L	-	L	-	-	-	-	-	-	M	S	-	-
CO2	L	S	S	-	M	-	-	-	-	-	-	M	-	-	-
CO3	S	M	M	-	L	M	-	-	-	-	-	M	M	-	M
CO4	S	L	L	-	L	S	-	-	-	-	-	M	M	M	M
CO5	M	M	S	-	M	L	-	-	-	-	-	M	-	M	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.
6. Qusay F. Hassan,'Internet of things a to z: technologies and applications' ,John Wiley and Sons Ltd,2018

COURSE DESIGNERS

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17ECEC06	MEMS AND SENSORS	Category	L	T	P	Credits
		EC (PS)	3	0	0	3

PREAMBLE

To gain basic knowledge on MEMS (Micro Electro Mechanical System). This enables them to design, analyze, fabricate and test the MEMS based components.

PREREQUISITE: Nil

COURSE OBJECTIVES

1	To understand the concepts of basic MEMS structures.
2	To learn about the various MEMS Sensors and its construction.
3	To learn about the micro machining products.
4	To understand the functioning of various optical MEMS Sensors.
5	To study the various applications of MEMS Sensors

Course Outcomes

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

CO1. Understand the basic fabrication of MEMS systems.	Understand
CO2. Design various MEMS sensors for required applications.	Apply
CO3.Apply the different micromachining process in MEMS sensor fabrication.	Apply
CO4. Analyze the light source utilization in MEMS sensors.	Analyze
CO5. Evaluate the various real time applications of MEMS Sensors.	Evaluate

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

S – Strong; M – Medium; L – Low

SYLLABUS

INTRODUCTION

MEMS and Microsystems, Typical products of MEMS and Microsystem products, Micro sensors, Micro actuator, Evolution of Micro fabrication, Microsystems and Microelectronics, MEMS materials.

MICRO SENSORS AND MICROSYSTEMS

Micro sensors- Acoustic wave sensors, Biomedical Sensors and Biosensors, Optical Sensors, Pressure sensors, Micro actuation- Actuation using Thermal Forces, Piezoelectric Crystals,

Electrostatic Forces, MEMS with Micro actuators- Micro grippers , Micro motors , Micro valves, Micro accelerometers.

PRINCIPLES OF MICROMACHINING

Introduction, Photolithography, Bulk Micromachining, Thin Film Deposition, Etching, surface Micromachining, LIGA

.

OPTICAL MEMS

Fundamental Principle of MOEMS Technology, Review Properties of Light, Light Modulators, Beam Spliotter, Micro lens, Micro mirrors, Digital Micro mirror Device (DMD),Light Detectors, Grating Light Valve, Optical Switch.

REAL TIME UTILISATION OF MEMS SENSORS

Health Care, Micro fluid Dispenser, Micro needle, Micro pumps, Chem-Lab-On-A-Chip(CLOC), E-Nose, DNA sensors, Surface Acoustic Wave(SAW) Sensors.

TEXT BOOKS:

1. Tai Ran Hsu," MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002. Liu,"MEMS", Pearson education, 2000.
2. N. P. Mahalik, "MEMS",Tata McGraw hill, Sixth reprint, 2012.

REFERENCE BOOKS:

1. Stephen Santeria," Microsystems Design", Kluwer publishers, 2000.
2. Nadim Maluf," An introduction to Micro electro mechanical system design", ArtechHouse, 2000.
3. Mohamed Gad-el-Hak, editor," The MEMS Handbook", CRC press Baco Raton, 2000

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17CSEC09	ETHICAL HACKING	Category	L	T	P	Credit
		EC	3	0	0	3

PREAMBLE
To analyze the basic concepts of security and hacking process

PREREQUISITE
NIL

COURSE OBJECTIVES

1	To understand Technical foundation of cracking and ethical hacking
2	To identify Aspects of security, importance of data gathering, foot printing and system hacking
3	To understand evaluation of computer security
4	To understand Practical tasks will be used to re-enforce and apply theory to encourage an analytical and problem based approach to ethical hacking
5	To discuss about security tools and its applications

COURSE OUTCOMES

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

CO1: Identify and analyse the stages an ethical hacker requires to take in order to compromise a target system.	Understand
CO2: Identify tools and techniques to carry out a penetration testing.	Understand
CO3: Critically analyze security techniques used to protect system and user data.	Apply
CO4: Demonstrate systematic understanding of the concepts of security at the level of policy and strategy in a computer system.	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	PSO1	PSO2	PSO3
CO1	M	M	-	-	-	-	S	-	-	-	M	M	M	M	M
CO2	M	M	S	M	-	-	-	-	-	-	L	M	M	M	S
CO3	M	M	M	M	-	M	-	L	-	-	L	-	S	S	M
CO4	M	S	M	-	-	M	-	-	-	M	-	M	M	M	M
CO5	M	M	-	-	S	M	-	L	-	-	M	M	M	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

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

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

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

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

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.

COURSE DESIGNERS

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17CSEC11	GREEN COMPUTING	Category	L	T	P	Credit
		EC	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
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: Explain the significance knowledge to adopt green computing practices	Understand
CO2: Design and develop the green asset used to minimize negative impacts on the environment	Apply
CO3: Identify an appropriate cooling technologies and infrastructure for optimizing the cost of data center operations	Apply
CO4: Make use of an knowledge about energy saving practices ,the impact of e-waste and carbon waste	Apply
CO5: Analyze about green compliance, implementation using IT and derive the case study.	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	-	-	-	-	-	**S**	S	-
CO2	S	S	M	-	L	-	S	S	-	M	-	M	M	S	-
CO3	S	M	M	-	-	M	S	M	-	-	-	-	M	M	M
CO4	S	S	-	-	-	-	S	S	-	M	-	M	M	M	-
CO5	S	M	M	-	-	S	M	-	M	-	M	S	M	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

FUNDAMENTALS

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

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

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, Systems Seamless Sharing Across. Collaborating and Cloud Computing, Virtual Presence.

GREEN COMPLIANCE

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

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
		EC	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: Analyze the open source project structure and how to successfully setup a project	Analyze
CO3 Apply the linux based user profile, file security, and file link and management.	Apply
CO4: Knowledge of free and open source tools like libre office, open office.	Apply
CO5: Apply the libre office- presentation like create, open, adding slide, text, background.	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	-	L	-	-	-	-	-	-	S	-	M	M
CO2	S	M	M	-	M	-	-	-	-	-	-	M	M	M	M
CO3	S	M	M	M	-	-	-	-	-	-	-	M	M	M	M
CO4	S	S	L	M	M	-	-	-	-	-	-	M	M	-	M
CO5	S	M	L	M	-	-	-	-	-	-	-	M	S	-	M

S- Strong; M-Medium; L-Low

SYLLABUS

OPEN SOURCE LICENSING

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

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

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

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

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.

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17CSEC32	VIRTUAL REALITY	Category	L	T	P	Credit
		EC	3	0	0	3

PREAMBLE
This course provides a detailed understanding of the concepts of Virtual Reality and its application.

PREREQUISITE
NIL

COURSE OBJECTIVES

1	To Learn Geometric modeling 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: Differentiate between Virtual, Mixed and Augmented Reality platforms.	Understand
CO2: Identify appropriate design methodologies for immersive technology development, especially from a physiological perspective.	Apply
CO3: Demonstrate foundational literacy in designing gaming systems	Apply
CO4: Categorize the benefits/shortcomings of available immersive technology platforms.	Analyze
CO5: To apply the VR concepts to various 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	L	-	M	-	-	-	-	-	-	M	**M**	M	M
CO2	S	M	L	L	M	-	-	-	-	-	-	L	**M**	M	M
CO3	S	M	L	-	M	-	-	-	-	-	-	M	**M**	M	M
CO4	S	L	L	L	M	-	-	-	-	-	-	M	**M**	M	M
CO5	S	M	L	-	M	-	-	-	-	-	-	L	**M**	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

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

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

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

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

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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17CSEC30	UNIX INTERNALS	Category	L	T	P	Credit
		EC	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.	Analyze
CO3: To analyze the UNIX system structure, system calls.	Analyze
CO4: To understand UNIX segmentation, scheduling, paging.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	S	M	L	L	M	-	-	-	-	-	-	M	-	-	M
CO2	S	M	L	L	M	-	-	-	-	-	-	M	**M**	-	M
CO3	S	M	L	-	L	-	-	-	-	-	-	M	**M**	-	M
CO4	S	M	L	L	M	-	-	-	-	-	-	M	**M**	-	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

General Review of the System-History-System structure-User Perspective-Operating System Services- Assumptions About Hardware. Introduction to the Kernel-Architecture System Concepts-Data Structures- System Administration

DISK BLOCKS

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

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

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

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

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