Faculty of Engineering and Technology

REGULATIONS 2017

Programme:

B.E PHARMACEUTICAL ENGINEERING

Full Time (4 Years)

STRUCTURED CHOICE BASED CREDIT SYSTEM (SCBCS)

CURRICULUM AND SYLLABUS

(Semester I to VIII)

PROGRAMME OUTCOMES

Engineering Graduates will be able to:

PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	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.
PO3	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.
PO4	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.
PO5	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.
PO6	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.
PO7	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.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	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.
PO11	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.
PO12	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.

PROGRAMME SPECIFIC OUTCOMES (PSOS)

Graduating Students of Pharmaceutical Engineering programme will be able to:

PSO1	To identify, formulate, design, analyze and develop processes and technologies for pharmaceutical products for societal usage and economically sustainable for the present and future.
PSO2	To assess the human health and environmental issues and provide various risk reduction methods as well as relevant professional mitigation measures.
PSO3	To function in a multi-disciplinary team and understand the professional ethics and responsibilities and equip themselves for higher learning for addressing technological challenges.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOS)

PEO1	To prepare students to gain the fundamentals and advances in the engineering and pharmaceutical principles and to enhance their skills to solve problems in engineering and technology, thus preparing them for a wide spectrum of career avenues in academia, research, and industries of pharmaceutical, biomedical, biotechnology, business, government and other pharmaceutical pursuits.
PEO2	To facilitate the students to understand simple and complex engineering and management principles, to enhance their communication and technical skills to work successfully as an individual, as a member/leader in a team and to manage projects in multidisciplinary environments.
PEO3	To provide collegial and nurturing environment for the students to realize the professional, ethical obligations and their concern to protect the health and welfare of the public and to be accountable for the social and environmental impact of their practice

Credit Requirement for the Course Categories

Sl. No.	Category of Courses	Credits to be earned Min – Max.
01	**A. Foundation Courses (FC)**	**54 - 63**
	i. Humanities and Sciences (English and Management Subjects)	12 – 21
	ii. Basic Sciences (Maths, Physics and Chemistry Subjects)	24 – 33
	iii. Engineering Sciences (Basic Engineering Courses)	18 - 27
02	**B. Core courses (CC) relevant to the chosen programme of study.**	**81**
03	**C. Elective Courses (EC)**	**18 - 27**
	i. Programme Specific (Class Room or Online)	12 – 15
	ii. Open (Class Room or Online)	6 - 9
04	**D. Project + Internship + Industry Electives (P + I + I)**	**18**
	i. Project	9
	ii. Internship / Industry Supported Courses	3
05	**E. Employability Enhancement Courses + Co - Curricular Courses + Extra Curricular Courses**	**9 - 18**
	Minimum Credits to be earned	**180**

**** - Mandatory, Credits would be mentioned in Mark sheets but not included for CGPA Calculations. For overall CGPA calculations, a student has to earn minimum 171 credits in Categories A to D.**

CURRICULUM

B.E. PHARMACEUTICAL ENGINEERING

SEMESTER I TO VIII

B.E –PHARMACEUTICAL ENGINEERING - SEMESTER I TO VIII									
CATEGORY A – FOUNDATION COURSES - HSS, BS AND ES COURSES - CREDITS (54-63)									
(i) HUMANITIES AND SCIENCES (ENGLISH AND MANAGEMENT SUBJECTS) - CREDITS (12 - 21)									
SL. NO	**CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1.	17EGHS01	TECHNICAL ENGLISH	ENGLISH	FC (HS)	3	0	0	3	NIL
2.	17EGHS02	BUSINESS ENGLISH	ENGLISH	FC (HS)	3	0	0	3	NIL
3.	17MBHS04	TOTAL QUALITY MANAGEMENT	MANAGEMENT	FC (HS)	3	0	0	3	NIL
4.	17EGHS81	ENGLISH LANGUAGE LAB	ENGLISH	FC (HS)	0	0	4	2	NIL
5.	17YMHS82	YOGA & MEDITATION	PHYSICAL EDUCATION	FC (HS)	0	0	4	2	NIL
6.	17EGHS82	PROFESSIONAL COMMUNICATION AND PERSONALITY DEVELOPMENT	ENGLISH	FC (HS)	0	0	2	1	NIL
(ii) BASIC SCIENCES (MATHS, PHYSICS AND CHEMISTRY SUBJECTS) - CREDITS (24 - 33)									
1.	17MABS03	MATHEMATICS FOR BIO-ENGINEERING	MATHS	FC (BS)	2	2	0	3	NIL
2.	17PCBS02	PHYSICAL SCIENCES	PHYSICS & CHEMISTRY	FC (BS)	4	0	0	4	NIL
3.	17MABS07	BIOSTATISTICS	MATHS	FC (BS)	2	2	0	3	MATHEMATICS FOR BIO-ENGINEERING
4.	17PHBS05	SMART MATERIALS	PHYSICS	FC (BS)	3	0	0	3	NIL
5.	17PHBS02	NANOTECHNOLOGY	PHYSICS	FC (BS)	3	0	0	3	NIL
6.	17CHBS10	FUNDAMENTALS OF CHEMISTRY	CHEMISTRY	FC (BS)	3	0	0	3	NIL
7.	17CHBS01	ENVIRONMENTAL SCIENCE AND ENGINEEIRNG	CHEMISTRY	FC (BS)	3	0	0	3	NIL
8.	17CHBS03	BIOORGANIC CHEMISTRY	CHEMISTRY	FC (BS)	3	0	0	3	NIL
9.	17PCBS81	PHYSICAL SCIENCES LAB	PHYSICS & CHEMISTRY	FC (BS)	0	0	4	2	NIL
10.	17CHBS81	BIOORGANIC CHEMISTRY LAB	CHEMISTRY	FC (BS)	0	0	4	2	NIL
(iii) ENGINEERING SCIENCES (BASIC ENGINEERING COURSES) - CREDITS (18 - 27)									
1.	17CSES01	ESSENTIALS OF COMPUTING	CSE	FC (ES)	3	0	0	3	NIL
2.	17CMES02	BASICS OF CIVIL AND MECHANICAL ENGINEERING	MECH/CIVIL	FC (ES)	4	0	0	4	NIL
3.	17CSES06	PROGRAMMING IN C	CSE	FC (ES)	3	0	0	3	NIL
4.	17MECC18	MANUFACTURING ENGINEERING	MECH	FC (ES)	3	0	0	3	NIL
5.	17BMES02	MEDICAL INSTRUMENTATION	BME	FC (ES)	3	0	0	3	NIL
6.	17CMES81	ENGINEERING SKILLS PRACTICE LAB	MECH/CIVIL	FC (ES)	0	0	4	2	NIL

7.	17CSES85	PROGRAMMING IN C LAB	CSE	FC (ES)	0	0	4	2	NIL
8.	17MECC94	MANUFACTURING ENGIINEERING LAB	MECH	FC (ES)	0	0	4	2	NIL

B.E. –PHARMACEUTICAL ENGINEERING- SEMESTER I TO VIII DETAILS OF CORE COURSES FOR DEGREE WITH SPECIALIZATION CATEGORY B – CORE COURSES RELEVANT TO THE PROGRAMME - CREDITS (81)									
SL. NO	**CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1.	17BTCC01	ESSENTIALS OF BIOCHEMISTRY	BTE	CC	3	0	0	3	NIL
2.	17BTCC02	CELL BIOLOGY	BTE	CC	3	0	0	3	NIL
3.	17BTCC03	MICROBIOLOGY	BTE	CC	3	0	0	3	NIL
4.	17PECC01	UNIT OPERATIONS IN PHARMA INDUSTRIES	PCE	CC	3	0	0	3	NIL
5.	17PECC02	PHYSICAL PHARMACEUTICS	PCE	CC	3	0	0	3	NIL
6.	17PECC03	FUNDAMENTALS OF HEAT AND MASS TRANSFER	PCE	CC	3	0	0	3	NIL
7.	17PECC04	HUMAN PHYSIOLOGY	PCE	CC	3	0	0	3	NIL
8.	17PECC05	MOLECULAR BIOLOGY AND GENETIC ENGINEERING	PCE	CC	3	0	0	3	CELL BIOLOGY
9.	17PECC06	ENZYME TECHNOLOGY	PCE	CC	3	0	0	3	NIL
10.	17PECC07	PHARMACEUTICAL ANALYSIS	PCE	CC	3	0	0	3	NIL
11.	17PECC08	PHARMACEUTICAL BIOPROCESS ENGINEERING	PCE	CC	3	0	0	3	ENZYME TECHNOLOGY
12.	17PECC09	TECHNOLOGY OF SOLID AND SEMISOLID DOSAGE FORMS	PCE	CC	3	0	0	3	NIL
13.	17PECC10	PHARMACEUTICAL CHEMISTRY	PCE	CC	3	0	0	3	NIL
14.	17PECC11	IMMUNOTECHNOLOGY (THEORY AND PRACTICE)	PCE	CC	2	0	2	3	NIL
15.	17PECC12	MEDICINAL CHEMISTRY	PCE	CC	3	0	0	3	FUNDAMENTALS OF CHEMISTRY
16.	17PECC13	PHARMACOLOGY	PCE	CC	3	0	0	3	HUMAN PHYSIOLOGY
17.	17PECC14	TECHNOLOGY OF STERILE PRODUCTS	PCE	CC	3	0	0	3	NIL
18.	17PECC15	DOWNSTREAM PROCESSING (THEORY AND PRACTICE)	PCE	CC	2	0	2	3	PHARMACEUTICAL BIOPROCESS ENGINEERING
19.	17PECC16	CHEMICAL ENGINEERING THERMODYNAMICS	PCE	CC	3	0	0	3	NIL
20.	17BTCC81	BIOCHEMISTRY LAB	BTE	CC	0	0	4	2	NIL
21.	17BTCC82	CELL BIOLOGY LAB	BTE	CC	0	0	4	2	NIL
22.	17BTCC83	MICROBIOLOGY LAB	BTE	CC	0	0	4	2	NIL
23.	17PECC81	PHYSICAL PHARMCEUTICS LAB	PCE	CC	0	0	4	2	NIL
24.	17PECC82	HUMAN PHYSIOLOGY LAB	PCE	CC	0	0	4	2	NIL

25.	17PECC83	MOLECULAR BIOLOGY AND GENETIC ENGINEERING LAB	PCE	CC	0	0	4	2	NIL
26.	17PECC84	PHARMACEUTICAL ANALYSIS LAB	PCE	CC	0	0	4	2	NIL
27.	17PECC85	PHARMACEUTICAL BIOPROCESS ENGINEERING LAB	PCE	CC	0	0	4	2	NIL
28.	17PECC86	PHARMACEUTICAL CHEMISTRY LAB	PCE	CC	0	0	4	2	NIL
29.	17PECC87	MEDICINAL CHEMISTRY& PHARMACOLOGY LAB	PCE	CC	0	0	4	2	NIL
30.	17PECC88	TECHNOLOGY OF DOSAGE FORMS LAB	PCE	CC	0	0	4	2	NIL
31.	17PECC89	CHEMICAL ENGINEERING THERMODYNAMICS LAB	PCE	CC	0	0	4	2	NIL

B.E PHARMACEUTICAL ENGINEERING - SEMESTER I TO VIII
DETAILS OF ELECTIVE COURSES FOR DEGREE WITH SPECIALISATION

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

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

SL. NO	CODE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1.	17PEEC01	NUTRACEUTICALS	PCE	EC (PS)	3	0	0	3	NIL
2.	17PEEC02	TECHNOLOGY OF FINE CHEMICALS AND BULK DRUGS	PCE	EC (PS)	3	0	0	3	NIL
3.	17PEEC03	SAFETYAND HEALTH EVALUATION	PCE	EC (PS)	3	0	0	3	NIL
4.	17BTEC04	DIAGNOSTICS AND THERAPEUTICS	BTE	EC (PS)	3	0	0	3	MICROBIOLOGY
5.	17PEEC04	FUNDAMENTALS OF POLYMER SCIENCE AND ENGINEERING	PCE	EC (PS)	3	0	0	3	NIL
6.	17PEEC05	CREATIVITY, INNOVATION AND NEW FOOD PRODUCT DEVELOPMENT	PCE	EC (PS)	3	0	0	3	NIL
7.	17BTEC03	PRINCIPLES OF BIOINFORMATICS	BTE	EC (PS)	3	0	0	3	NIL
8.	17PEEC06	BIOPHARMACEUTICS AND PHARMACOKINETICS	PCE	EC (PS)	3	0	0	3	NIL
9.	17PEEC07	HERBAL TECHNOLOGY	PCE	EC (PS)	3	0	0	3	NIL
10.	17PEEC08	CHEMISTRY OF NATURAL PRODUCTS	PCE	EC (PS)	3	0	0	3	FUNDAMENTALS OF CHEMISTRY
11.	17PEEC09	BIOSIMILARS AND BIOGENERICS	PCE	EC (PS)	3	0	0	3	NIL
12.	17PEEC10	PHARMACOGENOMICS	PCE	EC (PS)	3	0	0	3	PRINCIPLES OF BIOINFORMATICS
13.	17PEEC11	BIOCONJUGATE TECHNOLOGY AND APPLICATIONS	PCE	EC (PS)	3	0	0	3	NIL
14.	17PEEC12	FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT	PCE	EC (PS)	3	0	0	3	NIL
15.	17PEEC13	PHARMACOVIGILANCE	PCE	EC (PS)	3	0	0	3	NIL
16.	17PEEC14	CHEMICAL REACTION ENGINEERING	PCE	EC (PS)	3	0	0	3	NIL
17.	17PEEC15	REGULATORY TOXICOLOGY	PCE	EC (PS)	3	0	0	3	NIL
18.	17PEEC16	TRANSPORT PHENOMENA	PCE	EC (PS)	3	0	0	3	CHEMICAL ENGINEERING THERMODYNAMICS
19.	17BTEC22	MOLECULAR MODELLING AND DRUG DESIGNING	BTE	EC (PS)	3	0	0	3	PRINCIPLES OF BIOINFORMATICS
20.	17PEEC17	PRODUCT DEVELOPMENT AND TECHNOLOGY TRANSFER	PCE	EC (PS)	3	0	0	3	NIL

21.	17PEEC18	INSTRUMENTATION AND PROCESS CONTROL	PCE	EC (PS)	3	0	0	3	NIL
22.	17PEEC19	CLINICAL RESEARCH AND REGULATIONS	PCE	EC (PS)	3	0	0	3	NIL
23.	17PEEC20	INTRODUCTION TO BIOMATERIALS AND TISSUE ENGINEERING	PCE	EC (PS)	3	0	0	3	NIL
24.	17PEEC21	PHARMACOECONOMICS	PCE	EC (PS)	3	0	0	3	NIL

(ii) OPEN ELECTIVE (CLASS ROOM OR ONLINE) - CREDITS (6 - 9)									
1.	17CSCC02	OBJECT ORIENTED PROGRAMMING	CSE	EC (OE)	3	0	0	3	NIL
2.	17CSCC07	OPERATING SYSTEM	CSE	EC (OE)	3	0	0	3	NIL
3.	17CSCC09	JAVA PROGRAMMING	CSE	EC (OE)	3	0	0	3	NIL
4.	17CSCC16	CLOUD COMPUTING	CSE	EC (OE)	3	0	0	3	NIL
5.	17CSCC17	CYBERSECURITY	CSE	EC (OE)	3	0	0	3	NIL
6.	17CSEC30	UNIX INTERNALS	CSE	EC (OE)	3	0	0	3	NIL
7.	17CSEC34	WEB DESIGN AND MANAGEMENT	CSE	EC (OE)	3	0	0	3	NIL
8.	17CSES05	PROGRAMMING IN PYTHON	CSE	EC (OE)	3	0	0	3	NIL
9.	17CSPI07	LEARNING IT ESSENTIALS BY DOING	CSE	EC (OE)	3	0	0	3	NIL
10.	17CSPI10	MOBILE APPLICATION DEVELOPMENT	CSE	EC (OE)	3	0	0	3	NIL
11.	17BTCC15	FOOD PROCESSING TECHNOLOGY	BTE	EC (OE)	3	0	0	3	NIL
12.	17BTEC01	PLANT AND ANIMAL DISEASES AND THEIR CONTROL	BTE	EC (OE)	3	0	0	3	MICROBIOLOGY
13.	17BTEC31	APPLICATIONS OF ENZYME IN WASTE MANAGEMENT	BTE	EC (OE)	3	0	0	3	NIL
14.	17BMEC01	MEDICAL OPTICS	BME	EC (OE)	3	0	0	3	NIL
15.	17BMEC02	BIOTELEMETRY	BME	EC (OE)	3	0	0	3	NIL
16.	17BMCC03	BIOSENSORS AND TRANSDUCERS	BME	EC (OE)	3	0	0	3	NIL
17.	17BMEC04	MEMS AND ITS BIOMEDICAL APPLICATIONS	BME	EC (OE)	3	0	0	3	NIL
18.	17BMEC09	DESIGN OF MEDICAL DEVICES	BME	EC (OE)	3	0	0	3	NIL
19.	17BMCC10	MEDICAL IMAGE PROCESSING AND ANALYSIS	BME	EC (OE)	3	0	0	3	NIL
20.	17BMEC22	MEDICAL ETHICS AND STANDARDS	BME	EC (OE)	3	0	0	3	NIL
21.	17BMSE23	MEDICAL WASTE MANAGEMENT	BME	EC (OE)	3	0	0	3	NIL
22.	17BMSE24	MEDICAL TECHNOLOGY AND ENTREPRENEURSHIP	BME	EC (OE)	3	0	0	3	NIL
23.	17CVEC35	MUNICIPAL SOLID AND WASTE MANAGEMENT	CIVIL	EC (OE)	3	0	0	3	NIL
24.	17CVEC14	AIR POLLUTION MANAGEMENT	CIVIL	EC (OE)	3	0	0	3	NIL
25.	17CVEC06	HYDROLOGY	CIVIL	EC (OE)	3	0	0	3	NIL
26.	17CVEC07	DISASTER MITIGATION AND MANAGEMENT	CIVIL	EC (OE)	3	0	0	3	NIL

27.	17CVEC08	REMOTE SENSING TECHNIQUES AND APPLICATIONS	CIVIL	EC (OE)	3	0	0	3	NIL
28.	17EEEC18	RENEWABLE ENERGY TECHNOLOGY	EEE	EC (OE)	3	0	0	3	NIL
29.	17EEEC20	MATHEMATICAL MODELLING AND SIMULATION	EEE	EC (OE)	3	0	0	3	NIL
30.	17EEEC21	NON-CONVENTIONAL ENERGY SOURCES	EEE	EC (OE)	3	0	0	3	NIL
31.	17ECEC06	MEMS AND SENSORS	ECE	EC (OE)	3	0	0	3	NIL
32.	17ECEC23	MACHINE VISION	ECE	EC (OE)	3	0	0	3	NIL
33.	17ATEC18	ALTERNATIVE FUELS	AUTO	EC (OE)	3	0	0	3	NIL
34.	17ATEC02	NEW GENERATION AND HYBRID VEHICLES	AUTO	EC (OE)	3	0	0	3	NIL
35.	17AREC03	UNMANNED AIRCRAFT SYSTEMS	AERO	EC (OC)	3	0	0	3	NIL
36.	17MECC16	INDUSTRIAL AUTOMATION	MECH	EC (OE)	3	0	0	3	NIL
37.	17MESE03	HYDROGEN AND FUEL CELL TECHNOLOGY	MECH	EC (OE)	3	0	0	3	NIL
38.	17MESE05	WASTE ENERGY CONVERSION TECHNOLOGIES	MECH	EC (OE)	3	0	0	3	NIL
39.	17MESE06	BIO ENERGY TECHNOLOGY	MECH	EC (OE)	3	0	0	3	NIL

B.E. –PHARMACEUTICAL ENGINEERING - SEMESTER I TO VIII									
CATEGORY D – PROJECT + INTERNSHIP + INDUSTRY ELECTIVES (P + I + I)- CREDITS (18)									
SL. NO	**CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1	17PEPI01	PROJECT	PCE	PI	0	0	18	9	NIL
(ii) INTERNSHIP + INDUSTRY ELECTIVES - CREDITS (9)									
SL. NO	**CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1.	17PEPI02	MINI PROJECT	PCE	PI	0	0	6	3	NIL
2.	17PEPI03	VACCINE TECHNOLOGY	PCE	PI	3	0	0	3	NIL
3.	17PEPI04	PHARMACEUTICAL PACKAGING TECHNOLOGY	PCE	PI	3	0	0	3	NIL
4.	17PEPI05	REGULATORY REQUIREMENTS IN PHARMA INDUSTRIES	PCE	PI	3	0	0	3	NIL
5.	17BTPI06	WASTE MANAGEMENT	BTE	PI	3	0	0	3	NIL
6.	17BTPI07	PROCESS ECONOMICS AND INDUSTRIAL MANAGEMENT	BTE	PI	3	0	0	3	NIL

B.E. –PHARMACEUTICAL ENGINEERING - SEMESTER I TO VIII

CATEGORY E – EMPLOYABILITY ENHANCEMENT COURSES, CO - CURRICULAR COURSES AND EXTRA CURRICULAR COURSES (EEC) - CREDITS (9 - 18)**

(- MANDATORY, CREDITS WOULD BE MENTIONED IN MARK SHEETS BUT NOT INCLUDED FOR CGPA CALCULATIONS.)**

(i) EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SL. NO	CODE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1.	17APEE01	PERSONALITY SKILLS DEVELOPMENT – I	MATHS	EE	2 WEEKS OF TRAINING			1	NIL
2	17APEE02	PERSONALITY SKILLS DEVELOPMENT – II	ENGLISH & MANAGEMENT	EE	2 WEEKS OF TRAINING			1	NIL
3	17PEEE01	TECHNICAL SKILLS –I	PCE	EE	2 WEEKS OF TRAINING			1	NIL
4	17PEEE02	TECHNICAL SKILLS –II	PCE	EE	2 WEEKS OF TRAINING			1	NIL
5	17PEEE03	TECHNICAL SKILLS –III	PCE	EE	2 WEEKS OF TRAINING			1	NIL
6	17PEEE04	TECHNICAL SKILLS–IV	PCE	EE	2 WEEKS OF TRAINING			1	NIL
7	17PEEE05	TECHNICAL SKILLS –V	PCE	EE	2 WEEKS OF TRAINING			1	NIL

(ii) CO - CURRICULAR COURSES (CCC)

1.	17APEE03	NCC	NCC	EE	2 WEEKS OF TRAINING IN NCC CAMP		1	NIL
2.	17APEE04	NSS	NSS	EE	2 WEEKS OF SOCIAL SERVICE IN NSS CAMP		1	NIL
3.	17APEE05	SPORTS AND GAMES (INTER –UNIVERSITY LEVEL)	PHYSICAL EDUCATION	EE			1	NIL
4.	17APEE06	SPORTS AND GAMES (INTRA-UNIVERSITY LEVEL)	PHYSICAL EDUCATION	EE			2	NIL
5.	17APEE07	SPORTS AND GAMES (STATE AND NATIONAL LEVELS)	PHYSICAL EDUCATION	EE			2	NIL

(iii) EXTRA CURRICULAR COURSES (ECC)

1.	17PEEE06	EXTRA CURRICULAR COURSE – I	PCE	EE	15 HOURS		1	NIL
2.	17PEEE07	EXTRA CURRICULAR COURSE – II	PCE	EE	15 HOURS		1	NIL
3.	17PEEE08	EXTRA CURRICULAR COURSE – III	PCE	EE	15 HOURS		1	NIL
4.	17PEEE09	EXTRA CURRICULAR COURSE – IV	PCE	EE	15 HOURS		1	NIL

5.	17PEEE10	EXTRA CURRICULAR COURSE – V	PCE	EE	15 HOURS	1	NIL
6.	17PEEE11	MASSIVE OPEN ONLINE COURSES (MOOCs) - I	PCE	EE	30 HOURS	2	NIL
7.	17PEEE12	MASSIVE OPEN ONLINE COURSES (MOOCs) - II	PCE	EE	30 HOURS	2	NIL
8.	17PEEE13	MASSIVE OPEN ONLINE COURSES (MOOCs) - III	PCE	EE	45 HOURS	3	NIL

FOR DEGREE WITH SPECIALISATION

CATEGORY C –

PROGRAMME SPECIFIC ELECTIVE COURSES

CREDITS (12 - 15)

SPECIALIZATION – PHARMACEUTICAL MANUFACTURING

SPECIALIZATION – PHARMACEUTICAL MANUFACTURING									
1.	17PESE01	NOVEL DRUG DELIVERY SYSTEMS	PCE	EC (SE)	3	0	0	3	NIL
2.	17PESE02	COSEMETIC TECHNOLOGY	PCE	EC (SE)	3	0	0	3	NIL
3.	17PESE03	VALIDATION IN PHARMACEUTICAL INDUSTRIES	PCE	EC (SE)	3	0	0	3	NIL
4.	17PESE04	PHARMACEUTICAL PROCESS DESIGN	PCE	EC (SE)	3	0	0	3	NIL
5.	17PESE05	QUALITY BY DESIGN	PCE	EC (SE)	3	0	0	3	NIL
6.	17PESE06	QUALITY ASSURANCE	PCE	EC (SE)	3	0	0	3	NIL
7.	17PESE07	MOLECULAR PHARMACEUTICS	PCE	EC (SE)	3	0	0	3	NIL
8.	17PESE08	ADVANCED INDUSTRIAL PHARMACY	PCE	EC (SE)	3	0	0	3	NIL
9.	17PESE09	NOVEL DRUG DELIVERY SYSTEMS LAB	PCE	EC (SE)	0	0	4	2	NIL
10.	17PESE10	COSEMETIC TECHNOLOGY LAB	PCE	EC (SE)	0	0	4	2	NIL
11.	17PESE11	VALIDATION IN PHARMACEUTICAL INDUSTRIES LAB	PCE	EC (SE)	0	0	4	2	NIL

CURRICULUM

SEMESTER I

VINAYAKA MISSION'S RESEARCH FOUNDATION
(DEEMED TO BE UNIVERSITY, SALEM)
AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY, CHENNAI
&
VINAYAKA MISSION'S KIRUPANANDA VARIYAR ENGINEERING COLLEGE, SALEM
FACULTY OF ENGINEERING AND TECHNOLOGY
STRUCTURED CHOICE BASED CREDIT SYSTEM

BOARD : BIOTECHNOLOGY
REGULATION : 2017
PROGRAM : B.E., – PHARMACEUTICAL ENGINEERING (FULL TIME - REGULAR)

CURRICULUM AND SYLLABUS

SEMESTER – I									
S.NO	**COURSE CODE**	**COURSE TITLE**	**OFFERING DEPARTMENT**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
THEORY									
1	17EGHS01	TECHNICAL ENGLISH	ENGLISH	FC(HS)	3	0	0	**3**	NIL
2	17MABS03	MATHEMATICS FOR BIO-ENGINEERING	MATHS	FC(BS)	2	2	0	**3**	NIL
3	17PCBS02	PHYSICAL SCIENCES	PHYSICS & CHEMISTRY	FC(BS)	4	0	0	**4**	NIL
4	17CSES01	ESSENTIALS OF COMPUTING	CSE	FC(ES)	3	0	0	**3**	NIL
5	17CMES02	BASICS OF CIVIL AND MECHANICAL ENGINEERING	CIVIL & MECH	FC(ES)	4	0	0	**4**	NIL
PRACTICAL									
6	17EGHS81	ENGLISH LANGUAGE LAB	ENGLISH	FC(HS)	0	0	4	**2**	NIL
7	17PCBS81	PHYSICAL SCIENCES LAB	PHYSICS & CHEMISTRY	FC(BS)	0	0	4	**2**	NIL
8	17CMES81	ENGINEERING SKILLS PRACTICE LAB	CIVIL & MECH	FC(ES)	0	0	4	**2**	NIL
9	17YMHS82	YOGA & MEDITATION	PHYSICAL EDUCATION	FC(HS)	0	0	4	**2**	NIL
TOTAL					**15**	**2**	**18**	**25**	
L – LECTURE HOUR T – TUTORIAL HOUR P – PRACTICAL HOUR C – CREDIT									

HS	HUMANITIES AND SOCIAL SCIENCES	CC	CORE COURSES
BS	BASIC SCIENCES	EC	ELECTIVE COURSES
ES	ENGINEERING SCIENCES	SE	SPECIALISATION ELECTIVES
PI	PROJECT + INTERNSHIP + INDUSTRY ELECTIVES	EE	EMPLOYABILITY ENHANCEMENT COURSES + EXTRA CURRICULAR COURSES + CO - CURRICULAR COURSES

SYLLABUS

SEMESTER I

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

PREAMBLE

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**	**S**	**S**	**M**
CO2	**L**	**M**	**-**	**L**	**M**	**M**	**S**	**-**	**L**	**S**	**S**	**S**	**M**	**S**	**M**
CO3	**M**	**L**	**L**	**M**	**-**	**-**	**L**	**L**	**L**	**M**	**S**	**S**	**M**	**M**	**S**
CO4	**-**	**M**	**-**	**-**	**-**	**M**	**M**	**-**	**L**	**S**	**-**	**S**	**S**	**S**	**S**
CO5	**M**	**M**	**-**	**M**	**M**	**M**	**S**	**M**	**L**	**S**	**M**	**S**	**S**	**S**	**S**
CO6	**M**	**-**	**M**	**-**	**-**	**M**	**-**	**-**	**-**	**-**	**S**	**M**	**M**	**M**	**S**

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	Mail ID
1.	Dr.P.Saradha / Associate Professor - English	saradhap@vmkvec.edu.in
2	Mr.S.K.PremKishor/Assistant.Prof-English	Prem.english@avit.ac.in

17MABS03	MATHEMATICS FOR BIO-ENGINEERING	Category	L	T	P	Credit
		FC (BS)	2	2	0	3

PREAMBLE

This course offers the knowledge of solving basic problems involving rates of change of variables subject to a functional relationship, to solve optimization problems, to find the area under curves and the area between curves, to develop skills and knowledge of standard concepts in ordinary differential equations, to design data collection plans, analyze data appropriately and interpret and draw conclusions from those analyses.

PREREQUISITE

-

COURSE OBJECTIVES

1	To improve their ability in solving geometrical applications of differential calculus problems.
2	To develop the knowledge in integral calculus.
3	To enable the students to solve ordinary differential equations.
4	To get the single value that describes the characteristic of the entire group and to analyze variation of items from the central value.
5	To correlate two or more variables, one needs simple, multiple and partial correlations and suitable interpretation.

COURSE OUTCOMES

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

CO1. Apply the concept of differentiation in functions of single and several variables.	Apply
CO2. Apply the methods to find area and volume.	Apply
CO3. Apply knowledge of Ordinary differential equations in biological processes.	Apply
CO4. Apply statistics in conducting the experiments about the plants and animals.	Apply
CO5. Apply the concept of correlation and regression in computational biology.	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	--
CO2	S	S	M	--	M	--	--	--	--	--	--	--	M	M	--
CO3	S	S	M	--	M	--	--	--	--	--	--	--	M	M	--
CO4	S	S	M	S	M	--	--	--	--	--	--	--	S	S	M
CO5	S	S	M	S	M	--	--	--	--	--	--	--	S	S	M

S- Strong; M-Medium;L-Low

SYLLABUS

DIFFERENTIAL CALCULUS: Ordinary Differentiation – Basic Concepts – Slope – Maxima, Minima of a

function of a single variable – Second order derivates – Partial Differentiation– maxima and minima of a function of two variables.

INTEGRATION: Concept of integration-Integration of Rational and Trigonometric functions – Using Partial Fractions – Substitutions – Integration by parts.

ORDINARY DIFFERENTIAL EQUATIONS: Formation of differential equations – Solution of first order equation – Variable separable and solution of Linear differential equation of the form – Linear Second Order ordinary differential equation with constant coefficients (exp(ax) , cosax, sinax).

STATISTICS: Measure of central value – Average – Type of average – Arithmetic; Mean, Median, Mode – Measures of Dispersion – Measure of Skewness and Kurtosis – measure of Skewness based on Moments.

CORRELATION AND REGRESSION ANALYSIS: Correlation analysis – methods of correlation. Regression analysis – Regression equation – Multiple and partial correlation – Notations – Equation of regression plane (Three variables) – Multiple correlation coefficients – Partial Correlation coefficients

TEXT BOOKS:

1. Grewal, B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi (2012).
2. S.P. Gupta, "Statistical Methods", 34th Edition, Sultan Chand & Sons Publishers (2006).

REFERENCES:

1. Kreyszig, E., "Advanced Engineering Mathematics", 8th Edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore (2012).
2. Ewans&G.Grant, "Statistical Methods in Bio informatics – An Introduction", (2005).

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Name of the College	Mail ID
1	Dr.L.Tamilselvi	Professor	AVIT	ltamilselvi@avit.ac.in
2	Dr.P.Sasikala	Professor	VMKVEC	sasikalap@vmkvec.edu.in

17PCBS02	PHYSICAL SCIENCES PART A - ENGINEERING PHYSICS	Category	L	T	P	Credit
		FC(BS)	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		
CO2	S		L									M			
CO3	S			M			M					M			
CO4	S	M		M	M	S	M					M	S		M
CO5	S	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., ArunMurthy.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
		FC (BS)	2	0	0	2

Preamble

Objective of this course is to present a better understanding of basic concepts ofchemistry 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
CO7.	S	S	M	-	-	M	M	M	-	-	-	M	M	M	-
CO8.	S	S	M	-	-	M	S	M	-	-	-	M	M	M	-
CO9.	S	-	-	-	L	L	M	L	-	-	-	S	-	M	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
4.	Dr.K.Sanghamitra	Associate Professor	Chemistry	sanghamitra.chemistry@avit.ac.in

17CSES01	ESSENTIALS OF COMPUTING	Category	L	T	P	Credit
		ES	3	0	0	3

PREAMBLE

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

PRERQUISITE – Nil

COURSE OBJECTIVES

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

COURSE OUTCOMES

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

CO1. To understand the Basic knowledge on hardware and software terminologies.	Understand
CO2. To Demonstrate the various Application Packages like MS-word, MS- Excel etc.	Apply
CO3.To Understand Program Devolvement Cycle and apply various Problem Solving Techniques.	Apply
CO4.To analyze the efficiency of Algorithms.	Analyze
CO5.To Implement of Algorithms for various concepts.	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
CO2	S	M	M	-	M	-	-	-	-	-	-	M	M	M	M
CO3	S	S	S	-	M	-	-	-	-	-	-	-	-	-	-
CO4	S	S	S	-	S	-	-	-	-	-	-	-	-	M	M
CO5	S	M	M	-	M	-	-	-	-	-	-	S	-	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

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

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

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

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

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

TEXT BOOKS:

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

REFERENCES:

1. Aho.A.V., Hopcroft.J.E and Ullman.J.D, "The Design and Analysis of Computer Algorithms", Pearson Education, 2004.
2. Knuth D.E., "The Art of computer programming Vol 1: Fundamental Algorithms", 3rd Edition, Addison Wesley, 1997.

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1	K.Karthik	Assistant Professor	CSE	karthik@avit.ac.in
2	Mrs.T.Geetha	Assistant Professor	CSE	geetha@vmkvec.edu.in

17CMES02	**BASICS OF CIVIL AND MECHANICAL ENGINEERING PART -A BASICS OF CIVIL ENGINEERING (Common to CIVIL, MECHANICAL, CSE, ECE, EEE, S&AE & MECT)**	Category	L	T	P	Credit
		FC(ES)	**2**	**0**	**0**	**2**

Preamble

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

Prerequisite

Nil

Course Objectives

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

Course Outcomes

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

CO1. Describe the scientific terms related to surveying and construction materials.	Apply
Co2. Familiarize with the different components of building and forces acting on them.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

Syllabus

UNIT - I	**SURVEYING AND CIVIL ENGINEERING MATERIALS**	**15 - hours**
Surveying: Objects – types – classification – principles – measurements of distances – angles – levelling – determination of areas – illustrative examples. **Civil Engineering Materials:** Bricks – stones – sand – cement – concrete – steel sections.		

UNIT - II	BUILDING COMPONENTS AND STRUCTURES	15 - hours

Foundations: Types, Bearing capacity – Requirement of good foundations.

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

Text Books

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

Reference Books

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

Course Designers:

S.No.	Name of the Faculty	E-Mail ID
1.	S.SUPRIYA	jansupriyanair@gmail.com
2.	C.VAIDEVI	Vaidevi.c@avit.ac.in

17CMES02	BASICS OF CIVIL AND MECHANICAL ENGINEERING B-BASICS OF MECHANICAL ENGINEERING	Category	L	T	P	Credit
		FC(ES)	2	0	0	2

Preamble

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

Prerequisite –NIL

Course Objective

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

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

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

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

Syllabus

FOUNDRY AND WELDING

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

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

AUTOMOTIVE ENGINES AND COMPONENTS

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

Text Books

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

Reference Books

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

Course Designers

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

2	M.Saravanakumar	Asst. Prof	Mech /AVIT	saravanakumar@avit.ac.in

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

PREAMBLE

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

PREREQUISITE: NIL

COURSE OBJECTIVES

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

COURSE OUTCOMES

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

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

MODULEI: Ice Breaker, Grouping, Listening- (Hearing and listening)- Active Listening- Passive Listening – Listening to a song and understanding- (fill in the blanks) Telephone Conversation

MODULE II: Influence of mother tongue, videos, understanding nuances of English language (video) puzzle to

solve, Activity.

MODULE III:Why is English important, Communication skills, TED (video) Communication in different scenario – a case study, ingredients of success, Activity – chart, speak the design, feedback on progress, Group wise, Individual.

MODULE IV: Telephone Etiquette, Dining Etiquette, Meeting Etiquette.

MODULE V: Case study of Etiquette in different scenario.

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.PremKishor	Assistant Professor	English	Prem.english@avit.ac.in

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

CO10.	Recognize the importance of units while performing the experiments, calculating the physical parameters and obtaining results	Understand
CO11.	Operate the equipments with precision	Apply
CO12.	Practice to handle the equipments in a systematic manner	Apply
CO13.	Demonstrate the experiments through virtual laboratory	Apply
CO14.	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
		FC(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
CO15.	S	M	M	-	L	M	M	S	-	-	-	M	S	M	S
CO16.	S	M	M	-	L	M	M	L	-	-	-	M	S	M	S
CO17.	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 byVinayaka Mission's Research Foundation, Salem.

REFERENCE BOOKS

1. Laboratory Manual on Engineering Chemistry, K. Bhasin S, DhanpatRai 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

17CMES81	ENGINEERING SKILLS PRACTICE LAB PART A - BASIC CIVIL ENGINEERING (Common to All Branches)	Category	L	T	P	Credit
		FC(ES)	0	0	2	1

PREAMBLE

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

PREREQUISITE

Nil

COURSE OBJECTIVES

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

COURSE OUTCOMES

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

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	S	L	L	L	L	L	L	L	L	L	L	L	-	S	-
CO2	S	S	S	L	L	L	L	L	L	L	L	L	L	-	M

S- Strong; M-Medium; L-Low

SYLLABUS

Buildings:

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

Plumbing Works:

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

Carpentry using Power Tools only:

7. Study of the joints in roofs, doors, windows and furniture.

Hands-on-exercise: Wood work, joints by sawing, planning and cutting.

TEXT BOOK

1. Basic civil engineering Lab Manual by Department of Civil Engineering,VMRF.

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Name of the College	Mail ID
1	M.Senthilkumar	Asst.Professor	Civil / VMKVEC	senthilkumar@vmkvec.edu.in
2	Dr.D.S.Vijayan	Asst. Professor	Civil / AVIT	vijayan@avit.ac.in

17CMES81	ENGINEERING SKILLS PRACTICE LAB B. BASIC MECHANICAL ENGINEERING	Category	L	T	P	Credit
		FC(ES)	0	0	2	1

Preamble

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

Prerequisite –NIL

Course Objective

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

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

CO1.	Identify the different types of fitting using MS plate.	Apply
CO2.	Predict the different types of joints using wooden material	Apply
CO3.	Utilize the different types of joining process in metal by Arc Welding	Apply
CO4.	Make use of different types of green sand mould	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

Syllabus

LIST OF EXPERIMENTS

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

Text Books

1	**BASIC MECHANICAL ENGINEERING, LAB MANUAL**

Reference Books

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

Course Designers

S.No	Faculty Name	Designation	Department / Name of the College	Email id
1	Dr. V. K. Krishnan	Associate Professor	Mech / VMKVEC	vkkrishnan@vmkvec.edu.in

2	B.SELVA BABU	Assistant Professor	Mech/AVIT	selvababu@avit.ac.in

CURRICULUM

SEMESTER II

VINAYAKA MISSION'S RESEARCH FOUNDATION
(DEEMED TO BE UNIVERSITY, SALEM)
AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY, CHENNAI
&
VINAYAKA MISSION'S KIRUPANANDA VARIYAR ENGINEERING COLLEGE, SALEM
FACULTY OF ENGINEERING AND TECHNOLOGY
STRUCTURED CHOICE BASED CREDIT SYSTEM

BOARD : BIOTECHNOLOGY
REGULATION : 2017
PROGRAM :B.E., – PHARMACEUTICAL ENGINEERING (FULL TIME - REGULAR)

CURRICULUM AND SYLLABUS

SEMESTER – II									
S.NO	**COURSE CODE**	**COURSE TITLE**	**OFFERING DEPARTMENT**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
THEORY									
1	17MABS07	BIOSTATISTICS	MATHS	FC(BS)	2	2	0	**3**	17MABS03 Mathematics for Bio-Engineering
2	17CSES06	PROGRAMMING IN C	CSE	FC(ES)	3	0	0	**3**	NIL
3	17BTCC02	CELL BIOLOGY	BTE	CC	3	0	0	**3**	NIL
4	17PHBS05	SMART MATERIALS	PHYSICS	FC(BS)	3	0	0	**3**	NIL
5	17BTCC01	ESSENTIALS OF BIOCHEMISTRY	BTE	CC	3	0	0	**3**	NIL
PRACTICAL									
6	17CSES85	PROGRAMMING IN C LAB	CSE	FC(ES)	0	0	4	**2**	NIL
7	17BTCC81	BIOCHEMISTRY LAB	BTE	CC	0	0	4	**2**	NIL
8	17BTCC82	CELL BIOLOGYLAB	BTE	CC	0	0	4	**2**	NIL
TOTAL					**14**	**2**	**12**	**21**	
L – LECTURE HOUR T – TUTORIAL HOUR P – PRACTICAL HOUR C – CREDIT									

HS	HUMANITIES AND SOCIAL SCIENCES	CC	CORE COURSES
BS	BASIC SCIENCES	EC	ELECTIVE COURSES
ES	ENGINEERING SCIENCES	SE	SPECIALISATION ELECTIVES
PI	PROJECT + INTERNSHIP + INDUSTRY ELECTIVES	EE	EMPLOYABILITY ENHANCEMENT COURSES + EXTRA CURRICULAR COURSES + CO - CURRICULAR COURSES

SYLLABUS

SEMESTER II

17MABS07	BIOSTATISTICS (Statistical table permitted for Examination)	Category	L	T	P	Credit
		FC(BS)	2	2	0	3

PREAMBLE

Biostatistics is the application of statistical methods in studies in biology by collection of data, analysis and interpretation of data. The data come from a wide range of sources, including genomic studies, experiments with cells and organisms, and clinical trials. Testing of hypothesis is a Statistical procedure to draw inferences from samples about population. Statistical Quality control is a method of quality control, which employs statistical methods to monitor and control a process. This helps ensure the process operates efficiently, producing more specification-conforming product. Acceptance sampling allows measuring the quality of a batch of products by selecting a specified number of products for testing.

PREREQUISITE

Mathematics for Bio-Engineering (17MABS03)

COURSE OBJECTIVES

1	Develop skills in presenting quantitative data using appropriate diagrams, tabulations and summaries
2	Gain fundamental knowledge of the probability conceptswith respect to how they are applied to the fundamental interpretation of statistical data.
3	To acquire knowledge of Testing of Hypothesisuseful in making decision and test them by means of the measurements made on the sample.
4	To get exposed to the statistical methods designed to contribute to the process of making scientific judgments in the face of uncertainty and variation.
5	To understand the concept of Quality control and the use of operating characteristic (OC) curves in Acceptance sampling.

COURSE OUTCOMES

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

CO1. Plan a statistical data investigation in the biosciences and related fields, and propose a method for data collection and analysis.	Apply
CO2. Apply probability rules and probability models to solve problems and translate real-world problems into probability models. Identify and recognize the appropriate sample survey design for related problems.	Apply
CO3. Identifyand perform statistical significance tests for small, large samples and interpret the test results appropriately.	Analyze
CO4. Interpret results from Analysis of Variance (ANOVA), a technique used to compare means amongst more than two independent populations.	Analyze
CO5. Prepare Control charts and decide on the in-control status of the process. Estimate whether a lot is acceptable or unacceptable based on acceptance sampling plans.	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	M	--	--	--	--	--	--	M	S	M	--
CO2	S	S	M	S	M	--	--	--	--	--	--	M	S	M	--
CO3	S	S	S	S	S	--	--	--	--	--	--	S	S	S	S
CO4	S	S	S	S	S	--	--	--	--	--	--	S	S	S	S

CO5	S	S	S	S	S	--	--	--	--	--	--	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO BIOSTATISTICS : Statistics – Definition, Scope, Limitation – Collection of data – Primary & Secondary Data; Classification & Tabulation of data – Type of Classification & Tabulation – Diagrammatic and Graphical representation of data – Types and significance.

PROBABILITY AND SAMPLING: Probability – Definition – Measurement & Law of Probability – Conditional Probability – Baye's Theorem – Probability Distributions – Application of Probability. Sampling: Method of Sampling – Random and Non-Random Sampling – Merits and Demerits, Limitation of sampling.

TESTING OF HYPOTHESIS: Sampling distributions – Statistical hypothesis – Testing of hypothesis for mean, variance, proportions using Normal, t and F distributions. Chi-square Tests for independence of attributes and Goodness of fit.

DESIGN OF EXPERIMENTS: Analysis of variance – One way and Two way classifications – Completely randomized design – Randomized block design.

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

TEXT BOOKS:

1. S.P. Gupta, "Statistical Methods", 34th Edition, Sultan Chand & Sons Publishers (2006).
2. P.N.Arora, P.K.Malhan, "Biostatistics", Himalaya Publishing House (2010).

REFERENCES:

1. Milton.J.S, "Statistical Methods in Biological & Health Science", McGraw Hill, New York (1992).
2. S.S.Sundar Rao, J.Richard, "Introduction to Biostatistics and Research Methods", 5th Edition, Prentice-Hall of India Pvt. Ltd (2016).

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	College	Mail ID
1	Dr.P.Sasikala	Professor	VMKVEC	sasikalap@vmkvec.edu.in
2	Dr.L.Tamilselvi	Professor	AVIT	ltamilselvi@avit.ac.in

17CSES06	PROGRAMMING IN C	Category	L	T	P	Credit
		ES	3	0	0	3

PREAMBLE

This is a course offered in first semester for the students of Bio-Tech Engineering. This course has three credits dedicated to provide the students a strong foundation on programming concepts and its application. It also enables the students to solve problems using programmable logic.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To introduce Basics of C.
2	To understand Control Structures & Arrays.
3	To learn String concept, Structure and Union in C.
4	To understand the concepts of Functions and Pointers.
5	To understand Memory and File management concepts in C.

COURSE OUTCOMES

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

CO1: Understand the basics of C Data types, scope of variables, different types of Operators	Understand
CO2: Apply the concept of Input/ Output functions, Decision making and Loop structures in C programming	Apply
CO3: Demonstrate the C programs for string, arrays, union & structure.	Apply
CO4: Develop C programs for functions and pointers	Apply
CO5: Apply the file management concept to develop the C programs.	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	-	S	-	-	-	M	-	S	M	S	-	-
CO2	S	M	M	-	S	-	-	-	M	-	S	S	S	-	M
CO3	S	M	M	-	S	-	-	-	M	-	S	S	S	-	M
CO4	S	M	M	-	S	-	-	-	M	-	S	S	S	-	M
CO5	S	M	M	-	S	-	-	-	M	-	S	S	S	-	M

S- Strong; M-Medium; L-Low

SYLLABUS

BASICS OF C

Identifiers, variables, expression, keywords, data types, constants, scope of variables. Operators: arithmetic, logical, relational, conditional and bitwise operators – Special operators: size of ( ) & comma (,) operator – Precedence and associatively of operators – Type conversion in expressions.

CONTROL STRUCTURES

Basic input/output and library functions: Single character input/output i.e. getch( ), getchar( ), getche( ), putchar( ) – Formatted input/output:
printf( ) and scanf( ) – Library functions (mathematical and character functions). Decision Making and Branching – Looping statements.

ARRAYS, STRING, STRUCTURE & UNION

Arrays – Initialization – Declaration – One dimensional and two dimensional arrays. Strings: Declaration – Initialization and string handling functions. Structure and Union: structure declaration and definition – Accessing a Structure variable – Structure within a structure – Union.

FUNCTIONS AND POINTERS

Function – Function Declaration – function definition – Pass by value – Pass by reference – Recursive function – Pointers – Definition – Initialization

MEMORY AND FILE MANAGEMENT

Static and dynamic memory allocation – Storage class specifier – Preprocessor directives. File handling concepts – File read – write – Functions for file manipulation: fopen, fclose, gets, puts, fprintf, fscan, getw, putw, fputs, fgets, fread, fwrite.

TEXT BOOKS

1.Balaguruswami. E, “Programming in C”, TMH Publications, 1997

REFERENCES

1. Behrouz A. Forouzan & Richard F. Gilberg, “Computer Science A Structured Programming using C”, Cengage Learning, 3rd Edition, 2007.
2. Gottfried, “Programming with C”, schaums outline series, TMH publications, 1997.
3. Mahapatra , “Thinking in C”, PHI publications, 2nd Edition, 1998.
4. Subbura.R , “Programming in C”, Vikas publishing, 1st Edition, 2000

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1	Mr.B.Sundaramurthy	Associate Professor	CSE	sundaramurthy@ vmkvec.edu.in
2	Mr.K.Karthik	Assistant Professor	CSE	karthik@avit.ac.in

17BTCC02	CELL BIOLOGY	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Cell biology deals with the structures, organization and functions of the cells and organelles, their physiological properties, life cycle, metabolic processes, signalling pathways and their interactions with their environment at microscopic and molecular level. The subject helps to gain knowledge in fundamentals of cells to all biological sciences, for research in bio-medical fields such as cancer, and other diseases and also in research related to genetics, biochemistry, molecular biology, immunology, and developmental biology.

PRERQUISITE – NIL

COURSE OBJECTIVES

1	To understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles
2	Students will understand how these cellular components are used to generate and utilize energy in cells and the concepts behind cell division.
3	To give an overview of cell signaling molecules and their receptors.
4	To outline the pathways and intracellular signal transduction
5	To make students to apply their knowledge of cell biology to selected examples of changes or losses in cell function

COURSE OUTCOMES

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

CO1. Differentiate fundamental features of prokaryotic and eukaryotic cells, their structure, composition and role of cell membranes and the major stages of the cell cycle	Understand
CO2. To infer the specific processes and proteins involved in membrane transport	Understand
CO3. To illustrate about intercellular chemical messengers, receptor subclasses and their possible uses in cell signalling.	Apply
CO4. To examine the mechanisms by which different messenger-receptor interactions bring about long or short-term changes in cell state.	Analyze
CO5. To analyze and characterize the cell, cell line and culture techniques	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	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	M	-	-	M	-	-	-	-	-	-	-	-	-	-	-
CO3	M	-	-	-	S	-	M	-	-	-	-	-	-	-	-
CO4	M	M	M	M	M	-	-	-	-	-	-	-	M	M	-
CO5	M	M	M	-	S	M	-	-	-	-	-	M	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

CELL AND FUNCTIONS OF THE ORGANELLES

General structure – Prokaryotic and eukaryotic cell, Molecular organization of the cell membrane, Cell membrane – Proteins, Lipids and Carbohydrates, Cell organelles, Cytoskeletal proteins, Types of cell functions, Cell cycle - Mitosis and meiosis, apoptosis.

CELL MEMBRANE AND PERMEABILITY

Passive and active transport, Permeases, Sodium potassium pump, Ca2+, AT Pase pumps, Lysosomal and vacuolar membrane, Co-transport, Uniport, Symport, Antiport, Protein localization & Membrane trafficking, Endocytosis and exocytosis, Entry of viruses and toxins into cells.

CELL SIGNALING MOLECULES AND THEIR RECEPTORS

Cytosolic, Nuclear and membrane bound receptors, Examples of receptors, Modes of cell – cell signaling: Autocrine, Paracrine and Endocrine models of action, Secondary messenger's molecules, Quantitation and characterization of receptors.

PATHWAYS AND INTRACELLULAR SIGNAL TRANSDUCTION

Signal amplification – Different models of signal amplifications, Cyclic AMP, Role of inositol phosphates as messengers, Biosynthesis of inositol triphosphates, Cyclic GMP and G proteins role in signal transduction, Calcium ion flux and its role in cell Signaling, Current models of signal amplification, Phosphorylation of protein kinases.

CELL CULTURE

Techniques for the propagation of prokaryotic and eukaryotic cells, Cell line, Generation of cell lines, Maintenance of stock cells, Characterization of cell, Morphological analysis techniques in cell culture, Explant cultures, Primary cultures, Contamination, Differentiation.

TEXT BOOKS:

1. De Robertis E.D.P and De Robertis E.M.F, "Cell and Molecular Biology", 8th Edition, Lippincott Williams & Wilkins, New York, USA, 2001.
2. Harvey Lodish, Arnold Berk, Chirs A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher, HiddePloegh and Paul Matsudaira, "Molecular Cell Biology", 6th Edition, W. H. Freeman and Company, New York, 2008.

REFERENCES:

1. B Alberts, A Johnson, J Lewis, M Raff, K Roberts and P Walter, "Molecular Biology of the Cell", (4th Edition) New York: Garland Science, 2002.
2. Kimball, T.W., "Cell Biology', Addision Wesley Publishers, 1989.
3. Geoffrey M. Cooper and Robert E. Hansman, "The Cell: A Molecular Approach", ASM Press and Sinauer Associates Inc., USA, 4th Edition, 2007.
4. Ian Freshney, R, "Culture of Animal Cells", Alan R. Liss Inc., New York, 4th Edition, 2005

COURSE DESIGNERS

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1	Mrs.C.Nirmala	Assistant Professor	Biotechnology	nirmala@vmkvec.edu.in
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17PHBS05	SMART MATERIALS	Category	L	T	P	Credit
		FC (BS)	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			
CO2	S	M	S	M	S				M			M			M
CO3	S	S	S	S	S				S			M	M	M	
CO4	S	M	S	M	S				M			M	M	M	
CO5	M	S	S	M	M				S			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, 2009.

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

COURSE DESIGNERS

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3	Dr .G. LATHA	Professor	Physics	latha.physics@avit.ac.in
4	Dr. R. N. VISWANATH	Professor	Physics	viswanath.physics@avit.ac.in

17BTCC01	ESSENTIALS OF BIOCHEMISTRY	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Essentials of biochemistry deals with the study of biomolecules found in living organism. The course exposes the students to classification, properties, basic structure and functions of biomolecules like carbohydrate, amino acid, lipids, nucleic acid and vitamins. Knowledge of this course will enable students to understand the importance of biomolecules and give awareness to the various diseases associated with the deficiency of biomolecules.

PRERQUISITE - NIL

COURSE OBJECTIVES

1	To understand the basic structure and properties of carbohydrate, lipids, amino acids and nucleic acids
2	To emphasize the functional importance and role of biomolecules in living orgaisms
3	To illustrate the nutritional importance of Minerals.
4	To illustrate the nutritional importance of Vitamins and its deficiency diseases.

COURSE OUTCOMES

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

CO1. Recall the classification, properties and structure of carbohydrates, lipids, amino acids and protein	Remember
CO2. Discuss the biological importance of biomolecules and its nutritional value.	Understand
CO3. Identify about the structures of amino acids, proteins and Nucleic acids.	Understand
CO4. Correlate the vitamins and its deficiency diseases	Apply
CO5. Illustrate the minerals and its deficiency diseases	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO02	PSO3
CO1	M	-	L	-	-	-	-	-	-	-	-	-	-	-	-
CO2	M	-	M	-	-	-	-	-	-	-	-	-	-	-	-
CO3	M	-	M	-	-	-	-	-	-	-	-	-	-	-	-
CO4	S	L	M	S	-	L	-	-	-	-	-	L	M	S	M
CO5	S	L	M	S	-	M	-	-	-	-	-	L	M	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

CARBOHYDRATE

Biological importance, Classification and Properties of Monosaccharides, Disaccharides and Polysaccharides (Starch, Glycogen, Cellulose and their derivatives, Chitin, Peptidoglycans, Glycoaminoglycans, Glycoconjugates).

LIPIDS

Biological importance, Classification. Fattyacids: classification, nomenclature, structure and properties of saturated and unsaturated fatty acids. Essential fatty acids, Triacylglycerols: nomenclature, physical properties, chemical properties. Glycerophospholipids (lecithins, cephalins, phosphatidyl serine, phosphatidyl inositol, sphingomyelins).

AMINO ACIDS AND PROTEINS

Amino acids – Classification, Structure, Properties and Biological importance. Proteins – Classification, Structural organization of Proteins – Primary, Secondary (α-helix, β-pleated structure, triple helix), Tertiary and Quaternary (Myoglobin and Hemoglobin), Factors stabilizing, Properties and Biological importance, Denaturation and Renaturation.

NUCLEIC ACIDS

Nucleosides and nucleotides, configuration and conformation, Composition of RNA and DNA, Physico-chemical properties of nucleic acids – effect of alkali, acid and heat (denaturation and renaturation), features of phosphodiester bond, endonucleases. Complementary base pairing, secondary structure of RNA, features of DNA double helix (Watson-Crick model), Nucleoproteins – histone and nonhistone

VITAMINS

Nutritional importance of vitamin, classification, source, daily requirements and functions, Deficiency symptoms – hypervitaminosis of fat soluble vitamins. Nutritional importance of Minerals – classification, source, daily requirement and deficiency symptoms.

TEXT BOOKS

1. "Fundamentals of Biochemistry", Jain J.L., Sunjay Jain and Nitin Jain., S.Chand& Company Ltd., 6th Edition, 2005.

REFERENCES:

1. "Text Book of Biochemistry for Medical Students", AmbikaShanmugham, Lippincott Williams & Wilkins, 7th Edition, 2012.
2. "Biochemistry", Rastogi S.C. Mc. Graw-Hill Publishing Company Ltd, 6th Edition, 2007.
3. "Principles of Biochemistry", David L. Nelson and Michael M. Cox, W. H. Freeman and Company, 4th Edition, 2005.
4. "Text book of Biochemistry", Sathyanarayana U and Chakrapani U., Uppala Author Publishers Interlinks, 3rd Edition, 2006.

COURSE DESIGNERS

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2	Dr.B.Prabasheela	Associate Professor	Biotechnology	prabasheela@avit.ac.in

17CSES85	PROGRAMMING IN C LAB	Category	L	T	P	Credit
		ES	0	0	4	2

PREAMBLE

This course is designed to complement the course Problem Solving using Computer. The purpose of this laboratory course is to give hands on training to the students in understanding and practicing the programming concepts and algorithms. This will improve the problem solving capability of the students.

PREREQUISITE NIL

COURSE OUTCOMES

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

CO1 Write, compile, debug, link and execute C program for the given specification/application	Apply
CO2. Design and implement algorithms involving decision structures, loops, arrays and pointers.	Apply
CO3. Use different data structures for solving the given problem using computer	Apply
CO4. Create/update data files.	Apply
CO5. Analyze the implementation complexity of algorithm by modularizing the problem into small modules for the given problem	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

LIST OF EXPERIMENTS

1. Basic programs to understand different types of data, operators and expressions.
2. Programs using control structures
   - i) Factorial of a number
   - ii) Fibonacci series
   - iii) Generating prime numbers
   - iv) Generating Armstrong numbers
   - v) Greatest common divisor
3. Programs using arrays
   - i) Merging of arrays
   - ii) Array order reversal
   - iii) Selection sort
   - iv) Bubble sort
   - v) Insertion sort
4. Programs using strings
   - i) Palindrome checking
   - ii) String sorting
   - iii) Linear pattern search
   - iv) Text line editing

5. Programs using functions 6. Programs using pointers 7. Programs using structures 8. Programs using file structure

COURSE DESIGNERS

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1	Mr. B. Sundharamurthy	Associate Professor	CSE	sundharamurthy@vmkvec..edu.in
2	Mr K.Karthik	Assistant Professor	CSE	karthik@avit.ac.in

17BTCC81	BIOCHEMISTRY LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

The course is a laboratory course that focuses on developing the skills of the students by providing hands on training in various techniques in Biochemistry

PREREQUISITE - NIL

COURSE OBJECTIVES

1.	To Understand laboratory safety and standard operating procedures of common laboratory equipment's.
2.	To impart skills in preparation of solutions and biological buffers.
3.	To extend knowledge in analysis & estimation of biomolecules

COURSE OUTCOMES

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

CO1. Observe safe laboratory practices and handle the equipment safely	Understand
CO2. Prepare solutions and biological buffers	Apply
CO3. Estimate the quantity of lipids	Analyze
CO4. Separate biomolecules from various source	Analyze
CO5. Determine the quality and quantity of biomolecules	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	-	-
CO2	S	M	M	-	-	-	-	-	-	-	-	-	-	-	-
CO3	S	M	M	M	M	-	-	-	-	-	-	-	M	M	-
CO4	S	M	M	-	M	-	-	-	-	-	-	-	S	-	-
CO5	S	M	M	M	M	-	-	-	-	-	-	-	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

1. pH measurements and Buffer preparations.

TITRIMETRIC EXPERIMENTS

2. Estimation of Ascorbic acid by Titrimetric method using 2, 6 Dichloro phenol indophenols.
3. Determination of Saponification value of Edible oil
4. Determination of Acid number of Edible oils.
5. Determination of Iodine value of Oil.

BIOCHEMICAL PREPARATIONS

6. Isolation of Chloroplast from Spinach leaves.
7. Cheese Production from Milk.
8. Casein from Milk.
9. Starch from Potato.

REFERENCES:

1. Laboratory Manual.

COURSE DESIGNERS

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2	Dr.R.Subbaiya	Associate Professor	Biotechnology	subbaiya@avit.ac.in

17BTCC82	CELL BIOLOGY LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

To offer hands on training in the areas of cell culture, cell identification and to demonstrate various techniques to learn the morphology, identification and propagation of cells.

PREREQUISITE - NIL

COURSE OBJECTIVES

1.	Demonstrate working principles of microscopy
2.	Perform the basic techniques to work with cells.
3.	Differentiate the cells by staining techniques.
4.	Categorize the various stages of mitosis.
5.	Differentiate the types of blood cells.

COURSE OUTCOMES

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

CO18.	Demonstrate the basic concepts of sterilization techniques	Understand
CO19.	Interpret the behaviour of cells in their microenvironment	Understand
CO20.	Analyze scientific work and experimental results in cell biology	Analyse
CO21.	Categorize the cell organelles	Analyse
CO5.	Illustrate physiological processes of cell e.g. cell divisions	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	M	-	-	-	-	-	-	-	-	-	-	M	-	-
CO2	M	L	-	-	-	-	-	-	-	-	-	-	-	M	-
CO3	M	S	M	L	S	-	-	-	-	-	-	M	M	M	-
CO4	M	M	M	-	M	-	-	-	-	-	-	-	-	-	-
CO5	M	S	M	-	M	-	-	-	-	-	-	-	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

1. Introduction to principles of sterilization techniques and cell propagation.
2. Principles of Microscopy.
3. Isolation of Cell organelle – Mitochondria, Microtubules, Actin and Myosin filaments.
4. Cell Fractionation – Separation of peripheral blood mononuclear cells from blood.
5. Cell staining - Gram's staining, Leishman staining
6. Cell counting - Tryphan blue assay, Alamar blue assay.
7. Osmosis and Tonicity.
8. Staining for different stages of mitosis in *Allium cepa* (Onion).

REFERENCES

1. Rickwood, D. and J.R. Harris "Cell Biology: Essential Techniques", Johnwiley, 1996.
2. Davis, J.M. "Basic Cell Culture: A Practical Approach", IRL, 1994

COURSE DESIGNERS

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2	Dr.G.Karthigadevi	Assistant Professor	Biotechnology	karthigadevi@avit.ac.in

SYLLABUS
SEMESTERS
III TO VIII

CATEGORY ‘A’

FOUNDATION COURSES – HS, BS AND ES COURSES

(i) HUMANITIES AND SCIENCES (ENGLISH AND MANAGEMENT COURSES)

17EGHS02	BUSINESS ENGLISH	Category	L	T	P	Credit
		FC(HS)	3	0	0	3

PREAMBLE

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

PREREQUISITE: NIL

COURSE OBJECTIVES

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

COURSE OUTCOMES

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**		**M**
CO3	**L**	**M**				**M**		**L**		**S**	**L**	**M**		**M**	**M**
CO4		**L**	**M**	**M**			**L**	**M**	**M**	**S**	**L**	**M**	**M**		
CO5				**M**				**M**	**L**	**S**		**L**			
CO6		**L**		**M**		**L**	**L**			**S**		**S**			

S- Strong; M-Medium; L-Low

SYLLABUS

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

STRESS: Stress (Word Stress and Sentence Stress) Intonation- Difference between British and American English

Vocabulary-Indianism-Compound Words (including Technical Terminology).

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

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

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

TEXT BOOK

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

REFERENCE BOOKS

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
		FC(HS)	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	M	M	M
CO2	M	-	-	-	L	L	-	L	M	M	-	L	-	S	M
CO3	S	S	M	S	S	-	-	L	-	L	-	L	M	-	L
CO4	L	M	S	L	M	-	L	-	L	M	L	M	L	M	L
CO5	L	L	M	-	L	M	S	S	M	L	L	M	M	M	S

S- Strong; M-Medium; L-Low

SYLLABUS:

INTRODUCTION

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

TQM PRINCIPLES

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

STATISTICAL PROCESS CONTROL (SPC)

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

TQM TOOLS

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

QUALITY SYSTEMS

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

TEXT BOOKS:

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

REFERENCES:

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

COURSE DESIGNERS:

S.No	Name of the Faculty	Designation	Department	Mail ID	

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17EGHS82	PROFESSIONAL COMMUNICATION AND PERSONALITY DEVELOENT	Category	L	T	P	Credit
		FC(HS)	0	0	2	1

PREAMBLE

To develop students with good presentation and writing skills (Professionally & technically). Articulate and enunciate words and sentences clearly and effectively. Develop proper listening skills. Understand different writing techniques and styles based on the communication being used.

PREREQUISITE: NIL

COURSE OBJECTIVES

1	To develop communication and personality skills.
2	To improve Aptitude skills, train to improve self-learning / researching abilities, presentation skills & technical writing.
3	To improve students employability skills.
4	To develop communication and problem solving skills.
5	To develop professional with idealistic, practical and moral values.
6	To produce cover letters, resumes and job application strategies.

COURSE OUTCOMES

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

CO1. Improve students their vocabulary and use them in appropriate situation	Understand
CO2. Demonstrate effective use of team work skills to complete given tasks.	Apply
CO3. Speaking with clarity and confidence thereby enhancing employability skills of the students.	Apply
CO4. Train the students in organized and professional writing	Apply
CO5. Develop students reading skills that could be adopted while reading text	Apply
CO6. Improve communication and personality skills.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

COMMUNICATION AND SELF DEVELOPMENT: Basic Concepts of Communication; Barriers in Communication; How to Overcome Barriers to Communication.

GRAMMAR & SYNTAX: Subject verb concord, tenses, Homophones, Homonyms, Spotting errors.

READING AND WRITING SKILLS: Reading Comprehension; and suggesting title for given passage Back office job for organizing a conference / seminar (member of organizing committee and submit a report); Jumbled sentences, respond to real time advertisement and prepare a covering letter with CV.

SPEAKING SKILLS: Hard and soft Skills; Feedback Skills; Skills of Effective Speaking; Component of an effective Talk; how to make an effective oral presentation

TECHNICAL REPORT, RESEARCH CASE STUDY & REPORTING: Types and Structure of Reports; Collecting Data; Technical Proposals; Visual Aids; General Tips for Writing Reports. Research Case Study and reporting, how to make an effective power point presentation

TEXT BOOK

1. The Functional Aspects of Communication Skills, Prajapati Prasad and Rajendra K.Sharma, S. K Kataria & Sons, New Delhi, Rep''nt 2007

REFERENCE BOOKS

1. Business Communication, Sinha K. K. S. Chand, New Delhi.
2. Business Communication, Asha Kaul, Prentice Hall of India
3. Business Correspondence and Report Writing A Practical Approach to Business and Technical Communication, Sharma, R.C.and Krishna Mohan, Tata Mc Graw – Hill.

Course Designers:

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Dr.P.Saradha	Associate Professor	English	saradhap@vmkvec.edu.in
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CATEGORY ‘A’ FOUNDATION COURSES – HS, BS AND ES COURSES

(ii) BASIC SCIENCES (MATHS, PHYSICS AND CHEMISTRY COURSES)

17PHBS02	NANOTECHNOLOGY	Category	L	T	P	Credit
		FC(BS)	3	0	0	3

PREAMBLE

Nanotechnology is the study and application of extremely small things and can be used across all the other science fields, such as chemistry, biology, physics, materials science and engineering. Nanomaterials exhibit enhanced properties such as higher strength, lighter weight, and greater chemical reactivity than their larger-scale counterparts. The study about nanomaterials is extremely important for an engineer to understand its properties and designequipments.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To identify the properties and types of nanomaterials
2	To illustrate the preparation methods of nanomaterials
3	To illustrate about lithography techniques
4	To categorize about carbon nano tubes
5	To identify the various characterization techniques

COURSE OUTCOMES

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

CO1. Describe the properties of nanomaterials	Understand
CO2. Demonstrate the preparation methods of nanomaterials	Apply
CO3. Interpret the properties of carbon nanotubes	Apply
CO4. Utilize the lithographic techniques	Apply
CO5. Categorize various characterization techniques	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PS O3
CO1	M			M								M	M		M
CO2	S	M	M	M	M							M	M		M
CO3	S	M	S	S	S							M			M
CO4	S	M	S	S	S							M			M
CO5	S	S	M	S	S							M	S		

S- Strong; M-Medium; L-Low

SYLLABUS

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

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

LITHOGRAPHY FOR NANOSCALE DEVICES: Introduction to optical/UV electron beam and X- ray Lithography systems and processes, Wet etching, dry (Plasma /reactive ion) etching, Etch resists-dip pen lithography

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

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

TEXT BOOKS

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia,1996.
2. N John Dinardo, "Nanoscale charecterisation of surfaces & Interfaces", 2nd Edition, Weinheim Cambridge, Wiley-VCH,2000

REFERENCES:

1. Timp (Editor), "Nanotechnology", AIP press/Springer,1999

Akhilesh Lakhtakia (Editor), "The Hand Book of Nano Technology, Nanometer Structure", Theory, Modeling and Simulations", Prentice-Hall ofIndia (P) Ltd, New Delhi, 2007.

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	Asso. Professor	Physics	latha.physics@avit.ac.in
4	Dr. R. N. VISWANATH	Asso. Professor	Physics	rnviswanath@avit.ac.in

17CHBS10	FUNDAMENTALS OF CHEMISTRY	Category	L	T	P	Credit
		FC(BS)	3	0	0	3

Preamble: Fundamentals of Chemistry improves the ability to understand the scientific knowledge. Fundamental properties and general principles underlie all the engineering subjects and will be useful to develop the thinking skills.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To discuss the fundamental concepts of chemistry
2	To distinguish the configuration of organic molecules
3	To describe the mechanism of organic reactions
4	To demonstrate aromatic compounds
5	To compare the heterocyclic compounds

COURSE OUTCOMES

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

CO1 Summarize the fundamental concepts of chemistry	Remember
CO2 Demonstrate the mechanism of organic reactions	Understand
CO3 Describe the heterocyclic compounds	Understand
CO4 Illustrate the aromatic compounds	Apply
CO5 Categorize the configuration and stereoisomerism	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	M	M	-	-	-	-	-	-	-	M	M	-	M
CO2	S	M	S	M	L	-	-	-	-	-	-	-	M	M	M
CO3	M	M	M	M	L	-	-	-	-	-	-	M	M	M	M
CO4	S	M	M	M	-	-	-	-	-	-	-	-	M	M	-
CO5	M	M	S	M	-	-	-	-	-	-	-	M	M	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

Structure & Properties

Atomic structure, Atomic orbitals, Molecular orbitals, hybrid orbitals, bonds, Polarity of bond, Polarity of molecule, Dipole moment, Bond dissociation energy, Energy of activation, Inductive effect, Electromeric effect, Mesomeric effect, Resonance, Tautomerism, Conjugation, Hyper conjugation, Electrophiles and Nucleophiles. IUPAC nomenclature of organic compounds.

Stereochemistry

Isomerism, nomenclature, optical activity, stereoisomerism, specification of configuration, Stereoisomerism and its significance in medicinal compounds.

Chemistry of Aliphatic Compounds

Structure and important reactions of Alkanes, ethers, alcohols, amines, carbonyl compounds, and nitro compounds, Reactive intermediates - carbocations, carbanions, carbenes, nitrene and nitrenium ions. Reaction mechanisms - SN1, SN2, E1 and E2

Chemistry of Aromatic Compounds

Introduction, Huckel structure of Benzene, Resonance, theory of effect of substituent on reactivity and orientation. Polynuclear aromatic compounds.

Chemistry of Heterocyclic compounds

Classification and nomenclature. Important reactions of heterocyclic compounds containing N, O and S.

Text Books

1.Fundamentals of Organic Chemistry-I Paperback – 2018,by S.C. Sharma M.K. Jain , Amita

2. Organic Chemistry Fundamental Concepts Paperback – 2012,by V. K. Ahluwalia

Reference Books

1.Organic Chemistry Vol. 1,FINAR

2. A Textbook of Organic Chemistry,Bahl Arun

3.Organic Reactions Stereochemistry and Mechanism P. S. Kalsi

Course Designers:

S. No	Name of the Faculty	Designation	Department	Mail ID
1.	Mr.S.Krishnaraj	Assistant Professor	Chemistry/VMKVEC	Srajkrishna85@gmail.com
2.	Dr. R. Nagalakshmi	Professor	Chemistry/AVIT	nagalakshmi.chemistry@avit.ac.in

17CHBS01	Environmental Science And Engineering (Common to All Branches)	Category	L	T	P	C
		FC(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
CO1.	S	M	-	-	-	M	S	S	M	M	-	S	M	S	M
CO2.	S	-	-	-	-	S	S	S	-	-	-	S	M	S	M
CO3.	S	-	-	-	-	M	S	M	L	-	-	S	M	S	-
CO4.	S	-	-	-	-	M	S	S	M	M	-	S	M	S	M
CO5.	S	-	-	-	-	M	S	S	M	M	-	S	M	S	-
CO6.	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:

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1.	Dr. V. Anbazhagan	Professor	Chemistry	anbu80@gmail.com

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17CHBS03	BIOORGANIC CHEMISTRY	Category	L	T	P	Credit
		FC(BS)	3	0	0	3

Preamble

Bioorganic Chemistry explains the study of living cell chemistry in an organism. The Bioorganic study gives the knowledge of proximity effects in organic chemistry, molecular recognition and the supramolecular systems. It also deals analogy between organic reaction, energy transfer and biochemical transformations. It gives the basic knowledge of enzymes, peptides, proteins amides and metals and their roles. Acquiring the knowledge of concepts and principles will facilitate students to understand how they work in the research fields and show the way to the higher levels of various fields.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To acquire the knowledge of living cells chemistry.
2	To study the proximity effects in organic chemistry,molecular recognition and the supramolecular systems– concepts
3	To know the importance of enzyme catalysis in the living cells.
4	To understand the various reactions of metal ions in proteins and biological molecules. .
5	To apply the knowledge of enzymes designing in molecular theft and steroid templates.

COURSE OUTCOMES

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

CO1Discuss about the chemistry of living cells	Understand
CO2Describe the Proximity effects in organic chemistry,molecular recognition and the supramolecular systems - concepts	Understand
CO3Generalize the importance of enzyme catalysis in the living cells.	Apply
CO4Employ the various reactions of metal ions in proteins and biological molecules	Apply
CO5Use the knowledge of designing in molecular cleft and enzymes	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO BIO-ORGANIC CHEMISTRY

Basic Considerations - Proximity effects in Organic chemistry -Molecular recognition and the supramolecular systems

BIO - ORGANIC CHEMISTRY OF AMINO ACIDS ANDPEPTIDES

Chemistry of living cells, Analogy between organic reactions and Biochemical Transformations, Chemistry of the peptide bond, Asymmetric synthesis of amino acids - Retrosynthetic analysis, Transition state analogues.

ENZYME CHEMISTRY

Introduction to catalysis - Mutifunctional, Acid - base and Covalent catalysis, Introduction to enzymes - Chymotrypsin, Pyruvate dehydrogenase, Ribonuclease, Lysozyme, Enzymes in synthetic organic chemistry, Design of molecular clefts.

ENZYME MODELS

Host guest Complexation chemistry - Cyclodextrin, Development in Crown ether chemistry - Azo Crown ethers and Lariat Crown ethers, Enzyme design using steroid templates -, Co - enzyme chemistry- NAD, NADP, FAD and pyridoxal phosphate.

METAL IONS IN BIOLOGICAL SYSTEMS

Metal ions in proteins and biological molecules - Carboxy peptidase and role of zinc, Hydrolysis of amino acid esters, amides and peptides, Iron and oxygen transport, Biomodels for photosynthesis and energy transfer.

TEXT BOOKS

1. Zubay, G., 1987. Biochemistry. 2nd Edn., Maxwell Macmillan International Editions.

2. Dugas, H., 1989. Bio-organic Chemistry - A Chemical Ap-proach to Enzyme Action. Springer Verlag.3. David Van Vranken, Gregory A. Weiss., 2012. Introduction to Bioorganic Chemistry and Chemical Biology. (1st Edition) New York: Garland Science.

REFERENCE BOOKS

1. Mathew, Van Holde and Athern, 2000. Biochemistry. Pearson Publishers Ltd.

2. Page, M. I. and Williams, A., 1997. Organic and bio-organic mechanisms. Pearson India Edition.

3. Ariya, K. and Kumtake T., 2006. Supramolecular chemistry: Fundamentals and applications. Springer India Edition.

4. Palmer, Trevor, 2004. Enzymes: Biochemistry, biotechnology, clinical chemistry. East - West Press Pvt. Ltd.

5. Fersht, Alan, 1998. Structure and Mechanism in Protein Science: A Guide to Enzyme Catalysis and Protein Folding. W. H. Freeman.

Course Designers:

S.No	Name of the Faculty	Designation	Name of the College	Mail ID
1	Mr.S.Krishnaraj	Asst..Prof	Chemistry/VMKVEC	Srajkrishna85@gmail.com
2	Dr. R. Nagalakshmi	Professor	Chemistry/AVIT	nagalakshmi.chemistry@avit.ac.in

17CHBS81	BIOORGANIC CHEMISTRY LAB	Category	L	T	P	Credit
		FC(BS)	0	0	4	2

Preamble: Bioorganic Chemistry is a discipline that integrates organic chemistry and biochemistry. It aims at understanding the relevance of biological processes using the fundamental concepts of organic chemistry and also students should be able to develop theirskills in the synthesis and analysis of biomolecules.

PREREQUISITE

NIL

COURSE OBJECTIVES

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

COURSE OUTCOMES

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

CO1 Prepare the bimolecule from natural sources	Apply
CO2 Analyze the qualitative properties of biomolecules	Analyze
CO3 practice the applications of chemistry in pharmaceutical 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	S	M	M	-	L	M	L	L	-	-	-	M	S	S	S
CO2	S	M	M	-	L	M	-	-	-	-	-	M	S	M	S
CO3	S	S	M	-	M	M	M	M	-	-	-	M	S	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

1. Synthesis of Aspirin
2. Hydrolysis of Sucrose
3. Preparation of Pyruvic acid from Tartaric acid.
4. Preparation of Oleic acid
5. Preparation of alpha D- glucopyranose pentaacetate
6. Preparation of Lycopene from Tomato paste
7. Preparation of L-Proline.
8. Preparation of 1,2,5,6 di- O-Cyclohexylidine-alpha-D-glucofuranose.
9. Preparation of s-ethyl hydroxybutonate from ethyl acetoacetate using Yeast.
10. Preparation of s-ethyl hydroxybutonate using 3,5dinitrobenzoate

TEXT BOOKS

1. Laboratory Manual on Bioorganic Chemistry prepared by Vinayaka Mission's Research Foundation, Salem.

REFERENCE BOOKS

1. Fummis, B. S., Hannaford, A. J. and Smith, P. W. G., 1995.Textbook of Practical Organic Chemistry, Longman Edition.

Course Designers:

S. No	Name of the Faculty	Designation	Department	Mail ID
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CATEGORY ‘A’

FOUNDATION COURSES – HS, BS AND ES COURSES

(iii) ENGINEERING SCIENCES (BASIC ENGINEERING COURSES)

17MECC18	MANUFACTURING ENGINEERING	Category	L	T	P	Credit
		FC(ES)	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 foundrytechnology.
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	-	-	-	-	-	-	-			-	L	-	-
CO2	S	M	-	-	-	-	-	-	-	-		-	L	-	-
CO3	S	M	L	-	-	-	-	-	-	-		M	L	-	-
CO4	S	L	L	-	-	-	-	-	-	-		M	L	-	-

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

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

S.No	**Faculty Name**	**Designation**	**Department/ Name of the College**	**Email id**
1	S. ARUNKUMAR	Assistant Professor	MECH / VMKVEC	arunkumar@vmkvec.edu.in
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17BMES02	MEDICAL INSTRUMENTATION	Category	L	T	P	Credit
		FC-ES	3	0	0	3

PREAMBLE
To enable the students to develop knowledge of principles, design and applications of the Biomedical Instruments.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To know about bioelectric signals, electrodes and its types.
2	To know the various Biopotential recording methods.
3	To study about patient monitoring concept and various Physiological measurements methods.
4	To study the principle of operation blood flow meter, blood cells counter.
5	To study about bio chemical measurements and details the concept of biotelemetry and patient safety.

COURSE OUTCOMES

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

CO1. Explain the different Bio signal or biopotential.	Understand
CO2. Discuss the working principles of diagnostic and therapeutic equipments.	Understand
CO3. Examine the various instruments like as ECG, EMG, EEG, X-ray machine.	Apply
CO4. Illustrate medical instruments based on principles and application used in hospital.	Analyze
CO5. Analyze and calibrate fundamental biomedical instrumentation used in hospital.	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	M	M	--
CO2	M	--	--	--	--	--	--	--	L	--	--	L	M	M	--
CO3	S	S	M	S	M	--	--	--	M	--	--	M	M	M	S
CO4	S	M	M	M	L	--	--	L	S	L	--	S	M	S	S
CO5	S	S	M	M	L	M	--	L	S	L	--	S	M	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

BIOELECTRIC SIGNALS AND ELECTRODES
Basic medical instrumentation system, Origin of Bioelectric Potential, Recording electrodes – Electrode Tissue interface, Electrolyte – skin interface, Polarization, Skin contact impedance, motion artifacts. Electrodes – Silver – silver chloride electrodes, electrodes for ECG, electrodes for EEG, electrodes for EMG, Electrical conductivity of electrode jellies and creams, Microelectrodes.

BIO AMPLIFIER AND BIOMEDICAL RECORDERS

Bioamplifier, Need for Bioamplifier, Differential amplifier, Instrumentation amplifier, Chopper amplifier, Isolation Amplifier, ECG, EEG, EMG, PCG, EOG, ERG lead system and recording methods, typical waveform.

PATIENT MONITORING SYSTEM AND NON ELECTRICAL PARAMETERS MEASUREMENTS

System concepts of patient monitoring system, Bedside patient monitoring system, central monitors, Blood pressure measurement, Measurement of temperature, Respiration rate measurement, cardiac output measurement, Measurement of pulse rate, Plethysmography technique.

BLOOD FLOW METERS, BLOOD CELL COUNTERS

Electromagnetic blood flow meter, ultrasonic blood flow meter, Laser Doppler blood flow meter, Types of blood cells, Methods of cell counting, coulter counters, automatic recognition and differential counting.

BIO- CHEMICAL MEASUREMENTS AND BIOTELEMETRY AND PATIENT SAFETY

Ph, Pc02, p02, Phco3 and electrophoresis, colorimeter, spectrophotometer, flame photometer, auto-analyser. Biotelemetry-wireless telemetry, single channel telemetry, multichannel telemetry, multi patient telemetry.

TEXT BOOKS:

1. Khandpur R.S, **"Hand-book of Biomedical Instrumentation"**, Tata McGraw Hill, 2nd Edition, 2003.
2. Leslie Cromwell, Fred Weibell J, Erich Pfeiffer. A, **"Biomedical Instrumentation and Measurements"**, Prentice-Hall India, 2nd Edition, 1997.

REFERENCES:

1. John G. Webster, **"Medical Instrumentation application and design"**, John Wiley, 3rd Edition, 1997.
2. Carr, Joseph J, Brown, John.M, **"Introduction to Biomedical equipment technology"**, John Wiley and sons, New York, 4th Edition, 1997.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Mrs. S.Vaishnodevi	Assistant Professor	BME	vaishnodevi@vmkvec.edu.in
2	Dr. N.Babu	Professor	BME	babu@vmkvec.edu.in
3	Ms.Lakshmi Shree	Assistant Professor (Gr-I)	BME	lakshmi@avit.ac.in

17MECC94	MANUFACTURING ENGINEERING LAB	Category	L	T	P	Credit
		FC(ES)	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	-	-	-	L	-	-
CO2	S	M	-	-	L	-	-	-	M	-	-	-	L	-	-
CO3	S	M	-	-	L	-	-	-	M	-	-	-	L	-	-
CO4	S	M	-	-	L	-	-	-	M	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS:

LIST OF EXPERIMENTS:

1. Plain turning and step turning on lathe.
2. Taper turning on lathe.
3. Thread cutting on lathe.

4. Drilling, reaming and tapping in a drilling machine.
5. Plain milling.
6. Making square shape job in shaping machine.
7. Making Cutting key ways in a slotting machine.
8. To Perform Grinding process using a grinding machine

Text Book

MANUFACTURING ENGINEERING LAB - MANUAL

Course Designers

S.No	Faculty Name	Designation	Department/ College	Email id
1	S. ARUNKUMAR	Assistant Professor	MECH /VMKVEC	arunkumar@vmkvec.edu.in
2	S.PRAKASH	Assistant Professor	MECH/AVIT	prakash@avit.ac.in

CATEGORY ‘B’

CORECOURSES
RELEVANT TO THEPROGRAMME

81 CREDITS

17BTCC03	MICROBIOLOGY	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Microbiology deals with the study of microbes. It will cover wide spectrum of classification, cellular organization and characteristics of microscopic organisms, diseases caused and beneficial effects, environmental damage or stress. Microbiologists often use cutting-edge techniques and sophisticated machinery along with other applied fields of research like biotechnology, genetics to study microbes and their complex mechanisms. Knowledge of these principles will enable students to understand how they react under different conditions and how they cause different diseases and their control.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To describe about the evolution of microorganisms and microscopy.
2	To Explain the Structure and replication in microorganisms – concepts.
3	To interpret the effects of Microbes in food and the clinical importance of microorganisms.
4	To explain about the various Control measures and assessing the environmental impacts.
5	To outline the requirements of Microbial nutrition for growth of microorganisms and the impact of environment on its growth.

COURSE OUTCOMES

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

CO1. Explain about historical perspective of microbiology and its developments	Understand
CO2.Describe the fundamental structure, functions of a cell and the control of microbes using physical and chemical methods	Understand
CO3. Demonstrate the microbial nutritional requirements for growth	Apply
CO4. Demonstrate the microorganism have an indispensable role in the environment	Apply
CO5. Categorize the role of microorganisms in environmental 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	M	M	L	M	-	-	-	-	-	-	-	-	-	-	-
CO2	S	L	M	M	-	-	-	-	-	-	-	-	M	-	M
CO3	S	S	M	S	-	-	-	-	-	-	-	-	-	-	M
CO4	S	S	S	S	-	-	M	-	-	-	-	-	-	M	M
CO5	M	M	m	M	-	-	M	-	-	-	-	M	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

WORLD OF MICRORGANISMS AND MICROSCOPY

Historical review of the foundation of microbiology, Characteristics of microorganisms, Taxonomy methods of studying microorganisms, Microscopy - Light, Electron, Micrometry.

STRUCTURAL ORGANISATION OF MICROORGANISMS

General structural and cellular organization of Bacteria, virus, fungi, algae and protozoa.

MICROBIAL GROWTH AND NUTRITION

Nutritional requirements, Growth of microorganisms, Aerobic and anaerobic growth, Different methods of microbial enumeration, Methods of preservation of microbes. Effects of physical, chemical and environmental factors on microbial growth.

FOOD AND CLINICAL MICROBIOLOGY

Food spoilage and poisoning, Clinically important microorganisms and their effects on infections, Formation of toxic materials by microorganisms and their role in clinical microbiology.

CONTROL OF MICROORGANISMS AND ITS ENVIRONMENTAL APPLICATIONS

Pollution control through use of microorganisms, Recycling of biomaterials, Production of biogas, Leaching of ores by microorganisms, Microbial indicators, Biofouling.

TEXT BOOKS:

1. Pelzar, M.J., Chan, E.C. S and Krieg, N.R. 1993.Microbiology. Tata McGraw Hill Edition. New Delhi. India.
2. Ananthanarayan and JayaramPaniker, 1999. Text Book of Microbiology. Orient Longman Publishers.

REFERENCES:

1. Talaro, K., Talaro A. CassidaPelza and Reid, 1993. Foundation in Microbiology. W.C. Brown Publishers.
2. Prescott, Harley and Klen, 2003. Microbiology. McGraw Hill Publications. 5thEdn.
3. Frazier, W.S. and Weshoff, D.C., 1988. Food Microbiology, 4thEdn., McGraw Hill Book Co., New York.
4. George, J.B., 1987. Basic Food Microbiology. CBS Publishers and Distributors.
5. James, M.J., 1987. Modern Food Microbiology. CBS Publishers and Distributors.

COURSE DESIGNERS

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1	Mrs.G.Arthi	Assistant Professor	Biotechnology	arthi@vmkvec.edu.in
2	Dr.B.Prabasheela	Associate Professor	Biotechnology	prabasheela@avit.ac.in

17PECC01	UNIT OPERATIONS IN PHARMA INDUSTRIES	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE:

The concept and the importance of plant construction material particle size and particle shape in drug formulation. Understanding the mechanism of basic pharmaceutical operations including size reduction, mixing, separation processes, filtration, centrifugation and crystallization and evaporation.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To list out the construction materials of pharmaceutical plant.
2	To describe the Characterization and properties of particulate solids and screening equipment
3	To demonstrate the crystallization operations and its mechanism.
4	To describe the theory of filtration and centrifugation processes.
5	To describe the concept of mixing of powdered materials and its mechanism.

COURSE OUTCOMES

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

CO1.Classify the construction materials for pharmaceutical plant and its various properties.	Remember
CO2.Discuss the properties and characterization of particulate solids.	Understand
CO3. Discuss the Characters of crystals and mechanism of nucleation.	Understand
CO4. Generalize the theories of filtration and factors affecting it.	Apply
CO5. Categorize the process of centrifugation and centrifugal filters in industrial process.	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
CO2	M	M	M	-	-	L	M	-	-	-	-	L	-	M	M
CO3	S	S	S	S	-	-	-	-	-	-	-	--		-	-
CO4	M	M	L	M	-	-	-	-	M	-	-	-	M	M	-
CO5	-	-	-	-	M	-	M	-	M	-	-	-	S	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

MATERIALS OF PHARMACEUTICAL PLANT CONSTRUCTION

Overview of composition, corrosion, resistance, properties and applications of the materials of construction with special reference to stainless steel and glass- Industrial Hazards and Safety Precautions – Mechanical, Chemical, Electrical, Fire and Dust hazards, etc.

SIZE REDUCTION & SEPARATION

Properties and characterization of particulate solids — Introduction to storage and conveying of solids - Analysis and technical methods for size determination of powders - Size reduction equipment – Screening equipment

CRYSTALLIZATION

Characters of crystals like purity, size, shape, geometry, habit, forms, size and its factors-Solubility curves- Super saturation theory and its limitations- nucleation mechanism and crystal growth- crystallizers- Swenson Walker crystallizer - Caking of crystals and its prevention and numerical problems on yields.

FILTRATION AND CENTRIFUGATION

Theory of filtration, filter aids, filter media- Factors affecting filtration- industrial filters including filter press, rotary filter, edge filter, etc., - mathematical problems on filtration. Principles of centrifugation- industrial centrifugal filters - sedimentation centrifuges.

MIXING

Mixing of powdered materials – Mechanism of random mixing and interactive mixing. Sampling techniques, size and mixing indices. Factors affecting the mixing process. Types, characteristics and operation of mixers.

TEXT BOOKS:

1. McCabe WL, Smith J.C and Harriott "Unit operations of Chemical Engineering" McGraw Hill International Book Co. London 2004.
2. Girish K.Jani, "Pharmaceutical Engineering I, Unit Operation I" B.S.ShahPrakashan, India, 2006.
3. Cooper and Gunn's Tutorial Pharmacy, Edited by SJ Carter, CBS Publishers, New Delhi,2005.

REFERENCES:

1. Badger, W.L and Banchero, J.T "Introduction to Chemical Engineering" Tata McGrawHill,2002
2. Coulson, J.M. and Richardson, J.F." Chemical Engineering" 3rd Edition, Butterworth Heinemann Publication, 2001.
3. K. Sambamurthy, Pharmaceutical Engineering New Age International (P) Ltd., Publishers, New Delhi, 1998.

COURSE DESIGNERS

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1.	Mr.A.Gilbertsunderraj	Assistant Professor	Chemistry	gilbertsunderraj@vmkvec.edu.in
2.	Dr.T.Shanthi	Professor & Head	Chemistry	shanthi@vmkvec.edu.in

17PECC02	PHYSICAL PHARMACEUTICS	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

The course deals with the various physical, physicochemical properties and principle involved in dosage form formulations. Theory and practical components of the subject help the student to get a better insight into various areas of formulation research and development, and stability studies of pharmaceutical dosage forms.

PRERQUISITE

NIL

COURSE OBJECTIVES

1	To discuss various physicochemical properties of drug molecules in the designing the dosage forms.
2	To perform the formulation of emulsions and suspensions, access the physical stability of the product.
3	To execute the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations.
4	To compare the rheology of Newtonian and non-Newtonian fluids and to determine the various possible interaction of protein with drugs.
5	To outline the various laws of thermodynamics associated with formulation of dosage forms.

COURSE OUTCOMES

After completion of course, student is able to know

CO1. To describe the properties of drug molecules in the dosage form design	Understand
CO2. To demonstrate the formulation of emulsions and suspensions.	Apply
CO3. To illustrate the stability of various formulations.	Apply
CO4. To differentiate the rheology of various fluids used in development of various formulations.	Analyse
CO5. To develop formulation of various drugs using thermodynamic laws.	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	PO	PO	PO	PO	PO	PO	PO	PO	PO9	PO1	PO11	PO1	PSO1	PSO	PSO3
CO	-	M	M	L	-	L	-	-	-	M	M	M	M	S	S
CO	L	M	M	M	M	L	L	-	M	M	L	L	M	M	M
CO	M	M	M	M	L	-	-	-	M	M	M	L	M	M	M
CO	M	M	M	M	L	L	L	-	L	M	L	L	M	M	M
CO	M	L	L	L	L	L	L	-	L	M	L	L	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

Physical properties of drug molecules & Colloids

Physical properties- Bulk characteristic-crystallinity and polymorphism, Hygroscopicity, flow property, compressibility, excipient compatibility. Solubility analysis—Ionisation constant, Solubilisation, Partition coefficient, thermal effect, Dissolution, common ion effect. Stability analysis. Introduction, types of colloidal systems, optical properties of colloid, kinetic properties of colloids, electric properties of colloids, solubilization.

Coarse Dispersions Surface & Interfacial Phenomenon

Suspensions, interfacial properties of suspended particles. Formulation of suspensions, emulsions and theories of emulsification. Physical stability of emulsions, preservation of emulsions, rheologic properties of emulsions. Liquid interfaces, adsorption at liquid interfaces, adsorption at solid interfaces, Electrical properties of interfaces, surface tension and its determination, classification of surfactants.

Kinetics

Rates and orders of reaction, influence of temperature and other factors on rates, decomposition and stabilization of medical agents, kinetics in the solid state, accelerated stability analysis, kinetics of drug transport in vivo.

Micromeritics, Rheology &Complexation& Protein Binding

Particle size and size distribution, methods of determining particle size, particle shape and surface area, methods of determining surface area, pore size, derived properties of powders. Viscosity, Newtonian and non-Newtonian fluids, thixotropy and its application, Rheology of disperse system, viscometers. Metal-complexes, organic molecular complexes, inclusion compounds, protein binding, complexation and drug action.

Thermodynamics

Thermodynamics first, second, third law of thermodynamics. Free energy functions and applications. Internal energy–open, closed and isolated systems, Isothermal, adiabatic and reversible process. Enthalpy, entropy, criteria of spontaneity and equilibrium.

TEXT BOOKS:

1. Manavalan, R. and Ramasamy. C. “Physical Pharmaceutics” 2nd Ed., Vignesh Publishers, 2015.
2. C.V.S. Subrahmanyam, Text book of physical pharmaceutics, 3rdEdn., Vallabhprakashan, 2015.
3. Hadkar. U. B., Physical Pharmacy, NiraliPrakashan; 12th edition, 2017.

REFERENCES:

1. Alfred N. Martin, Patrick J. Sinko, Martin’s Physical Pharmacy and Pharmaceutical Sciences: Physical Chemical and Biopharmaceutical Principles in the Pharmaceutical Sciences, sixth edition, Lippincott Williams & Wilkins, 2011.
2. David B. Troy, Paul Beringer, Remington: The science and practice of pharmacy, 21st Edition, Lippincott Williams and Wilkins, 2006
3. Humphrey Moynihan and Abinacrean “Physicochemical Basis of Pharmaceuticals” Oxford University Press, 2009.

COURSE DESIGNERS				
S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.R.MargretChandira	Professor	Pharmaceutics	mchandira172@gmail.com
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17PECC03	FUNDAMENTALS OF HEAT AND MASS TRANSFER	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

This is an introductory course in different mode of heat transfer. The subject has a wide scope and is of prime importance in almost all fields of engineering and biological systems. The course emphasizes the underlying concepts of the conduction and convection modes of heat transfer and enumerates the laws and governing equations relating to the rates of heat transfer, based on derivation from fundamentals. There is a well balanced coverage of physical concepts, mathematical operations along with examples and exercise problems of practical importance. After completion of the course, the students will have a strong foundation on heat and mass transfer.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To Define the concepts of Heat transfer by conduction in solids for steady-state andtransient conditions
2	To Discuss the problems in heat transfer by convection.
3	To Describe the thermal analysis and design skills of heat exchangers.
4	To Describe the heat transfer process of radiation.
5	To Demonstrate the basics of mass transfer through molecular diffusion.

COURSE OUTCOMES

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

CO1.Explain the laws governing the heat transfer operations to solve the problems	Understand
CO2.Interpret the temperature variations and rate of heat flow in convection heat transfer problems	Understand
CO3. Discuss about the heat transfer equipment suitable for specific requirement,	Understand
CO4. Illustrate the real time applications of radiation mode of heat transfer	Apply
CO5. Practice the skill of mass transfer and its applications	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO 3
CO1	L	-	L	-	-	-	-	-	-	-	-	-	M	-	-
CO2	M	-	M	-	-	-	-	-	-	-	-	-	-	-	-
CO3	S	S	S	S	L	-	-	-	-	-	-	L		-	-
CO4	M	M	-	M	-	-	-	-	-	-	-	-	M	-	-
CO5	L	L	-	L	M	-	-	-	-	-	-	-	-	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

HEAT TRANSFER – CONDUCTION

Basic transfer processes – heat, mass and momentum – heat transfer process - conductors andinsulators - conduction – Fourier's fundamental equation – thermal conductivity and thermalresistance - linear heat flow – heat transfer through homogenous wall, composite walls, radial heat flow through cylinders and sphere – extended surfaces (fins) — solving problems in heat transferby conduction.

HEAT TRANSFER - CONVECTION

Newton Rikhman's law – film coefficient of heat transfer - convection – free and forced convection- dimensional analysis and its application – factors affecting the heat transfer coefficient in free andforced convection heat transfer – overall heat transfer coefficient - solving problems in heattransfer by convection.

HEAT TRANSFER – HEAT EXCHANGER

Heat exchangers – parallel, counter and cross flow – evaporator and condensers – LogarithmicMean Temperature Difference – overall coefficient of heat transfer – tube in tube heat exchanger,shell and tube heat exchanger, plate heat exchanger – applications of heat exchangers – solvingproblems in heat exchangers.

HEAT TRANSFER: RADIATION

Radiation heat transfer – concept of black and grey body - monochromatic total emissive power –Kirchoff's law – Planck's law - Stefan-Boltzman's law – heat exchange through non-absorbingmedia - solving problems in heat transfer by radiation.

MASS TRANSFER

Mass transfer – introduction – Fick's law for molecular diffusion - molecular diffusion in gases –equimolar counters diffusion in gases and diffusion of gas A through non diffusing or stagnant B -diffusion through a varying cross-sectional area and diffusion coefficients for gases – moleculardiffusion in liquids, biological solutions and gels.

TEXT BOOKS:

1. Bellaney, P.L. "Thermal Engineering". Khanna Publishers, New Delhi, 2001
2. Geankoplis C.J. "Transport Process and Unit Operations". Prentice-Hall of India Private Limited, New Delhi, 1999

REFERENCES:

1. Jacob and Hawkins. "Elements of Heat Transfer".John Willey and Sons Inc. New York,1983.
2. EcKert, E.R.G. "Heat and Mass Transfer". McGraw Hill Book Co., New York, 1981.
3. Holman, E.P. "Heat Transfer". McGraw-Hill Publishing Co. New Delhi, 2001.
4.Coulson, J.M. and etal. "Coulson & Richardson's Chemical Engineering", 6th Edition, Vol. I& II, Butterworth – Heinman (an imprint of Elsevier), 2004
5. McCabe, W.L., J.C. Smith and P.Harriot "Unit Operations of Chemical Engineering", 6th Edition, McGraw Hill, 2003.

COURSE DESIGNERS

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2.	Dr.T.Shanthi	Professor & Head	Chemistry	shanthi@vmkvec.edu.in

17PECC04	HUMAN PHYSIOLOGY	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

This subject is designed to impart fundamental knowledge on the structure and functions of the various systems in the human body. It also helps in understanding the homeostatic mechanisms. The subject provides the basic knowledge required to understand the therapeutic activity of various drugs.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To Describe the components of blood and its function
2	To Explain the structure & function of nervous system and various sense organs
3	To Discuss the various parts of Gastro Intestinal & Renal system & to understand how do they function
4	To Describe different parts and function of heart & lungs
5	To Summarize the roles of hormones in human system

COURSE OUTCOMES

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

CO1. Differentiate various blood cells and explain its importance.	Understand
CO2. Demonstrate the functions of Nervous, circulatory, respiratory system.	Understand
CO3. Recognize the process of digestion excretion and urine formation.	Understand
CO4. Utilizing the principles of agglutination in blood group detection.	Apply
CO5. Analyse various physiological parameters for detecting pathological condition	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO 3
CO1	M	M	M	L	L	L	-	-	L	-	-	-	M	M	M
CO2	M	M	M	L	L	-	-	-	L	L	-	-	M	M	M
CO3	M	M	-	L	L	-	-	-	L	L	-	-	M	M	M
CO4	M	M	M	L	L	-	-	-	L	L	-	-	M	M	M
CO5	M	M	M	L	M	-	-	-	L	L	-	-	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

HEAMATOLOGY

Composition and functions of blood, functions of plasma proteins, reaction of blood, coagulation ofblood, coagulation factors, functions of bone marrow, erythropoiesis, functions of hemoglobin, blood groups.

NERVOUS AND SENSORY SYSTEM

Anatomy and physiology of brain, blood-brain barrier, spinal cord, structure and types of theneuron, synapses neurotransmitters, organization of spinal and cranial nerves, central andperipheral nervous system, autonomic nervous system, receptors membrane potentials –gradedpotentials and action potentials, physiology of vision, audition, olfaction, taste and skin.

GASTROINTESTINAL AND RENAL SYSTEM

Anatomy and physiology of the gastrointestinal tract (secretion, motility, digestion andabsorption), structure and function of the liver, spleen, gall bladder, pancreas; the renalsystem structure – Anatomy and physiology of kidney; structure of the nephron and network of bloodcapillaries, urinary tract, formation of urine, concentration of urine; regulation of acid-base balance;the chemical acid-base buffer systems of body fluids and disease conditions

CARDIOVASCULAR AND RESPIRATORY SYSTEM

Anatomy and physiology of the heart, lungs, cardiac cycle; circulation of blood, heart rate, bloodpressure, ECG and heart sounds, lymphatic vessel, systemic and portal circulation; vascularsystem – arteries, arterioles, capillaries, venules. Anatomy of respiratory tract, mechanism anddynamics of respiration, lung volumes, transport of oxygen and carbondioxide, disorders likecyanosis

ENDOCRINE

Anatomy and physiology of Pituitary, thyroid, parathyroid, adrenal and pancreatic hormones anddisorders of these glands, endocrine control of growth and metabolism.

TEXT BOOKS:

1. Waugh, Anne and Allison Grant, "Ross and Wilson Anatomy and Physiology in HealthandIllness", Xth Edition, Churchill – Livingstone / Elsevier), 2006.
2. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypeebrothers medical publishers, New Delhi.
3. Textbook of Practical Physiology by C.L. Ghai ,Jaypee brothers medical publishers, New Delhi.
4. Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypeebrother'smedical publishers, New Delhi.

REFERENCE BOOKS:

1. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA
2. Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.
3. Human Physiology (vol 1 and 2) by Dr. C.C. Chatterrje ,Academic Publishers Kolkatta
4. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co,Riverview,MI USA
5. Text book of Medical Physiology- Arthur C,GuytonandJohn.E. Hall. Miamisburg, OH, U.S.A.
6. Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department	Mail ID
1.	Mr.P.Senniappan	Assistant Professor	Pharmacognosy	senniappan1979@gmail.com
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17PECC05	MOLECULAR BIOLOGY AND GENETIC ENGINEERING	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

To acquire the basic knowledge on organization and maintenance of the genome and on control of gene expression; to understand the processes that govern cell cycle and control mechanisms of cell death and renewal; to recognize the scheme of the cell-cell interactions and cell signaling; to relate the irregularities in the genome and basic cell processesto the development of cancer; to acquire the principles and practical applications of the basic methods in molecular biology and genetic engineering.

PREREQUISITE

17BTCC02- CELL BIOLOGY

COURSE OBJECTIVES

1	To Define the structure of Nucleic acids, their characteristics and organization, biological importance, replication process etc.,
2	To Describe about the process of transcription and translation mechanism, types of RNA and inhibitors involved in this process.
3	To Discuss about the tools and techniques involved in gene cloning
4	To Perform the nucleic acid isolation, PCR and hybridization techniques.
5	To Outline about gene expression and genome sequencing techniques

COURSE OUTCOMES

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

CO1. Explain the basic concepts and principles of nucleic acids in prokaryotic andeukaryotic organisms and their replication process.	Understand
CO2.Explain the synthesis of RNA and post-transcriptional modifications.	Understand
CO3. Describe about gene expression and genome sequencing techniques.	Understand
CO4.Illustrate various recombinant DNA techniques and their applications.	Apply
CO5. Determine the analysis of genomic informations.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

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

CO 4	M	M	M	M	M	L	L	-	-	L	L	L	M	M	M
CO 5	L	L	L	L	L	L	L	-	-	L	L	M	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

MOLECULAR GENETICS

Bacterial conjugation, transduction and transformation, prokaryotic and eukaryotic genomeorganization; Introduction to nucleic acids, Nucleic acids as genetic material, Structure andfunction of DNA and RNA, DNA replication, Overview of differences in prokaryotic and eukaryoticDNA replication, Telomere replication in eukaryotes. Mutagens, DNA mutations and their mechanism, various types of repair mechanisms.

TRANSCRIPTION ANDTRANSLATION

Structure and function of mRNA, rRNA and tRNA. RNA synthesis: Initiation, elongation andtermination of RNA synthesis, Translation: Introduction to Genetic code: Elucidation of geneticcode, Codon degeneracy, Wobble hypothesis and its importance, Steps in translation: Initiation, Elongation and termination of protein synthesis. Inhibitors of protein synthesis. Post-translationalmodifications and its importance. Organization of genes in prokaryotic and eukaryoticchromosomes.

RECOMBINANT DNA TECHNOLOGY

Manipulation of DNA – Restriction and Modification enzymes. Characteristics of cloning andexpression vectors based on plasmid and bacteriophage, Vectors for yeast, insect and mammaliansystems, Prokaryotic and eukaryotic expression host systems, Introduction of recombinant DNA in to host: Insulin, Interferons, Erythropoietin, DNA libraries: Construction of genomic and cDNA libraries.

SEQUENCING AND AMPLIFICATION OF DNA

Amplification of DNA; Types of PCR, Real-time PCR/qPCR – SYBR green assay, Taqmanassay,Site directed mutagenesis. Organization and structure of genomes, Maxam Gilbert's and SangerCoulson's and automated methods of DNA sequencing, Next generation sequencing technologies,
Genetic maps and Physical maps.

GENOME ANALYSIS AND GENOMICS

Gene therapy and Transgenic technology, Introduction to Functional genomics, Microarrays, Serial Analysis of Gene expression (SAGE), Web resources for Genomics, Regulation of Eukaryotic Gene Expression by Small RNAs (RNA Interference, RNAi).

TEXT BOOKS:

1. David Friedfeld "Molecular Biology." Narosa Publications, 1999.
2. Primrose SB and R. Twyman "Principles of Gene Manipulation & Genomic BlackwellSciencePublications, 2006.
3. Principles of Genome Analysis and Genomics by S.B. Primrose and R.M. Twyman, ThirdEdition (Blackwell Publishing), 2003.

REFERENCES:

1. Tropp, Burton. "Molecular Biology: Genes to Proteins". 3rd Edition. Jones andBartlett, 2008.

2. Ansubel FM, Brent R, Kingston RE, Moore DD, "Current Protocols in Molecular Biology"Greene Publishing Associates, NY, 1998
3. Genomes 3 by T.A.Brown, Third Edition (Garland Science Publishing), 2007.

S.No	Name of the Faculty	Designation	Department	Mail ID
1.	Mrs.C.Nirmala	Assistant Professor	Biotechnology	nirmala@vmkvec.edu.in
2.	Dr.M.Sridevi	Professor & Head	Biotechnology	sridevim@vmkvec.edu.in

17PECC06	ENZYME TECHNOLOGY	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Enzyme Engineering is the process of designing and modifying enzymes structures by altering amino acid sequences using recombinant DNA technology. Knowledge of structure and functions of proteins gained from advanced biochemistry can be applied here to design and modify structure of enzymes to perform different useful roles including enhanced catalytic activity, drug discovery and diagnostic applications.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To Describe about the different classes of enzymes and their characteristics.
2	To Generalize about enzyme inhibition with examples.
3	To Illustrate in detail about mechanism and kinetics of enzyme activity.
4	To outline organization and regulation of enzymes in cells.
5	To outline the applications of industrial and clinical enzymes.

COURSE OUTCOMES

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

CO1. Classify enzymes and their characteristics.	Understand
CO2. Demonstrate the effect of enzyme inhibition and enzyme immobilization.	Understand
CO3. Describe fundamental knowledge about enzyme kinetics and mechanism of enzyme activity.	Understand
CO4. Illustrate about the regulation and mechanism of enzymes in cells.	Apply
CO5. Categorize in detail about the application of various enzymes in industries and clinical use.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO	PO	PO5	PO	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO	S	L	-	-	-	-	-	-	L	L	-	-	-	-	-
CO	S	M	M	M	L	M	M	-	L	S	S	S	S	S	S
CO	S	S	M	S	L	L	-	-	L	M	M	M	S	M	M
CO	S	-	-	-	M	-	-	-	L	L	L	L	S	M	-
CO	S	S	M	M	M	S	S	S	L	L	L	S	S	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

General introduction and historic background- General Terminology, Nomenclature and Classification of Enzymes. Criteria of purity of enzymes- Specific activity. Enzyme units-Katal and IU. Enzyme activity-chemical nature of enzymes. Protein nature of enzymes and Non protein enzymes- Ribozymes and DNAzymes. Metalloenzymes and metal activated enzymes. Coenzymes and Cofactors- Prosthetic group, coenzymes involved in different metabolic pathways. Classification of coenzymes. Isozymes, Abzymes, Synzyme.

ENZYME CATALYSIS AND INHIBITION

Lock and key, Induced fit and Transition state Hypotheses. Mechanism of enzyme catalysis- Acid-base catalysis, covalent catalysis, Metal ion catalysis, Proximity and orientation effects etc. Mechanism of Serine proteases. Reversible Inhibition- Competitive, Non Competitive, Uncompetitive, Mixed, Substrate, Allosteric and Product Inhibition. Irreversible Inhibition- Suicide inhibition. Examples and Mechanism of various Inhibitions like Penicillin, Iodoacetamide and DIPF.

ENZYME KINETICS

Factors affecting the enzyme activity- Concentration, pH and temperature. Kinetics of a single-substrate enzyme catalyzed reaction, Michealis-Menten Equation, Km, Vmax, L.B Plot, Turnover number, Kcat. Kinetics of Enzyme Inhibition. Kinetics Allosteric enzymes.

ENZYME REGULATION

Feedback Regulation, Allosteric Regulation, Reversible Covalent Modification and Proteolytic Activation. Organization of enzymes in the cell. Enzymes in the cell, localization, compartmentation of metabolic pathways, enzymes in membranes, concentrations. Mechanisms of enzyme degradation, lysosomal and nonlysosomal pathways, examples.

INDUSTRIAL AND CLINICAL USES OF ENZYMES (APPLIED ENZYMOLOGY)

Industrial Enzymes- Thermophilic enzymes, amylases, lipases, proteolytic enzymes in meat and leather industry, enzymes used in various fermentation processes, cellulose degrading enzymes, Metal degrading enzymes. Clinical enzymes- Enzymes as thrombolytic agents, Anti-inflammatory agents, streptokinase, asparaginase, Isoenzymes like CK and LDH, Transaminases (AST, ALT), Amylases, Cholinesterases, Phosphatases. Immobilization of enzymes, ELIZA. Biosensors. Enzyme Engineering and site directed mutagenesis, Designer enzymes

TEXT BOOKS:

1. Bhatt S.M, 2014.Enzymology and Enzyme Technology. S Chand & Company, Bengaluru, Karnataka.
2. T. Devasena, 2010. Enzymology, Oxford University Press, Oxford, United Kingdom.
3. Trevor Palmer, 2008. Enzymes: Biochemistry, biotechnology and clinical chemistry. East West Press, Horwood.
4. Zubay, G. L., 1998. Biochemistry, McGraw-Hill Companies, Dubuque, 4thEdn.
5. Bailey and Ollis, D.F..2017. Biochemical Engineering Fundamentals. McGraw Hill. New York. 2ndEdn.

REFERENCES:

1. M. Y. Khan & Farha Khan, 2015.Principles of Enzyme Technology. PHI Learning.
2. Butterworth, 1995. Technological Applications of Biocatalysts. BIOTOL Series.

3. Cornish-Bowden, A., 1996. Analysis of Enzyme Kinetic Data. Oxford University Press.
4. Wiseman, A., Blakeborough, N. and Dunnill, P., 1981. Enzymatic and Nonenzymatic catalysis. Vol. 5, Ellis and Harwood, UK
5. Wiseman, A. Topics in Enzyme and Fermentation Biotechnology. Vol.5 Ellis and Harwood, UK.
6. Kolot, F.B. 1998 Immobilized Microbial Systems, Principles, Techniques and Industrial applications. R.R Krieger Publications.

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Mrs. J. Blessy Juliet	Assistant professor	Biotechnology	catch.blessy@gmail.com
2	Dr.S.Anusuya	Associate Professor	Pharmaceutical Engineering	dr.s.anusuya@vmkvec.edu.in

17PECC07	PHARMACEUTICAL ANALYSIS	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

This subject deals with various advanced analytical instrumental techniques for identification, Characterization and quantification of drugs. The course is designed to impart the knowledge in the field of Pharmaceutical analysis. The various modern analytical techniques like UV-Visible, IR, NMR, Mass, GC, HPLC, different chromatographic methods and other important topics are taught to enable the students to understand and apply the principles involved in the determination of different bulk drugs and their formulation. In addition to the theoretical aspects, the basic practical knowledge relevant to the analysis is also imparted.

PRERQUISITE

NIL

COURSE OBJECTIVES

1	To discuss about the principles of modern analytical techniquesand it's application in pharmacy.
2	To summarize the use of modern techniques of analysis used in different areas / fields of pharmacy.
3	To implement the given technical training and its applications in day to day practices.
4	To give hands on training on use of as many different instruments as possible.

COURSE OUTCOMES

After completion of course student is able to know

CO1. Discuss about the Drugs, Chemicals and Excipients used in Pharma industry	Understand
CO2. Interpretations of the various spectroscopic data	Understand
CO3. Illustrate the fundamental of analysis related to drug discovery.	Apply
CO4. Infer the modern analytical techniques, which is important for qualitative as well as quantitative analysis of drug substances and drug product.	Analyze
CO5. Measure and analysis various drugs in single and combination dosage forms	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M	L	L	L	-	-	-	-	-	-	-	M	M	M	M
CO2	M	M	M	M	M	-	-	-	-	-	-	S	S	M	M
CO3	S	S	S	L	L	-	-	-	-	-	-	L	M	-	M
CO4	M	M	M	M	M	-	-	-	-	-	-	S	M	M	M
CO5	S	M	L	M	M	-	-	-	-	-	-	S	M	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

SEPARATION TECHNIQUES

Fundamental principles, theory, instrumentation and application of Paper chromatography, TLC, Column chromatography, HPLC, HPTLC, Ion Exchange Chromatography and electrophoresis.

SPECTROSCOPIC METHODS

Theory, Instrumentations, chemical applications and structural elucidation by UV, IR, NMR, Mass Spectrometry, ESR and Emission spectroscopy.

ELECTROCHEMICAL METHODS

Potentiometry, Conductometry, Polarography, Colorimetry and Flourimetry

THERMAL METHODS

Thermogravimetry, Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC)

X-RAY DIFFRACTION METHODS

Introduction, generation of X-rays, elementary crystallography, Miller Indices, X-rays diffraction, Bragg's law, X-ray powder diffraction, X-ray powder diffractometer, obtaining and interpretation of X-ray powder diffraction data.

TEXT BOOKS:

1. Text book of pharmaceutical analysis by S.Ravishankar.
2. Instrumental methods of chemical analysis by Chatwal. K, Anand, 5th edition.
3. Spectroscopy by B.K.Sharma

REFERENCE BOOKS:

1. Spectrometric identification of organic compounds by Silverstein, Webster.
2. Fundamentals of analytical chemistry by Skoog
3. Organic spectroscopy by Y.R.Sharma.
4. Instrumental methods of analysis by Willard, Merit, Dean, Settle.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Mr.S.Alexandar	Assistant Professor	Pharmaceutical Chemistry	alexmpharm@gmail.com
2	Mr.N.Jawahar	Assistant Professor	Biotechnology	jawahar@vmkvec.edu.in

17PECC08	PHARMACEUTICAL BIOPROCESS ENGINEERING	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

The subject provides knowledge involving basic principle of fermentation process, bioreactor design, scaleup and recombinant protein production along with case studies, tohelp the students understand fermentation processes involved in PharmaceuticalIndustries.

PREREQUISITE 17PECC06 ENZYME TECHNOLOGY

COURSE OBJECTIVES

1	To Explain the basics of bioreactor engineering.
2	To Perform a biochemical process for the production of biologically important product.
3	To Implement fermentation processes and its control systems duringscale up operations.
4	To Outline the fundamentals of Enzyme kinetics, Inhibition kinetics andImmobilization.
5	To Develop a methodology for recombinant protein production.

COURSE OUTCOMES

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

CO1.Describe appropriate bioreactor configurations and operation modes based upon the nature of bioproducts.	Understand
CO2.Illustrate the principles of bioprocesses so as to reduce costs and to enhance the quality of products.	Apply
CO3.Generalize the production process in pharma industry with strong foundation of bioreactor design and scale-up.	Apply
CO4.Appraise the role Enzyme kinetics in bioprocess industry.	Analyse
CO5. Analyse the problems in bioprocess industry and seek practical solutions for large scale production of a product.	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO	PO	PO	PO	PO	PO	PO8	PO	PO10	PO11	PO12	PSO	PSO	PSO
CO1	L	L	S	L	M	-	-		L	-	S	L	M	M	-
CO2	M	M	M	M	-	-	L	-	-	-	S	L	M	-	-
CO3	S	S	M	S	L	L	-	M	L	L	L	L	M	M	-
CO4	M	L	L	M	M	M	-	-	-	-	-	-	-	M	-
CO5	S	S	L	S	M	-	-	L	-	S	M	M	S	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO BIOREACTOR DESIGN & CONSTRUCTION

General requirements of fermentation processes, Basic design and construction of CSTR, bioreactor design of agitator/agitator motor, power consumption in aerated bioreactor, design of sparger, mixing time estimation, oxygen mass transfer capability in bioreactor, Removal of Heat in bioreactor, Main parameters to be monitored and controlled in fermentation processes**.**

METABOLIC STOICHIOMETRY AND ENERGETICS

Stoichiometry of cell growth and product formation, elemental balances, degrees of reduction ofsubstrate and

biomass, available electron balances, yield coefficients of biomass and productformation, maintenance coefficients, energetic analysis of microbial growth and product formation,oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth.

BIOREACTOR SCALE–UP

Regime analysis of bioreactor processes, oxygen mass transfer in bioreactors – Mass transfers Coefficient - methods for the determination of mass transfer coefficients; mass transfer correlations. Power requirements of Bioreactors. Scale-up considerations on heat transfer oxygen transfer, power consumption and impeller tip speed.

BIOREACTOR CONSIDERATION IN ENZYME SYSTEMS

Analysis of film and pore diffusion effects on kinetics of immobilized enzyme reactions; formulation
Of dimensionless groups and calculation of effectiveness factors. Design of immobilized enzymereactors – packed bed, fluidized bed and membrane reactors.

CASE STUDIES IN FERMENTATION DERIVED PRODUCTS

Case studies on Production of penicillin, aminoglycosides, macrolides, recombinant Insulin and interferon. Case studies should deal withstrain improvement, medium design, reactor design & process optimization etc.

TEXT BOOKS

1. Michael L. Shuler and FikretKargi, Bioprocess Engineering, Basic Concept, 2nd Edition, Prentice Hall PTR, 2002.
2. Pauline Doran, Bioprocess Engineering Calculation, Blackwell Scientific Publications

REFERENCES

1. Anton Moser, “Bioprocess Technology, Kinetics and Reactors”, Springer Verlag.
2. James E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, McGraw Hill.
3. James M. Lee, Biochemical Engineering, PHI, USA.
4. Atkinson, Handbook of Bioreactors, Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Decker Inc.
5. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc.

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1.	Ms. C. Vanathi	Assistant professor	Biotechnology	vanathi@vmkvec.edu.in
2.	Mrs. G. Arthi	Assistant professor	Biotechnology	arthi@vmkvec.edu.in

17PECC09	TECHNOLOGY OF SOLID AND SEMISOLID DOSAGE FORMS	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

ThisCourseis designed to impart a fundamental knowledge and to provide the concepts of various parameters involved in the formulation anddevelopment of various solid dosage forms, semisolid and semi liquid formulations and to employ the different unit operations in the preparation and manufacturing of these dosage forms.

PRERQUISITE - NIL

COURSE OBJECTIVES

1	To impart the knowledge on the principles of solid and semisolid dosage forms formulation anddevelopment.
2	To summarize the concepts involved in troubleshooting and improvement of solid dosage forms, semi-solid and semi-liquid dosage forms
3	To describe the various pharmaceutical dosage forms and their manufacturing techniques
4	To provide the knowledge on the formulation and evaluations of dosage forms.
5	To select the appropriate method of achieving a successful dosage form formulation.

COURSE OUTCOMES

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

CO1. To understand the technology of various solid and semisolid dosage forms.	Understand
CO2. To recognize the formulation concepts and evaluate different dosage forms to meet out the requirements.	Understand
CO3. Ablity to formulate various solid and semisolid dosage forms	Apply
CO4. Apply the concepts of formulation in pharmaceutical industry	Apply
CO5. To apprehend the advances in solid dosage forms, semi solid dosage forms and dispersions	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	PO	PO	PO	PO	PO	PO	PO	PO	PO9	PO1	PO1	PO1	PSO	PSO	PSO
CO	M	L	L	L	M	-	-	-	-	-	-	M	M	M	M
CO	M	L	L	L	M	-	-	-	-	-	-	M	M	M	M
CO	S	S	M	M	M	-	-	-	-	-	-	S	S	S	S
CO	S	S	M	M	M	-	-	-	-	-	-	S	S	S	S
CO	S	S	M	M	M	-	-	-	-	-	-	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

SOLID DOSAGE FORMS -TABLETS

Types of tablets, brief study of novel tablets, formulation of tablets with detailed study of excipients,

theory of compression, process of compression, effect of friction, force – volume relationships in compression (Heckel's plot). Tablet manufacturing techniques, machinery for small and large scale tablet manufacturing, inprocess controls, processing problems, evaluation parameters and equipments. Coating of tablets: Objectives, types of coating, film forming materials, formulation of coating solution, equipment for coating, coating process, evaluation of coated tablets, coating defects, specialized coating process.

SOLID DOSAGE FORMS - CAPSULES

Types of capsules, size of capsules, material for production of hard gelatin capsules, formulation of hard gelatin capsules, method of capsule filling, problems and remedies in capsule manufacturing Soft gelatin capsule: shell and capsule content, manufacturing equipments, importance of base absorption and minimum/gm factors in soft capsule Quality control, stability testing & storage of capsule dosage forms.

Other Solid dosage Forms: Brief study of effervescent powders and granules, pelletization technology and its applications

ADDITIVES AND EXCEPIENTS IN SOLID AND SEMISOLID DOSAGE FORMS

Disintegrants, Lubricants, Glidants and Anti adherents, Surfactants and Colors in Tablets,Swellable and Rigid Matrices – Controlled Release Matrices with Cellulose Ethers, Carrageenanin Solid Dosage Form Design, Direct Compression and the Role of Filler-binders.

Vehicles, stabilizers, preservatives, suspending agents, emulsifying agents, solubilizers.

SEMISOLID DOSAGE FORMS AND DISPERSIONS

Types, mechanisms of drug penetration, factor influencing penetration,semisolid bases and their selection. General formulation of semisolids, manufacturing procedure, evaluation and packaging.

Monophasic liquids like gargles, mouth washes, Throat paint, Ear drops, Nasal drops, Liniments and lotions, Enemas and collodions.Biphasic dosage forms: Suspensions and emulsions, advantages and disadvantages, classification, test for the type of emulsion, formulation, stability and evaluation.

PREFORMULATION CRITERIA AND FORMULATION CHALLENGES

Study of physical and chemical properties of drugs and their effect on formulation, stability and bioavailability.Stability studies, Importance of accelerated stability study, effect of various environmental / processing on stability of the formulation and techniques for stabilization of products against the same.

Formulation challenges – multiple vitamin and mineral dosage forms, botanicals formulation into oral solid dosage forms, specialtablets formulation for slow oral dissolution, osmotic systems, tableting of multi particulate modified release systems.

TEXT BOOKS:

1. Lachman, Leon et al. "The Theory and Practice of Industrial Pharmacy" IIIrd Ed., VarghesePublishing House, 1987.
2. Larry L. Augsburger, Stephen W. Hoag, Pharmaceutical dosage forms: tablets, vol 3, rational design and formulation, Informahealthcare USA, Inc, 2008 IIIrd edition
3. Aulton, Michael E. "Pharmaceutics: The Science of Dosage Form Design" IInd Ed., ChurchillLivingstone, 2002.
4. Allen, Loyd V. et al. "Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems" IXthEd.,WoltersKluver/LippinCott Williams & Wilkins, 2011.
5. H. A. Liberman,, L. Lachman, and J. B. Schwartz: Pharmaceutical dosage forms: Tablets, Vol.1,2 and 3, IInd Edition Marcel Dekker, 1989.

6. Marcel Dekker, Drug stability- Principles and practice by Cartensen&C.J.Rhodes, 3rd Edition, series, Vol 107.

REFERENCES:

1. Remington's Pharmaceutical Sciences, A. R. Gennaro Mac Pub. Co. Easton, Pennsylvania1990.
2. Indian Pharmacopoiea, British Pharmacopoiea, United States Pharmacopoiea
3. Boca Raton, Coated Pharmaceutical Dosage Forms, K. H. Bauer, CRC Press,. Med Pharm.
4. G. C. Cole, Pharmaceutical Coating Technology, New York,
5. Ridgway. K, Hard Capsules, Pharmaceutical Press. London.

COURSE DESIGNERS

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1	Mrs.C.Nirmala	Assistant Professor	Biotechnology	nirmala@vmkvec.edu.in
2	Dr.S.Anusuya	Associate Professor	Pharmaceutical Engineering	dr.s.anusuya@vmkvec.edu.in

17PECC10	PHARMACEUTICAL CHEMISTRY	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

The students will able to understandimportant physical and chemicalproperties, pharmaceutical uses, storage conditions and chemical incompatibility of various important medicinal compounds. The discipline also includes concepts and processes of drug discovery, delivery, biomedical Analysis, Pharmacology, Pharmacokinetics, and Pharmacodynamics.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To Discuss the importance of pH maintenance in various chemical reactions.
2	To Describe the Drug-based cures and remedies for disease
3	To Demonstrate antibiotics as life-saving remedies
4	To Compare the uses of various radiopharmaceutics.
5	To Outline Quality assurance of drug.

COURSE OUTCOMES

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

CO1. Explain the role of buffer and pH in different reaction.	Understand
CO2. Summarize the function of antioxidant, antimicrobials and astringents.	Understand
CO3. Illustrate the mechanism of action of antibiotics and their side effects.	Apply
CO4. Examine the use of radiopharmaceuticals in drug formulation and diagnostics.	Analyse
CO5. Appraise the quality of a pharmaceutical product.	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO1	PSO	PSO	PSO3
CO1	M	L	L	L	M	-	-	-	-	-	-	-	M	M	-
CO2	M	M	M	M	M	-	-	-	-	-	-	M	M	M	M
CO3	S	S	S	S	L	-	-	-	-	-	-	M	M	M	M
CO4	M	L	M	L	L	-	-	-	-	-	-	L	M	S	M
CO5	M	M	M	L	L	-	-	-	-	-	-	M	M	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

ACIDS, BASES, BUFFERS

Boric acid, Hydrochloric acid, Strong Ammonium hydroxide, Sodium hydroxide and official buffers.

ANTIOXIDANTS, ANTIMICROBIALS AND ASTRINGENTS

Antioxidants- Hypophosphorous acid, Sulphur dioxide, Sodium bisulphite, Sodium meta-bisulphite, Sodium thiosulphate, Nitrogen and Sodium nitrite. Antimicrobials - Hydrogen peroxide, Potassium permanganate, Chlorinated lime, Iodine, Solutions of Iodine, Povidone-iodine, Boric acid, Borax, Silver nitrate, Mild silver protein, Mercury yellow, Mercuric oxide, Ammoniated mercury. Sulphur and its compounds- Sublimed sulphur, Precipitated sulphur, Selenium sulphide.Astringents- Alum and Zinc Sulphate.

ANTIBIOTICS

Benzyl penicillin, Phenoxy methyl penicillin, Benzathine penicillin, Ampicillin,Cloxacillin,Carbencicillin, Gentamicin, Neomycin, Erythromycin, Tetracycline, Cephalexin,Cephaloridine, Cephalothin, Griseofulvin, Chloramphenicol.

RADIO PHARMACEUTICALS AND CONTRAST MEDIA

Radio activity-Alpha; Beta and Gamma Radiations, Biological effects of radiations, Measurement of radio activity, G.M. Counter, Radio isotopes-their uses, Storage and precautions with special reference to the official preparations. Radio opaque contrast media-Barium sulfate.

QUALITY CONTROL OF DRUGS AND PHARMACEUTICALS

Importance of quality control, significant errors, methodsused for quality control, sources of impurities in pharmaceuticals. Limit tests for Arsenic, Chloride, Sulfate,Iron and Heavy metals.

TEXT BOOKS

1. Bentley and Driver's Textbook of Pharmaceutical Chemistry.
2. Inorganic Medicinal and Pharmaceutical Chemistry by J.H. Block, E.B. Roche, T.O.Soine and C.O.Wilson.
3. Roger's Inorganic Pharmaceutical Chemistry by T.O.Soine and C.O.Wilson.
4. Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake Vol. I.
5. Pharmaceutical Chemistry by M.L. Schroff.

REFERENCES

1. Mohammed Ali, Pharmaceutical Chemistry-I (Inorganic),1st edition,CBS.
2. Daniel Lednicer, The Organic Chemistry of Drug Synthesis, Hardcover, Good 2007, Wiley-Interscience.
3. Indian Pharmacopoeia 1996.

COURSE DESIGNERS

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1	Dr.M.Kumar	Professor & Head	Pharmaceutical Chemistry	kumarvmcp@yahoo.co.in
2	Mr.S.Alexandar	Assistant Professor	Pharmaceutical Chemistry	alexmpharm@gmail.com

17PECC11	IMMUNOTECHNOLOGY (THEORY AND PRACTICE)	Category	L	T	P	Credit
		CC	2	0	2	3

PREAMBLE

Immunotechnology is a specialized course which deals with biotechnological applications. Immunotechnology deals with immune systems and their components at the cellular and humoral levels. It focusses on gene rearrangement of immunoglobulin genes and T-cell receptor genes. Antigen processing and presentation, cellular responses, innate immunity and tolerance are included in that course.

Knowledgeon the fundamentals of immunology forms the basis of the courseimmunotechnology which deals with the practical aspects such as the production and engineering of antibodies, the application of antigens, the design of (recombinant) vaccines, strategies for immune intervention, etc.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To define the immune system and cells and organs involved in the immune response
2	To discuss immunity and their types.
3	To Illustrate various immune responses and their tolerance.
4	To outline the importance of immunological techniques in disease diagnosis and treatment.
5	To produce and purify monoclonal antibodies.

COURSE OUTCOMES

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

CO1. Underline the importance of immune system.	Understand
CO2. Describe about types of immunity and immunoglobulins.	Understand
CO3. Illustrate how immune regulation is maintained.	Apply
CO4. Practice immunotechniques.	Apply
CO5. Analyse Hybridoma techniques and their application in pharma industries.	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT I : FUNDAMENTAL ASPECTS OF IMMUNOLOGY

Introduction, cells and organs of the immune system, cellular basis of Immune response, primary and secondary lymphoid organs, antigen antibody and their structure. Types of immune responses, anatomy of immune response. Overview of innate and adaptive Immunity.

UNIT II: IMMUNITY AND ITS TYPES

Types of immunity, Active and Passive Immunity, Humoral Immunity - B – Lymphocytes and their activation. Structure and function of immunoglobulins, idiotypes and anti idiotypic antibodies. Cell mediated Immunity - Thymus derived lymphocytes (T cells) – their ontogeny and types, MHC complex, antigen presenting cells (APC), mechanisms of T cell activation, macrophages, dendritic cells, langerhans cells, and mechanism of phagocytosis.

UNIT III: IMMUNE REGULATION AND TOLERANCE

Complement activation and types and their biological functions, cytokines and their role in immune response, Antigen processing and presentation. Primary and Secondary Immune response; Generation of Humoral Immune Response; Generation of cell mediated Immune response (T cell activation, co-stimulatory signals); Killing mechanisms by CTL and NK cells, Hypersensitivity Types I-IV, Hypersensitivity reactions and treatment.

UNIT IV: IMMUNOLOGICAL TECHNIQUES

Affinity and Avidity; Principles of Precipitation, Agglutination reactions, Immunodiffusion, Immunoelectrophoresis, principles and application of ELISA, ELISPOT, Western Blotting, Immunofluorescence, Flow cytometry and Immunoelectron Microscopy, complement fixation, Widal test, VDRL test, immunoblot analysis. Immunohistochemistry, Radio Immuno Assay, chemiluminescence assay.

UNIT V: IMMUNOTECHNOLOGY

Hybridoma techniques – fusion methods for myeloma cells and B-Lymphocytes, selection and screening techniques. Production and purification of monoclonal antibodies and their applications in Pharmaceutical industry.

TEXT BOOKS

1. Lydyard, P. M., Whelan, A. and Fanger, M. W., 2003. Instant Notes in Immunology. Viva Books Private Limited, 2nd Edition.
2. Talwar, G. P., and Gupta, S. K., 1992. A Handbook of Practical and Clinical Immunology. CBS Publications, Volume I and II.
3. Weir, D. M., 1990. Practical Immunology. Blackwell Scientific Publications, Oxford.

REFERENCES

1. Talwar, G. P. and Gupta, S. K., 1992. A Handbook of Practical and Clinical Immunology. CBS Publications, Volume 12.
2. Richard, A., Goldsby, Thomas J. Kindt and Barbara A. Osborne, Kuby. Immunology. W. H. Freeman and Company, New York, 4th Edition.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1.	Mr.N.Jawahar	Assistant Professor	Biotechnology	jawahar@vmkvec.edu.in
2.	Mrs. J. Blessy Juliet	Assistant professor	Biotechnology	catch.blessy@gmail.com

17PECC12	MEDICINAL CHEMISTRY	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

The course highlights the importance of Medicinal Chemistry in all our lives and the fascination of working in a field that overlaps the disciples of chemistry, biology, biochemistry, pharmacology etc. It gives brief understanding about drug-receptor interactions, lead discovery, drug design and molecular mechanism by which drug act in the body. The course emphasizes on various drug targets in the body and drug development strategies with mechanism of action of antibacterial agents and concept of drug resistance.

PREREQUISITE – 17CHBS10 FUNDAMENTALS OF CHEMISTRY

COURSE OBJECTIVES

1	To state the chemical basis of drug action including physicochemical and steric properties of drug.
2	To discuss the classification, chemical nomenclature, generic names and synthesis of various medicinal agents.
3	To describe the structure activity relationship, biochemical/ molecular basis of mechanism of action and uses of drug.
4	To implement corresponding knowledge for the development of biologically and clinically active drugs
5	To compare the basic biological and pharmacological interactions by using both natural products and total synthesis of bioactive molecules.

COURSE OUTCOMES

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

CO1. Describe the importance of the physical properties of drugs with respect to the ionization, solubility and efficacy of drugs	Understand
CO2. Discuss how drugs are developed and demonstrated the importance of chemistry in the development and application of therapeutic drugs.	Understand
CO3. Illustrate how changes in the chemical structure of drugs affect efficacy.	Apply
CO4. Practice structural activity relationship studies to optimize the structure of drugs	Apply
CO5. Analyse techniques suitable for synthesizing different drug molecules.	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	PO1	PO2	PO	PO	PO	PO	PO	PO	PO9	PO1	PO1	PO1	PSO	PSO	PSO3
CO	M	L	L	L	L	-	-	-	-	-	-	M	M	M	M
CO	M	M	M	M	M	-	-	-	-	-	-	S	S	S	S
CO	S	S	S	S	M	-	-	-	-	-	-	S	S	M	S
CO	S	S	S	S	M	-	-	-	-	-	-	S	S	M	S
CO	M	M	M	M	M	-	-	-	-	-	-	S	M	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

PRINCIPLES OF MEDICINAL CHEMISTRY

Physicochemical properties in relation to biological action: Ionization, Drug distribution and pKa values and their relation to drug transport, hydrogen bonding, redox potential, surface activity and chelation. Steric properties of drugs: optical and geometrical isomerism. Functional group and their effects of on drug action: steric effect, concept of isosterism, bioisosterism, homologs and analogs.

DRUGS ACTING ON SYNAPTIC AND NEURO-EFFECTOR JUNCTION SITES

Classification, biochemical/molecular basis of mechanism of action, structure activity relationship including stereo chemical aspects, physiochemical properties and synthesis of selected drugs belonging to the class of Cholinergics, Anticholinergics, Anticholinesterases and Adrenergics.

DRUGS ACTING ON THE CENTRAL NERVOUS SYSTEM

Classification, molecular basis of mechanism of action, structure activity relationship and synthesis of Hypnotics and Sedatives, Opioid analgesics, Anticonvulsants and Psychopharmacological agents (neuroleptics, antidepressants, anxiolytics).

DRUGS ACTING ON CARDIOVASCULAR SYSTEM

Structural basis of mechanism of action, structure activity relationship including physiochemical properties, and synthesis of selected drugs belonging to the class of anti-anginal, vasodilators, calcium channel blockers and cardiac glycosides.

AUTOCOIDS

Synthetic procedures, uses, structure activity relationship including physicochemical properties of the following classes of drugs Antihistamines, Eicosanoids, Analgesic-antipyretics, Anti - inflammatory (non-steroidal) agents.

TEXT BOOKS:

1. AshutoshKar, Medicinal Chemistry, 6th Edition, New Age International (P) Ltd. Publishers, New Delhi 2015.
2. Graham L. Patrick, An introduction to Medicinal Chemistry, 6th Edition, Oxford University Press, 2017.
3. Ilango, K. and Valentina, P., "Text book of Medicinal Chemistry", Vol.1, 1st edition, Keerthi Publishers,2007.

REFERENCES:

1. Donald J. Abraham, Burger's Medicinal Chemistry and Drug Discovery, Vol V, 6th Edition,JohnWileyand Sons, Inc.,2003.
2. William O Foye, Thomas L Lemke, David A Williams Foye's Principles of Medicinal Chemistry, 7th Edition, Wolters Kluwer Health Adis (ESP) Publisher, 2012.
3. Indian Pharmacopoeia, Vol-I,7th Edition, Published by Indian Pharmacopoeia Commission India, 2014.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	G.Arthi	Assistant professor	Biotechnology	arthi@vmkvec.edu.in
2	Dr.S.Anusuya	Associate Professor	Pharmaceutical Engineering	dr.s.anusuya@vmkvec.edu.in

17PECC13	PHARMACOLOGY	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Basic principles of pharmacology, including receptor mechanisms, drug distribution and metabolism, and pharmacokinetics. Lectures, laboratories, and tutorials on the interactions of
drugs and biological systems as a basis for rational disease therapy

PREREQUISITE - 17PECC04 HUMAN PHYSIOLOGY

COURSE OBJECTIVES

1	Define the various factors that can affect the action of drugs.
2	Discuss the various routes of drug administration with advantages and disadvantages of the various routes.
3	Describe the methods in experimental pharmacology.
4	Outline the importance of rational prescribing of drugs and the concept of essential drugs.
5	Categorize the effects of drugs pertaining to GIT, endocrine system, haemopoietic system and also know the principles of chemotherapy.

COURSE OUTCOMES

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

CO1. Demonstrate the mechanism of drug action.	Understand
CO2. Discuss complete information about the drugs like sources, physico chemical properties, physiological and biochemical effects.	Understand
CO3. Illustrate pharmacokinetics and toxicities of drugs	Apply
CO4. Differentiate the routes of administration of different classes of drugs.	Apply
CO5. Examine comprehend the principles of chemotherapy	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO1	PSO	PSO	PSO3
CO1	M	M	M	M	M	-	-	M	-	-	-	M	M	S	S
CO2	M	M	M	M	M	-	-	M	-	-	-	M	M	S	S
CO3	S	S	S	S	M	-	-	M	-	-	-	M	M	S	S
CO4	M	M	M	M	M	-	-	L	-	-	-	M	M	S	M
CO5	M	M	M	M	M	-	-	L	-	-	-	M	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO PHARMACOLOGY

Sources of drugs, dosage forms and routes of drug administration, mechanism of action of drugs. Combined effect of drugs, factors modifying drug action, tolerance and dependence. Absorption, Distribution, Metabolism and Excretion of drugs. Principles of basic and clinical pharmacokinetics. Adverse drug reactions. Drug interactions, Bioassay of drugs and biological standardisation, Overview of drug discovery and development.

CENTRAL NERVOUS SYSTEM

Nerve conduction and transmission in the C.N.S, general anaesthetics, sedatives, hypnotics, anti-anxiety agents and centrally acting muscle relaxants, Psychopharmacological agents – Antipsychotics, antidepressants, neuroleptics, anti-maniacs and hallucinogens, thymoleptics, antiepileptic drugs, Anti-parkinsonism drugs, analgesics, antipyretics, anti-inflammatory (NSIADs) and anti-gout drugs, narcotic analgesics and antagonists, C.N.S. stimulants, drug addiction and drug abuse.

CARDIOVASCULAR SYSTEM AND HAEMOPOIETIC SYSTEM

Cardiac glycosides, anti-hypertensive drugs, anti-anginal and vasodilator drugs including calcium channel blockers and beta adrenergic antagonists, Anti-arrhythmic drugs, antihyperlipidemic drugs, Drugs used in the therapy of shock. Haematinics, Anticoagulants, vitamin K and haemostatic agents, Fibrinolytic and anti-platelet drugs, Blood plasma volume expanders.

GASTROINTESTINAL TRACT, RESPIRATORY TRACT AND URINARY SYSTEM

Antacids, anti-secretory and anti-ulcer drugs, Laxatives and Anti-diarrhoeal drugs, Appetite stimulants and suppressants, Emetics and anti-emetics. Fluid and electrolyte balance, Diuretics and Anti-diuretics, Anti-asthmatic drugs including bronchodilators, anti-tussives and expectorants.

CHEMOTHERAPY

General principles of chemotherapy, Sulfonamides, Antibiotics – Penicillins, Cephalosporins, Chloramphenicol, macrolides, Quinolones, fluroquinolones and other antibiotics. Chemotherapy of tuberculosis, leprosy, fungal diseases, viral diseases, urinary tract infections and sexually transmitted diseases. Chemotherapy of malignancy and immuno suppressive agents

TEXTBOOKS

1. Satoskar, Pharmacology and Therpeutics, Popular Prakashan Ltd, 2015
2. Tripathi, K.D. Medical Pharmacology, VIIth edition, 2013
3. Lippincott's Illustrated Reviews: Pharmacology by Karen Whalen, Lippincott Williams and Wilkins; VIth International edition, 2014
4. H. L. Sharma, K. K. Sharma, Principles of Pharmacology, Paras Medical Publishers, 3rd Edition, 2017.
5. Mycek M.J., Gerlnet S.B and Perper M.M. Pharmacology, Lippincott’s Illustrated
6. Reviews, Lipincott Company, Philadelphia

REFERENCES

1. Rang, M.P, Dale M.M, Reter J.M-Pharmacology.
2. Goodman and Gilman’s, The Pharmacological basis of therapeutics.
3. Ghosh M.N, Fundamentals of Experimental Pharmacology, Scientific Book Agency,Calcutta.
4. B. Lammer, Chronopharmacology
5. Katzung, B.G., Basic and Clinical Pharmacology, Prentice Hall International.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	G.Arthi	Assistant professor	Biotechnology	arthi@vmkvec.edu.in
2	Dr.S.Anusuya	Associate Professor	Pharmaceutical Engg	dr.s.anusuya@vmkvec.edu.in

17PECC14	TECHNOLOGY OF STERILE PRODUCTS	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Thiscourse enables the student to understandthe design, development and manufacturing of sterile drug dosage forms. This course also focuses towards formulation development and product manufacture of quality sterile dosage forms that meet or exceed expected good manufacturing practice requirements.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To describe the principles of parenteral dosage form formulation
2	To execute the concepts involved in the manufacture of sterile products
3	To solve the difficulties associated with drug delivery to ear, ophthalmic and Nasal region
4	To differentiate the use of various additives in sterile formulations.
5	To prepare parenteral based on the guidelines of regulatory bodies.

COURSE OUTCOMES

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

CO1. Describe the principle of manufacturing parenteral products	Understand
CO2. Illustrate the various strategies involved in manufacturing of sterile products.	Apply
CO3. Demonstrate drug delivery to ear, nose and ophthalmic organs.	Apply
CO4. Examine the role of additives in formulation of sterile products.	Analyse
CO5. Appraise the guidelines formulation, manufacturing, packaging and marketing of sterile products	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO1	PSO	PSO	PSO3
CO1	M	M	M	M	M	-	-	-	-	-	-	M	S	S	M
CO2	S	S	S	S	M	-	-	-	-	-	-	M	M	M	M
CO3	S	S	S	S	M	-	-	-	-	-	-	M	M	M	M
CO4	M	M	M	M	M	-	-	-	--	-	-	M	M	M	M
CO5	M	M	M	M	M	-	-	-	--	-	-	M	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO PARENTERAL PRODUCTS

Pre-formulation factors, routes of administration, water for injection, pyrogenicity, non-aqueousvehicles, isotonicity and methods of its adjustment. Formulation details, containers and closuresand their selection; Prefilling treatment, washing the container and closers, preparation of solution and suspension, filling, closing of ampoules, vials, infusion fluids, lyophilization, preparation ofsterile powders, equipment for large scale manufacture and evaluation of parenteral products.

ASEPTIC TECHNIQUES IN PARENTERALS

Aseptic techniques: Source of contamination, methods of prevention, design of aseptic area,laminar flow bench,

air handling units, services and maintenance; Stability evolution of sterilepharmaceutical dosage forms; special precautions on blood products, glandular products, medicalsutures, ligatures.

EAR, NASAL AND OPHTHALMIC DRUG DELIVERY

Nasal and ocular drug delivery overview, membrane transport processes in the eye, nasal andocular drug transfer following systemic drug administration, ocular pharmacokinetics andpharmacodynamics ocular penetration enhancers, corneal collagen shields for ocular drugdelivery, the noncorneal route in ocular drug delivery, ocular iontophoresis, mucoadhesivepolymers in ophthalmic drug delivery, dendrimers, new experimental therapeutic approaches fordegenerative diseases of the retina, gene, oligonucleotide, and ribozyme therapy in the eye.

FORMULATION ADDITIVES

Classifications of various additives in sterile formulations, Buffers, density modifiers, isotonicity modifiers, viscosity enhancers, preservatives, irrigation sadditives.

PARENTERAL REGULATIONS AND VALIDATIONS

cGMP regulations of parenteral drugs, Risk assessment and mitigation in aseptic processing,Development challenges and validation of fill and finish processes for bio-therapeutics, Excipientsfor parenteral dosage forms: regulatory considerations and controls, Parenteral productspecifications and stability, The management of extractables and leachable in pharmaceuticalproducts, Process analytical technology and rapid microbiological methods, Quality assurance.

TEXT BOOKS

1. Pharmaceutical Dosage Forms Parenteral Medications, Third Edition Volume 3, Sandeep Nema, John D. Ludwig, Informa Healthcare is a trading division of Informa UK Ltd
2. Lachman, Leon et al. “The Theory and Practice of Industrial Pharmacy” IIIrd Ed., Varghese Publishing House, 1987.
3. Aulton, Michael E. “Pharmaceutics: The Science of Dosage Form Design” IInd Ed., Churchill Livingstone, 2002.
4. Ophthalmic Drug Delivery Systems Second Edition, Revised and Expanded, Ashim K. Mitra, 2003 Marcel Dekker
5. Allen, Loyd V. et al. “Ansel’s Pharmaceutical Dosage Forms and Drug Delivery Systems”

REFERENCES

1. Remington’s Pharmaceutical Sciences (RPS).
2. Modern Pharmaceutics by Banker and Gilberts.
3. Theory and Practice of Industrial Pharmacy by Lachman.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. V. Muruganantham	Associate Professor	Pharmaceutics	svmanand@yahoo.com
2	Dr.R.MargretChandira	Professor	Pharmaceutics	mchandira172@gmail.com

17PECC15	DOWNSTREAM PROCESSING (THEORY AND PRACTICE)	Category	L	T	P	Credit
		CC	2	0	2	3

PREAMBLE

Downstream processing refers to the recovery and purification of biosynthetic products, particularly pharmaceuticals, from natural sources such as animal or plant tissue or fermentation broth, including the recycling of salvageable components and the proper treatment and disposal of waste. It is an essential step in the manufacture of pharmaceuticals such as antibiotics, hormones (e.g. insulin and humans growth hormone), antibodies (e.g. infliximab and abciximab) and vaccines; antibodies and enzymes used in diagnostics; industrial enzymes; and natural fragrance and flavor compounds.

PREREQUISITE

17PECC08-PHARMACEUTICAL BIOPROCESS ENGINEERING

COURSE OBJECTIVES

1	To implement the basic knowledge of downstream processing
2	To outline the physical methods of separation.
3	To differentiate the isolation of products
4	To distinguish purification methods
5	To justify the importance of formulation and finishing operation

COURSE OUTCOMES

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

CO1. Generalize the various basic processes in down streaming.	Understand
CO2.Distinguish the various physical methods of separation.	Understand
CO3. Demonstrate the various purification methods	Apply
CO4. Analyze the isolation of products	Analyse
CO5.Assess the knowledge of formulation and finishing operations	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

OVERVIEW OF DOWNSTREAM PROCESSING

Introduction to downstream processing - principles characteristics of biomolecules and bioprocesses. Cell disruption for product release – mechanical, enzymatic and chemical methods- Pretreatment and stabilization of bioproducts- **Formulation, Fill and Finish**

PHYSICAL METHODS OF SEPARATION

Unit operations for solid-liquid separation – thermal processing- filtration and centrifugation.

ISOLATION OF PRODUCTS

Adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation ultrafiltration and reverse osmosis, dialysis, precipitation of proteins by different methods.

PRODUCT PURIFICATION

Chromatography – principles, instruments and practice, adsorption, reverse phase, ion exchange, size exclusion, hydrophobic interaction, bio affinity and pseudo affinity chromatographic techniques.

FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS

Crystallization, drying and lyophilization in final product formulation.

TEXT BOOKS:

1. Belter, P.A., Clussler, E.L. "Bioseparation – Downstream Processing & Biotechnology". John – Wiley Interscience, 1998.
2. Asenjo, Juan A. "Separation Processes in Biotechnology". Taylor & Francis / CRC, 1990.
3. Scopes, R.K. "Protein Purification: Principles and Practice". Narosa Publication,
4. Krishna Kant Prasad, Nooralabettu Krishna Prasad. **"**Downstream Process Technology: A New Horizon in Biotechnology" PHI Learning Pvt Ltd, 2010.

REFERENCES:

1. Ghosh, Raja "Principles of Bioseparations Engineering". World Scientific, 2006.
2. "Product Recovery in Bioprocess Technology". (BIOTOL – Biotechnology by Open Learning Series). Butterworth – Heinmann / Elsevier.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1.	Dr.T. Shanthi	Professor and Head	Chemistry	Shanthi@vmkvec.edu.in
2.	Dr.S.Anusuya	Associate Professor	Pharmaceutical Engineering	dr.s.anusuya@vmkvec.edu.in

17PECC16	CHEMICAL ENGINEERING THERMODYNAMICS	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

The course introduces the basic principles and calculation techniques in the field of chemical engineering. It provides a concrete understanding of fundamentals and applications of material balances and energy balances which help students to understand the concepts of thermodynamics and fluid mechanics. It also provides a basis for non-chemical engineers to realize the chemical engineering aspects of subsequent modules.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To Summarizefirst law of thermodynamics to identify, formulateand solve engineering problems.
2	To demonstrate the practical implications of thermodynamic law in engineering design.
3	To implement power generation and refrigeration processes.
4	To outline the partial molar property and describe its role in determining the properties of mixtures.
5	To Differentiate the properties of phase and chemical equilibria.

COURSE OUTCOMES

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

CO1. Explain about correlation of mathematics, science and engineering principles for problem solving in process industries.	Understand
CO2. Demonstrate the fundamental concepts of thermodynamics to overcome existing industrial problems.	Apply
CO3. Differentiate the mixture based on molar property.	Apply
CO4. Ability to apply laws of thermodynamics to biological processes	Analyze
CO5. Appraise the equilibrium of a system.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO1	PSO2	PSO3
CO1	S	M	S	L	-	-	-	-	-	-	-	-	M	-	-
CO2	M	M	S	-	-	-	-	-	-	-	-	-	-	-	-
CO3	S	S	-	M	L	L	-	-	-	-	-	-	-	-	-
CO4	S	S	S	L		-	-	-	-	-	-	-	-	M	-
CO5	S	M	-	M	L	-	-	-	-	-	-	L	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

FUNDAMENTAL CONCEPTS AND FIRST LAW OF THERMODYNAMICS

Scope of thermodynamics – Basic concepts – Thermodynamic system – State andequilibrium – Process and cycles – Temperature and zeroth law of thermodynamics –Properties of pure substances – First law of thermodynamics – First law analysis of closedsystems and control volumes and its application.

ENTROPY AND THE SECOND LAW OF THERMODYNAMICS

The Clausius inequality – Entropy – Causes of entropy change – Entropy change of Pure substances –Thermal energy reservoirs – Heat engines – Perpetual motion machines –Reversible and irreversible processes – The Carnot cycle and principles – The Carnot Heat engine– The second law efficiency – Second law analysis of open and closed systems.

REFRIGERATION, VAPOR AND COMBINED POWER CYCLES

Refrigeration and liquefaction process, Thermodynamic Potentials, thermodynamic correlation,Maxwell relations, criteria for Equilibria and stability, Clapeyron equation.

MOLAR PROPERTIES OF SOLUTIONS AND MIXTURES

Partial molar properties, ideal and non-ideal solutions, standard states definition and choice,Gibbs-Duhem equation, activity and property change of mixing, excess properties of mixtures.

PHASE EQUILIBRIA AND CHEMICAL REACTION EQUILIBRIA

Activity coefficient-composition models, thermodynamic consistency of phase equilibria,Chemical Reaction equilibria, Extent of reaction, equilibrium constant and standard free energy change.

TEXT BOOKS:

1. Smith, J.M. and Van Ness, "Introduction to Engineering Thermodynamics", 5th Edition,McGraw Hill, 1996.
2. Narayanan, K.V., "A Text Book of Chemical Engineering Thermodynamics", Prentice Hall ofIndia, 2002.

REFERENCES:

1. Stanley I. Sandler, "Chemical, Biochemical and Engineering Thermodynamics", John-Wiley, 4th edition, 2006
2. Hougen and Watson, "Chemical Process Principles" Vol. II, CBS Publishers, 2002.
3. Kyle, "Chemical and Process Thermodynamics", 2nd Edition, Prentice Hall of India, 2000.
4. Rao,Y.V.C., "Chemical Engineering Thermodynamics", Universities Press, 1997.

COURSE DESIGNERS

S. No	Name of the Faculty	Designation	Department	Mail ID
1.	Mrs.C.Nirmala	Assistant Professor	Biotechnology	nirmala@vmkvec.edu.in
2.	Mrs.G.Arthi	Assistant Professor	Biotechnology	arthi@vmkvec.edu.in

17BTCC83	MICROBIOLOGY LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

This course includes preparing stained smears, culturing microorganisms, conducting immunology experiments, performing tests to identify bacteria and fungi, and studying microbial growth control.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	Describe the safe practices in a microbiology laboratory.
2	Perform various cells staining techniques.
3	Demonstrate proper usage, identify the parts/functions of the following microscopes
4	Perform transfer of living microbes using aseptic technique.
5	Differentiate the microbes enumerated from various environments.

COURSE OUTCOMES

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

CO1. Experiment with microscope to reveal the structure and function of microorganisms	Apply
CO2. Identify the methods for isolation, subculture, and maintenance of bacterial and fungal specimens	Apply
CO3 Examine the uses of various media and testing protocols with focus on clinical applications.	Analyze
CO4. Inspect the causes and consequences of microbial evolution and the generation of diversity as well as human impacts on adaptation.	Analyze
CO5.Determine the evidence of bacterial and fungal metabolism as it relates to identification and control of pathogenic organisms	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	-	-	-	L	-	M	-	-	-	-	-	M	M	S
CO2	M	S	M	-	-	-	M	-	-	-	-	-	M	M	-
CO3	M	M	M	M	M	-	-	-	S	M	-	-	M	M	-
CO4	L	M	M	M	-	-	S	-	S	M	-	-	S	S	M
CO5	L	-	L		M	S	M	-	-	S	-	M	M	S	-

S- Strong; M-Medium; L-Low

SYLLABUS

1. Sterilization Techniques.
2. Culture Media Preparations
   a. Broth media
   b. Agar
3. Culturing of Micro organisms
   a. Pure Culture techniques -Streak plate
   -Pour plate
4. Isolation, Enumeration and Purification of Microbes from a given sample.
5. Preservation of Bacterial Culture.
6. Identification of Microorganisms

a. Staining techniques-Simple-Gram-Spore-Hanging drop

b. Biochemical identification

7. Quantification of Microorganisms

Microscopy

a. Serial dilution and plating

8. Environmental Sample Analysis-.MPN Test

9. Food Microbiology

-Milk

-Fermented food

10. Clinical Microbiology

- Blood and Urine Culture
- Antibiotic Disc test Assay.

REFERENCES:

1. Cappuccino, J. G. and Sherman, N., 1999. Microbiology: Alaboratory Manual. 4th Edn, Addison - Wesley.

2.Collee, J. G., et al., 1996. Mackie and McCartney PracticalMedical Microbiology. 4th Edn, Churchill Livingstone.

3. Sundararaj, T., 2007. Microbiology laboratory manual. AswathySunndararaj.

4. Laboratory Manual

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Mrs.G.Arthi	Assistant Professor	Biotechnology	arthi@vmkvec.edu.in
2	Dr.R.Devika	Professor	Biotechnology	devika@avit.ac.in

17PECC81	PHYSICAL PHARMACEUTICS LAB	CATEGORY	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

The course deals with the various physical, physicochemical properties and principle involved in dosage form formulations. This course also provides a better insight into various areas of formulation research and development, and stability studies of pharmaceutical dosage forms.

PRERQUISITE

NIL

COURSE OBJECTIVES

1	To discuss various physicochemical properties of drug molecules in the designing the dosage forms
2	To perform the formulation of emulsions and suspensions, access the physical stability of the product.
3	To execute the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations.
4	To compare the rheology of Newtonian and non-Newtonian fluids and to determine the various possible interaction of protein with drugs.
5	To outline the various laws of thermodynamics associated with formulation of dosage forms.

COURSE OUTCOMES

After completion of course, student is able to know

CO1. To describe the properties of drug molecule	Understand
CO2. To demonstrate the formulation of emulsions and suspensions.	Apply
CO3.To illustrate the stability of various formulations.	Apply
CO4. To differentiate the rheology of various fluids used in development of various formulations	Analyse
CO5. To Test the parameters causing effect in the formulation.	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	PO	PO	PO	PO	PO	PO	PO	PO	PO9	PO1	PO1	PO1	PSO	PSO	PSO
CO	M	L	L	L	L	-	-	-	-	-	-	L	-	M	-
CO	M	M	M	L	M	-	-	-	-	-	-	M	M	M	M
CO	S	M	M	S	M	-	-	-	-	-	-	M	M	M	M
CO	M	L	L	L	M	-	-	-	-	-	-	M	-	M	M
CO	M	M	L	L	-	-	-		-	-	-	-	-	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

1. Determination of latent heat, vapor pressure, critical point.
2. Studies on polymorphs, their identification and properties.
3. Determination of particle size, particle size distribution and surface area using various methods of particle size analysis.
4. Determination of derived properties of powders like density, porosity, compressibility, angle of repose, etc.
5. Determination of surface/interfacial tension, HLB value and critical micellar concentration (CMC) of surfactants.
6. Study of rheological properties of various types of systems using different viscometers.
7. Study of different types of colloids and their properties.
8. Preparation of various types of suspensions and determination of their sedimentation parameters.
9. Preparation and stability studies of emulsions.
10. Studies on different types of complexes and determination of their stability constants.
11. Determination of half-life, rate constant and order of reaction.
12. Preparation of pharmaceutical buffers and determination of buffer capacity.
13. Experiments involving tonicity adjustments.

TEXT BOOKS:

1. R. Manavalan and C. Ramasamy. "Physical Pharmaceutics",Vignesh publisher,2015.
2. G. Agarwal. "Pharmaceutical Technology II",CBS publishers and distributors Pvt ltd,2012.

REFERENCEE BOOKS:

1. Dr.Jayapal Reddy Gangadi. "Physical Pharmacy-II", 1st Edition, Createspace 2017.
2. C.V.S. Subramanyam, S.G.Vasantharaju, "Laboratory manual for physical pharmacy", 2nd Edition, Vallabhah Prakash, 2005.

COURSE DESIGNERS

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17PECC82	HUMAN PHYSIOLOGY LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

The main purpose of the subject is to understand and recognize the anatomical structures and explain the physiological functions of body systems.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To understand the antigen-antibody and agglutination principle behind blood grouping
2	To estimate the number of different blood cells and haemoglobin in blood
3	To create an awareness of cell counts in an healthy and in a diseases state
4	To estimate human blood pressure

COURSE OUTCOMES

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

CO1. Detect blood group of an individual and capable of explaining the agglutination pattern during testing	Understand
CO2. Demonstrate laboratory procedures used to count blood cells	Apply
CO3. Evaluate the health of an individual from their blood cell counts	Analyse
CO4.Validate the blood pressure of an individual.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO3
CO 1	M	L	L	L	L	-	-	-	-	-	-	M	M	M	M
CO 2	M	M	M	M	M	-	-	-	-	-	-	L	M	M	-
CO 3	M	L	L	L	M	-	-	-	-	-	-	-	-	M	M
CO 4	M	L	L	L	L	-	-	-	-	-	-	-	M	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

1. Determination of bleeding time.
2. Determination of clotting time.
3. Determination of blood grouping.
4. Estimation of haemoglobin content.
5. Determination of RBC count.
6. Determination of WBC count.
7. Determination of pulse rate
8. Determination of heart rate.

9. Determination of blood pressure.
10. Erythrocyte sedimentation rate – Westergrens method.

REFERENCE

1. Lab manual

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1.	Mr.P.Senniappan	Assistant Professor	Pharmacognosy	senniappan1979@gmail.com
2.	Mr.S.Raghu	Assistant Professor	Pharmacology	sragusrinivasan@gmail.com

17PECC83	MOLECULAR BIOLOGY AND GENETIC ENGINEERING LAB	CATEGORY	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

Molecular Biology and Genetic engineering laboratory make undergraduate students to understand and develop basic molecular techniques and give training in the skills involved in rDNA Technology.

PRERQUISITE

NIL

COURSE OBJECTIVES

1	To describe the principle of nucleic acid isolation.
2	To discuss the principle of electrophoretic techniques for analyzing the biomolecules
3	To demonstrategene cloning and screening of recombinants
4	To summarize the knowledge of hybridization of biomolecules.

COURSE OUTCOMES

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

CO1. Exemplify the laboratory techniques used for the isolation of nucleic acids from various sources.	Understand
CO2. Describe core Nucleic acid techniques such as extraction, nucleic acid separations and elution.	Understand
CO3. Illustrate clearly about the gene amplification and methods for analysis of DNA, such as hybridization, restriction analysis and gene expressions.	Apply
CO4. Practice DNA Fingerprinting methods to analyze DNA samples	Apply
CO5.Examine the Purification of biomolecules by electrophoresis	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	PO	PO	PO	PO	PO	PO	PO	PO	PO9	PO1	PO1	PO1	PSO	PSO	PSO
CO	M	L	-	M	M	L	-	-	-	-	-	-	M	-	-
CO	M	L	-	M	M	L	-	-	-	-	-	-	M	-	-
CO	S	M	M	M	M	L	-	-	-	-	-	M	M	M	M
CO	S	M	M	M	M	L	-	-	-	-	-	M	M	M	M
CO	M	M	M	M	M	L	-	-	-	-	-	-	M	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

1. Isolation of Genomic DNA
2. Isolation of Plasmid DNA.
3. Isolation of Mitochondrial DNA.
4. Detection of Plasmid DNA by Agarose gel electrophoresis

5. Electroelution of DNA from Agarose gel.
6. SDS Poly Acrylamide Gel Electrophoresis.
7. Restriction digestion of λ DNA.
8. Ligation of DNA.
9. Preparation of Competent Cells – Calcium chloride Method.
10. Transformation in *E. coli* by Heat Shock Induction Method.
11. DNA Fingerprinting using Restriction fragment length polymorphism (RFLP)
12. DNA Fingerprinting using Random Amplified Polymorphic DNA(RAPD)
13. Blue White Screening of Recombinants.
14. Blotting techniques – Southern, Western

REFERENCE BOOKS:

1. Sambrook, Joseph and David W. Russell "The Condensed Protocols: From Molecular Cloning: A Laboratory Manual", Cold spring harbor Laboratory Press, New York, USA.
2. Ausubel, F.M. "Short Protocols in Molecular Biology", 4th Edition, John Wiley, 1999.

COURSE DESIGNERS

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2	Ms.G.Arthi	Assistant Professor	Biotechnology	arthi@vmkvec.edu.in

17PECC84	PHARMACEUTICAL ANALYSIS LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

This subject deals with various advanced analytical instrumental techniques for identification, Characterization and quantification of drugs. The course is designed to impart the knowledge in the field of Pharmaceutical analysis. The various modern analytical techniques like UV-Visible, IR, NMR, Mass, GC, HPLC,different chromatographic methods and other important topics are taught to enable the students tounderstand and apply the principles involved in the determination of different bulk drugs and theirformulation. In addition to the theoretical aspects, the basic practical knowledge relevant to the analysis also imparted.

PRERQUISITE

NIL

COURSE OBJECTIVES

1	To make students familiar with the principles of modern analytical techniques and it's application in pharmacy.
2	To familiarize students in use of modern techniques of analysis used in different areas / fields of pharmacy.
3	To give training in use of the technique & its applications in day to day practice.
4	To build on the basics learned at UG level & give latest advances in the area.
5	To give more stress on application-based knowledge than instrumentation basedone.
6	To give hands on training on use of as many different instruments aspossible.

COURSE OUTCOMES

After completion of course student is able to know

CO1.Describe Drugs, Chemicals and Excipients used in Pharma industry	Understand
CO2.Understanding the fundamental principles in analysis.	Understand
CO3. Concept of modern analytical techniques, which is important for qualitative aswell as quantitative analysis of drug substances and drug product.	Understand
CO4.Interpretations of the various spectroscopic data	Apply
CO5. Applying theoretical knowledge and practical skills in using the instruments	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	PO	PO	PO	PO	PO	PO	PO	PO	PO9	PO1	PO1	PO1	PSO	PSO	PSO
CO	M	M	M	M	L	M	-	-	-	-	-	M	M	M	M
CO	M	M	M	S	S	M	-	-	-	-	-	M	M	-	M
CO	M	S	M	S	M	M	-	-	-	-	-	M	M	-	M
CO	S	S	S	M	M	M	-	-	-	-	-	M	M	-	M
CO	S	S	S	M	M	M	-	-	-	-	-	M	M	-	M

S- Strong; M-Medium; L-Low

SYLLABUS

1. Calibration glassware
2. Calibration of pH meter and pH measurement of various buffers
3. Calibration of UV Spectroscopy
4. Calibration of HPLC
5. Calibration of flourimetry
6. Acid Base Titrations (minimum of 2 experiments)
7. Complexometric Titrations (minimum of 2 experiments)
8. Separation and calculation of Rf values by using paper chromatography, TLC
9. Technique (2-3 experiments)
10. Experiment base on HPLC (Isocratic and gradient) Techniques – (2 experiments)
11. Determination of λ max of different drugs and preparation of calibration curve
12. Estimation of single drug (raw material/ formulations) by UV spectrophotometry. (minimum of 4 experiments)
13. Estimation of multicomponent formulation by UV- Spectrophotometer (minimum of 4 experiments)
14. Identification of different functional groups by IR (amino group, alcoholic group amide, ester, acid group etc).

TEXT BOOKS:

1. Text book of pharmaceutical analysis by S.Ravishankar.
2. Instrumental methods of chemical analysis by Chatwal. K, Anand, 5th edition.
3. Spectroscopy by B.K.Sharma

REFERENCE BOOKS:

1. Spectrometric identification of organic compounds by Silverstein, Webster.
2. Fundamentals of analytical chemistry by Skoog
3. Organic spectroscopy by Y.R.Sharma.
4. Instrumental methods of analysis by Willard, Merit, Dean, Settle.

COURSE DESIGNERS

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1	Mr.S.Alexandar	Assistant Professor	Pharmaceutical Chemistry	alexmpharm@gmail.com
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17PECC85	PHARMACEUTICAL BIOPROCESS ENGINEERING LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

The course provides the student with the basics of bioreactor technology. It specifically focuses on bioreactor performance and operation and on the kinetics related to microbial growth, product formation, function of enzymes and transfer phenomena.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To Interpret the concept of design and procedures to evaluate the performance of thebioreactor in bioprocess.
2	To Perform enzyme immobilization in bioprocess industry.
3	To Demonstrate the media optimization based on the process.
4	To Outline the engineering principles of bioprocesses including characteristics of different microbial cells, enzymes, microbial kinetics, and design considerations.
5	To develop large scale production of a product in bioprocess industry.

COURSE OUTCOMES

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

CO1. Describe the fundamental concepts of bioprocessing; Understand the difference between bioprocesses and chemical processes.	Understand
CO2. Illustrate bio catalysis in scaling up the commercial processes using bioreactors	Apply
CO3. Demonstrate bioprocesses in a bacterium, fungi or yeast, and their energy metabolism and carbon sources through various parameter	Apply
CO4. Develop a Bioprocess design and operation and select suitable the bioreactor for a product.	Analyse
CO5. Evaluate, analyse and interpret data from bioprocesses.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO1	PSO	PSO	PSO3
CO1	L	L	L	L	L	-	-	-	L	-	L	L	M	M	-
CO2	M	M	M	M	-	-	-	-	-	-	L	L	M	-	-
CO3	S	S	S	S	L	L	-	L	L	L	L	L	S	M	-
CO4	M	L	L	M	M	-	-	-	-	-	-	-	-	M	-
CO5	L	L	L	L	M	-	-	L	-	S	M	M	S	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

1. Growth of bacteria – estimation of biomass, calculation of specific growth rate, yield coefficient
2. Medium optimization – Plackett Burman design, response surface methodology
3. Enzyme kinetics – MichelisMenton parameter, effect of temperature and pH
4. Enzyme immobilization – Gel entrapment, Cross linking

5. Preparation of bioreactor, Utilities for bioreactor operation
6. Thermal death kinetics
7. Batch sterilization design
8. Batch cultivation, Estimation of KLa – Dynamic gassing method, Exhaust gas analysis – Carbon balancing, Gas balancing
9. Fed batch cultivation, exhaust gas analysis – carbon balancing, gas balancing
10. Estimation of KLa – sulphite oxidation method
11. Estimation of overall heat transfer coefficient

TEXT BOOKS

1. Michael L. Shuler and FikretKargi, Bioprocess Engineering, Basic Concept, 2nd Edition, Prentice Hall PTR, 2002.
2. Pauline Doran, Bioprocess Engineering Calculation, Blackwell Scientific Publications

REFERENCES

1. Bailey, J.E. and Ollis, D.F. "Biochemical Engineering Fundamentals" 2nd Edition, McGraw – Hill, 1988.
2. Lee, James M. "Biochemical Engineering", PHI, U.S.A.Stanbury, P.F. etal.
3. Principles of Fermentation Technology", 2nd Edition, Butterworth – Heinemann /Elsevier, 1995.
4. El-Mansi, E.M.T. etal., "Fermentation Microbiology and Biotechnology", II Edition,CRC /Taylor & Francis, 2007.
5. Peppler, H.J. and D. Perlman "Microbial Technology" (vol. I Microbial Processes and Vol. I Fermentation Technology)" 2nd Edition, Academic Press / Elsevier, 2004Inc.

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1.	Ms.C.Vanathi	Assistant Professor	Biotechnology	vanathi@vmkvec.edu.in
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17PECC86	PHARMACEUTICAL CHEMISTRY LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

The subject deals with different analytical methods of organic and inorganic compounds in pharmaceutical industries.

PRERQUISITE

NIL

COURSE OBJECTIVES

1	To outline the presence and limitations of impurities in the pharmaceutical substances
2	To explain different identification tests for various chemical compounds
3	To Implement different preparation and standardization methods
4	To understand the principles of different assays and to inculcate the ability to apply this for quantitative analysis of various drugs
5	To understand the principles of conductometric and potentiometric titrations and finding the normality of a solution using these electro analytical methods
6	To outline the presence and limitations of impurities in the pharmaceutical substances

COURSE OUTCOMES

After completion of course student is able to know

CO1. Practice to test different impurities and their limits in drugs	Understand
CO2. Understanding the principles in different identification tests	Understand
CO3. Preparing and standardizing different reagents	Apply
CO4. Understanding the principles of various titrations and applying them for quantitative analysis of drugs/compounds	Apply
CO5. Estimating the normality by different electro-analytical methods	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	PO	PO2	PO	PO	PO	PO	PO	PO	PO9	PO1	PO1	PO1	PSO	PSO	PSO
CO	M	L	L	L	L	L	-	-	-	-	-	-	-	M	M
CO	M	M	L	M	-	L	-	-	-	-	-	L	-	M	-
CO	S	S	S	S	L	L	-	-	-	-	-	-	-	-	-
CO	S	L	M	M	M	L	-	-	-	-	-	M	M	M	M
CO	M	-	-	-	M	S	-	-	-	-	-	-	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

1. Limit tests for

Chlorides and Sulphates, Iron, Heavy metals, Lead, Arsenic

2. Identification test

Magnesium hydroxide, Ferrous sulphate, Sodium bicarbonate, Calcium gluconate, Copper sulphate

3.Preparation and standardization of

Sodium hydroxide, Sulphuric acid, Sodium thiosulphate, Potassium permanganate, ceramic ammonium sulphate

4.Assay for the following compounds along with standardization of titrants

a)Ammonium chloride by Acid base titration
b) Ferrous sulphate by Cerimetry
c) Copper sulphate by Iodometry
d) Calcium gluconate by Complexometry
e) Hydrogen peroxide by Permanganomaetry
f) Sodium benzoate by non- aqueous titration
g) Sodium Chloride by Precipitation titration

5.Test for purity

a) Swelling power of bentonite
b) Neutralizing capacity of aluminium hydroxide gel
c) Determination of potassium iodate and iodine in potassium iodide

6.Determination of Normality by electro-analytical methods

a) Conductometric titration of strong acid against strong base.
b) Conductometric titration of strong acid and weak acid against strong base.
c) Potentiometric titration of strong acid against strong base.

7.Preparation of inorganic pharmaceuticals

Boric acid, Potash alum, Ferrous sulphate

REFERENCE BOOKS:

1. A.H.Bockett and J.B.Stenlake's Practical Pharmaceutical chemistry Vol I and II. Stahlone Press of University of London, 4th Edition.
2. A.I.Vogel, Text Book of Quantitative Inorganic analysis.
3. P.Gundu Rao, Inorganic Pharmaceutical chemistry, 3rd Edition
4. M.L.Schroff, Inorganic Pharmaceutical chemistry
5. Bentley and Drivers, Text Book of Pharmaceutical chemistry
6. Anand and Chatwal, Inorganic Pharmaceutical chemistry

COURSE DESIGNERS

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17PECC87	MEDICINAL CHEMISTRY AND PHARMACOLOGY LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

The main aim of the medicinal chemistry is to provide advances in the method of drug designing and chemical synthesis. It is a stimulating field which has the scientific principles applied for the research of new pharmaceuticals. Pharmacology is the introduction of basic concepts and investigation aspects of function and effects of drug. Combination of these course will distributeaneffective knowledge about the synthesis, mechanism of transportation and target action of drug.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To recognize the correlation between pharmacology of a disease and its mitigation or cure.
2	To interpret the chemistry of drugs with respect to their pharmacological activity.
3	To implement the chemical synthesis and structural activity relationship of different class of drugs
4	To outline the mechanism pathways of different class of medicinal compounds
5	To construct the various diagnostic methods for the disease

COURSE OUTCOMES

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

CO1.Identify the synthetic outlines require for drugs synthesis	Understand
CO2. Interpret various animal handling techniques and preparation of pharmaceutical solutions	Understand
CO3. Illustrate the pharmacological effects in different *in-vitro, in-situ, in-vivo, in-silico* organ systems	Apply
CO4. Evaluate the mode of drug administration and their effects	Analyse
CO5. Test the antiparasitic, anticancer and anti-inflammatory properties of the drug	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

PART-I: Medicinal chemistry

1. Study on stereo-chemistry of some selected drugs with models and in-silico viewer
2. Synthesis of anti-inflammatory/analgesic and its analysis (Eg. Paracetamol, aspirin).
3. Synthesis of antimicrobial drugs and its analysis (Eg. Hexamethylenetetramine)
4. Synthesis of anticonvulsant drugs involving minimal steps (Eg. phenytoin) and its analysis.
5. Synthesis of sulphonamide drugs (Eg.Suphacetamide) and its analysis

6. Synthesis of anthelmintic drugs and its analysis (Eg.Benzimidazoles)
7. Synthesis of antiseptic organic compounds (Eg. Iodoform) and its analysis

PART-II: Pharmacology Experiments

1. Evaluation of pyrogens by *in vitro* LAL test (Limulus amebocyte lysate) test
2. Bioassay experiments - study of effects of various drugs on isolated frogs tissues (heart, muscle etc.,) e.g Ach, adrenaline, effect of adrenergic and cholinergic blockers, effect of ions (through audiovisual demonstration)
3. Introduction to humane handling of animals for research (Eg. Mice, Rats, Jirds/Gerbils, rabbits)
4. Study of physiological salt solutions and laboratory appliances used in experimental pharmacology.
5. Routes of drug administration in animal models (through audiovisual demonstration)
6. Experiments to study analgesic/anti-inflammatory effects of drugs
7. Experiments to study local/general anaesthetic effects of drugs
8. Experiments to study antiparasitic drugs (*in-vitro* /*in-vivo* methods using nematodes)
9. Experiments to study anticancer drugs by cytotoxic assay (MTT assay)

TEXT BOOKS

1. A Text Book of Medicinal Chemistry Vol. I and II by Surendra N. Pandeya, S.G. Publisher, 6, Dildayal Nagar, Varanasi -10.
2. Pharmaceutical Chemistry drug Synthesis Vol. I and II by H. J. Roth and A. Kleemann.

REFERENCE BOOKS

PART I

1. Wilson and Gisvold's Text book of Organic, Medicinal and Pharmaceutical Chemistry,
2. Lippincott-Raven Publishers-New York, Philadelphia.
3. William.O.Foye, Principles of Medicinal Chemistry, B.I. Waverly Pvt. Ltd., New Delhi.
4. Indian Pharmacopoeia

PART II

1. Fundamentals of experimental pharmacology by M.N.Ghosh.
2. Handbook of experimental pharmacology by S.K.Kulkarni.
3. Text book of In vitro practical pharmacology by IanKitchen.
4. Pharmacological experiments on intact preparations by Churchill Livingstone.
5. Clinical pharmacology by Molmon and Morrelli.

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
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17PECC88	TECHNOLOGY OF DOSAGE FORMS LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

This course provides the knowledge on the theory and problems involved inincorporating chemicals into stable dosage forms suitable for human medication. It also describes the basics of the appropriate handling, use of various dosage forms and illustrate important physical principles, and willdevelop basic manipulative skills.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To interpret the accurate and rapid measurements of material on a prescription balance
2	To express an appropriate dosage form for a given route of drug administration.
3	To outline the combination and formulation of raw materials into acceptable dosage forms.

COURSE OUTCOMES

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

CO1. Recognize the formulation aspects of different dosage forms	Understand
CO2.Discuss different pharmaceutical calculation involved in formulation	Understand
CO3. Employ different types of dosage forms	Apply
CO4. Appraise the importance of good formulation for effectiveness	Analyze
CO5. Evaluate various prepared dosage forms for standards.	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	M	M	M	-	M	-	-	-	M	M	M	M
CO2	M	L	L	L	L	L	-	-	-	-	-	M	M	-	M
CO3	S	M	M	M	S	M	-	M	-	-	-	M	M	M	M
CO4	M	S	M	S	M	M	-	M	-	-	-	M	M	M	M
CO5	M	M	S	S	S	M	-	-	-	-	-	-	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

1. Preparation of solutions.
2. Preparation of syrups.
3. Preparation of lotions.
4. Preparation of liniments.
5. Preparation of ointments with different classes of bases.
6. Preparation of creams.
7. Preparation of pastes.
8. Preparation of suspensions.
9. Preparation and evaluation of emulsions.
10. Preparation and evaluation of injection.

11. Preparation of tabletsfrom wet & dry granules.
12. Formulation and filling of hard gelatin capsules.

REFERENCES:

1. Howard C. Ansel , Pharmaceutical Calculations. 15th edition,
2. Howard C. Ansel, Nicholas G. Popovich and Lloyd V. Allen, Pharmaceutical Dosage Forms and Drug Delivery Systems, , Jr. 9th Edition, 2009.
3. Thompson J.E , A Practical Guide to Contemporary Pharmacy Practice, 1998.
4. Remington's Pharmaceutical Sciences, 20th Edition, 2000.

COURSE DESIGNERS

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2	Dr.S.Anusuya	Associate Professor	Pharmaceutical Engineering	dr.s.anusuya@vmkvec.edu.in

17PECC89	CHEMICAL ENGINEERING THERMODYNAMICS LAB	CATEGORY	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

Chemical engineering laboratory includes pilot and lab scale experimental set-up on Fluid mechanics, Unit Operations, Mass Transfer and Heat Transfer. It helps students for the development of their skills in understanding and operating basic and more complex industrial systems

PRERQUISITE

NIL

COURSE OBJECTIVES

1	To learn chemical engineering principles and their practical applications in the areas of mass transfer, reaction engineering and particle mechanics.
2	To analyze and design chemical processes that span molecular to macroscopic scales.
3	To determine different coefficients and factors involved in fluid flow
4	To construct the governing equations for designing and analyzing heat transfer equipment

COURSE OUTCOMES

After completion of course student is able to know

CO1. Calibrate flow meters	Understand
CO2. Design and operate filtration equipments	Apply
CO3. Characterize particles and perform size analysis	Analyze
CO4. Evaluate the constants for crushing	Analyze
CO5. Analyze Solid liquid separation in industrial equipment based on settling,	Analyze
CO6. Determine minimum fluidization velocity in a fluidized bed	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	PO	PO	PO	PO	PO	PO	PO	PO	PO9	PO1	PO1	PO1	PSO	PSO	PSO
CO	M	M	M	S	M	-	-	-	-	-	-	-	S		M
CO	M	M	S	M	M	-	-	-	-	-	-	-			M
CO	M	M	M	M	L	-	-	-	-	-	-	-	M	S	
CO	M	M	M	M	L	-	-	-	-	-	-	-			M
CO	M	S	M	S	L	-	-	-	-	-	-	-		M	S
CO	M	M	M	M	L	-	-	-	-	-	-	-		S	S

S- Strong; M-Medium; L-Low

SYLLABUS

1. Flow measurement a) Orifice meter b) Venturimeter, c) Rotameter
2. Filtration.
3. Heat exchangers.
4. Simple and Steam distillation.
5. Pressure drop in pipes and packed columns.
6. Distillation in packed column.
7. Liquid – liquid equilibria in extraction.
8. Solid liquid extraction
9. Adsorption equilibrium.
10. Determination of Screen effectiveness.
11. Sedimentation.
12. Mechanical equivalent of heat – heat, work and the first law of thermodynamics.
13. Calorimetry – heat capacities, heat of formation, Hess's law

TEXT BOOKS:

1. M. D. Koretsky, Engineering and Chemical Thermodynamics, John Wiley & Sons, 20132.

REFERENCE BOOKS:

1. N. de Nevers, Physical and Chemical Equilibrium for Chemical Engineers, 2nd Ed., Wiley, 2012.
2. J. W. Tester and M. Modell, Thermodynamics and Its Applications, 3rd Ed., Prentice Hall, 1997.

COURSE DESIGNERS

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CATEGORY ‘C’

ELECTIVE COURSES

PROGRAMMESPECIFIC ELECTIVES

12-15 CREDITS GENERAL

17PEEC01	NUTRACEUTICALS	Category	L	T	P	Credit
		EC - PS	3	0	0	3

PREAMBLE

This course lead to the new era of medicine and health in which the food industry has become a research oriented sector. It plays a significant role in modifying and maintaining normal physiological functions of healthy human beings.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To Discuss the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction.
2	To Describe the role of Nutraceuticals and functional food in health and disease.
3	To Implement the biochemical functions and physiological effects and their comprehensive in health optimization
4	To Outline the industry and consumer roles involved in the growing field.
5	To Organize and appreciate The Commercial Aspects of Nutraceuticals

COURSE OUTCOMES

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

CO1. Discuss about Nutraceuticals in different food sources	Understand
CO2. Illustrate about their significances in treating the infectious diseases.	Understand
CO3. Demonstrate the methods to access the antioxidant activity of nutraceuticals	Apply
CO4. Examine the mechanism of action of some important phytochemicals and zoochemicals as nutraceuticals and their role in health and diseases.	Analyse
CO5. Analyze the safety issues associated with the nutraceuticals	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	L	M	-	-	-	-	-	-	-	L	-	-	-
CO2	M	M	M	M	-	-	-	-	-	-	-	L	M	M	M
CO3	S	S	S	S	M	-	-	-	-	-	-	L	-	-	M
CO4	S	S	S	S	M	-	-	-	-	-	-	L	-	M	M
CO5	S	M	M	M	M	M	S	M	-	-	-	L	-	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION AND SIGNIFICANCE

Introduction to Nutraceuticals and functional foods; importance, history, definition, classification,list of functional foods and their benefits, Phytochemicals, zoochemicals and microbes in food,plants, animals and microbes.

ROLE IN HEALTH AND DISEASE

The health benefit of - soy protein, spirulina, tea, olive oil, plant sterols, broccoli, omega3 fattyacid and eicosanoids.

nutraceuticals and functional foods in gastrointestinal disorder, cancer,CVD, diabetic mellitus, HIV and dental disease; importance and function of probiotic, prebioticand symbiotic and their applications, functional foods and immune competence; role and use inobesity and nervous system disorders.

ASSESSMENT OF ANTIOXIDANT ACTIVITY

In vitro and in vivo methods for the assessment of antioxidant activity, Comparison of different invitro methods to evaluate the antioxidant, antioxidant mechanism, Prediction of the antioxidant activity of natural phenolics from electrotopological state indices, Optimizing phytochemical release by process technology; Variation of Antioxidant Activity during technological treatments, new food grade peptidases from plant sources.

PHYTOCHEMICALS AS NUTRACEUTICALS

Phytoestrogens in plants; isoflavones; flavonols, polyphenols, tannins, saponins, lignans, lycopene, chitin, caratenoids. Manufacturing practice of selected nutraceuticals such as lycopene, isoflavonoids, glucosamine, phytosterols. Formulation of functional foods containing nutraceuticals– stability, analytical and labelling issues.

SAFETY ISSUES

Health Claims, Adverse effects and toxicity of nutraceuticals, regulations and safety issues-International and national

TEXT BOOKS:

1. Bisset, Normal Grainger and Max WichH "Herbal Drugs and Phytopharmaceuticals", 2nd Edition, CRC, 2001.
2. Handbook of Nutraceuticals and Functional Foods: Robert Wildman, CRC, Publications.2006
3. WEBB, PP, Dietary Supplements and Functional Foods Blackwell Publishing Ltd (UnitedKingdom), 2006
4. Ikan, Raphael "Natural Products: A Laboratory Guide", 2nd Edition, Academic Press /Elsevier, 2005.

REFERENCES:

1. Asian Functional Foods (Nutraceutical Science and Technology) by John Shi(Editor),Fereidoon Shahidi (Editor), Chi-Tang Ho (Editor), CRC Publications, Taylor & Francis,2007
2. Functional Foods and Nutraceuticals in Cancer Prevention by Ronald Ross Watson(Author), Blackwell Publishing, 2007
3. Marketing Nutrition: Soy, Functional Foods, Biotechnology, and Obesity by Brian Wansink.
4. Functional foods: Concept to Product: Edited by G R Gibson and C M Williams, Woodhead Publ., 2000
5. Hanson, James R. "Natural Products: The Secondary Metabolites", Royal Society ofChemistry, 2003.

COURSE DESIGNERS

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17PEEC02	TECHNOLOGY OF FINE CHEMICALS AND BULK DRUGS	CATEGORY	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

This course covers the chemical process industries and explains the synthesis, formulation and importance of fine chemicals, industrial manufacture, flow diagram, properties and uses of fine chemicals.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To Discuss the basic fundamentals of fine chemicals and bulk drugs.
2	To Explain the basic concepts and principles in designing of equipment for various unit operations
3	To Implement the knowledge of various parameters involved in the formulation and development of various dosage forms
4	To Demonstrate about the plant design, production techniques and process chemistry involved in the drug industry.
5	To Categorize the concept of the pharmaceutical industrial manufacturing practices, quality attributes of pharmacy products

COURSE OUTCOMES

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

CO1. Describe the basic concept of fine chemicals and bulk drugs	Understand
CO2. Demonstrate on plant design, process development and chemical hazards in fine Chemical and bulk drug industry.	Understand
CO3. Employ kinetics, thermodynamics and plant construction materials for the production of bulk drugs and fine chemicals	Apply
CO4. Utilize various parameters involved in the formulation and development of various dosage forms	Apply
CO5. Infer the quality aspects and good manufacturing practices in pharmaceutical industry.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO	PO	PO	PO	PO	PO9	PO1	PO1	PO1	PSO	PSO	PSO
CO1	M	L	L	M	-	-	-	-	-	-	-	L	M	-	M
CO2	M	M	-	-	-	-	-	-	-	-	-	L	M	-	M
CO3	S	S	S	S	M	L	M	-	-	-	-	L	M	-	M
CO4	S	S	S	S	M	M	M	S	M	-	-	M	S	M	M
CO5	M	M	M	M	M	M	M	-	-	-	-	-	-	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION OF FINE CHEMICALS AND BULK DRUGS

Characteristic features of fine chemicals manufacture, Concept of fine and Bulk drugs and their manufacture, Evolution of process, Process selection: process profile analysis, Factors influencing Process choice: cleaner and safer technologies, Research and development strategies in pharmaceutical industries, Basic drug formulation, Radiopharmaceuticals

UNIT PROCESSES

Chemical conversion processes- Alkylation, Carboxylation, Condensation & Cyclisation, Dehydration, Esterification, Halogenation, Oxidation, Sulfonation, Complex Chemical conversions, Industrial Fermentation products. Choice of raw materials and reagents, Development techniques for safe process design, Identification of highly-energetic materials.

PRODUCTION PLANTS

Types of production plants-Dedicated, multipurpose and mixed plants, Equipments in multipurpose plants-Reactors, filters, centrifuges, driers, extractors and evaporators, Production cost- capital investment costs, operating costs, Designing of batch plants-production planning and scheduling, Principles of good manufacturing practices.

BASE CHEMICALS, DRUG INTERMEDIATES AND FINE CHEMICALPRODUCTION

Manufacture of following chemicals and their applications – Sulphuric acid – Caustic soda –Ammonia – Phenol – Industrial alcohol - Urea – Acrylonitrile –Ethyl acetate – Butadiene – Aniline
– Titanium dioxide –Vanillin. Fermentation products.

BULK DRUGS

Raw Materials, Production Techniques, Reaction Flow Sheet, Equipments, Utilities for the production of drugs below – Paracetamol, Aspirin, Ibuprofen, Diazepam, Darvon, Niacinamide,Chloramphenicol and Erythromycin, Antimicrobial agent

TEXT BOOKS:

1. Andrzej Cybulski, Jacob A. Moulijn, M.M. Sharma, Roger A. Sheldon "Fine Chemicals Manufacture: Technology and Engineering" Elseiver Science B.V, 2001.
2. Gopal Rao, M. and Sittig, M., "Dryden's Outlines of Chemical Technology", 3rd Edition,
3. Affiliated East West Press Pvt. Ltd., 2001.
4. Pandey, G.N., "A Text Book of Chemical Technology", Vol. II, Vikas Publishing House (P) Ltd., 2000.
5. Austin, G.T., "Shreve's Chemical Process Industries", 5th Edition, McGraw Hill Book Company, 2012

REFERENCES:

1. Rawlins E.A, Bentleys Text Book of Pharmaceutics, A.I.T.B.S.Publisher& Distributors, Delhi, 1996.
2. Coulson and Richadson, "Chemical Engineering"Vol 6,3rd edition,Butterworth Heinemann, 2000.
3. Shah, K.M., "Hand Book of Industrial Chemistry", Vol. I and II, Multi-Tech Publishing Co, 1999.
4. B.M. Mithal., "A textbook of Pharmaceutical formulation", published by vallabhprakashan, 15th reprint 2013, ISBN 81-85731-04-7.
5. Rebecca A.Bader, David., "Engineering Polymer systems for improved drug" Wiley publication, December 2013, ISBN: 979-1-118-09847-9

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17PEEC03	SAFETY AND HEALTH EVALUATION	CATEGORY	L	T	P	CREDIT
		EC - PS	3	0	0	3

PREAMBLE

The evaluation of any organisations' health and safety programs is an integral part of any inspection. In order to assist in conducting a thorough evaluation there are four basic elements that every worksite should have in place to protect members of the organisation from occupational hazards. These four basic elements are: management commitment and employee involvement; worksite analysis; hazard prevention and control; health and safety training. Effective implementation of the health and safety program must be focused during the evaluation. Evaluation includes analysis about comprehensiveness of program, safety rules specified, measures enforced when rules are not followed, status about personal protective equipment, members participation encouraged, etc.

PRERQUISITE

NIL

COURSE OBJECTIVES

1	To define the concepts and methods of safety.
2	To explain In detail about safety audit and its importance.
3	To outline importance of investigation and reporting about accident.
4	To distinguish between biological and ergonomical hazards.
5	To assess about occupational health and toxicology in work environment.

COURSE OUTCOMES

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

CO1. Describe the concepts and methods of safety and its importance in work environment.	Understand
CO2. Describe in detail about the importance of safety and significance of safety audit.	Understand
CO3. Estimate in detail about the consequence of accident and to prepare report on the accident.	Analyse
CO4. Inspect and distinguish among biological hazards and psychological and physiological hazards in working environment.	Analyse
CO5. Inspect work related health and toxicological issues	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO 3
CO1	M	L	L	L	-	L	L	-	-	-	-	L	-	-	M
CO2	M	-	-	-	-	L	M	-	-	-	-	L	-	M	M
CO3	M	L	M	L	-	M	M	-	-	-	-	M	-	-	M
CO4	M	M	M	M	-	M	M	-	-	-	-	L	-	M	M
CO5	M	M	M	M	-	M	M	-	-	-	-	L	-	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

CONCEPTS AND TECHNIQUES

History of Safety movement –Evolution of modern safety concept- general concepts of management – planning for safety for optimization of productivity -productivity, quality and safety-line and staff functions for safety-

budgeting for safety-safety policy. Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, evaluation of performance of supervisors on safety.

SAFETY AUDIT – INTRODUCTION

Components of safety audit, types of audit, audit methodology, non conformity reporting (NCR), audit checklist and report – review of inspection, remarks by government agencies, consultants, experts – perusal of accident and safety records, formats – implementation of audit indication - liaison with departments to ensure co-ordination – check list – identification of unsafe acts of workers and unsafe conditions in the shop floor.

ACCIDENT INVESTIGATION AND REPORTING

Concept of an accident, reportable and non reportable accidents, reporting to statutory authorities – principles of accident prevention – accident investigation and analysis – records for accidents, departmental accident reports, documentation of accidents – unsafe act and condition – domino sequence – supervisory role – role of safety committee –cost of accident.

BIOLOGICAL AND ERGONOMICAL HAZARDS

Classification of Biohazardous agents – examples, bacterial agents, rickettsia and chlamydial agents,viral agents, fungal, parasitic agents, infectious diseases - Biohazard control program, employeehealth program-laboratory safety program-animal care and handling-biological safety cabinets -building design.Work Related Mucoskeletal Disorders –carpal tunnel syndrome CTS- Tendon pain-disorders of theneck- back injuries.

OCCUPATIONAL HEALTH AND TOXICOLOGY

Concept and spectrum of health - functional units and activities of occupational health services, preemploymentand post-employment medical examinations - occupational related diseases, levels ofprevention of diseases, notifiable occupational diseases such as silicosis, asbestosis,pneumoconiosis, siderosis, anthracosis, aluminosis and anthrax, lead-nickel, chromium andmanganese toxicity, gas poisoning (such as CO, ammonia, coal and dust etc) their effects andprevention – cardio pulmonary resuscitation, audiometric tests, eye tests, vital function tests.Industrial toxicology, local, systemic and chronic effects, temporary and cumulative effects,carcinogens entry into human systems

TEXT BOOKS

1. Krishnan N.V. “Safety Management in Industry” Jaico Publishing House, Bombay, 1997.
2. Lees, F.P., “Loss Prevention in Process Industries” Butterworth publications, London, 2nd edition, 1990.
3. Hand book of “Occupational Safety and Health”, National Safety Council, Chicago, 1982.

REFERENCES

1. Dan Petersen, “Techniques of Safety Management”, McGraw-Hill Company, Tokyo, 1981.
2. Relevant India Acts and Rules, Government of India.
3. Encyclopedia of “Occupational Health and Safety”, Vol.I and II, published by International Labour Office, Geneva, 1985.

COURSE DESIGNERS

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17BTEC04	DIAGNOSTICS AND THERAPEUTICS	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

The Diagnostics and Therapeutics is to explore the fundamental mechanisms of disease and use the knowledge to design, test and evaluate new drugs and develop innovative drug delivery and release strategies. It creates technologies and tools to combat disease, promote health, and safeguard the environment. The Knowledge gained will help in realization of physical systems at scales and dimensions similar to biological entities such as bacterial and mammalian cells, viruses, spores, etc.

PREREQUISITE

17BTCC03- MICROBIOLOGY

COURSE OBJECTIVES

1	List the nature of infection, procedural skills to collect and interpret data.
2	Classify the cause of infection and the pathogens.
3	Demonstrate the genetic nature of Human diseases.
4	Organize current Molecular diagnostics of infectious diseases.
5	Assess the biosafety aspects involved in molecular diagnosis.

COURSE OUTCOMES

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

CO1. Demonstrate about collection, Transport, Processing of samples and Classify infection and interpret the result.	Understand
CO2. Explain about the most appropriate infectious agent.	Understand
CO3. Identify the microorganism and its role in disease diagnosis	Apply
CO4. Make use of the genomic knowledge.	Apply
CO5. Assume the tool for disease diagnosis and plan diagnostics based on the bio-safety aspects	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO DIAGNOSTICS AND THERAPEUTICS

Mode of transmissions of infection, Pre-disposing factors of microbial pathogenicity, Normal microbial flora of the human body, Types of infectious diseases, Host - Parasite relationships, Clinical specimens – Collection, Transport and Processing of samples, Interpretation of results.

MICROBIAL INFECTIONS AND DIAGNOSIS

Pathogenicity and diagnosis of major bacterial infections: Streptococcus, Coliforms, Salmonella, and Mycobacterium, Pathogenicity and diagnosis of major fungal infections: Dermetophytosis, Candidiosis and Aspergillosis, Pathogenicity and diagnosis of major Protozoan infections: Amoebiosis, Malaria, Leishmaniasis, DNA and RNA Viruses: Pox viruses, Hepatitis viruses, Adeno viruses and Retro viruses.

MEDICAL GENETICS

Organization of Human genome, Identifying human disease genes, Genetic disorders - Sickle cell anemia, Duchenne muscular Dystrophy, Retinoblastoma, Cystic Fibrosis, Neonatal and Pre-natal disease diagnostics, Gender identification, Analysis of mitochondrial DNA for maternal inheritance, Genetic counselling.

METHODS IN MOLECULAR DIAGNOSTICS

Isolation and purification of nucleic acids, Nucleic acid labelling, Hybridization, PCR and types, PCR based molecular typing, Molecular diagnosis of pathogens based on 18S and 16S rRNA sequences, Automated DNA sequencing, Microarrays - types and applications.

BIOSAFETY FOR MOLECULAR DIAGNOSTICS

Good Laboratory Practices, Different levels of biosafety containments for rDNA experiments, Biosafety aspects of tissue / Cell transplantation.

TEXT BOOKS:

1. Lele Buckingham and Maribeth L. Flaws, 2007. Molecular Diagnostics: Fundamentals, Methods & Clinical Applications.
2. David E. Bruns, Edward R. Ashwood and Carl A. Burtis, 2007. Fundamentals of MolecularDiagnostics.
3. Griffiths, A. J. F., Miller, J. H. and Suzuki, D. T., 2000. An Introduction to Genetic Analysis.
4. Jeremy M. Berg, John L. Tymoczko and LubertStryer, 2002. Biochemistry. W.H. Freeman andCompany.5thEdn.
5. Parasitology, Chatterjee K.D, Chatterjee Medical Publisher

REFERENCES:

1. Lodish, Berk, Zipursky, Matsudaira, Baltimore Darnell, 2000. Molecular Cell Biology. W.H. Freeman and Company. 4thEdn.
2. Benjamin L., 2008. Genes IX. Jones and Bartlett.
3. Turner, P. C., McLennan, A. G., Bates, A. D. and White, M. R. H., 2003. Instant Notes in Molecular Biology. *Viva Books Private Limited*

COURSE DESIGNERS

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17PEEC04	FUNDAMENTALS OF POLYMER SCIENCE AND ENGINEERING	CATEGORY	L	T	P	CREDIT
		EC-PS	3	0	0	3

PREAMBLE

Polymers are materials of very high molecular weight that are found to havemultifarious applications in our modern society. They usually consist of severalstructural units bound together by covalent bonds. Polymers are obtained through the chemical reaction of small molecularcompounds called monomers. In order to form polymers, monomers either havereactive functional groups or double (or triple) bonds whose reaction provides thenecessary linkages between repeat units. Polymeric materials usually have highstrength, possess a glass transition temperature, exhibit rubber elasticity, and havehigh viscosity as melts and solutions.Polymers are used in synthesis of biomaterials which are used to treatment patients.

PRERQUISITE

NIL

COURSE OBJECTIVES

1	To State the basic concepts of polymer.
2	To Explain the mechanism of polymerization.
3	To Discuss the mechanism of copolymerization.
4	To Compare the molecular weight polymer.
5	To Assess the reactions of polymers.

COURSE OUTCOMES

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

CO1.Describe the basic concepts anf fundamental principles behind polymers	Understand
CO2.Discuss the mechanism and kinetics of free radical cationic and anionic polymerization.	Understand
CO3.Recognise various copolymerization mechanisms	Understand
CO4.Estimate the molecular weight of the polymer and understand the techniques used for determination.	Analyse
CO5. Analyse the degradation mechanism of polymers and chemical reaction of polymers.	Analyse

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	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M	L	L	L	-	-	-	-	-	-	-	L	M	-	-
CO2	M	L	L	L	-	-	-	-	-	-	-	L	-	-	M
CO3	M	M	M	M	-	-	L	-	-	-	-	L	M	-	M
CO4	M	M	M	M	M	-	L	-	-	-	-	L	M	-	M
CO5	M	M	M	M	M	-	L	-	-	-	-	L	M	-	M

S- Strong; M-Medium; L-Low

SYLLABUS

BASIC CONCEPTS OF POLYMER

Basic concepts of macromolecules – Monomers - Functionality - Classification and nomenclature of polymers - Types of polymers. Step growth polymerization - Mechanism - Kinetics - Bi-functional systems - Poly functional systems.

POLYMERIZATION MECHANISM

Addition polymerization Mechanism and kinetics of free radical – Cationic - Anionic Polymerisation - Initiator systems - Chain length and degree of Polymerization – Control of molecular weight - Chain transfer - Inhibition Coordination polymerization- Mechanism – Kinetics - Ring opening polymerization-Atom transfer radical-polymerization. Reversible Addition Fragmentation Termination (RAFT).

COPOLYMERIZATION MECHANISM

Copolymerization - Mechanism and Kinetics of free radical - Ionic copolymerization -Determination of Monomer reactivity ratios. Polymerization techniques - Bulk polymerization - Solution polymerization - Suspension polymerization - Emulsion polymerization - Interfacial condensation.

POLYMER MOLECULAR WEIGHT

Molecular weight- Molecular weight averages - Molecular weight distribution - Unidispersity, polydispersity, Degree of polymerization. Molecular weight determination - Basic concepts of end group analysis, colligative properties, osmametry, light scattering, and gel permeation chromatography - Viscosity of polymers solutions.

REACTIONS OF POLYMERS

Chemical reactions of polymers – Addition and substitution reactions - Hydrolysis – Acidolysis – Aminolysis — cross linking reactions. Polymer degradation – Mechanical degradation – Oxidative degradation – Hydrolytic degradation – Photo degradation.

TEXT BOOKS:

1. F.W. Billmeyer, "Textbook of Polymer Science", Wiley international publishers, 2008, 3rd Edition.
2. V.R. Gowariker,N.V. Viswanathan, Jayadev Sreedhar, "Polymer Science" – New Age International (P) Ltd, Publishers, 2015, 2nd edition.
3. George Odian, "Principles of polymerisation", Wiley international publishers, 2004, 4th Edition

REFERENCES

1. JM.G. Cowie, "Polymers: Chemistry and Physics of Modern Materials", Blackie, and 38 London, 1991.
2. R.J. Young and P.Lovell, "Introduction to Polymers", 2nd Ed., Chapman & Hall, 1991.
3. Premamoy Ghosh, "Polymer Science and Technology of Plastics and Rubbers", Tata McGraw- Hill, New Delhi, 1990.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Mr.N.Jawahar	Assist prof	Biotechnology	jawahar@vmkvec.edu.in
2	Mrs.G.Arthi	Assistant Professor	Biotechnology	arthi@vmkvec.edu.in

17PEEC05	CREATIVITY, INNOVATION AND NEW FOOD PRODUCT DEVELOPMENT	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

On completion of the course, students will gain knowledge on various issues related to Creativity, Innovation, Planning, Quality, Evaluation, Patents for the development of a new product.This course also helps to develop leadership qualities and creative thinking capability in Engineering Product Development.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To Express creativity and problem-solving method
2	To implement innovative approach to issues.
3	To Execute their skills in project selection
4	To categorize Patent Laws and international practices.
5	To outline the design, testing & quality standards in developing aPharmaceutical product.

COURSE OUTCOMES

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

CO1. Explain the need, process and factors of creative thinking and innovation in new product development.	Understand
CO2. Demonstrate the fundamentals of project selection and evaluation.	Apply
CO3. Generalize the new product planning	Apply
CO4. Develop a new product based on the requirement.	Analyze
CO5. Appraise the new product development process.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO1	PSO2	PSO3
CO1	M	L	L	L	-	-	-	-	-	-	-	L	M	-	M
CO2	M	M	M	M	-	-	-	-	-	-	-	L	M	M	M
CO3	S	M	M	M	-	-	-	-	-	-	-	L	S	M	M
CO4	S	S	S	S	M	-	-	-	-	-	-	L	S	S	M
CO5	S	S	S	S	-	-	-	-	-	-	-	L	S	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

The process of technological innovation - factors contributing to successful technologicalinnovation - the need for creativity and innovation - creativity and problem solving - brain storming- different techniques.

PROJECT SELECTION AND EVALUATION

Collection of ideas and purpose of project - Selection criteria - screening ideas for new products**(**evaluation techniques)

NEW PRODUCT PLANNING

Design of proto type - testing - quality standards - marketing research - introducing new products

NEW PRODUCT DEVELOPMENT

Research and new product development - Patents - Patent search - Patent laws - International code for patents - Intellectual property rights (IPR).

MODEL PREPARATION & EVALUATION

Creative design - Model Preparation - Testing - Cost evaluation - Patent application

TEXT BOOKS:

1. Twiss, Brian. "Managing Technological Innovation", Pitman Publishing Ltd., 1992.
2. Watton, Harry B. "New Product Planning", Prentice Hall Inc., 1992.

REFERENCES:

1. Nystrom, Harry "Creativity and Innovation", John Wiley & Sons, 1979.
2. Khandwalla, N. – "Fourth Eye (Excellence through Creativity) - Wheeler Publishing", 1992.
3. I.P.R. Bulletins, TIFAC, New Delhi, 1997.

COURSE DESIGNERS

S. No	Name of the Faculty	Designation	Department	Mail ID
1.	Mrs.C.Nirmala	Assistant Professor	Biotechnology	nirmala@vmkvec.edu.in
2.	Mrs.G.Arthi	Assistant Professor	Biotechnology	arthi@vmkvec.edu.in

17BTEC03	PRINCIPLES OF BIOINFORMATICS	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

Principles of Bioinformatics is an interdisciplinary field that combines Computer Science, Molecular Biology, Genetics ,Mathematics, Statistics and Engineering etc. to analyze and interpret biological data. Bioinformatics has been used for *in silico* analyses of biological queries using mathematical and statistical techniques. This course includes the use computer programming as part of their methodology, in the field of genomics, the identification of candidate genes, genetic basis of disease etc. leading to specific drug discovery by molecular modelling.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	Define the basis of Bioinformatics in the biological field
2	Explains the *in-silico* analysis of biological queries using mathematical and statistical techniques.
3	Implement the Bioinformatics software and tools based on its applications
4	Construct the phylogenetic tree based on the biological information and queries using bioinformatics tools.
5	Develop bioinformatics tools in various field like medicine, agriculture etc.,

COURSE OUTCOMES

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

CO1. Relate the basics of computer science and interdisciplinary subjects related to Bioinformatics	Understand
CO2. Demonstrate the importance of biological databases and their significance in Biotechnology	Understand
CO3. Construct various tools and software which can be adopted in different fields of Biotechnology	Apply
CO4. Build the evolutionary traits using Bioinformatics tools and software	Apply
CO5. Apply the various bioinformatics tools in different fields	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO BIOINFORMATICS

Introduction, Scope of bioinformatics – Introduction to UNIX- Files and processes, Basic UNIX commands for listing files and directories, Making directories, Changing to a different directory, Copying and moving files, Removing files in directories, Clear, CAT and Less commands, Word count, Help, Redirection, Access rights, Running background process and killing processes, ftp, telnet, Internet, http, Search engines.

DATABASES

Introduction to databases – Flat files, Relational databases, Object oriented databases and hypertext databases, Biological databases and their uses, Introduction to EMB net and NCBI, Classification of biological databases; Primary

nucleic acid sequence databases – Gen Bank, EMBL, DDBJ; Primary protein sequence databases – PIR, SWISS-PROT; Composite databases – NRDB, OWL, SWISS-PROT+TrEMBL; Secondary databases – PROSITE, PRINTS; Structural databases – PDB, MMDB.

SEQUENCE ALIGNMENT

Introduction to sequence alignment and its significance, Types – Global, Local, Pairwise and Multiple alignment. DOT PLOTS, Scoring matrices – PAM, BLOSSUM. Dynamic programming algorithms, BLAST, FASTA. Multiple sequence alignment by PSI- BLAST.

PHYLOGENETIC ANALYSIS

Terminology and basics of Phylogenetics – Clades, Taxons, Baranches, Nodes; Orthologs and Paralogs. Steps to construct a Phylogenetic tree – Constructing a Multiple Sequence Alignment, Determining the substitution model, Tree building and tree evaluation.

APPLICATION OF BIOINFORMATICS

Application of bioinformatics in various fields – Medicine, Agriculture and Industries.

TEXT BOOKS:

1. Rastogi, S.C., Namita Mendiratta, Parag Rastogi. 2006. Bioinformatics – Concepts, Skills, Application. CBS Publications.
2. Westhead, D.R., Parish, J.H., Twyman, R.M., 2000. Instant Notes in Bioinformatics. *BIOS Scientific Publishers*.
3. Teresa, K., Attwood and David J. Parry-Smith, 2007. Introduction to Bioinformatics. *Pearson Education Ltd*.

REFERENCES:

1. Bergeran, B., 2002. Bioinformatics Computing. *PHI*.
2. Richard Durbin, Sean Eddy, Anders Krogh and Graeme Mitchison, 1998. Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids. *Cambridge University Press*.
3. Bishop, M.J., Rawlings, C.J., 1997. DNA and Protein Sequence Analysis. A Practical Approach. *IRL Press*, Oxford.
4. Gibas, C. and Jambeck, P., 1999. Developing Bioinformatics Skills. *O'Reilly*.
5. Dan Gusfield, 2007. Algorithms on Strings Tree and Sequence. *Cambridge University Press*.
6. Baldi, P. and Brunak, S., 1998. Bioinformatics: A Machine Learning Approach. *MIT Press*
7. Essential Bioinformatics. Jin Xiong. Cambridge University Press. 2006.
8. An Introduction ti Bioinformatics Algorithms. Neil C Jones, Pavel A Pevzner. MIT Press.2004.
9. The New Avenue in Bioinformatics. Joseph Seckbeck Eitan Rubin. Springer.2010.

COURSE DESIGNERS

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2	Mr.N.Jawahar	Assistant Professor	Biotechnology	jawahar@vmkvec.edu.in

17PEEC06	BIOPHARMACEUTICS AND PHARMACOKINETICS	Category	L	T	P	Credit
		EC- PS	3	0	0	3

PREAMBLE

This course will enable the students about the physical and chemical properties of formulated drug molecule and the effects produced by the drug to the biological system. It also helps to identify the movement of drug within the body.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To Recognize the important parameters involved in drug administration and its principles in living systems.
2	To Demonstrate the various process of elimination of drug in the biological system
3	To Outline the physico-chemical properties and the effect of drug
4	To Distinguish the methods of administration and the action of the bioactive molecule.
5	To Assess the dosage with the movement of drug within the body.

COURSE OUTCOMES

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

CO1. Explain the various factors influencing the drug disposition, and various pharmacokinetic parameters.	Understand
CO2. Design and interpret the bioavailability and bioequivalence of dosage forms.	Apply
CO3. Identify the factors affecting the rate of drug absorption.	Analyse
CO4.Examine the activity of drug in varying modes of administration.	Analyse
CO5. Estimate the parameters influencing the dosage and pharmacokinetics.	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO1	PSO	PSO	PSO3
CO1	M	M	M	M	M	-	-	L	-	-	-	M	-	M	-
CO2	S	S	S	S	M	-	-	S	-	-	-	M	M	M	M
CO3	M	M	M	M	M	-	-	S	-	-	-	M	M	M	-
CO4	M	M	M	M	M	-	-	S	-	-	-	M	M	M	M
CO5	M	M	M	M	M	-	-	S	-	-	-	M	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

DRUG ABSORPTION AND DISTRIBUTION

Mechanisms of drug absorption through GIT, factors influencing drug absorption though GIT, absorption of drug from Non-per oral extra-vascular routes, Distribution of drugs, Tissue permeability of drugs, binding of drugs, apparent volume of drug distribution, plasma and tissue Protein binding of drugs, factors affecting protein-drug binding. Kinetics of protein binding, Clinical significance of protein binding of drugs.

ELIMINATION

Drug metabolism, metabolic pathways, factors affecting metabolism, renal excretion of drugs, factors affecting renal excretion of drugs, renal clearance, Non- renal routes of drug excretion of drugs.

BIOAVAILABILITY AND BIOEQUIVALENCE

Definition and Objectives of bioavailability, absolute and relative bioavailability, measurement of bioavailability, in-vitro drug dissolution models, in-vitro - in-vivo correlations, bioequivalence studies, methods to enhance the dissolution rates and bioavailability of poorly soluble drugs.

PHARMACOKINETICS

Introduction to Pharmacokinetics, Pharmacokinetic models, One compartment open model- Intravenous Bolus Injection – Intravenous infusion - Extra vascular administrations. Determination of pharmacokinetics parameters and their significance - Absorption Rate Constant (ka),Elimination Rate Constant (K) & Elimination Hal- life (t½), AUC, C maxand tmax. Apparent Volume of Distribution (Vd) & Renal Clearance (Q).

MULTIPLE DOSAGE REGIMENS AND NONLINEAR PHARMACOKINETICS

Concept, Accumulation, Persistent and elimination factors. Calculation of dosage regimenFollowing repetitive IV and oral administration.Nonlinear Pharmacokinetics - Introduction, factors causing Non-linearity, Michaelis-menton method of estimating pharmacokinetic parameters.

TEXT BOOKS

1. Rosenbaum, S. E. "Basic Pharmacokinetics and Pharmacodynamics: An Integrated Textbook and Computer Simulations", 2nd Edition, John Wiley & Sons, 2016.
2. Brahmankar, D.M. and Jaiswal, S.B. "Biopharmaceutics and Pharmacokinetics: a Treatise", 3rd Edition, Vallabh Prakashan, 2015.
3. Chatwal, G.R. "Biopharmaceutics and Pharmacokinetics", 2ndEdition, Himalaya Publishing House, 2014.

REFERENCES

1. Shargel,L and Andrew, B.C. Yu. "Applied Biopharmaceutics & Pharmacokinetics", 7th Edition, The McGraw-Hill Companies, Inc, 2016.
2. Gibaldi, M."Biopharmaceutics& Clinical Pharmacokinetics",4th Edition,Pharma Book Syndicate, 2016.
3. Jambhekar, S.S. and Philip,J. B. "Basic Pharmacokinetics" 2ndEdition, Pharmaceutical Press, 2012.

COURSE DESIGNERS

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17PEEC07	HERBAL TECHNOLOGY	Category	L	T	P	C
		EC-PS	3	0	0	3

PREAMBLE

To acquire knowledge on the preparation and standardization of herbal preparation and also give exposure to various methods of extraction, preparation, and purification of herbal extracts.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To List the plant kingdom, classification& source of crude drugs, taxonomy of medicinal plants and medicinal plant families.
2	To Discuss the Phyto-chemical screening techniques and able to identify the Phyto-constitutes of plants.
3	To Implement fundamental principles on cultivation, collection processing and evaluation of medicinal plants.
4	To Categorise the biomedicine, pharmacology, herbal preparations, history, clinical assessment, safety, and plant identification and wild crafting.
5	To Generate integrate knowledge of raw materials, formulation, and herbal pharmacy for product development purposes

COURSE OUTCOMES

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

CO1. Explain extraction techniques used for herbal drugs.	Understand
CO2. Recognize the history and present status of herbs in cosmetics and the techniques of incorporation of herbal extracts	Understand
CO3. Illustrate various plant tissue culture methods	Apply
CO4.Develop basic techniques for standardization of extracts and screening methods.	Analyse
CO5. Analyse traditional knowledge to bridge the gap of evidenced based data to make rational decisions in developing safe and effective herbal products.	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO	PO	PO	PO	PO	PO	PO	PO	PO10	PO1	PO12	PSO	PSO2	PSO
CO1	M	L	L	M	M	-	-	-	-	-	-	L	-	-	M
CO2	M	M	M	M	M	-	-	M	-	-	-	L	M	M	M
CO3	S	S	S	S	S	-	-	L	-	-	-	L	M	M	M
CO4	M	M	M	M	M	-	-	-	-	-	-	M	M	-	M
CO5	M	M	M	M	M	-	-	M	-	-	-	M	M	-	M

S- Strong; M-Medium; L-Low

SYLLABUS

INDIAN SYSTEMS OF MEDICINE

Introduction, basic principles and treatmentmodalities of Ayurveda – Unani – Homeopathy –Siddha – naturopathy- Introduction and streams of Yoga. Asanas, Pranayama, Meditations and relaxation technique. Classification of herbs - Harvesting – Post harvesting – Conditions ofstorage- seasonal and geographical variation.

In-vitro CULTURE OF MEDICINAL PLANTS

Requirements – Setting up a tissue culture lab – Basic laboratory procedure – Processing of plat tissue culture – Growth profile – Growth measurement – Plant tissue culture methods – Callus culture – Types of tissue culture – Tissue culture of medicinal plants – Applications of plant tissue culture.

EXTRACTION, ISOLATION AND ANALYSIS OF PHYTO PHARMACEUTICALS

Traditional and modern extraction technique : Successive solvent extraction- Super critical fluid extraction – Steam distillation – Head space techniques – Sepbox –General extraction process : Carbohydrates – Proteins – Alkaloids –Glycosides. Isolation and purification of phytochemicals: Quinine from cinchona, vincristine from Vinca, sennoside from senna, Euginol from clove oil.

SCREENING METHODS FOR HERBAL DRUGS

Screening methods for anti-fertility agents – Antidiabetic drugs – Anti anginal drugs – Diuretic –Analgesic activity – Antipyretic activity – Anti cancer activity –Evaluation of hepatoprotective agents – anticonvulsive- Anti ulcer drugs.

STANDARDIZATION AND CONSERVATION OF HERBAL DRUGS

Importance of standardization – Problems involved in the standardization of herbs- Standardization of single drugs and compound formulations – WHO guidelines for the quality assessment herbal drugs– Estimation of parameter limits used for standardization – Conservation strategies of medicinal plants – Conservation types – Government policies for protecting the traditional knowledge.

TEXT BOOKS :

1. Agarwal, S.S. and Paridhavi, M., "Herbal Drug Technology" UniversitiesPress(India)Private Limited, 2007.
2. Wallis, T.E., "Textbook of Pharmacognosy" 5th Edition, CBS Publishers andDistributors,2005.
3. Indian System of Medicine and Homeopathy in India, Planning and Evaluation Cell, Govt.ofIndia, New Delhi, 2001.
4. Yoga- The Science of Holistic Living by V.K.Yoga, Vivekananda Yoga PrakashnaPublishing, Bangalore, 2005.
5. Quality Control Methods for medicinal plant material, WHO Geneva, 1998.

REFERENCES :

1. Evans, W.C., "Trease and Evans Pharmacognosy" 15th Edition, Elsevier Health Sciences,2001.
2. Pulok K. Mukherjee., "Quality control of HerbalDrugs"Reprintedn, Business Horizons, New Delhi, 2012.
3. Daniel, M., "HerbalTechnology : Concepts and Advances" Satish Serial Publishing House,2008.

COURSE DESIGNERS

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

1	Ms.R.Ramapriya	Assistant professor	Biotechnology	ramapriya@vmkvec.edu.in
2	Mrs.G.Arthi	Assistant Professor	Biotechnology	arthi@vmkvec.edu.in

17PEEC08	CHEMISTRY OF NATURAL PRODUCTS	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

The students will able to understand the main classes of natural products and their distinctive pharmacological effects. It further gives a proper understanding about the extraction, isolation, chemical tests and medicinal properties of various alkaloids and vitamins. This would enable the students to learn the chemistry, synthesis and structural elucidationof natural products.

PREREQUISITE

17CHBS10 - FUNDAMENTALS OF CHEMISTRY

COURSE OBJECTIVES

1	To explain the chemistry and medicinal importance of natural compounds as lead moleculesfor new drug discovery.
2	To discuss about the classification, isolation, purification and structural characterization of simple constituents from natural source.
3	To interpret general method of structural elucidation of compounds of natural origin.
4	To outline the medicinal and pharmaceutical uses of vitamins and flavanoids.
5	To develop theoretical knowledge of students in the chemistry of natural productsand to explore thisknowledge for practical applications.

COURSE OUTCOMES

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

CO1. Explain the chemistry of carbohydrates, heterocyclic compounds, amino acids, proteins and nucleic acids.	Understand
CO2. Describe the fundamentals of terpenoids, alkaloids, vitamins, lipids and steroids.	Understand
CO3. Summarize the biosynthesis, biological activity and stereochemistry of pharmaceutical products.	Apply
CO4. Identify natural products using various chromatographic and spectroscopic methods.	Apply
CO5. Demonstarte various methods to test the activity of natural products	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO	PO	PO	PO4	PO	PO	PO	PO	PO	PO1	PO1	PO1	PSO	PSO	PSO
CO1	M	L	L	L	-	-	-	-	-	-	-	L	-	-	M
CO2	M	L	L	L	-	-	-	-	-	-	-	L	-	-	M
CO3	S	M	M	M	M	-	-	-	-	-	-	L	M	M	-
CO4	S	S	M	S	S	-	-	-	-	-	-	M	M	M	M
CO5	S	S	M	S	S	-	-	-	-	-	-	M	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

STRUCTURAL CHARACTERISATION OF NATURAL PRODUCTS

Chemical and spectral approaches to simple molecules of natural origin. Identification of natural products by chromatographic and spectroscopic methods and application of I.R., N.M.R. and Mass Spectroscopy in the structural elucidation of organic compounds.

GLYCOSIDES

Classification, biosynthetic studies and basic metabolic pathways, introduction to biogenesis ofsecondary metabolites, chemistry, general methods of extraction, isolation, chemical tests, medicinal properties and structural elucidation of sennosides, cardenolides and bufadienolides, digoxin and digitoxin, scillaren A and ouabain.

ALKALOIDS

Classification, chemistry, general methods of extraction, isolation, chemical tests, and structural elucidation of pyridine alkaloids, tropane alkaloids, quinoline and iso-quinoline alkaloids,phenanthrene alkaloids, indole alkaloids, imidazole alkaloids, alkaloid amines, glycoalkaloids andXanthene alkaloids.

FLAVONOIDS

Classification, biosynthetic studies and basic metabolic pathways, introduction to biogenesis of secondary metabolites, chemistry, general methods of extraction, isolation, chemical tests, medicinal properties and structural elucidation of flavonoids, quercetin.

TERPENES

Terpenes–special isoprene rule, mono, diterpenes, triterpenoids and sesquiterpenes and structural elucidation of citral, carvone, menthol and camphor; Steroids – cholesterol, colour reactions of steroids, stigmasterol, β-sitosterol, bile acids, ergosterol, diosgenin, solasodine and hecogenin.

TEXT BOOKS:

1. CO.P. Agarwal, Chemistry of Natural Products (Vol.-1 & 2), 41st edition,GoelpublishingHouse, 2014.
2. Gurdeep Chatwal, Organic Chemistry of Natural Products (Vol. 1 & 2), Himalaya Publishing House, 2015.
3. I.L.Finar, “Organic chemistry” Volume 2, 5th edition, Published by Pearson India, 2012.

REFERENCES:

1. Varro E. Tyler, Lynn R. Brady, James E. Robbers, Pharmacognosy, 9th edition, Publishedby Lea &Febiger, 2011.
2. Trease, G. E. and Evans, W.C. Pharmacognosy, 16th edition, Published by Elsevier, 2009.
3. Wallis, T.E. Textbook of Pharmacognosy, 5th Edition, CBS Publishers, 2005.

COURSE DESIGNERS

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17PEEC09	BIOSIMILARS AND BIOGENERICS	Category	L	T	P	Credit
		EC - PS	3	0	0	3

PREAMBLE

The aim of this course is to provide knowledge about basics, manufacturing and regulatory affairs associated with bio generics and biosimilars.It also offers knowledge in characterization of bio generics and biosimilars using analytical methods and presumptions of therapeuticequivalence along with case studies.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To define bio generics and biosimilars along with their regulatory affairs.
2	To explain about production and current market value of bio generics and biosimilars
3	To perform characterization of biosimilars using various analytical methods.
4	To outline various immune reactions associated with biopharmaceuticals.
5	To check stability of biosimilars

COURSE OUTCOMES

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

CO1. To recognize the difference between bio generics and biosimilars	Understand
CO2. To describe regulations in production and marketing of bio generics and biosimilars	Understand
CO3. To illustrate various methods of characterization of biosimilars.	Apply
CO4. To examine adverse immune reactions of biopharmaceuticals.	Analyse
CO5. To validate the stability of follow on biologics	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO	PO	PO	PO	PO	PO	PO9	PO1	PO1	PO1	PSO	PSO	PSO3
CO1	L	L	-	-	-	-	L	-	-	L	-	-	-	-	-
CO2	L	L	-	-	-	-	L	-	-	-	-	-	-	-	-
CO3	M	M	-	M	-	-	S	-	-	-	-	-	-	-	-
CO4	S	M	L	-	-	-	-	-	M	-	-	-	-	M	-
CO5	S	M	L	-	-	-	-	-	M	-	L	-	-	-	-

S- Strong; M-Medium; L-Low

BIOGENERICS INTRODUCTION

Definition: Generics and its advantages; Biogenetics and Biosimilars; Why biosimilars arenot (bio) generics? The advent of Biosimilars; The role of patents in the drug industry; Protein based biopharmaceuticals; Manufacturing processes; Global market; International Non-proprietary names (INN) nomenclature system

biosimilars regulation (EU position, USpathways, Government initiatives)

BIOSIMILARS AND ITS SCENARIO

Approved follow-on proteins/Biosimilars; Characteristics of high selling peptides and proteins;Products with expired patents; Challenging originator's patents; Target productsfor FOB (followonbiologicals)/Biosimilars development peptides; Recombinant non-glycosylated proteins;Recombinant glycosylated proteins; Industries dealing with bio generics and its market value;World scenario; Indian scenario

CHARACTERIZATION OF BIOSIMILARS

Approaches to the characterization of biosimilars; Problems in characterizing biologics (Types ofbiologic, Peptides, Non-glycosylated proteins, Glycosylated proteins, Monoclonalantibodies);Equivalence issues; Post-translational modifications; Effect of micro heterogeneity; Pharmacokinetics; Pharmacodynamics; and Clinical efficacy; Analytical methods for thecharacterization of biosimilars (Chromatography, Protein sequencing, Mass spectrometry, UVabsorption, Circular dichroism, X-ray techniques, Nuclear magnetic resonance, Electrophoresis,Western blotting, Bioassays, ELISA, Immunoprecipitation and other procedures)

IMMUNOGENECITY OF BIOPHARMACEUTICALS

Immunogenicity of biopharmaceuticals: Immunogenicity; Factors contributing to immunogenicity (product-related factors**,** host- related factors), Consequence of immunogenicity to biopharmaceuticals; Measurement of immunogenicity

STABILITY ANALYSIS AND CASE STUDIES OF BIOLOGICS

Regulatory Stability Guidelines on Biologicals; Stability Designs; Statistical Analysis; Casestudies: Erythropoietin, Insulin, Somatotropin, Interleukin-2, Interferon Granulocyte macrophage-CSF, Factor VIIa, Factor IX, Factor VIII, Activated protein C, Tissue plasminogenactivator, Monoclonal antibodies etc.

TEXT BOOKS

1. Niazi, Sarfaraz K. "Biosimilars and Interchangeable Biologics: Tactical Elements",CRC Press, 2015.
2. Laszlo Endrenyi, Dr. Paul Declerck, Shein-Chung Chow. "Biosimilar Drug Product Development",CRC Press,2017.

REFERENCES

1. Niazi, Sarfaraz K. "Handbook of Biogeneric Therapeutic Proteins: Regulatory,Manufacturing,Testing, and Patent Issues". CRC, 2002
2. Prugnaud, Jean-Louis, Trouvin, Jean Hugues. "Biosimilars" Springer, 2012
3. Shein-Chung Chow. "Biosimilars: Design and Analysis of Follow-on Biologics" CRC Press, 2013

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
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2.	Ms.G.Arthi	Assitant Professor	Biotechnology	arthi@vmkvec.edu.in

17PEEC10	PHARMACOGENOMICS	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

Pharmacogenomics involves the study of the relationship between an individual's genetic makeup and his or her response to a drug. Pharmacogenetics, a component of pharmacogenomics, is the study of the relationship between a single gene and its response to a drug.

PREREQUISITE

17BTEC03 PRINCIPLES OF BIOINFORMATICS

COURSE OBJECTIVES

1	Discuss about the basic knowledge about pharmacogenomics and drug design using genomic applications for drug action and toxicity.
2	Perform how individualization of drug therapy can be achieved based on a person's genetic makeup while reducing unwanted drug effects.
3	Outline the Pharmacogenomics studies on how genetic differences between individuals can affect responses to various drugs.
4	Formulate on medicine skills acquired by the student and his action in different pathologies
5	Develop acquire knowledge about the influence of genetic alterations on the therapeutic effect and adverse reactions of the drugs, from a perspective of individualized therapy.

COURSE OUTCOMES

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

CO1.Recognize the effect of genetic differences between individuals in the outcome of drug therapy and in drug efficacy and toxicity.	Understand
CO2. Describe the role of single nucleotide polymorphism as a biomarker for the prediction of risk, therapeutic response and prognosis of malignancies.	Understand
CO3. Utilize and manage the new genomics based tools as they become available as well as make best treatment choices.	Understand
CO4. Examine the applications of genomics principles in drug action and toxicology	Analyze
CO5. Validation of case studies related to pharmacogenomics	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO	PO	PO	PO	PO	PO	PO	PO1	PO11	PO12	PSO	PSO2	PSO
CO1	L	L	-	-	M	-	L	-	-	L	-	-	M	M	
CO2	L	L	-	M	-	-	L	-	-	L	M	M	M	M	-
CO3	L	L	-	M	-	M	L	-	-	L	-	-	M	M	-
CO4	S	M	L	-	-	-	-	-	M	-	L	-	M	M	-
CO5	S	M	L	-	-	-	-	L	M	-	L	-	S	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

PHARMACOGENOMICS AND PERSONALIZED MEDICINE

Pharmacogenetics- Roots of pharmacogenomics and it is not just pharmacogenomics, Genetic drug response profiles, the effect of drugs on Gene expression, pharmacogenomics in drug discovery and drug development. Concept of individualized drug therapy, Drivers and the promise of personalized medicine, Strategies for application of pharmacogenomics to customize therapy, Barriers.

HUMAN GENOME

Expressed sequence Tags (EST) and computational biology, Microbial genomics, computational analysis of whole genomes, computational genome analysis, Genomic differences that affect the outcome of host pathogen interactions, Protein coding genes, repeat elements, genome duplication, analysis of proteome, DNA variation, Biological complexity. Single nucleotide polymorphisms (SNP's) in Pharmacogenomics - approaches, number and types of SNPs, Study design for analysis, Analytical issues, Development of markers.

ASSOCIATION STUDIES IN PHARMACOGENOMICS

Viability and Adverse drug reaction in drug response, Multiple inherited genetic factors influence the outcome of drug treatments, Association studies in pharmacogenomics, Strategies for pharmacogenomics Association studies, Benefits of Pharmacogenomics in Drug R & D.

GENOMICS APPLICATIONS FOR DRUG ACTION, TOXICITY AND DESIGN

Platform technologies and Pharmaceutical process, its applications to the pharmaceutical industry, Understanding biology and diseases, Target identification and validation, Drug candidate identification and optimization, safety and toxicology studies. The need of protein structure information, protein structure and variation in drug targets- the scale of problem, Mutation of drug targets leading to change in the ligand binding pocket.

PHARMACOGENOMICS – CASE STUDIES

Study of pharmacogenomics of human P-Glycoprotein, drug transporters, lipid lowering drugs, chemotherapeutic agents for cancer treatment.

TEXT BOOKS:

1.Martin M. Zdanowicz, M.M. "Concepts in Pharmacogenomics" Second Edition, American Society of Health-System Pharmacists, 2017.
2.Licinio, J and Wong, Ma-Li. "Pharmacogenomics: The Search for the Individualized Therapies", Wiley-Blackwell, 2009.
3. Yan Q, "Pharmacogenomics in Drug Discovery and Development" Humana Press, 2nd Edition, 2014.

REFERENCES:

1. Brazeau, D.A. and Brazeau, G.A. "Principles of the Human Genome and Pharmacogenomics" American Pharmacist Association, 2011
2. Werner, K., Meyer, U.A., Tyndale, R.F. "Pharmacogenomics", Second Edition, Taylor and Francis, 2005.
3. Langman, L.J. and Dasgupta, A. "Pharmacogenomics in Clinical Therapeutics", Wiley – Blackwell, 2012

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	G.Arthi	Assistant professor	Biotechnology	arthi@vmkvec.edu.in

2	Ms.C.Vanathi	Assitant Professor	Biotechnology	vanathi@vmkvec.edu.in

17PEEC11	BIOCONJUGATE TECHNOLOGY AND APPLICATIONS	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

This course helps the students in getting exposed to methods of extraction, preparation, and purification of herbal extracts. To acquire knowledge on the preparation and standardization of herbal preparation. They will expose to various research institutions of natural products.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To Recognize the functional targets and chemistry of active groups.
2	To Summarize the knowledge about the linkers and cleavable reagent systems.
3	To Illustrate about the bioconjugateReagents.
4	To Outline about enzyme, nucleic acid modification and its application in bioconjugation.
5	To Design and develop the synthetic polymers.

COURSE OUTCOMES

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

CO1.Summarize active groups of various chemical reactions and targets of the functional groups.	Understand
CO2. Discuss about joining of two molecules to form a hybrid conjugate with the help of linkers.	Understand
CO3. Demonstrate the antibody modification and conjugation.	Apply
CO4. Develop the immunotoxin conjugation techniques	Analyse
CO5. Asses the novel methods for the mild and site- specific derivatization of proteins, DNA, RNA, and carbohydrate developed for application such as ligand discovery, disease diagnosis and high- throughput screening.	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO1	PSO	PSO	PSO
CO1	M	L	L	L	-	-	-	-	-	-	-	L	-	-	-
CO2	S	M	S	S	M	-	-	-	-	-	-	L	-	M	-
CO3	M	L	M	M	-	-	-	-	-	-	M	L	-	M	-
CO4	L	L	S	L	-	-	-	-	-	-	-	M		M	-
CO5	S	M	L	L	M	M	-	-	-	-	-	S	S	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

FUNCTIONAL TARGETS

Modification of AminoAcids, Peptides and Proteins – Modification of sugars, polysaccharides and glycolconjugates – modification of nucleicacids and oligonucleotides.

CHEMISTRY OF ACIVE GROUPS

Amine reactivechemicalreactions – Thiol reactivechemicalreactions – carboxylate reactive chemicalreactions – hydroxylreactivechemicalreactions – aldehyde and ketonereactivechemicalreactions – Photoreactivechemicalreactions.

BIOCONJUGATE REAGENTS

Zerolength cross linkers – Homo bifunctional cross linkers – Heterobifunctional cross linkers –Trifunctional cross linkers – Cleavablereagentsystems – tags and probes.

ENZYME AND NUCLEIC ACID MODIFICATION AND CONJUGATION

Properties of common enzymes – Activated enzymes for conjugation – biotinylated enzymes –chemical modification of nucleicacids – biotin labeling of DNA- enzyme conjugation to DNA –Fluorescent of DNA.

BIOCONJUGATE APLICATIONS

Preparation of Hapten-carrier Immunogenconjugates - antibody modification and conjugation – immunotoxinconjugation techniques – liposome conjugated and derivatives- Colloidal – gold labeledproteins – modification withsyntheticpolymers.

TEXT BOOKS AND REFERENCES :

1. Bioconjugate Techniques , G.T. Hermanson, Academic Press, 1999

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
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2	Ms.C.Vanathi	Assistant Professor	Biotechnology	vanathi@vmkvec.edu.in

17PEEC12	FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

This course provides exploratory awareness to play a role of entry level design engineer in engineering environment. It contributes an impression towards new product development methodologies and marketing of a product.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To Explain the global trends and development methodologies of various types ofproducts and services.
2	To Implement product management plan for a new productbased on the type of the product and development methodology.
3	To Outline the requirements for new product development and convert them in to designspecification.
4	To Organize system modelling and their interfaces andarrive at the optimum systemspecification and characteristics.
5	To develop documentation, test specifications and coordinate with various teams tovalidate and sustain up to theEnd of Life support activities for engineeringcustomer.

COURSE OUTCOMES

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

CO1.Discuss on how to formulate a product and analyse a problem in an industrial process.	Understand
CO2. Operate on specific problems independently or as part of a team.	Apply
CO3. Appraise the Product Development process in industries.	Analyse
CO4. Develop system modelling for a particular process.	Analyse
CO5. Validate a project from start to finish.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO1	PSO	PSO	PSO3
CO1	L	L	L	L	L	L	-	-	L	-	L	L	M	M	M
CO2	M	M	L	M	L	-	-	L	M	-	L	L	M	M	M
CO3	S	S	S	S	L	L	L	L	L	L	L	L	M	M	M
CO4	M	M	M	M	L	-	-	L	S	L	L	L	M	-	M
CO5	L	L	L	L	L	S	L	S	-	-	M	M	S	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

FUNDAMENTALS OF PRODUCT DEVELOPMENT

Global Trends Analysis and Product decision - Social Trends - Technical Trends-Economic Trends - Environmental Trends - Political/Policy Trends - Introduction toProduct Development Methodologies and Management - Overview of Products andServices - Types of Product Development - Overview of Product

Development methodologies- Product Life Cycle – Product Development Planning and Management.

REQUIREMENTS AND SYSTEM DESIGN

Requirement Engineering - Types of Requirements - Requirement Engineering -traceability Matrix and Analysis - Requirement Management - System Design &Modeling -Introduction to System Modeling - System Optimization - System Specification - Sub-SystemDesign - Interface Design.

DESIGN AND TESTING

Conceptualization - Industrial Design and User Interface Design - Introduction to Conceptgeneration Techniques – Challenges in Integration of Engineering Disciplines – ConceptScreening & Evaluation - Detailed Design - Component Design and Verification –Mechanical, Electronics and SoftwareSubsystems - High Level Design/Low Level Designof S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Componentdesign, Layout and Hardware Testing – Prototyping - Introduction to Rapid Prototyping andRapid Manufacturing - System Integration, Testing, Certification and Documentation

SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT

Introduction to Product verification processes and stages - Introduction to Product Validationprocesses and stages - Product Testing Standards and Certification - Product Documentation- Sustenance -Maintenance and Repair – Enhancements - Product EoL– ObsolescenceManagement – Configuration Management - EoLDisposa.

BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY

The Industry - Engineering Services Industry - Product Development in Industry versusAcademia –The IPD Essentials - Introduction to Vertical Specific Product DevelopmentProcesses Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical,Embedded and Software Systems – Product Development Trade-offs - Intellectual PropertyRights and Confidentiality – Security and Configuration Management.

TEXT BOOKS

1. Book specially prepared by NASSCOM as per the MoU.
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill 11thEdition.

REFERENCES:

1. Hiriyappa B, “Corporate Strategy – Managing the Business”, Author House, 2013.
2. Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford,2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, “Enterprise Resource Planning –Concepts”, Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013.

COURSE DESIGNERS

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1.	C.Vanathi	Assistant professor	Biotechnology	vanmathi@vmkvec.edu.in
2	Mrs.G.Arthi	Assistant Professor	Biotechnology	arthi@vmkvec.edu.in

17PEEC13	PHARMACOVIGILANCE	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

This course enriches the students with drug safety related to the collection, detection, assessment, monitoring and prevention of adverse effects with pharmaceutical products. It focuses on adverse drug reaction on the biological system and plays a key role inindustrial development and testing of new medications.

PREREQUISITE NIL

COURSE OBJECTIVES

1	To compare the development and global scenario ofpharmacovigilance and their establishment in an organization.
2	To developthe skills of classifying drugs, diseases and adverse drug reactions.
3	To compare the methods of pharmacovigilance.
4	To distinguish the statistical methods for the evaluation of drug molecule.
5	To check and formulate the regulatory aspects of bioactive molecule.

COURSE OUTCOMES

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

CO1. Explain adverse drug reaction in proper format.	Understand
CO2. Illustrate the data generated during pharmacovigilance study	Apply
CO3. Correlate the regulatory requirements of different countries.	Analyse
CO4. Predict the phases of clinical trials and pharmcovigilance	Analyse
CO5. Analyse pharmacokinetics and pharmacodynamics of the drug	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO1	PSO	PSO	PSO3
CO1	L	L	L	L	L	L	-	-	L	L	L	L	M	-	-
CO2	M	L	M	M	-	L	M	L	-	-	-	L	-	M	-
CO3	L	M	L	L	S	L	S	L	-	-	-	-	-	M	-
CO4	-	-	-	-	-	L	-	L	-	-	-	-	-	-	-
CO5	-	-	-	-	L	M	L	S	-	-	-	-	M	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO PHARMACOVIGILANCE

Scope and development of Pharmacovigilance - Importance of safety monitoring of Medicine –WHO international drug monitoring programme - Pharmacovigilance Program of India (PvPI) -Definitions and classification of adverse drug reactions - Detection and reporting - Methods in Causality assessment - Severity and seriousness assessment - Predictability and preventability assessment - Management of adverse drug reactions - Terminologies used in pharmacovigilance, adverse medication related events and Regulatory terminologies.

SOURCES OF DATA

Anatomical, therapeutic and chemical classification of drugs - International classification of diseases -Daily defined doses - International Nonproprietary Names for drugs - Drug dictionaries and coding in pharmacovigilance - WHO adverse reaction terminologies - MedDRA and Standardised MedDRA queries - WHO drug dictionary - Eudravigilance medicinal product dictionary Information resources in pharmacovigilance - Basic drug information resources - Specialised resources for ADRs Establishing pharmacovigilance programme - Pre-clinical studies-Human volunteer studies - Clinical trials - Post-marketing surveillance - Systematic reviews and meta-analysis

PHARMACOVIGILANCE METHODS

Pharmacovigilance methods - Passive surveillance – Spontaneous reports and case series - Stimulated reporting - Active surveillance – Sentinel sites, drug event monitoring and registries - Comparative observational studies – Cross sectional study, case control study and cohort study - Targeted clinical investigations. Communication in pharmacovigilance - Effective communication in Pharmacovigilance -Communication in Drug Safety Crisis management - Communicating with Regulatory Agencies, Business Partners, Healthcare facilities & Media.

STATISTICAL METHODS FOR EVALUATING MEDICATION SAFETY DATA

Safety data generation - Pre clinical phase - Clinical phase - Post approval phase. ICH Guidelines for Pharmacovigilance - Organization and objectives of ICH - Expedited reporting - Individual case safety reports - Periodic safety update reports - Post approval expedited reporting – Pharmacovigilance planning - Good clinical practice in pharmacovigilance studies.

PHARMACOGENOMICS OF ADVERSE DRUG REACTIONS

Drug safety evaluation in special population - Pediatrics - Pregnancy and lactation – Geriatrics. CIOMS - CIOMS Working Groups - CIOMS Form. CDSCO (India) and Pharmacovigilance - D&C Act and Schedule Y - Differences in Indian and global pharmacovigilance requirements.

TEXT BOOKS:

1. SumitVerma, S and Gulati, Y. Fundamentals of Pharmacovigilance, Paras Medical Publishers, 2017
2. Gupta, S. K. Text book of Pharmacovigilance, Jaypee Brothers Medical Publishers,2011
3. Mohanta, G.P and Manna, P.K. A Textbook of Pharmacovigilance: Concept and Practice, PharmaMed Press, 2015.

REFERENCES:

1. Andrews, E.B and Moore, N. Mann's Pharmacovigilance, Wiley-Blackwel, 3rd Edition, 2014.
2. Waller, P and Harrison Woolrych, M. An Introduction to Pharmacovigilance, Wiley- Blackwel, 2nd Edition, 2017.
3. Orleans-Lindsay, J. Pharmacovigilance Medical Writing: A Good Practice Guide, Wiley-Blackwell, 2012.

COURSE DESIGNERS

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17PEEC14	CHEMICAL REACTION ENGINEERING	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

Chemical reaction engineeringcourse covers the basic concepts of types of reactions, variable affecting the rate of reaction,predicting the rate equations for different types of reactions and also to study about different reactor systems, deriving the performance equations and predicting the rate equations in chemical reaction engineering system.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To Define chemical reactors and reaction systems.
2	To Discuss about biodiversity in marine environment and their resources
3	To Outline the conversion and yield for chemical reactions.
4	To Develop the appropriate selection technique for intended problem.
5	To Learn conceptual design of separation processes and design of equipment involved.

COURSE OUTCOMES

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

CO1. Identify the algorithm that allows the student to solve chemical engineering through logic rather than memorization.	Understand
CO2. Describe the steps in a catalytic mechanism and how those about deriving a rate law, mechanism and rate limiting step that are consistent with experimental data.	Understand
CO3. Calculate the reaction order and specific reaction rate from experimental data.	Analyse
CO4. Assess the separation system for multi component mixtures.	Analyse
CO5. Design separation system for the effective solution of intended problem.	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO	PO2	PO	PO4	PO	PO	PO	PO	PO	PO1	PO11	PO1	PSO	PSO	PSO
CO1	S	M	S	S	-	-	-	-	-	-	-	L	M	M	-
CO2	S	M	S	S	-	-	L	-	-	-	-	L	M	M	-
CO3	M	L	M	M	-	-	-	-	-	-	-	-	-	-	-
CO4	L	L	L	L	-	-	-	-	-	-	-	-	M	M	-
CO5	S	M	L	L	S	-	L	-	-	-	-	S	S	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

CHEMICAL KINETICS

Introduction to chemical kinetics, rate equation, concentration dependent term of a rate equation: single and multiple reaction. Elementary and non- elementary reactions. Molecularity and order, theories of reaction rate and temperature dependency.

IDEALREACTORS

Batch Reactor–ConstantVolume,Variable volume batch reactor- Batch Reactor data for typical reactions– integral and differential method of analysis. Performance Equations for Single Batchreactor, Ideal CSTR, Ideal PFR.

SINGLEANDMULTIPLEREACTIONS

Designforsinglereaction: size comparison of single reactors, multiple reactor system, pfr in series/ parallel, equal size mfr in series, Recycle reactor, introduction to multiple reactions, qualitative analysis of product distribution.

NON-IDEALREACTORS

Residence time distribution as a factor performance, residence time function and relationship between them in reactor, basic models for non ideal reactor like dispersion model, tanks in series model.

HETEROGENEOUSREACTIONS

Fluidparticlereactions: selection of a model, unreacted core models for spherical particles, determination of the rate controlling step. Catalyst preparation, surface area and pore volume measurements: promoters, poisons.

TEXTBOOKS

1. Octave Levenspiel, Chemical Reaction Engineering, John Wiley and sons. 3rd Edition, 1999.
2. Gavhane K.A., Chemical Reaction Engineering – I, NiraliPrakashan Publishers, 2009.

REFERENCES

1. Foggler H.S., Elements of chemical reaction engineering, Prentice Hall Publishing Co. 4th Edition, 2006.
2. Smith J.M., Chemical Engineering Kinetics, McGraw-Hill Inc 2003.
3. Narayanan, K.V., 2001. A Text Book of Chemical Engineering Thermodynamics, Prentice Hall India.
4. Smith, J.M., Van Ness, H.C. and Abbot, M.M., 2001. Chemical EngineeringThermodynamics. 6th Edn., McGraw- Hill.
5. Irving J. Dunn and Zurich, 2003. Biological Reaction Engineering. John Wiley and Sons.

COURSE DESIGNERS

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17PEEC15	REGULATORY TOXICOLOGY	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

Regulatory Toxicology encompasses the collection, processing and evaluation of epidemiological as well as experimental toxicology data to permit toxicologically based decisions directed towards the protection of health against harmful effects of chemical substances. Furthermore, Regulatory Toxicology supports the development of standard protocols and new testing methods in order to continuously improve the scientific basis for decision-making processes.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To Recognize the international, and national regulatory processes concerning chemical risk assessment in humans, biomaterials and medical devices.
2	To Discuss about how to develop awareness of how toxicology is applied in real world regulatory situations.
3	To Explain the complexities and competing interests that are part of the regulatory decision making.
4	To Classify the methods used to evaluate risk and produce safety guidelines, including laboratory testing, epidemiological studies.
5	To Outline the product regulations and produce alternative strategies for challenges in the future.

COURSE OUTCOMES

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

CO1. Discuss the general principles in toxicological risk assessment, both ecotoxicology and human toxicology	Understand
CO2. Explain the safety testing strategies, legal regulations and alternative options in toxicology.	Understand
CO3. Tell the basic principles of current, cutting-edge knowledge in environmental and human health toxicology.	Understand
CO4.Demonstrate an understanding of legal, regulatory, and ethical considerations relating totoxicology within the broader societal context.	Apply
CO5. Categorise different testing strategies and alternatives for societal needs.	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO1	PSO1	PSO	PSO3
CO1	L	L	L	L	-	L	L	-	-	L	-	L	M	M	M
CO2	M	M	L	M	-	L	L	L	-	-	-	L	-	-	-
CO3	L	M	M	S	-	S	-	L	-	-	-	-	-	M	-
CO4	M	-	L	-	-	S	-	S	-	-	-	-	M	-	-
CO5	L	L	L	-	L	S	L	S	-	-	-	-	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION gulatory aspects and strategy in medical device and biomaterials safety evaluation. Regulationsaffecting cosmetic and over-the- counter drug products.

REGULATIONS GOVERNING TOXICOLOGY

Aim and mission, working areas, regulatory process in toxicology, quality assurance in regulatorytoxicology, toxicological risk assessment.

TOXICOLOGY AND DRUG PRODUCT REGULATIONS

Introduction, aspects of the IND / NDA process, toxicology and other issues, pediatric drugproducts, drug combinations, excipients and reformulations, conclusions.

TOXICOGENEOMICS, GENETIC TOXICOLOGY AND REGULATORYPOLICY

Microarrays in toxicology, proteomics and metabolomics, case examples, toxicogenomics inregulatory environment. Initiation of genetic toxicology testing, EPA GENE TOX (Phase I and II),ICPEMC, NTP, Genetic toxicology technologies and concepts. Influence of genetic toxicology research on regulatory policy, future role in safety testing strategies.

ALTERNATIVES IN TOXICOLOGY

Introduction, Societal need for information about toxic chemicals, evolution of alternatives intoxicology, human science and animal welfare, assessing alternatives, challenges and future.

TEXT BOOKS:

1. Shayne C. Gad, Regulatory Toxicology, Second Edition, CRC Press, 2001.
2. Ian Dewhurst,Regulatory Toxicology in the European Union, Royal Society of Chemistry,2017
3. Renuka Sengupta,Regulatory Toxicology: Essentially Practical Aspects, Narosa Publishing House 2015

REFERENCES:

1.Shayne C. Gad. Taylor and Francis, Regulatory Toxicology, 2nd Edition, CRC Press,2001.
2. Toxicology and Regulatory Process. Sidney Green, CRC Press, 2006.
3. Regulatory Toxicology. Eds. Franz XaverReichl and Michael Schwenk. Springer, 2014.

COURSE DESIGNERS

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2	Mrs.G.Arthi	Assistant Professor	Biotechnology	arthi@vmkvec.edu.in

17PEEC16	TRANSPORT PHENOMENA	Category	L	T	P	Credit
		EC – PS	3	0	0	3

PREAMBLE

Transport Phenomena deals with the balanced knowledge of movement of different physical quantities such as momentum, energy and mass in any chemical or mechanical process with the fundamental equations and laws of various types of transport.

PREREQUISITE

17PECC16- CHEMICAL ENGINEERING THERMODYNAMICS

COURSE OBJECTIVES

1	To understand different types of fluids, flow characteristics and mathematical models applied to actual situations
2	To understand the mechanisms of fluids in motion under different conditions.
3	To employ heat, mass and momentum transfer analysis
4	To apply the concepts in analyzing industrial problems with appropriate assumptions and boundary conditions.
5	To analyze various transport processes with understanding of solution approximation methods and their limitations.

COURSE OUTCOMES

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

CO1. Identify overall balances for conservation of momentum, energy and mass.	Understand
CO2. Review the analogies among momentum, heat and mass transfer.	Understand
CO3. Employ the appropriate equations of change to obtain preferred summaries for velocity, temperature and concentration.	Apply
CO4. Utilize information obtained from balance equations solutions to obtain Engineering quantities of interest.	Apply
CO5. Predict and correlate appropriate macroscopic balances for conservation of momentum, energy and mass	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO	PO	PO	PO	PO	PO9	PO1	PO1	PO1	PSO	PSO	PSO
CO1	L	L	-	-	-	-	L	-	-	-	-	-	M	-	M
CO2	L	M	-	-	-	-	L	-	-	-	-	-	M	-	M
CO3	S	M	L	-	-	M	L	-	-	-	-	-	S	-	-
CO4	S	S	L	-	-	M	L	-	-	-	-	-	S	-	-
CO5	S	S	M	M	M	-	L	-	-	-	-	-	S	-	S

S- Strong; M-Medium; L-Low

SYLLABUS

TRANSPORT PHENOMENA BY MOLECULAR MOTION

Importance of Transport Phenomena; Analogous nature of Transfer Process; Conservation Laws; Continuous Concept, Field, Reference Frames, Substantial Derivative and Boundary Conditions; Methods of Analysis;

Differential, Integral and Experimental Methods.

ONE DIMENSIONAL MOMENTUM TRANSPORT

Shell Momentum balances, boundary conditions, velocity profiles, average velocity, momentum flux at the surfaces, of Newtonian and non-Newtonian for flow of a falling film, flow through circular tube, slits, flow through an Annulus, Adjacent flow of two Immiscible fluids. Equations of Change (Isothermal), equation of continuity, equation of motion, equation of energy (isothermal) theirapplications in fluid flow problems.

ONE DIMENSIONAL HEAT TRANSPORT

Steady State Condition and Fourier's Law, Shell Energy Balance, Applications of Shell Energy Balance: Heat Conduction with Electrical Source, Heat Conduction with Chemical Heat Source, Temperature Distribution in Two Concentric Cylinder's, Natural Convention Heat Transfer Governing Equation, Flow over Flat Plate

ONE DIMENSIONAL MASS TRANSPORT

Equation of Molecular Mass Transport, Molecular Diffusion in Gases, Equimolar Counter Diffusion, Diffusion of A through Non-Diffusing B, Mass and Molar Transport by Convection: Mass and Molar Concentrations, Mass Average and Molar Average Velocity, Molecular Mass and Molar Fluxes, Convective Mass and Molar Fluxes.

TRANSPORT IN TURBULENT AND BOUNDARY LAYER FLOW

Turbulence phenomena; phenomenological relations for transfer fluxes; time smoothed equations of change and their applications for turbulent flow in pipes; boundary layer theory; laminar and turbulent hydrodynamics thermal and concentration boundary layer and their thicknesses; analysis of flow over flat surface. Analogies between transport processes.

TEXT BOOKS:

1. R. B. Bird, W.E. Stewart, E.W. Lightfoot, Transport Phenomena, 2nd RevisedEdition, John Wiley, 2007
2. Robert, S Brodkey, Harry C. Hershey, "Transport Phenomena A Unified Approach", Brodkey Publishing 2003.

REFERENCES:

1. C. J. Geankoplis, Transport Processes and Separation Process Principles, Prentice- HallInc., 4th Edition 2003.
2. C. O. Bennett, J. O. Myers, Momentum, Heat and Mass Transfer, 2nd International StudentEdition Mc-Graw Hill, 1983.
3. R. Welty, R.W. Wilson, and C.W.Wicks, Rorer G.E, Wilson R.W. "Fundamentals of Momentum Heat and Mass Transfer", 5th Edition, John Wiley, New York, 2007.

COURSE DESIGNERS

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2	Mrs.G.Arthi	Assistant Professor	Biotechnology	arthi@vmkvec.edu.in

17BTEC22	MOLECULAR MODELLING AND DRUG DESIGNING	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

This course enables the students to broaden their interests to use structure-based and non-linear classification methods in drug design.

PREREQUISITE

17BTEC03-PRINCIPLES OF BIOINFORMATICS

COURSE OBJECTIVES

1	To list concepts involved in molecular modeling
2	To summarize molecular mechanisms involved in energy minimization
3	To execute the molecular dynamics using different models
4	To develop basic steps involved in modeling of proteins
5	To justify the molecular dynamics in drug designing and discovery

COURSE OUTCOMES

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

CO1. Recognize about molecular modelling concepts	Remember
CO2. Classify molecular mechanisms behind energy minimization problems	Understand
CO3. Illustrate the models to study the molecular dynamics	Understand
CO4. Compare molecular dynamics with drug designing concepts	Apply
CO5. Design new techniques for the discovery of drugs	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

QUANTUM MECHANICS & CONCEPTS IN MOLECULAR MODELING

Introduction – coordinate systems – potential energy surfaces – introduction to quantum mechanics – postulates – Schrodinger wave equation – hydrogen molecule – Born-Oppenheimer approximation, introduction to computer hardware and software

MOLECULAR MECHANICS AND ENERGY MINIMIZATION

Empirical force field models – Bond stretching – angle bending – torsional term – nonbonding interactions – thermodynamics properties using a forcefield – derived and non-derived energy minimization method – simplex –

sequential univariate method – steepest descent method – conjugate gradient method- Newton-Rapson method.

MOLECULAR DYNAMICS AND MONTE CARLO SIMULATION

Introduction – Using single Model – time steps – Multiple steps – Setting up MD – energy conservation in MD Simulation Examples – Monte Carlo – Random number generation – Difference in MD & MC

HOMOLOGY MODELING

Comparative modeling of proteins – comparison of 3D structure – Homology – steps in homology modeling – tools – databases – side chain modeling – loop modeling.

DRUG DESIGN

General approach to discovery of new drugs - lead discovery – lead modification – physiochemical principles of drug action – drug stereo chemistry –drug action - 3D database search – computer aided drug design – docking - molecular modeling in drug design – structure based drug design – pharmacophores - QSAR

TEXTBOOKS:

1. Leach R. (1996), "Molecular Modeling Principles and Application", 2nd edition, Longman Publications.
2. Baxivanis D. and Foulette - Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd Edition edition, Wiely-Blackwell Publishers
3. Kothekar V. (2001), "Essentials of Drug Designing", Indian Edition, Dhruv Publications
4. Gerhard Edwin Seibold, Alexander Hillisch, Rolf, (2002) "Modern Methods of Drug Discovery", Hilgenfeld Publisher.

REFERENCES:

1. Attwood, T K , parry-Smith, D J (2005), " Introduction to Bioinformatics", Pearson Education, 1st Edition, 11th Reprint
2. Alan Hinchliffe, (2003), " Molecular Modelling for Beginners", John-Wiley
3. "Drug Design: Cutting Edge Approaches". AngewandteChemie, International Edition,Vol.42
   "Advanced Drug Design and Development" Kourounakis Taylor and Francis

COURSE DESIGNERS

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2	Mrs.G.Arthi	Assistant Professor	Biotechnology	arthi@vmkvec.edu.in

17PEEC17	PRODUCT DEVELOPMENT AND TECHNOLOGY TRANSFER	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

This course enables the students to know about the various issues related to Creativity, Innovation and Product development.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To describe the various factors and technology involve for the product development.
2	To implement the selection criteria and technology for formation of new product.
3	To outline the aspects of IPR.
4	To develop the model or prototype to produce a new product.
5	To produce the prototype to obtain the patent for the developed product.

COURSE OUTCOMES

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

CO1. Explain the process of technical innovation	Understand
CO2. Practice the various aspects of Creativity and Innovation for New Product Development	Apply
CO3. Develop the objectives of Product Selection and Evaluation	Analyse
CO4. Test new technologies developed to obtain the yield.	Analyse
CO5. Formulate a new product in the laboratory	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO	PO2	PO3	PO	PO5	PO6	PO	PO8	PO	PO1	PO1	PO1	PSO	PSO	PSO
CO1	L	L	L	-	S	M	L	L	-	-	-	-	-	-	-
CO2	M	L	L	-	S	L	-	-	L	M	-	L	M	-	-
CO3	L	L	L	S	M	L	-	-	L	-	-	L	M	M	M
CO4	S	M	S	L	L	M	-	-	L	-	L	S	S	M	M
CO5	M	L	L	-	L	-	L	-	S	M	S	-	M	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

The process of technological innovation - factors contributing to successful technological innovation - the need for creativity and innovation - creativity and problem solving - brain storming - different techniques.

PROJECT SELECTION AND EVALUATION

Collection of ideas and purpose of project - Selection criteria - screening ideas for new products (evaluation techniques)

NEW PRODUCT DEVELOPMENT

Research and new product development - Patents - Patent search - Patent laws - International code for

patents - Intellectual property rights (IPR).

NEW PRODUCT PLANNING
Design of prototype - testing - quality standards - marketing research - introducing new products.

LABORATORY
Creative design - Model Preparation - Testing - cost evaluation - Patent application

TEXT BOOKS:

1. Harry B.Watton, “New Product Planning ", Prentice Hall Inc., 1992.
2. P.N.Khandwalla, "Fourth Eye (Excellence through Creativity) - Wheeler Publishing ", Allahabad, 1992.
3. I.P.R. Bulletins, TIFAC, New Delhi, 1997.

REFERENCES:

1. Harry Nystrom, “Creativity and innovation", John Wiley & Sons, 1979.
2. Brain Twiss, “Managing technological innovation", Pitman Publishing Ltd., 1992.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
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17PEEC18	INSTRUMENTATION AND PROCESS CONTROL	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

To familiarize the students with concepts of process dynamics and control leading to control system design. This course also introduces dynamic response of open and closed loop systems, control loop components andstability of control systems along with instrumentation.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To Discuss the basic principles of instrumentation.
2	To Demonstrate the process mechanism involved in open loop system.
3	To Perform feedback control process.
4	To Construct frequency response for both feedback and non-feedback system.
5	To Outline advanced control system over different process in pharmaceutical industry.

COURSE OUTCOMES

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

CO1. Describe the basic principles & importance of process control in industrial process plants.	Understand
CO2. Generalize the required instrumentation and final elements to ensure that well-tuned control is achieved.	Apply
CO3. Illustrate the importance and application of good instrumentation for the efficient design of process control loops for process engineering plants	Apply
CO4. Demonstrate stability, frequency response, and other characteristics relevant to process control.	Apply
CO5. Develop design and operate process control systems to industrial process.	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO1	PSO	PSO	PSO3
CO1	L	-	L	L	L	-	-	L	-	-	-	-	-	-	-
CO2	M	M	L	M	L	-	-	-	L	-	-	L	M	M	-
CO3	S	S	S	S	L	L	-	L	L	-	L	L	M	M	-
CO4	M	M	M	M	M	-	-	-	-	M	L	-	M	-	-
CO5	L	L	L	L	L	S	L	-	-	L	L	M	S	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

INSTRUMENTATION

Principles of measurements and classification of process instruments, measurement oftemperature, pressure, fluid flow, liquid weight and weight flow rate, viscosity, pH, concentration, electrical and thermal conductivity, humidity of gases.

OPEN LOOP SYSTEMS

Laplace transformation, application to solve ODEs. Open-loop systems, first order systems and their transient response for standard input functions, first order systems in series, linearization and its application

in process control, second order systems and their dynamics; transportation lag.

CLOSED LOOP SYSTEMS

Closed loop control systems, development of block diagram for feed-back control systems, servo and regulatory problems, transfer function for controllers and final control element, principles of pneumatic and electronic controllers, transient response of closed-loop control systems and their stability

FREQUENCY RESPONSE

Introduction to frequency response of closed-loop systems, control system design by frequency response techniques, bode diagram, stability criterion, tuning of controller settings.

ADVANCED CONTROL SYSTEMS

Introduction to advanced control systems, cascade control, feed forward control, Smith predictor controller, control of distillation towers and heat exchangers, introduction to computer control of chemical processes

TEXT BOOKS

1. Stephanopoulos, G., "Chemical Process Control ", Prentice Hall of India, 2003.
2. Coughnowr, D., "Process Systems Analysis and Control ", 2nd Edn., McGraw Hill, New York, 1991.

REFERENCES

1 Marlin, T. E., "Process Control ", 2nd Edn, McGraw Hill, New York, 2000.
2. Smith, C. A. and Corripio, A. B., "Principles and Practice of Automatic Process Control", 2nd Edn., John Wiley, New York, 1997.

COURSE DESIGNERS

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17PEEC19	CLINICAL RESEARCH AND REGULATIONS	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

This course will upgrade the knowledge of students in health-care which determines the safety and effectiveness of medications, devices, diagnostic products and treatments for human beings. It can used for the prevention, treatment of a diseases and their documents. Those documents responsible for the evaluation of quality of the research to which is to be submitted for the regulatory bodies.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To explain the drug development process and their validation through statistical analysis.
2	To implement the regulations of various regulatory bodies.
3	To organize the data obtained from the clinical research.
4	To differentiate the advance modules applied in the field of research.
5	To assess the various modules of regulations and safety.

COURSE OUTCOMES

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

CO1. Demonstrate the steps for developing a drug through various process.	Understand
CO2. Operate the research based on the requirements of regulatory bodies.	Apply
CO3. Examine the data from the research modules.	Analyse
CO4. Develop and test the process involved in the research laboratories	Analyse
CO5. Analyse the regulations and safety module of the research	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO1	PSO	PSO	PSO3
CO1	M	-	S	-	-	L	L	-	-	L	L	L	S	-	-
CO2	M	L	M	M	L	M	S	-	-	-	L	L	-	-	-
CO3	L	L	L	-	-	-	M	M	M	-	-	L	-	M	-
CO4	L	-	S	-	S	L	S	-	-	M	-	M	M	-	-
CO5	L	L	-		M	S	-	-	M	-	L	S	-	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

DRUG DEVELOPMENT MODULE

Drug development overview, Phases of clinical research, Pre-clinical (Non-clinical) development. Discovery and selection of compounds, Toxicology, Pharmacology Clinical Development programmes; Basics of clinical research statistics

CLINICAL RESEARCH MODULE

Understanding the evolving role of the Clinical Trial Administrator (CTA)/Clinical Project Assistant (CPA); Good Clinical Practice (GCP) and international harmonization. Case Report Forms; Protocols; Informed Consent; Ethics Committees / Institutional Boards. Role of the Sponsor including the Clinical Research

Associate/Monitor.

CLINICAL RESEARCH MODULE II

Clinical trial set up; Trial Master Files and study filling, Data Management. Review of the EU Clinical Trial Directive; How to prepare for Regulatory Inspections or Audit; Fraud in clinical Research

ADVANCED CLINICAL RESEARCH MODULE

Project Management; How to develop a proactive approach to supporting clinical trials Building a Successful working relationship with your manager(s) and the rest of the clinical research team; Team effectiveness: working as an effective clinical research team; Working in partnership with CROs. Legal aspects of clinical research; Laboratory tests Communication skills, Cross-cultural communication with other offices and departments internationally. Time management and optimizing your effectiveness

REGULATORY AFFAIRS AND SAFETY MODULE

Regulatory requirements for international clinical research - Regulatory requirements forBiotechnology products, medical devices and veterinary products; Health economics; Safety reporting; Responding to drug safety alerts Post marketing surveillance

TEXT BOOKS:

1. Matoren, Gary M. "The Clinical Research Process in the Pharmaceutical Industry", Marcel Dekker, 1984.
2. Abraham, John "Regulation of the Pharmaceutical Industry", Palgrave, 2003.
3. Blaisdell, Peter, "Twenty – First Century Pharmaceutical Development", Interpharm Press, 2001.

REFERENCE:

1.Gad, Shayne C. "Drug Safety Evaluation", John – Wiley & Sons, 2002.

COURSE DESIGNERS

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17PEEC20	INTRODUCTION TO BIOMATERIALS AND TISSUE ENGINEERING	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

To Introduce the concepts, underlie the mechanical and biological properties of synthetic and natural biomaterials and tissue engineering principles and scaffolding techniques.The main purpose of the subject is to understand aboutbiomaterials, stem cell therapy and molecular therapy and how it can be applied to clinical use.

PREREQUISITE NIL

COURSE OBJECTIVES

1	To State the concepts of stress and strain, and the parameters used to characterize the physical bulk and surface properties of materials.
2	To discuss the composition, structure and mechanical properties of the main classes of biomaterials-metals, ceramics, polymers, composites and the body tissues
3	To generalize scaffold characteristics and design methodologies, cell seeding, biofunctionalization, bioreactors.
4	To detect the biomaterials are used to fabricate devices for clinical use.
5	To design a biomaterial system considering the main issues of biocompatibility including toxicity.

COURSE OUTCOMES

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

CO1. Summarize the biological requirement for designed tissue engineering systems.	Understand
CO2. Describe and the developments of biomaterials for regenerative therapies and tissue engineering.	Understand
CO3. Initiate the role of tissue engineering and stem cell therapy in organogenesis.	Apply
CO4. Develop fabricate multicomponent biomaterials using advanced manufacturing technologies including 3D printing.	Analyse
CO5. Analyse the scaffolds for growing biological materials.	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO1	PSO	PSO	PSO
CO1	M	L	L	L	-	L	-	-	-	-	-	L	-	-	-
CO2	S	M	S	S	-	L	-	-	-	-	-	L	-	M	-
CO3	M	L	M	M	L	-	-	-	-	-	-	L	-	-	-
CO4	L	L	S	L	S	L	-	-	-	-	-	M	M	M	-
CO5	S	S	L	M	L	L	-	-	-	-	-	M	M	S	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Introduction to tissue engineering: Basic definition-current scope - cell numbers and growth rates measurement of cell characteristics –morphology- numberviability- motility and functions. Measurement of tissue characteristics appearance- cellular component-ECM component physical properties.

TISSUE ARCHITECTURE

Tissue types and Tissue components, Tissue repair and Engineering -wound healingand sequence of events - Cell-Matrix- Cell-Cell Interactions - telomeres and Self renewal- Control of cell migration in tissue engineering.

BIOMATERIALS

Biomaterials: Properties of biomaterials-Surface, bulk, mechanical and biological- Scaffolds &tissue engineering - Types of biomaterials-biological and synthetic materials- Biopolymers-Applications – Modifications - Role of Nanotechnology.

BASIC BIOLOGY OF STEM CELLS

Stem Cells: Introduction- hematopoietic differentiation pathway -Potency and plasticity of stem cells- Stem Cell markers- Types and sources of stem cell with characteristics: embryonic adulthaematopoietic-fetal- cord blood-placenta- bone marrow-primordial germ cells- cancer stem cells inducedpluripotent stem cells.

CLINICAL APPLICATIONS

Stem cell therapy-Molecular therapy - In vitro Organogenesis-Neuro degenerative diseases- spinal cord injury-heart disease- diabetes- burns and skin ulcers- muscular dystrophy-orthopaedic applications - Patent protection and regulation of tissue engineered products- ethical issues.

TEXT BOOKS:

1. Bernhard O.Palsson, Sangeeta N.Bhatia, "Tissue Engineering" Pearson Publishers 2009.
2. Meyer, U.; Meyer, Th.; Handschel, J.; Wiesmann, H.P. Fundamentals of TissueEngineering and Regenerative Medicine. 2009.
3. R. Lanza, J. Gearhart et al (Eds), Essential of Stem Cell Biology, Elsevier Academic press,2006.

REFERENCES:

1. J. J. Mao, G. Vunjak-Novakovic et al (Eds), Translational Approaches in TissueEngineering & Regenerative Medicine" Artech House, INC Publications, 2008
2. Bernard N. Kennedy (editor), Stem cell transplantation, tissue engineering, and cancer applications, New York: Nova Science Publishers, 2008.
3. Raphael Gorodetsky, Richard Schäfer Stem cell- based tissue repair, Cambridge: RSC publishing, 2011.

COURSE DESIGNERS

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17PEEC21	PHARMACOECONOMICS	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

This course covers the principles of Pharmacoeconomics, introduce the fundamental topics and define the terminology used in pharmacoeconomic research.Also, it aims to impart knowledge on basic concepts, assumptions, terminology, and methods associated with Pharmacoeconomics and health related outcomes, and when should be appropriate Pharmacoeconomic model should be applied for a health care regimen.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To Define thefundamental principles of Pharmacoeconomics.
2	To Describe the Pharmacoeconomic decision analysis methods and its applications.
3	To Explain the current Pharmacoeconomic methods and issues
4	To Classify the steps for conducting a pharmacoeconomic analysis.
5	To Outline relevant cost and consequences associated with pharmacy products and services.

COURSE OUTCOMES

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

CO1. Discuss the principles and tools of pharmacoeconomics.	Understand
CO2. Identify the role of economic evaluation in decision making and health policy.	Understand
CO3. Employ economic evaluation and health technology assessment to genetic tests.	Apply
CO4.Demonstrate a simple decision analysis model.	Apply
CO5. Compare and contrast the different methods for economic evaluation in healthcare.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO1	PSO	PSO	PSO3
CO1	L	M	L	L	-	M	L	-	-	M	-	L		M	M
CO2	M	M	M	M	-	L	M	L	-	-	-	L	-	M	-
CO3	L	L	-	M	-	-	-	L	-	-	-	-	-	M	-
CO4	M	-	L	-	-	L	L	L	-	-	-	-	M	-	-
CO5	M	L	L	M	L	M	L	M	-	-	-	-	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO PHARMACOECONOMICS

Definition, history of Pharmacoeconomics, Need of Pharmacoeconomic studies in healthcare system. Cost categorization and resources for cost estimation: Direct costs. Indirect costs. Intangible costs.

OUTCOMES AND MEASUREMENTS OF PHARMACOECONOMICS

Types of outcomes: Clinical outcome, Economic outcomes, Humanistic outcomes; Quality Adjusted Life Years, Disability Adjusted Life Years Incremental Cost Effective Ratio, Average Cost Effective Ratio. Person

Time, Willingness To Pay, Time Trade Off and Discounting.

PHARMACOECONOMIC EVALUATIONS

Definition, Steps involved, Applications, Advantages and disadvantages of the following Pharmacoeconomic models: Cost Minimization Analysis (CMA), Cost Benefit Analysis (CBA), Cost Effective Analysis (CEA) and Cost Utility Analysis (CUA).

HEALTH RELATEDQUALITY OF LIFE: HEALTH STATUS MEASURES

Definitions, HRQoL measures versus utility measures, domains of health status, assessing HRQoL instruments, Pharmacoeconomics and HRQoL measures, preference based classification system, patient – reported outcomes.

APPLICATIONS

Decision Analysis and Decision tree, Sensitivity analysis, Markov Modeling, Software used in Pharmacoeconomic analysis, Applications of Pharmacoeconomics.

TEXT BOOKS:

1. Karen L. Rascati, Essentials of Pharmacoeconomics, Woulters Kluwer Lippincott Williams & Wilkins, 2014.
2. Decision Modelling for Health Economic Evaluation Andrew Briggs, Karl Claxton, Mark Sculpher, Published by the Oxford University Press 2006.

REFERENCES:

1. Thomas E. Getzen, Health Economics: Fundamentals and Flow of Funds, 2nd Edition, John Wiley & Sons, 2003.
2. Graker and Dennis, Pharmacoeconomics And Outcomes, Amer College of Clinical Pharmacy, 2003
3. Michael Drummond, Mark Sculpher, George Torrence, Bernie O'Brien and Greg Stoddart, Methods for the Economic Evaluation of Health Care Programmes, Oxford University Press, 2005

COURSE DESIGNERS

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SPECIALIZATION – PHARMACEUTICAL MANUFACTURING

17PESE01	NOVEL DRUG DELIVERY SYSTEMS	Category	L	T	P	Credit
		EC - SE	3	0	0	3

PREAMBLE

This course is designed to impart basic knowledge on the area of novel drug delivery systems, controlled drug delivery systems including oral, transdermal, targeted delivery such as Liposomes and Nanoparticles.

PRERQUISITE- NIL

COURSE OBJECTIVES

1	To discuss various approaches for development of novel drug delivery systems
2	To demonstrate the criteria for selection of drugs and polymers for the development of Novel drug delivery systems, their formulation and evaluation
3	To compare the design, evaluation and application related to oral, parenteral, transdermal, implants, bioadhesives and targeted drug delivery systems

COURSE OUTCOMES

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

CO1. Recognose the importance of delivery systems.	Understand
CO2. Understand the concepts and applications of Novel Drug Delivery Systems.	Understand
CO3.Apply knowledge in developing various novel formulations as per requirements.	Apply
CO4. Analyze various evaluation parameters for oral, parenteral, topical etc. drug delivery systems.	Analyze
CO5.Formulate industrially feasible, cost effective strategy for development of new dosage forms	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO1	PSO	PSO	PSO
CO	M	M	M	M	L	L	M	L	M	-	-	L	M	-	-
CO	M	M	M	M	L	L	M	L	M	-	-	L	M	-	-
CO	S	S	S	S	L	L	M	L	M	-	-	L	M	-	-
CO	M	M	M	M	M	M	S	-	S	-	-	M	M	M	-
CO	L	L	L	L	S	M	L	-	L	-	-	S	M	-	M

S- Strong; M-Medium; L-Low

SYLLABUS

POLYMERS

Polymers used in controlled drug delivery modules – Classification – Advantages and disadvantages of polymers – Polymerization mechanisms – Degradation mechanism – Polymer characterization.

SUSTAINED RELEASE DRUG DELIVERY SYSTEMS

Physicochemical and biological properties of drugs – Oral dosage forms – Diffusion systems – Systems utilizing dissolution – Osmotic systems – Ion exchange resins.

TARGETED DRUG DELIVERY SYSTEM

Nanoparticles – Liposomes – Resealed erythrocytes – Immunologically based system –Antibodies for drug delivery – Magnetic microspheres.

MODULE FOR GASTRO INTESTINAL TRACTS

Approaches to increase gastric retention – Factors affecting gastric retention –Formulation development of floating drug delivery system – Expanding systems –Systems for colon specific delivery – Targeting approaches to colon.

MUCOADHESIVE DRUG DELIVERY SYSTEMS

Buccal drug delivery – Concepts – Advantages – Disadvantages – Permeabilityenhancers – In vitro and in-vivo evaluation – Nasal drug delivery system – Pulmonarydrug delivery system – Applications.

TEXT BOOKS:

1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.
2. Robinson, J. R., Lee V. H. L, Controlled Drug Delivery Systems, Marcel Dekker, Inc., New York, 1992.
3. Encyclopedia of Controlled Delivery. Edith Mathiowitz, Published by Wiley Interscience Publication, John Wiley and Sons, Inc, New York. Chichester/Weinheim.
4. Y. Madhusudan Rao, A. V. Jithan, Advances in Drug Delivery, Vol 1, 2, 3.

REFERENCES:

1. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edi- tion 1997 (reprint in 2001).
2. S.P. Vyas and R.K. Khar, Controlled Drug Delivery -concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002.
3. Aukunuru Jithan, Oral Drug Delivery Technology, 2nd ed.

-

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Mrs.C.Nirmala	Assistant Professor	Biotechnology	nirmala@vmkvec.edu.in
2	Mrs.G.Arthi	Assistant Professor	Biotechnology	arthi@vmkvec.edu.in

17PESE02	COSMETIC TECHNOLOGY	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

The course gives extensive training in Cosmetic Formulation, Manufacturing, Analysis and Marketing. Industrial training and Educational tour are two essential components of the course. The focus of this scientific, hard- back, reference manual is to provide Formulators, Chemists, Heads of Research and Development at the forefront of Product Development, with concise comprehensive information on the latest raw materials, laboratory procedures, and testing methods available worldwide. Job opportunists available in the areas of Production/Marketing/R and D in cosmetic companies.

PRERQUISITE

NIL

COURSE OBJECTIVES

1	To Define the significance of cosmetic.
2	To Compose and Discuss about emulsions.
3	To Demonstrate the preparation of suspensions.
4	To Outline the interfacial phenomena in cosmetic.
5	To Produce drugs in solubilized form.

COURSE OUTCOMES

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

CO1. Summarize the significance of cosmetic.	Understand
CO2. Summarize the importance of emulsions.	Understand
CO3. Illustrate the preparation of suspensions.	Apply
CO4. Examine the interfacial phenomena in cosmetic.	Analyse
CO5. Evaluate the formation of solubilized drugs.	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

COSMETICS

Physical & Chemical properties of agents (Drug & Cosmetics) influencing design of products forms. Additives, their definition, classification, properties and significance in formulations like surfactants, diluents, preservatives and speciality additives. Monophasic liquid formulations, techniques of enhancing solubilities of ingredients in vehicles, other problems involved in preparation and stability of liquid with special emphasis on spray.

EMULSIONS

Electrical theories of stabilization of emulsions, assessment and prediction of emulsion shelf life, equations, involved in

emulsion stability stress conditions and physical parameters employed to evaluate emulsion stability, prevention of interaction between preservatives and emulsion ingredients like surface active agents hydrophilic polymers, suspended particles packaging materials etc. Predication of preservative‟s efficiency. Production, equipments, Industrial processing and large-scale manufacture.

SUSPENSIONS

Floculated and non-floculated suspensions, selection of wetting suspending and dispensing agents, preparation and stafility. Equipments, industrial processing and large-scale manufacturing.

INTERFACIAL PHENOMENA

Liquid – Liquid interface: Insoluble monalyers, surface pressure, surface potential, surface rheology and their measurement, structure and state of monolayers, mixed monolayers, Macromolecular films, Biological membranes, Liquid-solid interface, detailed study of wetting, detergency and water repellency.

SOLUBLIZATION

Surface Active agents, Micelle formation, factors affecting micelle formation and physical methods of investigation of micellar solutions. Theory and mechanism of solubilization.

TEXT BOOKS

1. B.M. Mithal, “A Textbook Of Pharmaceutical Formulation”, Published by Vallabh Prakashan, 1997.

2. John W Cooper& Colin Gunn, “Cooper and Gunn's Dispensing for Pharmaceutical Students”,London, 12th ed, Pitman Medical Pub. Co. 2008.

REFERENCES

1.IPC , “The Pharmacopoeia of India”,Educational Book Agency (India),2018.

COURSE DESIGNERS

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17PESE03	VALIDATION IN PHARMACEUTICAL INDUSTRIES	Category	L	T	P	C
		EC – SE	3	0	0	3

PREAMBLE

This course provides a basic understanding of the validation process as required by the Food and Drug Administration of the United States for drugs manufactured in the United States and all imported drugs. The main purpose of the subject is to understand about validation and how it can be applied to industry and thus to improve the quality of the products. The subject covers the complete information about validation, types, methodology and application.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To define calibration, qualification and validation.
2	To discuss the validation of sterilization, lyophilisation and solid dosages forms.
3	To demonstrate the process of pharmaceutical packaging and quality control.
4	To outline the analytical methods for estimation of drugs.
5	To validation of equipment's employed in the manufacture of pharmaceuticals.

COURSE OUTCOMES

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

CO1. Describe the regulatory basics for process validation and outline the prospective validation.	Understand
CO2. Explain the GMP regulation regarding the utilities Pharmaceutical manufacturing.	Understand
CO3. Illustrate the importance of impurity and the procedure for determination of expirydate.	Apply
CO4.Examine the process of validation and quality assurance.	Analyse
CO5. Assess the environmental impact of an industrial process.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO11	PO1	PSO	PSO	PSO3
CO1	M	M	M	M	L	L	M	L	M	L	L	L	-	-	-
CO2	M	M	M	M	L	L	M	-	M	L	L	L	-	-	-
CO3	S	S	S	S	L	L	M	-	M	L	L	L	-	-	-
CO4	M	M	M	M	M	M	S	-	S	-	-	M	-	M	-
CO5	L	L	L	L	M	S	M	-	M	-	-	M	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

DRUGS AND COSMETICS ACT AND GMP FOR API

Drugs and cosmetics act-1948–Organization and personnel –Buildings and facilities –Equipment – Documentation and records–Material management– Production a n d in process control– Packaging and labelling–Storage Distribution.

IMPURITIES IN DRUG SUBSTANCES AND DRUG PRODUCTS

Definition of impurities–Validation and impurity issue related to manufacturing – Processing of drug substances –Enantiomers as impurities –Polymorphs as unwanted components.

CLEANING PROCEDURE INAPI MANUFACTURING FACILITIES

Regulatory requirements–Multiple vs dedicated equipment– Unique nature of API–Multiple level approach to cleaning–Nature of contaminants–Selection of a worst case–Cleaning techniques – Sampling – Analytical methods – Limits and acceptance criteria, documentation.

STABILITY TESTING

Reasons for stability testing–Modes of degradation –Shelf lives and expiration dates– Possible strategies to improve shelf lives–Stability testing of new drug substances and products (Q1A)– Photostability testing of new substances and products(Q1B)–Validation on analytical Procedures(Q2A).

PROCESS VALIDATION

Process validation as a quality assurance tool-General QA tools, purpose of process validation, Qualification activities, Process validation activities. Prospective process validation-Organization, documentation, product development, development of manufacturing capability, full scale production development, defining experimental programs, experimental design and analysis.

TEXT BOOKS:

1. R.A. Nash, A.H. Wachter, "Pharmaceutical Process Validation", 3rd ed., CRC Press, Taylor & Francis Group, 2003.
2. Y. Anjaneyulu,R.Maraya, "Quality Assurance and Quality Management inPharmaceuticalIndustry",PharmaBookSyndicate,2005.
3. J. P. Agalloco,F.J. Carleton, "Validation of Pharmaceutical Processes", 3rd ed., Informa Healthcare, NY, USA, 2007.

REFERENCES:

1. Willig,S.H., "Good Manufacturing Practice for Pharmaceuticals", 5th Edition, MarcelDekker,2005.
2. A.A. Signore, T. Jacobs, "Good Design Practices for GMP Pharmaceutical Facilities" 1st ed., CBS Publishers & Distributors Pvt. Ltd., 2009.
3. S.C. Chow, "Statistical Design and Analysis of Stability Studies" Chapman andHall, 2007.

COURSE DESIGNERS

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17PESE04	PHARMACEUTICAL PROCESS DESIGN	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

The pharmaceutical process design is a systematic approach to development that begins with predefined objectives and emphasizes product and process understanding and process control, based on sound science and quality risk management. It is emerging to enhance the assurance of safe, effective drug supply to the consumer, and also offers promise to significantly improve manufacturing quality performance.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	ToRecognize meaningful product quality specifications that are based on clinical performance.
2	To discuss on process capability and product variability.
3	To Summarize how to reduce defects by enhancing product and process design, understanding, and control.
4	To implement new technologies in product development and manufacturing efficiencies.
5	To Outline root cause analysis and postapproval change management.

COURSE OUTCOMES

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

CO1. Recognize the opportunities and constraints of the drug development process.	Understand
CO2. Describe a process for manufacturing a desired product or parallel products.	Understand
CO3. Identify a variety of processing alternatives for manufacturing a desired product.	Understand
CO4.Operate different techniques for complex process simulation.	Apply
CO5. Validate process design by taking regulatory requirements into consideration.	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO1	PSO1	PSO	PSO3
CO1	M	M	M	M	L	L	M	L	M	-	L	L	M	M	M
CO2	M	M	M	M	L	L	M	-	M	-	L	L	M	M	-
CO3	M	M	M	M	L	L	M	-	M	L	L	L	M	M	-
CO4	S	S	S	S	L	L	M	-	M	-	L	L	M	-	-
CO5	M	M	M	M	M	M	S	-	S	-	S	M	M	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

EVOLUTION OF PROCESS DESIGN AND MANAGEMENT

Introduction, Universal Principles of Process, Revolutionary Thinkers on Process, Language and Boundaries, Artisan heritage.

FIVE PROCESS ELEMENTS

Man: The Mind of the Process, Machine: The Voice of the Process, Method: The Techniques of Process Control,

Materials: The Life-Blood of the Process, Environment.

EFFECTIVE PHARMACEUTICAL PROCESS DESIGN AND MANAGEMENT

Changing the Way We Think, Cause and Effect: Getting to the Root Cause, Corrective Action and Preventive Action, Process-Driven Quality Systems, Statistics and Decision Boundaries: Data Certainty, Problem-Solving Tools and Techniques, Reducing Risk: The New Paradigm, Customers, Process Integrated Accounting.

KEY ELEMENTS OF QUALITY BY DESIGN

Target product profile, Target product quality profile, Design and development of product, Design of experiments - Comparative experiments, Screening experiments, Response surface Modeling, Regression Modeling; Common experimental designs, Risk assessments.

PROCESS ANALYTICAL TECHNOLOGY

Introduction, Process analytical technology tools; Multivariate tools for design, data acquisition, and analysis, Process analyzers, Process control tools, Continuous improvement and knowledge management tools, Critical quality attributes, Control strategy, Product lifecycle management and continual improvement, Change management system.

TEXT BOOKS:

1. Kate McCormick,D. Wylie McVay Jr, Pharmaceutical Process Design and Management, Routledge; 1 edition, 2016.

REFERENCES:

1. Kannissery Pramod, M. Abu Tahir, Naseem A. Charoo, Shahid H. Ansari, and Javed Ali: Pharmaceutical product development: A quality by design approach, International journal of pharmaceutical investigation, 2016.

COURSE DESIGNERS

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2.	R.Ramapriya	Assistant Professor	Biotechnology	ramapriya@vmkvec.edu.in

17PESE05	QUALITY BY DESIGN	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

"Quality by Design" (QbD) gaining much attention among pharmaceutical industries for maintaining Quality. It serves as a bridge between industry and drug regulatory authorities to move towards a scientific, risk based holistic and proactive approach for development of pharmaceutical product. It mainly covers designing and developing formulations and manufacturing processes to ensure predefined product quality.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	Summarize the principles of the QbD approach in pharmaceutical development and manufacturing
2	Demonstrate basic knowledge of risk management, Design of Experiments (DoE) and Process Analytical Technology (PAT)
3	Demonstrate basic knowledge of how the QbD approach can be applied in design space and further in the regulatory framework
4	Categorize on basic risk analysis and experiment with design techniques using practical case studies
5	Plan and implement a basic DoE approach ,Suggest a QbD approach for constructing a design space

COURSE OUTCOMES

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

CO1.Describe the origins and need for QbD for pharmaceutical products, and the objectives for current QbD practices	Understand
CO2. Illustrate the overall logic and flow of the QbD development process, including the use and application of the various tools applied.	Apply
CO3.Development and use of Quality Target Product Profiles (QTPPs), and definition and verification of Critical Quality Attributes (CQAs), Critical Material Attributes (CMAs) and Critical Process Parameters (CPPs)	Analyse
CO4. Validate facets of statistical design of experiments (DOEs), e.g., screening designs, response surfaces and optimization, transfer functions	Evaluate
CO5. Design Space and its application: process control, lifecycle management, understanding design space limits "edges". Development and optimization of process control strategies, including real-time release testing.	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO	PO	PO	PO	PO	PO	PO	PO1	PO11	PO12	PSO	PSO2	PSO
CO1	M	M	M	M	L	L	M	L	M	L	L	L	M	M	
CO2	S	S	S	S	L	L	M	L	M	L	L	L	M	M	-
CO3	M	M	M	M	M	M	S	M	S	M	S	M	-	M	-
CO4	L	L	L	L	M	S	M	S	M	S	M	M	M	M	-

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

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO QUALITY BY DESIGN

Science and Risk Based Approaches, QbD Terminology, QbD Framework, QbD Application and Benefits, Regulatory aspects, Overview of ICH, Start QRM Process, Risk Assessment, Risk Control, Risk Review, Risk Management Tools, Practical Examples of Use for QbD, Pre-work, Scoring Meeting, FMECA Tool, Risk Score, Detectability Score.

DEVELOPMENT AND MANUFACTURE OF DRUG PRODUCT

Applying QbD to Pharmaceutical Drug Product Development, Product Design Intent and the Target Product Profile (TPP), The Quality Target Product Profile (QTPP), Identifying the Critical Quality Attributes (CQAs), Product Design and Identifying the Critical Material Attributes (CMAs), Process Design and Identifying the Critical Process Parameters (CPPs), Product and Process Optimisation

DESIGN OF EXPERIMENTS

Experimental Design in Action, The Curse of Variation, Signal to Noise Ratio, Fitting a Model Summary of Fit, Parameter Estimates, Analysis of Variance, 'To Boldly Go' – An Introduction to Managing Resource Constraints using DoE, Sequential Classical Designs and Definitive Screening Designs

MULTIVARIATE DATA ANALYSIS (MVDA)

Principal Component Analysis (PCA), PCA Case Study: Raw Material Characterization using Particle Size Distribution Curves, Dataset Description, Fitting a PCA Model to the Training Set Batches, Classification of the Test Set Batches, Added Value from DoE to Select Spanning Batches.

ANALYTICAL METHOD DESIGN

Comparison of the Traditional Approach and the Enhanced QbD Approach, Details of the Enhanced QbD Approach , Defining Method Requirements, Designing and Developing the Method, Understanding the Impact of Method Parameters on Performance, Defining the Method Control Strategy and Validating the Method, Monitoring Routine Method Performance for Continual Improvement

TEXT BOOKS

1.Rathore AS, Winkle H, Quality by Design for biopharmaceuticals. Nature Biotechnology,2009

2.Pharmaceutical Quality by Design: A Practical Approach (Advances in Pharmaceutical Technology) Hardcover – Import, 19 Mar 2018

REFERENCES:

1. Woodcock J, The concept of pharmaceutical quality. American Pharmaceutical Review, 7(6), 2004.

2. Quality Risk Management. ICH Harmonized Tripartite Guidelines. International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use, 2006.

3. Pharmaceutical Quality System, ICH Tripartite Guidelines. International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use, 2007.

4. Lionberger RA, Lee LS, Lee L, Raw A ,Yu LX, Quality by design: Concepts for ANDAs, The AAPS Journal,

10, 2008.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	G.Arthi	Assistant professor	Biotechnology	arthi@vmkvec.edu.in
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17PESE06	QUALITY ASSURANCE	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

This course imparts knowledge on various legal regulations and governing bodies involved in the trade and practice of pharmaceutical and biopharmaceutical industries. It also enriches beginners in the practice of GMP, biosafety and ethicalguidelines.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To Interpret various pharmacopeia and drug regulatory aspects.
2	To Perform regulatory aspects in pharmaceutical manufacturing.
3	To Execute the process of patenting.
4	To Outline the quality guidelines for pharmaceutical products.
5	To check the accuracy of the instrument.

COURSE OUTCOMES

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

CO1.Describe drug regulatory affairs in India and at International level.	Understand
CO2.Illustrate pharmaceutical industry manufacturing practices and regulatory aspects of the products.	Apply
CO3.Initiate the process of patenting.	Apply
CO4.Develop the quality guidelines followed for pharmaceutical products and few of the aspects involved in document preparation for pharmaceutical product registration.	Analyse
CO5.Validate the accuracy and efficiency of the instrument	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO1	PSO	PSO	PSO3
CO1	M	M	M	M	L	L	M	L	M	S	L	L	-	-	-
CO2	S	S	S	S	L	L	M	S	M	S	L	L	M	M	-
CO3	S	S	S	S	L	L	M	L	M	M	L	L	M	M	M
CO4	M	M	M	M	M	M	S	M	S	M	S	M	M	M	-
CO5	L	L	L	L	M	S	M	S	M	S	M	M	S	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

PHARMACOPOEIA AND INTRODUCTION TO DRUGS & COSMETICS ACT

Descriptions & Monographs; Standards & Specifications; Testing of Drugs; VariousCountriesPharmacopoeias; Indian, British, U.S, European, Japan. Definitions, Forms, Licenses; Schedules, New Schedule M, Schedule Y.

REGULATORY ASPECTS

Pharmaceuticals: Bulk drug manufacture; Personnel, Buildings and Facilities, Process Equipment, Documentation and Records, Materials Management, Production and In-Process Controls,Packaging and Identification Labelling of API's and Intermediates, Storage and distribution, –Biotechnology derived products; Principles, Personnel,

Premises and equipment, Animal quartersand care, production, labelling, Lot processing records and distribution records, quality assurance and quality control**.**

INTELLECTUAL PROPERTY RIGHTS AND ETHICAL ISSUES IN PATENTING LIFE FORMS

What are patents, know-how, copyright, trademark, service mark, design, Conditions forpatentability; Indian Patent Act; Opposition and Infringements of patents; Case study on patentingindigenous products (e.g. Neem, turmeric), DNA, Microbes, Transgenic Plants and AnimalsIndustrial property, TRIPS, WTO, treaties, Budapest Convention. Application process for a patentand the post application process.

cGMPS& REGULATORY RECORDS-SITE MASTER FILE, DRUG MASTER FILE, DRUG DOSSIERS

cGMP concepts – Development, Manufacturing Record, Analytical & ProcessValidation, Equipment & utility Qualification and Calibration, Personnel procedures;Regulatorybodies & requirements - Indian FDA, WHO GMP; U.S. FDA, U.K. MCA, AustralianTGA, JapanesePMDA. Drug dossier contents - CTD (CMC section) & data.

CALIBRATION AND VALIDATION IN PHARMACEUTICAL INDUSTRY

Introduction, definition and general principles of calibration, qualification and validation, importance and scope of validation, types of validation, validation master plan. Calibration of pH meter, Qualification of UV-Visible spectrophotometer, General principles of Analytical method Validation. Warehousing:Good warehousing practice, materials management

TEXT BOOKS

1. C.V. S. Subbrahmanyam&J.Thimmasetty, Pharmaceutical regulatory affairs, First edition., Vallabh Prakashan, New Delhi, 2012.
2. Willig, H., Tuckeman, M.M. and Hitchings, W.S., "Good Manufacturing Practices for Pharmaceuticals", 5th Edition, Marcel Dekker Drugs and the Pharmaceutical Sciences, by CRC Press, New York, 2000.
3. N Udupa, Krishnamurthy Bhat, A Concise Textbook of Drug Regulatory Affairs, Manipal University Press (MUP); First Edition, 2015.

REFERENCES

1. Abraham, John and Smith, H.W. "Regulation of the PharmaceuticalIndustry",Palgrave, Macmillan, 2003.
2. Berry, Ira R. and Harpaz, Daniel "Validation of Active Pharmaceutical Ingredients",2nd Edition, CRC Press, 2001
3. British Pharmacopeia, 2016.
4. Gad, Shayne C. "Drug Safety Evaluation", Wiley-Interscience, 2002
5. Indian Pharmacopeia, 2014.
6. Malik, Vijay "Drugs and Cosmetics Act, 1940". EBC Publishing Co, 1998.
7. "Quality Assurance of Pharmaceuticals: A Compendium of Guidelines and Related Materials", Vol.I&II, World Health Organization and Pharma Syndicate, 2002.
8. United States Pharmacopeia, 2016.
9. Weinberg, Sandy "Good Laboratory Practice Regulations" 3rd Edition, MarcelDekker,2003**.**

COURSE DESIGNERS				
S. No.	**Name of the Faculty**	**Designation**	**Department**	**Mail ID**
1.	Ms. C.Vanathi	Assistant professor	Biotechnology	vanmathi@vmkvec.edu.in
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17PESE07	MOLECULAR PHARMACEUTICS	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

This course is designed to promote high quality research advancing the understanding of pharmaceutics at the molecular level while providing a forum for research among the fields of physical and pharmaceutical chemistry, biochemistry, molecular and cell biology and materials science focused on drug delivery.

PRERQUISITE- NIL

COURSE OBJECTIVES

1	To recognize various approaches for development of novel drug delivery systems
2	To discuss the criteria for selection of drugs and polymers for novel drug delivery
3	To outline the formulation and evaluation of novel drug delivery systems.

COURSE OUTCOMES

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

CO1. Discuss the mechanism of drug actions at cellular and molecular level.	Understand
CO2. Choose various approaches fordevelopment of novel drug delivery systems.	Understand
CO3.Generalize the criteria for selection ofdrugs and polymers for the development of NTDS	Apply
CO4.Appraise the different formulation techniques for novel drug delivery	Analyze
CO5.Examine the formulation andevaluation of novel drug delivery systems.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO1	PSO	PSO	PSO
CO	M	M	M	M	L	L	M	L	M	L	L	L	S	S	-
CO	M	M	M	M	L	L	M	L	M	L	L	L	S	-	-
CO	S	S	S	S	L	L	M	L	M	L	L	L	S	-	-
CO	M	M	M	M	M	M	S	-	S	-	S	M	S	S	M
CO	M	M	M	M	M	M	S	-	S	-	S	M	S	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

TARGETED DRUG DELIVERY SYSTEMS

Concepts, Events and biological process involved in drug targeting. Tumor targeting and Brain specific delivery.

TARGETING METHODS

Introduction preparation and evaluation. Nano Particles & Liposomes: Types, preparation and evaluation.

MICRO CAPSULES / MICRO SPHERES

Types, preparation and evaluation, Monoclonal Antibodies; preparation and application, preparation and

application of Niosomes, Aquasomes, Phytosomes, Electrosomes.

PULMONARY DRUG DELIVERY SYSTEMS

Aerosols, propellents, Containers types, preparation and evaluation, Intra Nasal Route Delivery systems; Types, preparation and evaluation.

NUCLEIC ACID BASED THERAPEUTIC DELIVERY SYSTEM

Gene therapy, introduction (ex-vivo & in-vivo gene therapy). Potential target diseases for gene therapy (inheriteddisorder and cancer). Gene expression systems (viral and nonviral gene transfer). Liposomal gene delivery systems. Biodistribution and Pharmacokinetics. Knowledge of therapeutic antisense molecules and aptamers asdrugs of future.

TEXT BOOKS

1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.
2. S.P.Vyas and R.K.Khar, Controlled Drug Delivery - concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002.
3. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, NewDelhi, First edition 1997, (reprint in 2001).

REFERENCES

1. Schreier H., Drug Targeting Technology Physical, Chemical and Biological Methods, Marcel Dekker, New York.
2. Roland A., Particulate Carriers: Therapeutic Applications, Marcel Dekker, New York.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
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2	Ms .G.Arthi	Assistant professor	Biotechnology	arthi@vmkvec.edu.in

17PESE08	ADVANCED INDUSTRIAL PHARMACY	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

Advanced industrial pharmacy includes manufacturing, development, marketing and distribution of drug products including quality assurance of these activities. This course relates to different functions in pharmaceutical industry and having contact areas with engineering and economics. Industrial pharmacy which involves developing the professional roles of pharmacists. Disease-state management, Clinical interventions, recommendation to change and/or add a drug to a patient's pharmacotherapy, dosage adjustments, Professional development, Pharmaceutical care, Extemporaneous pharmaceutical compounding, Patient care, Drug abuse prevention, Incompatibility, Drug discovery and evaluation, Community Pharmacy etc.,

PRERQUISITE - NIL

COURSE OBJECTIVES

1	To define the components of drug to be developed by Pre-formulation studies.
2	To prepare report of materials require to produce specific drug.
3	To demonstrate production of drug and perform Scale-up process.
4	To outline formulations of pharmaceutical products.
5	Design and develop Production planning and control system.

COURSE OUTCOMES

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

CO1. Choose the components needed to produce various drugs.	Understand
CO2. Summarize the materials require to produce specific drug.	Understand
CO3. Employe knowledge to perform Scale-up operations.	Apply
CO4.Develop know how on product formulations in pharmaceuticals.	Analyse
CO5. Appraise design of Production planning and control system.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

PREFORMULATION STUDIES

Introduction, organoleptic properties, purity, particle size, shape and surface area. Solubility, Methods to improve solubility of Drugs: Surfactants & its importance, co-solvency. Techniques for the study of Crystal properties and polymorphism. Preformulation stability studies.

INVENTORY AND MATERIAL MANAGEMENT

Costs in inventory, inventory categories - special considerations, selective inventory control, reorder quantity methods and

EOQ, inventory models, safety stock - stock out, lead time - reorder time methods. Materials - quality and quantity, value analysis, purchasing - centralized and decentralized stores management.

PILOT PLANT SCALE UP TECHNIQUES

significance, pilot study of some important dosage forms such as tablets, capsules and liquid orals, discussion on important parameters such as formula, equipments, product uniformity and stability, raw material process and physical layouts, personnel requirements and reporting responsibilities.

EXCIPIENTS IN PHARMACEUTICAL FORMULATIONS

Introduction to excipients and their importance in pharmaceutical industry; requirement of excipients, classification and properties of excipients, specialized type of excipients used in tablets such as directly compressible excipients and super-disintegrants; surfactants and hydrocolloids in disperse systems, taste masking excipients, colors, flavours, sweetening agents, gel and film forming agents, solubilizers etc. and their quality control.

PRODUCTION PLANNING & CONTROL AND DOCUMENTATION

Production scheduling, forecasting, vendor development, capacity assessment (plant, machines, human resources), production management, production organization, objectives and policies. Productivity, management and cost controls. Entrepreneurship and project management: Creativity, innovation entrepreneurship & project management.

TEXT BOOKS

1. C.V.S. Subrahmanyam," Pharmaceutical Production and management", Published by Vallabh Prakashan, 1 st edition, 2005.

2. D.A.Savant "The Pharmaceutical Sciences Pharma Pathway Pure Applied Pharmacy", Published by Nirali Publication; 1st edition, 2016.

3. Yoshoika.S. Stella V.J., "Stability of Drugs and Dosage Forms", Published by Kluwer Academic/Plenum Publishers, 1 st edition 2005.

REFERENCES

1. Shayne Cox Gad, "Pharmaceutical Manufacturing Handbook: Production and Processes", Published by John Wiley & Sons, 1 st edition, 2008.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1.	Mr.N.Jawahar	Assistant Professor	Biotechnology	jawahar@vmkvec.edu.in
2.	Ms .G.Arthi	Assistant professor	Biotechnology	arthi@vmkvec.edu.in

17PESE09	NOVEL DRUG DELIVEY SYSTEMS LAB	Category	L	T	P	Credit
		EC - SE	0	0	4	2

PREAMBLE

Novel Drug Delivery Systems practical course trains thestudents on skills of designing and preparation various novel drug delivery systems. This course also deals with theevaluation of controlled drug delivery systems.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To describe the various novel drug delivery systems and their preparations.
2	To compare the study of drug releasethrough various biological membranes
3	To summarize knowledge on filing of various regulatory agencies

COURSE OUTCOMES

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

CO1. Demonstrate the skills on advanced techniques adopted in preparation and evaluation of various novel drug delivery systems.	Understand
CO2. Review the Product development and filing to various regulatory agencies	Understand
CO3. Illustrate the study of drug permeation through various biological membranes	Apply
CO4. Examine various novel drug delivery systems	Analyze
CO5. Evaluate nanomaterials, microspheres, liposomes and other controlled release systems for standards.	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	M	L	L	M	L	M	L	L	L	-	-	-
CO2	M	M	M	M	L	L	M	L	M	L	L	L	-	-	-
CO3	M	M	M	M	M	M	S	-	S	-	S	M	M	-	-
CO4	M	M	M	M	M	M	S	-	S	-	S	M	M	-	-
CO5	L	L	L	L	M	S	M	M	M	-	M	M	M	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

1. Formulation and evaluation of egg albumin microspheres by single emulsion technique
2. Formulation and evaluation of microspheres by emulsion solvent evaporation method
3. Formulation and evaluation of microcapsules through coacervation phase separation by solvent evaporation method
4. Formulation and evaluation of solid dispersion by fusion method
5. Formulation and evaluation of solid dispersion by melting point solvent technique

6. Preparation and evaluation of magnetic microsphere
7. Formulation and evaluation of transdermal films
8. Formulation and evaluation of sustained release matrix tablets
9. Comparison of in vitro release studies of marketed sustained release tablets
10. In vitro release studies of marketed enteric coated tablets
11. Demonstration of various techniques like fluidized bed processing, spray drying, freeze drying etc

REFERENCES:

1. Gennaro, Alfonso R., Remington: The Science and Practice of Pharmacy, Vol-I & II, Lippincott Williams & Wilkins, New York**.**
2. Lieberman, Leon Lachman and Joseph B. Schwartz, Marcel Dekker, Pharmaceutical Dosage Forms: Tablets: Vol.1, Vol. 2 and Vol.3, Ed. Inc., New York.
3. Joseph R. Robinson, Marcel Dekker Inc., New York, Sustained and controlled drug and delivery.
4. Robinson JR, Lee VHI. Controlled drug delivery – Fundamentals and Applications.2d Edi. New York: Marcel Dekker; 1982

COURSE DESIGNERS

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1	Mrs.C.Nirmala	Assistant Professor	Biotechnology	nirmala@vmkvec.edu.in
2	Ms .G.Arthi	Assistant professor	Biotechnology	arthi@vmkvec.edu.in

17PESE10	COSMETIC TECHNOLOGY LAB	Category	L	T	P	Credit
		ES-SE	0	0	4	2

PREAMBLE

A cosmetic for a consumer means a substance for improving appearance superficially. A cosmetic for a consumer means a substance for improving appearance superficially. Cosmetic technology laboratory gives an extensive training in cosmetic formulation, manufacture, analysis and application of cosmetics. This course gives complete knowledge about everything related to cosmetics.

PRERQUISITE

NIL

COURSE OBJECTIVES

1	To define the Preparation of various types of Emulsions.
2	To explain the formulation of suspensions
3	To demonstrate physical and chemical properties of ingredients used in Cosmetics
4	Outline the importance of suspensions.
5	To develop various type of cosmetic without side effects.

COURSE OUTCOMES

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

CO1. Summarize the knowledge of Preparation of various types of Emulsions.	Understand
CO2. Describe the formulation of suspensions and its significance	Understand
CO3. Illustrate the role of additives in cosmetic products.	Apply
CO4. Develop novel techniques to improve performance of suspensions.	Analyze
CO5. Design and develop new combinations of components to formulate effective cosmetic products.	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

Develop and formulate the following cosmetic products

1. Various types of Emulsions
2. Suspension
3. Talcum powder & compact powders
4. Lipsticks
5. Shampoos
6. Colorants
7. Tooth paste & powder
8. Nail lacquers

9. Aerosol
10. Shaving cream
11. Aftershave lotions
12. Soaps

TEXT BOOKS

3. B.M. Mithal, “A Textbook of Pharmaceutical Formulation”, Published by Vallabh Prakashan, 1997.

4. John W Cooper& Colin Gunn, “Cooper and Gunn's Dispensing for Pharmaceutical Students”, Published by Pitman Medical Pub. Co. 12th edition, 2008.

5. P.P. Sharma, “Cosmetic formulation, Management and quality control” 5th Edition.

REFERENCES

1. IPC, “The Pharmacopoeia of India”, Educational Book Agency (India),2018.

2. David B. Troy, Paul Beringer, “Remington: The Science and Practice of Pharmacy”, Published by Lippincott Williams and Wilkins, 21st Revised edition. 2005.

COURSE DESIGNERS

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17PESE11	VALIDATION IN PHARMACEUTICAL INDUSTRIES LAB	Category	L	T	P	Credit
		EC-SE	0	0	4	2

PREAMBLE

The main purpose of the subject is to understand about validation and how it can be applied to industry and thus to improve the quality of the products.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To Explain the importance of calibration to be performed for the instruments.
2	To Describe the various validation aspects that has to be carried out in the industry.
3	To Outline the quality control tests for various drugs.
4	To Categorize the basic arrangements for process estimation of drugs.
5	To Develop knowledge on how drugs are estimated using different equipments.

COURSE OUTCOMES

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

CO1. Describe the concepts of calibration, qualification and validation.	Understand
CO2. Demonstrate the estimation of drugs by Spectrophotometry, fluorimetry and flame photometry.	Understand
CO3. Test the stability and effect of pH on the solubility of drug.	Analyse
CO4. Develop quality control tests for the estimation of drugs.	Analyse
CO5. Validate pre formulation studies for tablets and parenterals.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

1. Analysis of Pharmacopoeial compounds in bulk and their formulations (tablet/ capsules/semisolids) by UV Vis spectrophotometer.

2. Simultaneous estimation of multi-drug component containing formulations by UV Spectrophotometry.
3. Estimation of riboflavin/quinine sulphate by fluorimetry.
4. Estimation of sodium/potassium by flame photometry.
5. Case studies on
    a) Total Quality Management
    b) Six Sigma
    c) Change Management/ Change control. Deviations
    d) Out of Specifications (OOS)
    e) Out of Trend (OOT)
    f) Corrective & Preventive Actions (CAPA)
    g) Deviations
6. Development of Stability study protocol.
7. Estimation of process capability.
8. In process and finished product quality control tests for tablets, capsules, parenterals and semisolid dosage forms.
9. Assay of raw materials as per official monographs.
10. Testing of related and foreign substances in drugs and raw materials.
11. To carry out pre formulation study for tablets, parenterals.
12. To study the effect of pH on the solubility of drugs.

REFERENCE

1. Lab manual

COURSE DESIGNERS

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1.	J.Blessy Juliet	Assistant Professor	Biotechnology	catch.blessy@gmail.com
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CATEGORY ‘C’

OPENELECTIVE COURSES

6 - 9 CREDITS

17CSCC02	OBJECT ORIENTED PROGRAMMING	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

This syllabus is intended for the Computer science students and enables them to learn Object Oriented Programming and the design of computer solutions in a precise manner. The syllabus emphasizes on OOP concepts, Functions, Polymorphism, Inheritance and I/O. The intention is to provide sufficient depth in these topics to enable candidates to apply Object Oriented Programming approach to programming. The modules in the syllabus reflect solving general problems via programming solution. Thus, modules collectively focus on programming concepts, strategies and techniques; and the application of these toward the development of programming solutions.

PRERQUISITE

Nil

COURSE OBJECTIVES

1.	To learn about the syntax and semantics of C++ programming language
2.	To learn about the concepts of object oriented programming.
3.	To determine how to reuse the code, Constructors and member functions
4.	To Analyse how to reduce the coding by applying overloading concepts
5.	To Analyse how to reuse the code, how to verify and validate the coding

COURSE OUTCOMES

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

CO1. Construct object-oriented programs for a given scenario using the concepts of abstraction, encapsulation, message-passing and modularity	Apply
CO2. Construct object-oriented programs for a given application by using constructors	Apply
CO3. Develop object-oriented programs for a given application using the concepts of compile-time and run-time polymorphism	Analyze
CO4. Develop object-oriented applications through inheritance concepts	Analyze
CO5. Construct object-oriented applications for a given scenario using files, Sting handling and to handle exceptions	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	M	-	-	-	-	-	M	L	M	-	-
CO2	M	M	M	M	M	-	-	-	-	-	M	L	M	-	-
CO3	M	M	S	M	S	-	-	-	-	-	M	L	M	-	M
CO4	S	M	M	M	S	-	-	-	-	-	M	L	M	-	M
CO5	S	M	M	M	M	-	-	-	-	-	M	L	M	-	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO FUNDAMENTAL CONCEPTS OF OOP

Object Oriented Paradigm: Elements of Object Oriented Programming – Working with classes, Classes and Objects-Class specification- accessing class members- defining member functions - Passing and returning objects – Array of objects -

inline functions - accessing member functions within class - Static members.

OBJECT INITIALIZATION AND FRIEND FUNCTION

Constructors - Parameterized constructors - Constructor overloading. Copy constructor, Destructors, Default arguments - new, delete operators - "this" pointer, friend classes and friend functions.

OVERLOADING AND GENERIC PROGRAMMING

Function overloading – Operator overloading- Non-over loadable operators- unary operator overloading- operator keyword- limitations of increment/decrement operators- binary operator overloading- Generic programming with templates-Function templates- class templates.

INHERITANCE AND VIRTUAL FUNCTION

Inheritance-Base class and derived class relationship-derived class declaration-Forms of inheritance- inheritance and member accessibility, abstract class, virtual functions, pure virtual function**.**

EXCEPTION HANDLING AND STREAMS

Exception handling - Try Catch Throw Paradigm - Uncaught Exception- Files and Streams-Opening and Closing a file- file modes- file pointers and their manipulation, sequential access to a file-random access to a file-Reading and Writing – Exception handling. String Objects.

TEXT BOOKS:

1. B. Trivedi, "Programming with ANSI C++", Oxford University Press, 2007.
2. K. R. Venugopal, Rajkumar, T. Ra vishankar, Mastering C++, 4th Edition, Tata McGraw 2. Hill, 2008.
3. Budd T., An Introduction to Object-oriented Programming, Addison-Wesley 3rd 4. Edition, 2008.
4. Bjarne stroustrup, The C++ programming Language, Addison Wesley, 3rd edition2008.
5. Harvey M. Deitel and Paul J. Deitel, C++ How to Program, 7th edition, Prentice Hall, 2010.
6. Tony Gaddis, Starting Out with Java: From Control Structures through Objects, 4/E, Addison-Wesley, 2009.

REFERENCES:

1. H.M. Deitel and P.J. Deitel, C How to program Introducing C++ and Java, Fourth Edition, Pearson Prentice Hall, 2005.
2. 2. B. Stroustrup, "The C++ Programming language", Third edition, Pearson Education, 2004.

COURSE DESIGNERS

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2.	Mr.S. Muthuselvan	Assistant Professor Gr. II	CSE	muthuselvan@avit.ac.in

17CSCC07	OPERATING SYSTEM	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

The student will be able to understand the concepts of operating system to distributed environment like cloud computing, mobile computing etc. This course also includes set of case studies that provides insight into some existing distributed operating systems.

PREREQUISITE

Nil

COURSE OBJECTIVES

1.	To be aware of the evolution of operating systems.
2.	To learn what processes are, how processes communicate, how process synchronization is done and how to manage processes.
3.	To have an understanding of the main memory and secondary memory management techniques.
4.	To understand the I/O Subsystem.
5.	To have an exposure to the role of operating system in cloud and mobile environment operating systems.

COURSE OUTCOMES

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

CO1. To learn the concepts of operating system to an evolution of operating systems and identify the features specific to operating systems	Apply
CO2. To Understand the process synchronization concepts for the given scenario in operating systems environment.	Apply
CO3.Illustrate the different techniques of management of memory (the main memory and secondary memory management techniques).	Understand
CO4.Apply the I/O Subsystem concepts for a given scenario.	Apply
CO5. Identify the role of operating system in cloud and mobile environment.	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	-	-
CO2	S	S		M	-	-	-	-	-	-	-	-	M	-	-
CO3	S	S		M	-	-	-	-	-	-	-	-	M	-	-
CO4	S	M	L	M	-	-	-	-	-	-	-	-	M	-	-
CO5	S	M	L	L	-	-	-	-	-	-	-	-	M	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

OPERATING SYSTEM 6hrs

Introduction & Structure: Basics, OS Architecture, OS Operations, System calls.

PROCESSES &SYNCHRONIZATION 13hrs

Process concept – Process scheduling – Operations on processes – Cooperating processes – Inter process communication – Communication in client-server Systems. Case study: IPC in Linux. Threads: Multi-threading models – Threading issues. Case Study: Threads library– Clock Synchronization – Event Ordering – Mutual Exclusion – Deadlock Modelling – Deadlock Prevention – Deadlock Avoidance – Deadlock Detection and Recovery - Election Algorithms.

STORAGE MANAGEMENT 11hrs

Background – Swapping – Contiguous memory allocation – Paging – Segmentation – Segmentation with paging. Virtual Memory: Background–Demand paging – Process creation – Page replacement – Allocation of frames – Thrashing. Case Study: Memory management in Linux.

I/O SYSTEMS 10hrs

I/O Systems – I/O Hardware – Application I/O interface – kernel I/O subsystem – streams – performance. Mass-Storage Structure: Disk scheduling – Disk management – Swap-space management – RAID – disk attachment – stable storage – tertiary storage. Case study: I/O in Linux.

CLOUD OS & MOBILE OS 5hrs

Introduction to Cloud Computing, Features of Cloud OS, Case Studies. - Introduction to Mobile Computing Features of Mobile OS, Case Studies.

TEXT BOOKS:

1. Silberschatz, Galvin, and Gagne, "Operating System Concepts", 8th Edition, Wiley India Pvt. Ltd, 2008.

REFERENCES:

1. Andrew S. Tanenbaum, "Modern Operating Systems", Second Edition, Pearson Education, 2004.
2. Gary Nutt, "Operating Systems", Third Edition, Pearson Education, 2004.
3. Harvey M. Deital, "Operating Systems", Third Edition, Pearson Education, 2004.
4. Fundamentals Of Mobile Computing, Patnaik, Prasant, Kumar , Mall, Rajib, PHI, 2012.
5. Mobile Computing - Technology, Applications, and Service Creation – 1st edition, Asoke K Talukder,Roopa Yavagal, McGraw-Hill, 2006.
6. The Practice of Cloud System Administration: Designing and Operating Large Distributed Systems, Thomas A. Limoncelli Strata R. Chalup , Christina J. Hogan , Addison-Wesley Professional; 1st Edition ,2014.
7. Cloud Computing: Concepts, Technology & Architecture, Thomas Erl, Ricardo Puttini , Zaigham Mahmood , Prentice Hall; 1st Edition, 2013.

COURSE DESIGNERS

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17CSCC09	JAVA PROGRAMMING	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

This course of study builds on the skills gained by students in Java Fundamentals and helps to advance Java programming skills. Students will design object-oriented applications with Java and will create Java programs using hands-on, engaging activities.

PREREQUISITE

NIL

COURSE OBJECTIVES

1.	Understand fundamentals of programming such as variables, conditional and iterative execution, methods, etc.
2.	Understand fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc.
3.	Be aware of the important topics and principles of software development.
4.	Understand Event Handling and Swing Components.
5.	Understand Generic Programming.

COURSE OUTCOMES

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

CO1.Knowledge of the structure and model of the Java programming language	Understand
CO2.Use the Java programming language for various programming technologies	Understand
CO3. Develop software in the Java programming language	Apply
CO4.Evaluate user requirements for software functionality required to decide whether the Java programming language can meet user requirements	Analyze
CO5.Choose an engineering approach to solving problems, Starting from the acquired knowledge of programming and knowledge of operating systems.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

BASICS OF JAVA

Object oriented programming concepts – objects – classes – methods and messages – abstraction and encapsulation – inheritance – abstract classes – polymorphism.- Objects and classes in Java – defining classes – methods - access specifiers – static members – constructors – finalize method.

ARRAYS, STRINGS &OBJECTS

Arrays – Strings - Packages – Java-Doc comments –- Inheritance – class hierarchy – polymorphism – dynamic binding –

final keyword – abstract classes - The Object class – Reflection – interfaces – object cloning – inner classes – proxies.

EVENTS & GRAPHICS PROGRAMMING

I/O Streams - Filter and pipe streams – Byte Code interpretation - Basics of event handling – event handlers – adapter classes – actions – mouse events – AWT event hierarchy – Graphics programming – Frame – Components – working with 2D shapes.

SWING & GENERIC PROGRAMMING

Introduction to Swing – Model-View-Controller design pattern – buttons – layout management – Swing Components – exception handling – exception hierarchy – throwing and catching exceptions - Motivation for generic programming – generic classes – generic methods – generic code and virtual machine – inheritance and generics – reflection and generics.

THREADS & SOCKET PROGRAMMING

Multi-threaded programming – interrupting threads – thread states – thread properties – thread synchronization – Executors – synchronizers – Socket Programming – UDP Datagram – Introduction to Java Beans.

TEXT BOOKS:

1. Cay S. Horstmann and Gary Cornell, “Core Java: Volume I – Fundamentals”, Eighth Edition, Sun Microsystems Press, 2008.
2. Elliotte Rusty Harold, “ Java Network Programming”, O‟Reilly publishers, 2000.
3. Ed Roman, “Mastering Enterprise Java Beans”, John Wiley & Sons Inc., 1999.

REFERENCES:

1. K. Arnold and J. Gosling, “The JAVA programming language", Third edition, Pearson Education, 2000.
2. Timothy Budd, "Understanding Object-oriented programming with Java", Updated Edition, Pearson Education, 2000.
3. C. Thomas Wu, "An introduction to Object-oriented programming with Java", Fourth Edition, Tata McGraw-Hill Publishing company Ltd., 2006.

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17CSCC16	CLOUD COMPUTING	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

To study and understand the concepts in cloud computing and apply them practically.

PREREQUISITE NIL

COURSE OBJECTIVES

1.	To understand cloud computing concepts.
2.	To study various cloud services.
3.	To apply cloud computing in collaboration with other services.
4.	To Apply cloud computing services.
5.	To apply cloud computing online.

COURSE OUTCOMES

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

CO1: Able to Understand basics in Cloud Computing	Understand
CO2: Able to apply cloud computing concepts in real time	Apply
CO3: Able to develop cloud computing projects	Apply
CO4: Able to apply cloud services	Apply
CO5: Able to collaborate cloud services with other 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	M	M	M	M	-	-	-	-	-	-	-	-	M	-	-
CO2	M	M	M	M	-	-	-	-	-	-	-	-	M	M	M
CO3	M	M	S	M	-	-	-	-	-	-	-	-	M	-	M
CO4	S	M	M	M	-	-	-	-	-	-	-	-	M	-	M
CO5	S	M	M	M	-	-	-	-	-	-	-	-	S	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Cloud Computing – History of Cloud Computing – Cloud Architecture – Cloud Storage –Why Cloud Computing Matters – Advantages of Cloud Computing – Disadvantages of Cloud Computing – Companies in the Cloud Today – Cloud Services.

DEVELOPING CLOUD SERVICES

Web-Based Application – Pros and Cons of Cloud Service Development – Types of Cloud Service Development – Software as a Service – Platform as a Service – Web Services – On-Demand Computing – Discovering Cloud Services Development Services and Tools – Amazon Ec2 – Google App Engine – IBM Clouds.

CLOUD COMPUTING FOR EVERYONE

Centralizing Email Communications – Collaborating on Schedules – Collaborating on To-Do Lists – Collaborating Contact Lists – Cloud Computing for the Community – Collaborating on Group Projects and Events – Cloud Computing for the Corporation.

USING CLOUD SERVICES

Collaborating on Calendars, Schedules and Task Management – Exploring Online Scheduling Applications – Exploring Online Planning and Task Management – Collaborating on Event Management – Collaborating on Contact Management – Collaborating on Project Management – Collaborating on Word Processing - Collaborating on Databases – Storing and Sharing Files.

COLLABORATING ONLINE

Collaborating via Web-Based Communication Tools – Evaluating Web Mail Services –Evaluating Web Conference Tools – Collaborating via Social Networks and Groupware –Collaborating via Blogs and Wikis.

TEXT BOOKS

1. Rajkumar Buyya, James Broberg, Andzej M.Goscinski, "Cloud Computing –Principles and Paradigms",John Wiley & Sons, 2010.
2. Michael Miller, "Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online", Que Publishing, August 2008.

REFERENCES

1. Haley Beard, "Cloud Computing Best Practices for Managing and Measuring. Processes for On-demand Computing, Applications and Data Centers in the Cloud with SLAs", Emereo Pty Limited, July 2008.

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1.	Dr.R.Jaichandran	Professor	CSE	rjaichandran@avit.ac.in
2.	T.GEETHA	Assistant professor	CSE	geetha_kcs@yahoo.com

17CSCC17	CYBER SECURITY	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

To understand the need for Cyber Security in real time and to study techniques involved in it.

PREREQUISITE : NIL

COURSE OBJECTIVES

1.	To understand the fundamentals of Cyber Security
2.	To study various attacking techniques
3.	To apply exploitation in cyber space
4.	To study about Malicious codes
5.	Defending against cyber attacks

COURSE OUTCOMES

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

CO1: Able to Understand basics in cyber security	Understand
CO2: Able to apply attackers techniques in real time	Apply
CO3: Able to apply exploitation in web applications	Apply
CO4: Able to understand and apply malicious in networks.	Apply
CO5: Able to apply defense and analysis techniques 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	M	M	-	-	-	-	-	-	-	-	M	-	-
CO2	M	M	M	M	M	-	-	-	-	-	-	-	M	M	M
CO3	M	M	S	M	M	-	-	-	-	-	-	-	M	M	M
CO4	S	M	M	M		-	-	-	-	-	-	-	-	M	-
CO5	S	M	M	M	S	-	-	-	-	-	-	-	-	M	M

S- Strong; M-Medium; L-Low

SYLLABUS:

INTRODUCTION
Network and security concepts – basic cryptography – Symmetric encryption – Public key Encryption – DNS – Firewalls – Virtualization – Radio Frequency Identification – Microsoft Windows security Principles.
ATTACKER TECHNIQUES
Antiforensics – Tunneling techniques – Fraud Techniques - Threat Infrastructure.
EXPLOITATION
Techniques to gain a foot hold – Misdirection, Reconnaissance, and disruption methods.
MALICIOUS CODE
Self Replication Malicious code – Evading Detection and Elevating privileges – Stealing Information and Exploitation.
DEFENSE AND ANALYSIS TECHNIQUES
Memory Forensics – Honeypots – Malicious code naming – Automated malicious code analysis systems – Intrusion detection systems – Defense special file investigation tools.
TEXT BOOKS
1. James Graham, Richard Howard and Ryan Olson, "Cyber Security Essentials", CRC Press, Taylor & Francis Group, 2011. 2. By Dan Shoemaker, Ph.D., William Arthur Conklin, Wm Arthur Conklin, "Cyber security: The Essential Body of Knowledge", Cengage Learning, 2012.
REFERENCES
1.. Ali Jahangiri, "Live Hacking: The Ultimate Guide to hacking Techniques & Counter measures for Ethical Hackers & IT Security Experts", 2009.

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

COURSE DESIGNERS

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17CSEC34	WEB DESIGN AND MANAGEMENT	Category	L	T	P	Credit
		EC	3	0	0	3

PREAMBLE

To understand and learn the scripting languages with design of web applications. and maintenance and evaluation of web design management.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To introduce the student to the tools and facilities of web design
2	To understand and learn the scripting languages with design of web applications
3	To learn the maintenance and evaluation of Web design/development process, with Macromedia Dreamweaver as the primary Web development tool
4	Topics covered include basic and enhanced site structure, local and remote site management, and optimization of Web graphics

COURSE OUTCOMES

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

CO1: Apply an Information Architecture document for a web site.	Apply
CO2: Construct a web site that conforms to the web standards of today and includes e-commerce and web marketing	Analyze
CO3: Perform regular web site maintenance (test, repair and change).	Analyze
CO4: Understand the principles of various process of Project management	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

SITE ORGANIZATION AND NAVIGATION

User Centered Design–Web Medium–Web Design Process–Basics of Web Design –Introduction to Software used for Web Design – ADOBE IMAGE READY, DREAM WEAVER, FLASH – Evaluating Process – Site Types and Architectures – Navigation Theory – Basic Navigation Practices – Search – Sitemaps.

ELEMENTS OF PAGEDESIGN

Browser Compatible Design Issues-Pages and Layout – Templates – Text – Color – Images – Graphics and Multimedia – GUI Widgets and Forms – Web Design Patterns – STATIC pages: Slice– URL in ADOBE IMAGE READY. Creation and Editing of site map – Layer, Tables, Frame set, - CSS style – Forms –Tools like Insert, Rollover etc., in DREAM WEAVER

SCRIPTING LANGUAGES AND ANIMATION USING FLASH

Client side scripting :XHTML – DHTML – JavaScript – XML Server Side Scripting: Perl–PHP– ASP/JSP Designing a Simple Web Application - Introduction to MACROMEDIA FLASH, Importing Other File Formats to Flash – Saving and Exporting Flash Files, Frame by Frame Animation–Motion Tweening – Shape Tweening.

PRE-PRODUCTION MANAGEMENT

Principles of Project Management – Web Project Method – Project Road Map – Project Clarification – Solution Definition – Project Specification – Content – Writing and Managing Content.

PRODUCTION, MAINTENANCE AND EVALUATION

Design and Construction – Testing, Launch and Handover – Maintenance – Review and Evaluation – **Case Study:** Using the Skills and Concepts Learn with the ADOBE IMAGE READY, DREAM WEAVER, FLASH, and Scripts, Develop Portfolios in the Form of Web Pages which have to be uploaded in Free Public Domain.

TEXT BOOKS

1.Themas A. Powell, ―The Complete Reference–Web Design‖, Tata McGraw Hill, Third Edition, 2003.
2.Ashley Friedlein, ―Web Project Management‖, Morgan Kaufmann Publishers, 2001.
3.H.M. Deitel, P.J. Deitel, A.B. Goldberg, ―Internet and World Wide Web – How to Program‖, Third Edition, Pearson Education, 2004.

REFERENCES

1.Joel Sklar, ―Principles of Web Design‖, Thomson Learning, 2001.
2.Van Duyne, Landay and Hong, ―The Design of Sites: Patterns for Creating Winning Websites‖, Second Edition, Prentice Hall, 2006.
3.Lynch, Horton and Rosenfeld, ―Web Style Guide: Basic Design Principles for Creating Websites‖, Second Edition, Yale University Press, 2002.

COURSE DESIGNERS

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

PREAMBLE

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

PRERQUISITE

NIL

COURSE OBJECTIVES

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

COURSE OUTCOMES

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

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT-1 INTRODUCTION

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

UNIT-2 DATA STRUCTURES

Strings-Lists-Tuples-Dictionaries-Sets

UNIT-3 CONTROL STATEMENTS

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

UNIT-4 FUNCTIONS

Declaration-Types of Arguments-Fixed arguments, variable arguments, keyword arguments and keyword variable arguments-Recursions-Anonymous functions: lambda- Decorators and Generators.

UNIT-5 EXCEPTION HANDLING

Exception Handling-Regular Expression-Calendars and clock files:File input/output operations-Dictionary operations-Reading and writing in structured files:CSV and JSON.

TEXT BOOKS:

1. Bill Lubanovic, "Introducing Python Modern Computing in Simple Packages", 1st Edition, O'Reilly Media, 2014.

2. Programming With Python Book ‘Himalaya Publishing House Pvt Ltd
3. “Dive Into Python” by Mark Pilgrim

REFERENCES:

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

COURSE DESIGNERS

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17CSPI07	LEARNING IT ESSENTIALS BY DOING	Category	L	T	P	Credit
		PI	3	0	0	3

PREAMBLE

The proposed elective course exposes the non-CS/IT students to IT Essentials. The core modules of this Elective includes programming , Database and web Technology amongst other related topics. This course refers to the basic tools and technologies for the right type of website development and enable student to create simple web applications

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To learn about the essentials of Information Technology
2	To get an idea about the scripting languages.
3	To get an idea about the internet protocols

COURSE OUTCOMES

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

CO1 Understand the networking concept internet protocols, network routing	Understand
CO2. Understand the fundamentals of web applications and its modeling	Understand
CO3. Understand and learn the scripting languages with design of web applications	Understand
CO4. Analyze the process of mobile communication and network technologies	Analyze
CO5. Build simple interactive applications, database applications and multimedia 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	M	M	M	-	-	-	-	-	-	-	M	M	-	-
CO2	S	M	M	M	-	-	-	-	-	-	-	M	M	-	-
CO3	S	M	M	M	-	-	-	-	-	-	-	M	M	-	-
CO4	M	M	M	M	M	-	-	-	-	-	-	M	M	M	M
CO5	M	M	M	M	S	-	-	-	-	-	-	M	S	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

Fundamentals of Computer architecture

introduction-organization of a small computer -Central Processing Unit - Execution cycle – Instruction categories – measure of CPU performance Memory – Input/output devices - BUS-addressing modes. System Software – Assemblers – Loaders and linkers – Compilers and interpreters

Operating system

Introduction – memory management schemes Process management Scheduling – threads.
Problem solving with algorithms- Programming styles – Coding Standards and Best practices - Introduction to C -Programming Testing and Debugging. Code reviews -System Development Methodologies – Software development Models -User interface Design – introduction – The process – Elements of UI design & reports.

RDBMS

Data processing – the database technology – data models-ER modeling concept –notations – Extended ER features -Logical database design - normalization -SQL – DDL statements – DML statements – DCL statements
Writing Simple queries – SQL Tuning techniques – Embedded SQL - OLTP

Objected oriented concepts

Object oriented programming -UML Class Diagrams– relationship – Inheritance – Abstract classes – polymorphism-Object Oriented Design methodology - Common Base class -Alice Tool – Application of OOC using Alice tool.

Client server computing

Internetworking – Computer Networks – Working with TCP/IP – IP address – Sub netting – DNS – VPN – proxy servers World Wide Web – Components of web application - browsers and Web Servers
URL – HTML – HTTP protocol – Web Applications - Application servers – Web Security.

REFERENCES

1. Andrew S. Tanenbaum, Structured Computer Organization, PHI, 3rd ed., 1991
2. Silberschatz and Galvin, Operating System Concepts, 4th ed., Addision-Wesley, 1995
3. Dromey R.G., How to solve it by Computers, PHI, 1994
4. Kernighan, Ritchie, ANSI C language PHI,1992
5. Wilbert O. Galitz, Essential Guide to User Interface Design, John Wiley, 1997
6. Alex Berson, Client server Architecture, Mc Grew Hill International, 1994
7. Rojer Pressman, Software Engineering-A Practitioners approach, McGraw Hill, 5th ed., 2001
8. Alfred V Aho, John E Hopcroft, Jeffrey D Ullman, Design and Analysis of Computer Algorithms, Addison Wesley Publishing Co., 1998
9. Henry F Korth, Abraham Silberschatz, Database System Concept, 2nd ed. McGraw-Hill International editions, 1991
10. Brad J Cox, Andrew J.Novobilski, Object – Oriented Programming – An evolutionary approach, Addison – Wesley, 1991

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17CSPI10	MOBILE APPLICATION DEVELOPMENT	Category	L	T	P	Credit
		PI	3	0	0	3

PREAMBLE

In this modern era almost every hands has a handheld devices. Each handheld device have the computing capability to meet the half the needs of user such as banking, browsing, education and emergency etc. It is a must for a computer engineer to have some basic knowledge about the handheld devices platform and its supporting software development. This course will give adequate knowledge in developing a mobile applications for different such as Android, iOS, Windows.

PRE REQUISITE – NIL

COURSE OBJECTIVES

1.	Understand system requirements for mobile applications
2.	Generate suitable design using specific mobile development frameworks
3.	Generate mobile application design
4.	Implement the design using specific mobile development frameworks
5.	Deploy the mobile applications in marketplace for distribution

COURSE OUTCOMES

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

CO1. Expose to technology and business trends impacting mobile applications	Understand
CO2.Understand enterprise scale requirements of mobile applications	Understand
CO3. Familiarize in the Graphics used for Android application development	Apply
CO4. Competent with the characterization and architecture of mobile applications	Apply
CO5. Competent with designing and developing mobile applications using one application development framework.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT I INTRODUCTION

Introduction to mobile applications –Embedded systems -Market and business drivers for mobile applications – Publishing and delivery of mobile applications –Requirements gathering and validation for mobile applications

UNIT II BASIC DESIGN

Introduction –Basics of embedded systems design –Embedded OS -Design constraints for mobile applications, both hardware and software related –Architecting mobile applications –User interfaces for mobile applications –touch events and gestures –Achieving quality constraints –performance, usability, security, availability and modifiability.

UNIT III ADVANCED DESIGN

Designing applications with multimedia and web access capabilities – Integration with GPS and social media networking applications – Accessing applications hosted in a cloud computing environment – Design patterns for mobile applications.

UNIT IV TECHNOLOGY I – ANDROID

Introduction – Establishing the development environment – Android architecture – Activities and views – Interacting with UI –Persisting data using SQLite–Packaging and deployment –Interaction with server side applications –Using Google Maps, GPS and Wifi –Integration with social media applications.

UNIT V TECHNOLOGY II –IOS

Introduction to Objective C –iOS features –UI implementation –Touch frameworks –Data persistence using Core Data and SQLite –Location aware applications using Core Location and Map Kit –Integrating calendar and address book with social media application –Using Wifi -iPhone marketplace.

TEXT BOOKS

1. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox, 2012.

REFERENCES

1. Charlie Collins, Michael Galpin and Matthias Kappler, “Android in Practice”, DreamTech, 2012.

2. James Dovey and Ash Furrow, “Beginning Objective C”, Apress, 2012.

3. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, “Beginning iOS 6 Development: Exploring the iOS SDK”, Apress, 2013

Course Designers:

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17BTCC15	FOOD PROCESSING TECHNOLOGY	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

PREAMBLE

Food Processing Technology deals with the study of food production, processing, packaging, preservation and the use of technology and Engineering techniques in aiding the above-mentioned stages. It also deals with artificial food, artificial edible items, nutrition science and its Chemistry. It allows students to learn about food and nutrients, role of functional foods and the strategies to produce specific food ingredients.

PRERQUISITE - NIL

COURSE OBJECTIVES

1.	To explain different types of foods, factors affecting food & food products and the micro-organisms which cause food borne diseases
2.	To explain the concepts of food spoilage and different food preservation methods, and their impact on the shelf life, quality, and other physical and sensory characteristics of foods
3.	To discuss the different food processing methods and its applicability in food product preparations
4.	To choose appropriate modern methods of food preservation for industrialization
5.	To Choose the materials and types of packaging for foods and its quality testing

COURSE OUTCOMES

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

CO1. Identify different microbes associated with foods, and food borne diseases.	Understand
CO2. 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	-	-	-	-	-	M	S	M
CO2	M	M	M	M	L	L		-	-	-	-	-	M	S	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	-	-	-	-	-	M	S	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

17BTEC01	PLANT AND ANIMAL DISEASES AND THEIR CONTROL	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

PREAMBLE

Plant and animal diseases and their control deals with the study of different types of pests and their impact on agriculture and live stocks. Students will learn about the fungus, bacteria, virus or nematodes that can cause damages to the plant parts above or below the ground. The farmers challenges will be solved by identifying the proper ecofriendly control measures will pave the new path in the area of plant breeding. To familiarize the students with principles of insect pest management, including concept and philosophy of Integrated Pest Management. Knowledge of these principles will enable students to understand the different factor that threatens the agricultural productivity and humans.

PREREQUISITE

17BTCC03 - MICROBIOLOGY

COURSE OBJECTIVES

1	To recognize the pest morphology and its corresponding pesticides
2	To describe the pest in agriculture and their control measures.
3	To choose the appropriate pest control method
4	To outline the vector plant pathogen interaction and management of vectors for controlling diseases.
5	To formulate the different sampling methods and monitoring protocol

COURSE OUTCOMES

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

CO1. Demonstrate the common plant pathogens in agriculture	Understand
CO2. Discuss about epidemiology of diseases caused by pests in plant and animals.	Understand
CO3. Classify about the plant and animal disease & integrated control measures.	Apply
CO4. Examine the diseases in plants and animal & its control	Analyze
CO5. Infer the different samplings methods	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	L	-	L	L	-	L	-	-	L	-	-	-
CO2	M	M	M	L	L	M	L	-	M	L	-	-	-	M	M
CO3	S	S	S	-	L	-	M	L	M	-	-	L	M	M	M
CO4	S	M	M	M	L	M	S	M	S	-	L	M	M	M	-
CO5	M	L	-		M	M	S	S	S	-	-	M	M	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

CLASSIFICATION OF PESTS AND PESTICIDES

Pests – Definition, Morphology and Life cycle, classification of pests – Vertebrate pests, Invertebrate pests and plant pests, Classification of pesticides on chemical nature and according to target species, mode of action.

AGRICULTURAL PESTS AND THEIR CONTROL

Concept of Pest and Types of pests in agricultural products - stored grains- veterinary- forestry and nursery. Major insect pests of agricultural- importance -Marks of identification- life cycle- nature of damage, chestnut blight, potato late blight, downy mildew, Damage economic threshold level and control measures.

PEST CONTROL PRACTICES

Issues, Challenges and Opportunities in the Control of Insects in Vegetable Crops, Control measures- Cultural, Physical, Mechanical, Chemical, Herbal and Biological control. Pheromonal and autocidal control.

EMERGING CONCEPTS AND PRACTICES IN INTEGRATED CONTROL MEASURES

The integrated control/IPM concept, Damage thresholds, Forecasting, Increasing agro-ecosystem resistance, Pesticide selectivity, Eradication versus control, Pests and humans – direct pests and vectors of plant and animal diseases, potential human practices and the occurrence of pests, Prevention of communicable diseases after the disaster.

SAMPLING AND MONITORING ARTHROPODS

Methods of sampling and monitoring, Components of a sampling plan, Types of sampling plans, Allocation of Sampling units.

TEXT BOOKS:

1. Principles and procedures of plant protection, 1993. S.B.Chattopadhyay, Oxford-IBH.
2. Agricultural pests of India and south East Asia - A. S. Atwal, 1986. Kalyani Publishers.
3. Francisco Prieto Garcia, Sandra Y. Cortés Ascencio, John C. Gaytan Oyarzun, Alejandra Ceruelo Hernandez and 3Patricia Vazquez Alavarado (2012) Pesticides: classification, uses and toxicity. Measures of exposure and genotoxic risks. Journal of Research in Environmental Science and Toxicology (Vol. 1(11) pp. 279-293.

REFERENCES:

1. Agricultural insect pests of the crops and their control-D.S.Hill, Cambridge Univ. Press Insect pest of crops - S.Pradhan, National Book trust.
2. Healthy Roses: Environmentally friendly ways to manage pests and disorders in your garden and landscape, 2nd Edition , John Karlik, Mary Louise Flint, and Deborah Golino.
3. Hayes' Handbook of Pesticide Toxicology, Editor-in-Chief: Robert Krieger, University of California, Riverside, U.S.A. Published by January 2010, imprint: Academic Press, ISBN: 978-0-12-374367-1.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.S.Vinoth	Assistant Professor	Biotechnology	vinoth@avit.ac.in
2	Ms.G.Arthi	Assistant Professor	Biotehnology	arthi@vmkvec.edu.in

17BTEC31	APPLICATIONS OF ENZYME IN WASTE MANAGEMENT	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

PREAMBLE

This course explains about different waste generation in environment, management of waste, general characters of enzymes, their immobilization process, makes an attempt to bring students in direct contact with nature, to find the environmental problems and possible solutions. To empower the students to enrich their knowledge on waste treatment using biocatalyst to solve the environmental pollution.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To state the basic knowledge on different wastes
2	To discuss about the waste management methods
3	To perform the waste treatment using enzymes
4	To implement the basics of enzyme immobilization process
5	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	M
CO2	M	M	-	-	-	-	M	-	-	-	-	-	-	M	M
CO3	M	M	-		L	-	-	S	-	-	-	S	-	-	-
CO4	M	M	-	-	S	-	L	-	-	-	-	-	-	-	-
CO5	M	M	L	L	S	S	-	L	-	-	-	-	-	-	S

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

17BMEC01	MEDICAL OPTICS	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

PREAMBLE

Medical optics is a branch of science uses light as an electromagnetic wave, similar to X-rays, microwaves, and radio waves, which is used as an investigational technique for medical applications. Examples include optical microscopy, spectroscopy, endoscopy, scanning laser ophthalmoscopy and optical coherence tomography.

PREREQUISITE: Nil

COURSE OBJECTIVES

1	To learn about properties of light and its application
2	To study various instruments in photonics
3	To understand the applications of laser
4	To understand optical holography
5	To study optical tomography

COURSE OUTCOMES

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

CO1. Describe the optical properties of the tissues.	Understand
CO2. Apply laser in medical field for diagnosis and therapeutic application.	Apply
CO3. Analyze the various instruments used in photonics	Analyze
CO4. Categorize the various techniques for hologram construction.	Analyze
CO5. Illustrate about optical tomogram.	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	--	--	M	M	S	M
CO2	S	M	L	--	--	--	--	--	L	--	--	S	M	S	M
CO3	S	S	M	M	--	M	--	--	M	--	--	S	S	S	S
CO4	S	S	S	S	M	M	--	L	M	M	--	S	S	S	S
CO5	S	S	S	S	M	M	--	L	M	M	--	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

OPTICAL PROPERTIES OF THE TISSUES

Refraction, Scattering, absorption, light transport inside the tissue, tissue properties, Light interaction with tissues, optothermal interaction, fluorescence, speckles.

INSTRUMENTATION IN PHOTONICS

Instrumentation for absorption, scattering and emission measurements, excitation light sources – high pressure arc lamp, solid state LEDs, LASERs, optical filters, polarisers, solid state detectors, time resolved and phase resolved detectors.

APPLICATIONS OF LASERS

Laser in tissue welding, lasers in dermatology, lasers in ophthalmology, otolaryngology, urology.

OPTICAL HOLOGRAPHY

Wavefronts, Interference patterns, principle of hologram, optical hologram, applications.

OPTICAL TOMOGRAPHY

Optical coherence tomography, Elastography, Doppler optical coherence tomography, Application towards clinical imaging.

TEXT BOOK

1. Leon Goldman, M.D., & R. James Rockwell, Jr., **"Lasers in Medicine"**, Gordon and Breach, Science Publishers Inc., New York, 1971.

REFERENCE

1. Mark E. Brezinski., **"Optical Coherence Tomography: Principles and Applications"**, Academic Press, 2006.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.N.Babu	Professor	BME	babu@vmkvec.edu.in
2	Ms.B.Farhana Ansoor	Assistant Professor (G-I)	BME	farhanaansoor@avit.ac.in
3	Mrs.S.Vaishnodevi	Assistant Professor	BME	vaishnodevi@vmkvec.edu.in

17BMEC02	BIOTELEMETRY	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

PREAMBLE
To study the overall concept of a Biotelemetry system and the concept of signal transmission.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To study the basic concepts and the principles used in a Telemetry system.
2	To study the building blocks used to make a electrical telemetry system.
3	To study the basic components of transmitting and receiving techniques.
4	To know about how optical fibers are used in signal transmission.
5	To understand the real time application in biotelemetry.

COURSE OUTCOMES

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

CO1. Discuss about the basic information about Telemetry system.	Understand
CO2. Describe the knowledge about design of Electrical Telemetry Systems.	Understand
CO3. Demonstrate the different types of modulation techniques.	Apply
CO4. Analyze the implementation of optical fibers in telemetry system.	Analyze
CO5. Validate the healthcare system using Telemetry system.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION
Fundamental concepts – Significance, Principle, functional blocks of Telemetry and Telecontrol system- Methods of telemetry – Electrical, Pneumatic, Hydraulic and Optical Telemetry – State of the art-Telemetry standards.

ELECTRICAL TELEMETRY
Electrical Telemetry – Current Systems – Voltage Systems – Synchro Systems – Frequency systems – Position and Pulse systems – Example of a landline telemetry system.

RADIO TELEMETRY SYSTEM
Block diagram of a Radio Telemetry system – Transmitting and receiving techniques – AM, FM, PM, Multiplexing and demultiplexing – Transmitting and receiving techniques – Digital coding methods – Advantages of PCM, PWM, PM,

FSK – Delta modulation – coding and decoding equipment – Example of a radiotelemetry system.

OPTICAL TELEMETRY SYSTEM

Optical fibers for signal transmission – Sources for fiber optic transmission – Optical detectors – trends in fiber– optic device development – Example of an optical telemetry System.

APPLICATION OF BIOTELEMETRY

Use of computers in distance mode of healthcare delivery, Web technology, Satellite communication systems; hypertext, voice & image transfer protocols, Medical image scanning, Data compression and Transfer, Capturing of medical signals, Analog to digital conversion, Video conferencing, Remote sensing, Rural primary setups, Referral and Super specialty centers, Societal medico legal aspects, Networking (local, national & global).

TEXT BOOKS

1. D.Patranabis, **"Telemetry principles"**, Tata Mcgraw Hill Publishers.
2. Marilyn J. Field, **"Telemedicine: A Guide to Assessing Telecommunications for Health Care"**, National Academic Press, 1996.

REFERENCE

1. Charles J. Amlaner, David W. Macdonald, **"A Handbook on Biotelemetry and Radio Tracking"**, Pergamon Press; 1st Edition (January 1, 1980).

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Mrs. S.Vaishnodevi	Assistant Professor	BME	vaishnodevi@vmkvec.edu.in
2	Ms.R.Sandhiya	Assistant Professor (Gr-I)	BME	sandhiya@avit.ac.in

17BMCC03	BIOSENSORS AND TRANSDUCERS	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

PREAMBLE

The course is designed to make the student acquire conceptual knowledge of the transducers and biological components used for the detection of an analyte. The relation between sensor concepts and biological concepts is highlighted. The principles of biosensors that are currently deployed in the clinical side are introduced.

PREREQUISITE – Nil

COURSE OBJECTIVES

1	To use the basic concepts of transducers, electrodes and its classification.
2	To discuss the various types of electrodes.
3	To determine the recording of biological components.
4	To employ the knowledge in electrochemical and optical biosensors.
5	To outline the various biological components using biosensors.

COURSE OUTCOMES

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

CO1. Describe the working principles of transducers.	Understand
CO2. Explain the various types of electrodes.	Understand
CO3. Utilize various FET sensors for recording of biological components.	Apply
CO4. Distinguish various biosensors like electrochemical and optical biosensors.	Analyze
CO5. Analyze the biological components using biosensors in various 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	M	L	--	M	--	M	--	--	L	--	--	M	--	--	--
CO2	M	L	--	M	--	M	--	--	L	--	--	M	--	M	--
CO3	S	M	L	S	--	S	M	M	M	--	--	M	--	M	S
CO4	S	S	L	S	--	S	M	M	S	--	--	M	M	S	S
CO5	S	S	L	S	--	S	M	M	S	--	--	S	M	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION: General measurement system, Transducers and its classification, Resistance transducers, capacitive transducer, Inductive transducer.

TRANSDUCERS:

Temperature transducers, piezoelectric transducers, Piezo resistive transducers, photoelectric transducers.

BIO POTENTIAL ELECTRODES:

Half cell potential, Types of Electrodes –Micro electrodes, Depth and needle electrodes, Surface electrodes, Chemical electrodes, Catheter type electrodes, stimulation electrodes, electrode paste, electrode material.

BIOSENSORS:
Biological elements, Immobilization of biological components, Chemical Biosensor-ISFET, IMFET, electrochemical sensor, chemical fibro sensors.

APPLICATIONS OF BIOSENSORS:
Bananatrode, blood glucose sensors, non invasive blood gas monitoring, UREASE biosensor, Fermentation process control, Environmental monitoring, Medical applications.

TEXT BOOKS:

1. H.S. Kalsi, **"Electronic Instrumentation & Measurement"**, Tata McGraw HILL, 1995.
2. Brain R Eggins, **"Biosensors: An Introduction",** John Wiley Publication, 1997.
3. Shakthi chatterjee, **"Biomedical Instrumentation"**, Cengage Learning, 2013.
4. John G Webster, **"Medical Instrumentation: Application and design"**, John Wiley Publications, 2001.

REFERENCES:

1. K.Sawhney, **"A course in Electronic Measurements and Instruments"**, Dhapat Rai & sons, 1991.
2. John P Bentley, **"Principles of Measurement Systems"**, 3rd Edition, Pearson Education Asia, (2000 Indian reprint).
3. Geddes and Baker, **"Principles of Applied Biomedical Instrumentation"**, 3rd Edition, John Wiley Publications, 2008.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Mrs.S.Vaishnodevi	Assistant Professor	BME	vaishnodevi@vmkvec.edu.in
2	Mr.V.Prabhakaran	Assistant Professor (Gr-II)	BME	prabhakaran@avit.ac.in
3	Dr.N.Babu	Professor	BME	babu@vmkvec.edu.in

17BMEC04	MEMS AND ITS BIOMEDICAL APPLICATIONS	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

PREAMBLE

To enable the students to acquire knowledge about the principles and applications of MEMS & Nanotechnology in Biomedical Industry.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To understand the working principle of MEMS & Microsystems.
2	To understand the working of MOEMS Technology.
3	To give an insight to the microfluidic systems.
4	To give an insight to the Bio-MEMS & its application in healthcare.
5	To study about the biomedical Nanotechnology & its application in research domain.

COURSE OUTCOMES

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

CO1. Discuss the concepts of microfluidic systems.	Understand
CO2. Explain about the basics of working of MOEMS Technology.	Understand
CO3. Illustrate the working principle of MEMS & Microsystems.	Apply
CO4. Analyze the nanomaterial in various biomedical applications.	Analyze
CO5. Evaluate about the biomedical Nanotechnology & its application in research domain.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

MEMS & MICROSYSTEM

MEMS and Microsystems-Introduction-Typical MEMS and Microsystem Products-Application of Micro- system in Healthcare Industry – Working Principles of Microsystems Micro-sensors – Micro-actuation – MEMS with Microactuation – Micro-accelerators.

MICRO-OPTO ELECTROMECHANICAL SYSTEMS (MOEMS)

Fundamental principle of MOEMS Technology, Advantages - Light Modulators, Beam splitter – Micro-lens, Micro-mirrors - Digital Micro-mirror Device, Grating Light Valve, Optical Switch, Waveguide and Tuning

MICROFLUIDIC SYSTEMS

Microfluidics - Introduction and Fluid Properties, Applications of MFS-Fluid Actuation Methods - Electrophoresis,

Dielectrophoresis, Electrowetting, Optoelectrowetting, Electro osmosis Flow, Electrothermal Flow, Thermocapillary Effect – Microfluidic Channel – Microdispenser – Microneedle - Microfilter

BIOMEMS

Introduction to BioMEMS, BioMEMS for Clinical Monitoring, Lab on a chip, DNA Sensors, E-Nose, E-Tongue, Microsystem approaches to PCR, MEMS based Implantable Drug Delivery System, Emerging, BioMEMS Technology.

BIOMEDICAL NANOTECHNOLOGY

Introduction to nanoscale phenomena, Nanoparticles - Nanomaterial characterization – XRD,SAXS,TEM,SEM, Scanning Tunneling microscopy, AFM, SPM technique, Biomolecular sensing for cancer diagnostics using carbon nanotubes, Carbon nanotube biosensors, Magnetic nanoparticles for MRImaging, Nano-devicesin biomedical applications.

TEXT BOOKS:

1. Tai-Ran Hsu, **"MEMS & Microsystems- Design, Manufacture and Nanoscale Engineering"**, John Wiley & Sons, 2nd Edition, 2008.
2. Nitaigour Premch and Mahalik, **"MEMS"**, Tata McGraw Hill, 2nd Reprint 2008.
3. Wanjun Wang & Steven A. Soper, **"BioMEMS – Technologies and applications"**, CRC Press, First Edition 2007.

REFERENCES:

1. Steven S. Saliterman, **"Fundamentals of BioMEMS & Medical Microdevices"**, International Society for Optical Engineering, 1st Edition 2006.
2. Gerald A Urban, **"BioMEMS"**, Springer, 1st Edition 2006.
3. Abraham P. Lee and James L. Lee, **"BioMEMS and Biomedical Nanotechnology"**, Volume-I, Springer, 1st Edition, 2006.

COURSE DESIGNERS

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1	Dr. M.Ravindiran	Professor & Head	BME	ravindiran@avit.ac.in
2	Mr. R. Ezhilan	Assistant Professor	BME	ezhilan@vmkvec.edu.in
3	Mr.S.Kannan	Assistant Professor	BME	kannan@vmkvec.edu.in

17BMEC09	DESIGN OF MEDICAL DEVICES	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

PREAMBLE

This course will offer students exposure to the core concepts of the global medical device regulatory framework and provide a foundation for the practical application. It includes all elements of the device product lifecycle from idea to initial market entry, sustaining activities and post-market activities.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To understand the post-marketing requirements associated with medical devices.
2	To understand the necessary steps to take an idea to a prototype.
3	To follow a deterministic engineering design process to create new products.
4	To apply engineering theory to practice.
5	To perform risk assessment and countermeasure development.

COURSE OUTCOMES

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

CO6. Discuss the necessary steps to take an idea to a prototype.	Understand
CO7. Utilize fundamental design principles, machine elements, manufacturing and assembly techniques.	Apply
CO8. Analyze risk management concepts into the quality management system.	Analyze
CO9. Assess the medical device regulatory framework for any given country based upon device type.	Evaluate
CO10. Create potential regulatory pathway.	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO MEDICAL DEVICES AND MEDICAL DEVICE REGULATIONS

Medical Device Classification, Bioethics and Privacy, Biocompatibility and Sterilization Techniques, Design of Clinical Trials, Design Control & Regulatory Requirements.

INTRODUCTION TO SPECIFIC MEDICAL TECHNOLOGIES

Biopotential measurement (EMG, EOG, ECG, EEG), Medical Diagnostics (In-vitro diagnostics), Medical Diagnostics (Imaging), Minimally Invasive Devices, Surgical Tools and Implants.

MEDICAL DEVICES STANDARD AND INTELLECTUAL PROPERTY

Standard-ISO, IES, Intellectual Property - Patents, Copy rights, Trademarks, Trade secrets.

HARDWARE AND SOFTWARE DESIGN

Hardware design, Hardware risk analysis, Design and project merits, Design for six sigma, software design, software coding, software risk analysis, software metrics.

DESIGN TRANSFER AND MANUFACTURING

Transfer to manufacturing, hardware manufacturing, software manufacturing, configuration management, documents and deliverables.

TEXT BOOKS:

1. Richard Fries, **"Reliable Design of Medical Devices"**, CRC Press, 2nd Edition, 2006.
2. Paul H. King, Richard C. Fries, Arthur T. Johnson, **"Design of Biomedical Devices and Systems"**, Third Edition, ISBN 9781466569133.

REFERENCES:

1. John G. Webster (ed), **"Medical Instrumentation: Application and Design"**, 2007.
2. Peter J. Ogrodnik, **"Medical Device Design: Innovation from Concept to Market"**, Academic Press Inc; 1st Edition (2012), ISBN-10: 0123919428

COURSE DESIGNERS

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17BMCC10	MEDICAL IMAGE PROCESSING AND ANALYSIS	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

PREAMBLE

To learn the fundamental concepts of medical image acquisition and understand how to apply the image processing techniques for various medical images.

PREREQUISITE: 17BMCC08 - BIOMEDICAL SIGNAL PROCESSING

COURSE OBJECTIVES

1	To learn the image fundamentals and mathematical transforms necessary for image processing.
2	To study the various image enhancement techniques.
3	To study about the various segmentation techniques applied to Medical Images.
4	To gain knowledge about the basic concepts of image compression procedures.
5	To apply various image restoration procedures in Medical images.

COURSE OUTCOMES

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

CO1. Summarize the general terminology of digital image processing.	Understanding
CO2. Examine the need for image transforms and their types both in spatial and frequency domain.	Apply
CO3. Classify different types of image segmentation and apply restoration techniques.	Analyze
CO4. Analyze the image compression models and image compression techniques.	Analyze
CO5. Illustrate various methodologies for image segmentation in medical imaging.	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	M	M	--
CO2	S	S	M	M	S	M	--	--	S	--	--	S	M	M	--
CO3	S	S	M	M	S	M	--	--	S	--	--	S	M	S	--
CO4	S	S	M	M	S	M	--	--	S	--	--	S	M	S	--
CO5	S	S	M	M	S	M	--	M	S	--	--	S	M	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

DIGITAL IMAGE FUNDAMENTALS

Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels – Color image fundamentals – RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms – DFT, DCT.

IMAGE ENHANCEMENT

Basic gray level transformation, Histogram processing, Smoothening by spatial filters – Sharpening by spatial filters, Smoothening- frequency domain filters, Sharpening - frequency domain filters, Color image Processing- color models – Pseudo color image processing – Color Image Transformation – Smoothening – Sharpening.

IMAGE SEGMENTATION AND OBJECT RECOGNITION

Edge detection- Marr Hidreth edge detector - Canny edge detector, Thresholding foundation – Basic global thresholding – Basic Adaptive thresholding, Region Based segmentation, Watershed segmentation algorithm, Patterns and pattern classes, Recognition based on decision theoretic methods – matching, Optimum statistical classifiers.

IMAGE COMPRESSION

Introduction – Principle of compression – Types of compression – Run length Encoding – Huffman Coding – Modified Huffman Coding – Modified READ – LZW – Arithmetic Coding – JPEG – Other State-of-the-Art Image Compression – Image Compression Standard File Formats.

IMAGE RESTORATION AND RECONSTRUCTION OF MEDICAL IMAGES

Image degradation models, Algebraic approach to restoration, inverse filtering, Least mean square filter, Image reconstruction from projections – Radon transforms - Filter back projection algorithm – Fourier reconstruction of MRI Images.

TEXT BOOKS:

1. Rafael C, Gonzalez and Richard E Woods, **"Digital Image Processing"**, Pearson Education Asia, 3rd Edition, 2007.
2. Anil K Jain, **"Fundamentals of Digital Image Processing"**, Prentice Hall of India, 2nd Edition, 1997.

REFERENCES:

1. William K Pratt, **"Digital Image Processing"**, John Wiley, 4th Edition, 2007.
2. Albert Macouski, **"Medical Imaging systems"**, Prentice Hall, New Jersey, 2nd Edition, 1997.

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17BMEC22	MEDICAL ETHICS AND STANDARDS	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

PREAMBLE
To enable the students to acquire knowledge about the medical standards, ethics medicine and drugs acts, Drugs and cosmetics standards and various medical acts.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To enable the students to understand the medical ethics.
2	To analyze medical standards.
3	To study the medicine and drug acts.
4	To learn about drugs and cosmetics standards.
5	To learn about various medical laws.

COURSE OUTCOMES

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

CO1. Explain the basic principle of medical ethics.	Understand
CO2. Discuss the various medical standards.	Understand
CO3. Describe the Medicine and drug related acts.	Understand
CO4. Illustrate about drugs and cosmetics standards.	Apply
CO5. Outline the various medical Laws.	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	--	M	--	--	--	M	--	--	S
CO2	L	--	--	--	--	L	--	M	--	--	--	S	--	M	M
CO3	L	--	--	--	--	L	--	M	--	--	--	S	M	M	M
CO4	M	--	--	--	--	M	--	S	L	--	--	S	M	M	S
CO5	M	--	--	--	--	M	--	S	M	--	--	S	M	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

MEDICAL ETHICS
Introduction - Medical ethics, Code of conduct, Basic principles of medical ethics, Autonomy and informed consent, Organ transplantation, Medico legal aspects of medical.

MEDICAL STANDARDS
Evolution of Medical Standards – IEEE 11073 - HL7 – DICOM – IRMA - LOINC – HIPPA – Electronics Patient Records –Healthcare Standard Organizations – JCAHO (Join Commission on Accreditation of Healthcare Organization) - JCIA (Joint Commission International Accreditation) - Evidence Based Medicine - Bioethics.

MEDICINE AND DRUGS ACTS

Narcotics and Psychotropic substances Act, Drugs and Magic remedies (Objectionable advertisement) Act 1954, Poisons act 1919 – Patent Act – Intellectual Property Rights.

DRUGS AND COSMETICS STANDARDS

Medicinal and Toilet preparations (Excise duties) Act and rules, Drugs Price control order, Shops & Establishments Act, Sales promotion employees (conditions of service) Act.

MEDICAL ACT

Medical Termination of Pregnancy Act, Prevention of cruelty to Animals act, Insecticides Act. Consumer protection Act 1986 - The Factories Act 1948 and the Amendment (salient features).

TEXT BOOKS

1. R.D.Lele, **"Computers in Medicine Progress in Medical Informatics"**, Tata McGraw Hill Publishing computers Ltd, New Delhi, 2005.
2. Mohan Bansal, **"Medical informatics**", Tata McGraw Hill Publishing computers Ltd, New Delhi, 2003.
3. N. K. Jain,**"Forensic Pharmacy"**, 6th Edition, CBS Publishers. Delhi
4. 4K. Ram Kumar,**"Forensic Pharmacy and Pharmaceutical Business Management"**, 1st Edition, 2006

REFERENCES

1. G. Vidyasagar & T. V. Narayana,**"Forensic Pharmacy"**, Kalyani Publishers, New Delhi.
2. Vijay Malik,**"Drugs and Cosmetics Act, 1940"**, Eastern Book Company, Lucknow.

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17BMSE23	MEDICAL WASTE MANAGEMENT	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

PREAMBLE
To learn more about managing medical waste, Health Care and its necessary.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To understand the process of managing medical waste.
2	To educate awareness among the various Medical Establishments producing Bio-Medical Waste regarding the hazardous effects of Bio-Medical Waste and necessity of compliance of Bio-Medical Waste
3	To create awareness among people associated with different local bodies and healthcare units about the necessities and requirements for scientific segregation, storage, treatment and disposal of Bio-Medical Waste
4	To Make available treatment & disposal of Bio-Medical Waste in Most scientific manner at a reasonable cost & to comply all the rules of the Bio-Medical Waste Management.
5	To understand modern technologies for managing medical waste.

COURSE OUTCOMES

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

CO1: Summarize the history of waste management including impacts from early human civilization to current day.	Understand
CO2: Describe the major categories of waste.	Understand
CO3: Illustrate waste collection, recycling, and materials recovery techniques for MSW.	Apply
CO4: Characterize the components and chemical and physical properties of medical waste.	Analyze
CO5: Classify requirements for hazardous waste generation, transportation, treatment, storage, and disposal.	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	S	S	--	--	S	M	S	M
CO2	S	M	M	--	--	M	S	S	S	--	--	S	M	S	M
CO3	S	S	M	--	--	S	S	S	S	L	M	S	M	S	S
CO4	S	S	M	--	--	S	S	S	S	M	M	S	M	S	S
CO5	S	S	M	--	--	S	S	S	S	M	M	S	--	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION
General Introduction, Definition of Biomedical Waste, General and Hazardous health care waste – Colour Coding and types of containers for disposal of medical waste, Segregation, Collection & Disposal.

BIOMEDICAL WASTES
Infectious waste, Genotoxic waste, Waste Sharps – Categories, Categorization and composition of Biomedical waste. Liquid Biomedical Waste - Radioactive wastes, Metals, Chemicals & drugs.

BLOOD PRODUCTS

Human Blood and Blood Products, pathological wastes, Contaminated sharps, Contaminated animal carcasses, body parts, and bedding Basic information about infection, Infectious agents on organizations spread of infection, Basic information about Hospital acquired infection.

STERILISATION

Disinfections unit container for Autoclaving, Sharp waste containers for storage & transportation, autoclaving, Incineration, Plasma Pyrolysis / Gasification systems, Composting.

MODERN TECHNOLOGY FOR MEDICAL WASTES

Modern Technology for handling Biomedical Wastes – Monitoring & Controlling of Cross Infections, Protective Devices – Bioethics and Handling of Waste Management.

TEXT BOOK:

1. V. J. Landrum, **"Medical Waste Management and disposal"**, Elsevier, 1991.

REFERENCES:

1. Malhotra A., **"Hospital Management: An Evaluation"**, Global India Publications, 2009.
2. S L Goel, **"Hospital Management"**, Deep and Deep Publications, 2010.
3. J Glyn Hendry & Gary W Heinke, **"Environmental Science and Engineering"**, Prentice Hall India, 2004.
4. Shyam Divan, **"Environmental law and policy in India"**, Oxford India Press, 2004.
5. Charles A Wentz, **"Hazardous Waste Management"**, McGraw Hill Inc, Newyork, 1995.

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17BMSE24	MEDICAL TECHNOLOGY AND ENTREPRENEURSHIP	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

PREAMBLE

The purpose of learning this course on medical technology and entrepreneurship for biomedical engineering students is to acquire knowledge and understand the advanced in medical equipments in therapeutic, diagnostic and entrepreneurship.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To impart the system description of different therapeutic & diagnostic equipments.
2	To make the students understand the active control trials in the evaluation of new treatments.
3	To impart the knowledge about ethical and regulatory guidance.
4	To study the minimally invasive device and technique used in medical devices.
5	To get knowledge about the advances in healthcare technologies and wireless technology related to healthcare system.

COURSE OUTCOMES

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

CO11. Explain the system description of different therapeutic & diagnostic equipments.	Understand
CO12. Use the ethical and regulatory guidance.	Apply
CO13. Categorize healthcare technologies and wireless technology related to healthcare system.	Analyze
CO14. Illustrate the advancement in medical technologies.	Analyze
CO15. Support entrepreneurial products for medical applications.	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	M	--	--	--	M	M	--	--	S	--	M	M
CO2	S	S	M	M	--	M	--	S	S	--	--	S	--	M	S
CO3	S	S	S	M	M	M	--	M	S	--	--	S	--	S	M
CO4	S	S	S	S	M	S	--	M	S	M	--	S	--	S	S
CO5	S	S	S	S	M	S	S	M	S	M	--	S	M	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

SYSTEM DESCRIPTION OF THERAPEUTIC EQUIPMENT

Pacemaker, External cardiovector defibrillator, Implantable cardiovector defibrillator, Deep brain stimulation, Functional electrical stimulator (FES), Hemodialysis delivery system, Mechanical ventilator.

SYSTEM DESCRIPTION OF DIAGNOSTIC EQUIPMENT

Patient monitoring system, ECG, EEG, Blood pressure monitor, Digital stethoscope, Thermometer, System description and diagram of pulse oximeter, optical fiber optics for circulatory and respiratory system measurement.

ETHICAL AND REGULATORY GUIDANCE

Immobilization, The Nurenberg code, Declaration of Helsinki: Ethical principles of medical research involving human subjects, The Belmont report: Ethical principles and guidelines for the protection of human subjects, The common rule,

Code of federal regulations

WIRELESS TECHNOLOGY

Wireless communication basics – Types of wireless network, Body area network – Emergency rescue – Remote recovery – General health assessments Technology in medical information processing – Future trends in healthcare technology.

ADVANCEMENT IN MEDICAL TECHNOLOGIES

Advances and trends in health care technologies – Driver impacting the growth of medical Technologies – Impact of Moore's law of medical imaging – E-health and personal healthcare – Defining the future of health Technology – Inventing the future – tools for self health – Future of nano fabrication molecular scale devices – Future of telemedicine – Future of medical computing.

TEXT BOOKS:

1. Ezekiel J, Emanuel, Robert A Crouch, John D Arras, Jonathan D Moreno, Christine Grady, **"Ethical and Regulatory Aspects of Clinical Research"**, Johns Hopkins University Press, First Edition, 2003.
2. Kenneth J. Turner, **"Advances in Home Care Technologies: Results of the match Project"**, Springer, 2011.

REFERENCES:

1. Anthony Y. K, Chan, **"Biomedical Device Technology: Principles and Design"**, Charles Thomas, 2008.
2. Theodore R, Kucklick, **"The Medical Device Ramp-D Handbook"**, Taylor & Francis Group LLC, 3rd Edition 2013.

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17CVEC35	MUNICIPAL SOLID WASTE MANAGEMENT	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

Preamble

Structure is an arrangement and organization of interrelated elements in a material object or system, or the object or system so organized. Material structures include man-made objects such as buildings and machines and natural objects such as biological organisms, minerals and chemicals.

Prerequisite

Nil

Course Objectives

1. The on-site/off-site processing of the same and the disposal methods.
2. The student is expected to know about the various effects and disposal options for the municipal solid waste.
3. The collection and supply of water
4. The offsite processing involved in site

Course Outcomes

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

Co1. To know about the types of waste & Sources	Analyse
Co2 . To Study the on site Storage & Processing	Apply
Co3. To study about the collection & transfer the waste	Apply
Co4. To Study the process of off site processing	Apply
CO5. To know about the solid waste disposal	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	M	M
CO2.	S	M	L	S	-	-	-	-	-	-	-	-	L	M	M
CO3.	S	M	M	S	-	-	-	-	-	-	-	-	L	L	M
CO4.	S	M	M	M	-	-	-	-	-	-	-	-	L	M	M
CO5.	S	M	M	-	-	-	-	-	-	-	-	L	L	M	M

S- Strong; M-Medium; L-Low

Syllabus

UNIT - I	SOURCES AND TYPES OF MUNICIPAL SOLID WASTES	9 - hours
Sources and types of solid wastes - Quantity – factors affecting generation of solid wastes; characteristics – methods of sampling and characterization; Effects of improper disposal of solid wastes – public health effects. Principle of solid waste management – social & economic aspects; Public awareness; Role of NGOs; Legislation.		
UNIT - II	**ON-SITE STORAGE & PROCESSING**	**9 - hours**

On-site storage methods – materials used for containers – on-site segregation of solid wastes – public health & economic aspects of storage – options under Indian conditions – Critical Evaluation of Options.		
UNIT - III	**COLLECTION AND TRANSFER**	**9 - hours**
Methods of Collection – types of vehicles – Manpower requirement – collection routes; transfer stations – selection of location, operation & maintenance; options under Indian conditions.		
UNIT - IV	**OFF-SITE PROCESSING**	**9 - hours**
Processing techniques and Equipment; Resource recovery from solid wastes – composting, incineration, Pyrolysis - options under Indian conditions.		
UNIT - V	**DISPOSAL**	**9 - hours**
Dumping of solid waste; sanitary landfills – site selection, design and operation of sanitary landfills – Leachate collection & treatment		

Text Books

1. George Tchobanoglous et.al., "Integrated Solid Waste Management", McGraw-HillPublishers, 2002.
2. B.Bilitewski, G.HardHe, K.Marek, A.Weissbach, and H.Boeddicker, "Waste Management",Springer, 1994.

Reference Books

1. R.E.Landreth and P.A.Rebers, "Municipal Solid Wastes – problems and Solutions", Lewis Publishers, 1997.
2. Bhide A.D. and Sundaresan, B.B., "Solid Waste Management in Developing Countries", INSDOC, 1993.

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17CVEC14	AIR POLLUTION MANAGEMENT	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

Preamble

The course work offers the basic knowledge on various sources of air pollutants and their possible effects on local, regional and global environment. It provides various techniques for sampling and analyzing he pollutants. Also, it deals with the principles and design of control of particulate/gaseous air pollutants and its emerging trends to fulfil the legal aspects of air pollution to have a sustainable environment for future generation. In addition.

Prerequisite

Environmental engineering

Course Objectives

1. About noise pollution and the methods of controlling the same.
2. The student is expected to know about source inventory and control mechanism.
3. To impart knowledge on the sources, effects
4. The control techniques of air pollutants and noise pollution
5. The sources, characteristics and effects of air

Course Outcomes

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

CO1. Identify the sources of air pollution, impacts of air pollutants and their measurements	apply
Co2. identify the significance of meteorological factors in pollutants dispersion and to predict the pollutant concentration	apply
Co3. Suggest preventive and control measures for air pollution.	apply
Co4. Suggest locations for industries and appropriate city planning tips for the effective air pollution management of a city	apply
CO5. Understand the basic knowledge on various sources of air pollutants and their possible effects on local, regional and global 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	S	M	L	L	---	L	---	L	---	---	---	---	M	M	L
CO2	S	M	L	L	L	M	---	L	---	L	L	---	L	M	L
CO3	S	M	L	L	L	M	---	L	---	L	---	---	S	L	L

CO4	**S**	**M**	**M**	**S**	**L**	**---**	**---**	**L**	**---**	**L**	**---**	**L**	**-**	**-**	**L**
CO5	**S**	**M**	**M**	**S**	**---**	**---**	**---**	**M**	**---**	**M**	**L**	**---**	**L**	**M**	**L**

S- Strong; M-Medium; L-Low

Syllabus

UNIT – I	**SOURCES AND EFFECTS OF AIR POLLUTANTS**	**9 – hours**
Classification of air pollutants – Particulates and gaseous pollutants – Sources of air pollution – Source inventory – Effects of air pollution on human beings, materials, vegetation, animals – global warming-ozone layer depletion, Sampling and Analysis – Basic Principles of Sampling – Source and ambient sampling – Analysis of pollutants – Principles.		
UNIT – II	**DISPERSION OF POLLUTANTS**	**9 – hours**
Elements of atmosphere – Meteorological factors – Wind roses – Lapse rate – Atmospheric stability and turbulence – Plume rise – Dispersion of pollutants – Dispersion models – Applications.		
UNIT – III	**AIR POLLUTION CONTROL**	**9 – hours**
Concepts of control – Principles and design of control measures – Particulates control by gravitational, centrifugal, filtration, scrubbing, electrostatic precipitation – Selection criteria for equipment – gaseous pollutant control by adsorption, absorption, condensation, combustion – Pollution control for specific major industries.		
UNIT – IV	**AIR QUALITY MANAGEMENT**	**9 – hours**
Air quality standards – Air quality monitoring – Preventive measures – Air pollution control efforts – Zoning – Town planning regulation of new industries – Legislation and enforcement – Environmental Impact Assessment and Air quality		
UNIT – V	**NOISE POLLUTION**	**9 – hours**
Sources of noise pollution – Effects – Assessment – Standards – Control methods – Prevention		

Text Books

1. Anjaneyulu, D., “Air Pollution and Control Technologies”, Allied Publishers, Mumbai, 2002.
2. Rao, C.S. Environmental Pollution Control Engineering, Wiley Eastern Ltd., New Delhi, 1996

Reference Books

1. W.L.Heumann, Industrial Air Pollution Control Systems, McGraw-Hill, New Yark, 1997
2.Mahajan S.P., Pollution Control in Process Industries, Tata McGraw-Hill Publishing Company,New Delhi, 1991.

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17CVEC06	HYDROLOGY	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

Preamble

It is the science that deals with the waters of the earth, their occurrence, circulation, distribution and their reaction with environment including their relation to living things.

Prerequisite

Nil

Course Objectives

1	The mechanics of rainfall, its spatial and temporal measurement and their applications will be understood.
2	The mechanics of rainfall, its distribution and measurement of rainfall using Hydrograph.
3	Simple statistical analysis and application of probability distribution of rainfall and run off shall also be understood.
4	Student will also learn simple methods of flood routing and ground water hydrology.

Course Outcomes

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

Co1.Explain the importance of Hydrological cycle and the measurement and analysis of rainfall data	Understand
Co2. Compute the quantity of runoff generated from a catchment	Apply
Co3.Develop hydrographs to measure the stream flow	Apply
Co4.Estimate floods and propose suitable control measures	Apply
Co5.Suggest methods of conserving surface and groundwater storage	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

Syllabus

UNIT – I	PRECIPITATION	9 – hours
Hydrologic cycle – Types of precipitation – Forms of precipitation – Measurement of Rainfall – Spatial measurement methods – Temporal measurement methods – Frequency analysis of point rainfall – Intensity, duration, frequency relationship – Probable maximum precipitation.		
UNIT – II	**ABSTRACTION FROM PRECIPITATION**	**9 – hours**

Losses from precipitation – Evaporation process – Reservoir evaporation – Infiltration process – Infiltration capacity – Measurement of infiltration – Infiltration indices – Effective rainfall.		
UNIT – III	**HYDROGRAPHS**	**9 – hours**
Factors affecting Hydrograph – Baseflow separation – Unit hydrograph – Derivation of unit hydrograph – S curve hydrograph – Unit hydrograph of different deviations - Synthetic Unit Hydrograph		
UNIT – IV	**FLOODS AND FLOOD ROUTING**	**9 – hours**
Flood frequency studies – Recurrence interval – Gumbel's method – Flood routing – Reservoir flood routing – Muskingum's Channel Routing – Flood control		
UNIT – V	**GROUND WATER HYDROLOGY**	**9 – hours**
Types of aquifers – Darcy's law – Dupuit's assumptions – Confined Aquifer – Unconfined Aquifer – Recuperation test – Transmissibility – Specific capacity – Pumping test – Steady flow analysis only.		

Text Books

1. Subramanya, K., "Engineering Hydrology", Tata McGraw-Hill Publishing Co., Ltd., 2006
2. Raghunath, H.M., "Hydrology", Wiley Eastern Ltd., 2000

Reference Books

1. Chow, V.T. and Maidment, "Hydrology for Engineers", McGraw-Hill Inc., Ltd., 2000
2. Singh, V.P., "Hydrology", McGraw-Hill Inc., Ltd.,
3. Raghunath,H.M,Ground Water,New Age International(P) Limited,Publishers.
4. Raghunath,H.M, Hydrology:Principles,Analysis & Design, New Age International(P) Limited,Publishers.

Course Designers:

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1.	M.Senthilkumar , Asst. Professor	senthilkumar@vmkvec.edu.in
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17CVEC07	DISASTER MITIGATION AND MANAGEMENT	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

Preamble

This course deals with the various disasters and to expose the students about the measures, its effect against built structures, and Hazard Assessment procedure in India. This course also deals with the methods of mitigating various hazards such that their impact on communities is reduced.

Prerequisite

Nil

Course Objectives

1	To Understand basic concepts in Disaster Management
2	To Understand Definitions and Terminologies used in Disaster Management
3	To Understand the Challenges posed by Disasters
4	To understand Impacts of Disasters

Course Outcomes

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

Co1. Understand the various types of disaster viz Hydrological, Coastal and Marine Disasters, Atmospheric Disasters, Geological, Mass Movement and Land Disasters, Wind and Water Driven Disasters.	Understand
Co2. Identify the potential deficiencies of existing buildings for Earthquake disaster and suggest suitable remedial measures.	Understand
Co3.Derive the guide lines for the precautionary measures and rehabilitation measures for Earthquake disaster.	Apply
Co4. Derive the protection measures against floods, cyclone, land slides	Apply
Co5. Understand the effects of disasters on built structures in India	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

Syllabus

UNIT – I	INTRODUCTION	9 – hours
Concept of disaster; Different approaches; Concept of Risk; Levels of disasters; Disaster phenomena and events (Global, national and regional); Natural and man-made hazards		
UNIT – II	RISK ASSESSMENT AND VULNERABILITY ANALYSIS	9 – hours

Response time, frequency and forewarning levels of different hazards; Characteristics and damage potential of natural hazards; hazard assessment ;Dimensions of vulnerability factors; vulnerability assessment; Vulnerability and disaster risk; Vulnerabilities to flood and earthquake hazards		
UNIT – III	**DISASTER MANAGEMENT MECHANISM**	**9 – hours**
Concepts of risk management and crisis management ; Disaster management cycle ;Response and Recovery ; Development, Prevention, Mitigation and Preparedness; Planning for relief		
UNIT – IV	**DISASTER RESPONSE**	**9 – hours**
Mass media and disaster management; Disaster Response Plan; Communication, Participation, and Activation of Emergency Preparedness Plan; Logistics Management; Psychological Response; Trauma and Stress Management; Rumour and Panic Management ;Minimum Standards of Relief; Managing Relief; Funding.		
UNIT – V	**DISASTER MANAGEMENT IN INDIA**	**9 – hours**
Strategies for disaster management planning; Steps for formulating a disaster risk reduction plan; Disaster management Act and Policy in India; Organisational structure for disaster management in India; Preparation of state and district disaster management plans.		

Text Books

1. Alexander, D. Natural Disasters, ULC press Ltd, London, 1993.
2. Carter, W. N. Disaster Management: A Disaster Management Handbook, Asian Development Bank, Bangkok, 1991.
3. Chakrabarty, U. K. Industrial Disaster Management and Emergency Response, Asian Books Pvt. Ltd., New Delhi 2007.

Reference Books

1. Abarquez I. & Murshed Z. Community Based Disaster Risk Management: Field Practitioner's Handbook, ADPC, Bangkok, 2004.
2. Goudie, A. Geomorphological Techniques, Unwin Hyman, London 1990.
3. Goswami, S. C. Remote Sensing Application in North East India, Purbanchal Prakesh, Guwahati, 1997.
4. Manual on Natural Disaster Management in India, NCDM, New Delhi, 2001.
5. Disaster Management in India, Ministry of Home Affairs, Government of India, New Delhi, 2011.
6. National Policy on Disaster Management, NDMA, New Delhi, 2009.
7. Disaster Management Act. (2005), Ministry of Home Affairs, Government of India, New Delhi, 2005.

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17CVEC08	REMOTE SENSING TECHNIQUES AND APPLICATIONS	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

Preamble

Remote sensing is the science and art of obtaining information about an object, area or phenomenon, by the use of either recording or real time sensing devices that are not in physical contact with the object. The Global Positioning System (GPS) is a satellite-based navigation system made up of a network of 24 satellites placed into orbit by the U.S. Department of Defense. These GPS satellites circle the earth twice a day in a very precise orbit and transmit signal information to earth. Remote sensing and GPS data are further used in numerous applications, including GIS data collection, surveying, and mapping.

Prerequisite

Nil

Course Objectives

1	Students will learn about the land use mapping techniques,site suitability techniques
2	Students will learn about the use of zone mapping for water bodies
3	Students will learn about the use of mapping techniques for Agriculture and Earth sciences
4	Students will also learn about the recent techniques used for GPS system

Course Outcomes

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

Co1. Recollect the fundamentals of physics of Remote sensing and concepts.	Remember
Co2. Outline the various data acquisition systems and collection methods for remote sensing data information and storage	Understand
Co3.Apply knowledge of satellites on various Civil Engineering applications.	Apply
Co4. Utilize the various data input methods for mapping	Apply
Co5. Creation of data models using remote sensing techniques and GPS	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

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

S- Strong; M-Medium; L-Low

Syllabus

UNIT - I	**INTRODUCTION**	**9 - hours**
Definition – Physics of remote sensing – electromagnetic radiation (EMR) – remote sensing windows – interaction of EMR with atmosphere, earth surface, soils, water and vegetation – platform and sensors – image interpretations.		
UNIT - II	**LAND USE STUDIES**	**9 - hours**
Definition of land use – land use / land cover classification – schemes and levels of classification systems with RS data – land use mapping – change detection – urban land use planning, site suitability analysis, transportation planning.		
UNIT - III	**WATER RESOURCES**	**9 - hours**
Areal assessment of surface water bodies – Capacity survey of water bodies – mapping of snow-covered areas – flood risk zone mapping – identification of groundwater potential zones, recharge areas – droughts, definition, drought assessment and management.		
UNIT - IV	**AGRICULTURE, SOIL AND FORESTRY**	**9 - hours**
Crop inventory mapping – production estimation – command area monitoring – soil mapping – crop stress detection - estimation of soil erosion – forest types and density mapping – forest fire risk zone mapping.		
UNIT - V	**EARTH SCIENCE**	**9 - hours**
Lithology – lithological mapping – structural mapping – Geomorphology – nature and type of landforms – identification – use of remote sensing data for landslides – targeting mineral resources – Engineering geology and Environmental geology.		

Text Books

1. Lillesand, T.M., Kiefer, R.W. and J.W.Chipman., Remote Sensing and Image Interpretation. V Edn. John Willey and Sons (Asia) Pvt. Ltd., New Delhi, 2004

2. Lo. C.P.and A.K.W.Yeung, Concepts and Techniques of Geographic Information Systems. Prentice-Hall of India Pvt. Ltd., New Delhi, 2002

Reference Books

1 .Chandra,A.M,Geo Informatics,New Age International(P) Limited,Publishers.

2. Fazal,Shahab,GIS Basics,New Age International(P) Limited,Publishers.

3. Space Applications Centre. Manual for Forest mapping and Damage detection using satellite data, Report No.IRS-UP/SAC/FMDD/TN/16/90,1990, pp-253.

4. Sabins, F.F.Jr. Remote sensing principles and interpretation, W.H.Freeman & Co., 1978.

5. Manual of Remote Sensing Vol. II. American Society of Photogrammetry

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17EEEC18	**RENEWABLE ENERGY TECHNOLOGY**	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

PREAMBLE

This course helpful for the students to enhance their knowledge in renewable sources and empower the students to understand the need of renewable source, utilization of techniques and its advantages. Energy is a vital input for the development and economic growth of a country. The growth for energy sector is critical for socio-economic development particularly for rural areas.Students will be exposed to the status of energy resources, its interaction with environment, different renewable energy sources technologies, different techniques and technologies for energy management and energy conservation along with the economic aspects of renewable energy based power generation. It is to provide specialist manpower to meet the challenges of the energy sector.

PREREQUISITE

- NIL

COURSE OBJECTIVES

1	Tofamiliarizethestudentwiththeutilizationmethodsoftherenewableenergyresources
2	To learn about PV Technology principles.
3	To learn economical and environmental merits of solar energy for variety applications.
4	To learn modern wind turbine control & monitoring.
5	To learn various power converters in the field of renewable energy technologies.
6	To study and Analyze different types of Power converters for Renewable energy conversion

COURSE OUTCOMES

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

CO1	Understand the various PV technologies	Understand
CO2	Implement The PV technology to various applications.	Apply
CO3	Assess the control and monitoring systems	Analyse
CO4	Realize modern control methods of wind turbine	Understand
CO5	Analyze various power converters.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

SOLAR THERMAL TECHNOLOGIES

Principle of working, types, design and operation of - Solar heating and cooling systems – ThermalEnergy storage systems – Solar Desalination – Solar cooker : domestic, community – Solar pond – Solar drying. Principle of working, types, design and operation of - Solar heating and cooling systems – ThermalEnergy storage systems – Solar Desalination – Solar cooker : domestic, community – Solar pond – Solar drying.

SPV SYSTEM DESIGN AND APPLICATIONS

Solar cell array system analysis and performance prediction- Shadow analysis: reliability - solar cellarray design concepts - PV system design - design process and optimization - detailed array design - storage autonomy - voltage regulation - maximum tracking - centralized and decentralized SPVsystems - stand alone - hybrid and grid connected system - System installation - operation andmaintenances - field experience - PV market analysis and economics of SPV systems.

DIRECT ROTOR COUPLED GENERATOR (MULTIPOLE) [VARIABLE SPEEDVARIABLE FREQ.]

Excited Rotor Synch. Generator / PMG Generator, Control Rectifier, Capacitor Banks, Step Up / BoostConverter (DC-DC Step Up), Grid Tied Inverter, Power Management, Grid Monitoring Unit (Voltageand Current), Transformer, Safety Chain Circuits

MODERN WIND TURBINE CONTROL & MONITORING SYSTEM

Details of Pitch System & Control Algorithms, Protections used & Safety Consideration in Windturbines, Wind Turbine Monitoring with Error codes, SCADA & Databases: Remote Monitoring and Generation Reports, Operation & Maintenance for Product Life Cycle, Balancing technique (Rotor &Blade), FACTS control & LVRT & New trends for new Grid Codes.

POWER CONVERTERS

Solar: Block diagram of solar photo voltaic system: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection Of inverter, battery sizing, array sizing.Wind: three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWMInverters, Grid Interactive Inverters-matrix converters.

TEXT BOOK

1.Goswami, D.Y., Kreider, J. F. and & Francis., Principles of Solar Engineering, Taylor and Francis,2000

2.Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, 1996

3. Renewable Energy Sources and Emerging Technologies, Kothari, Prentice Hall India Learning Private Limited; 2 edition (2011), ISBN-10: 8120344707, ISBN-13: 978-8120344709

REFERENCES

1. Sukhatme S P, J K Nayak, Solar Energy – Principle of Thermal Storage and collection, Tata McGraw Hill, 2008.
2. Solar Energy International, Photovoltaic – Design and Installation Manual – New Society Publishers, 2006
3.Twidell, J.W. and Weir, A., Renewable Energy Sources, EFN Spon Ltd., 1983
4. John D Sorensen and Jens N Sorensen, Wind Energy Systems, Woodhead Publishing Ltd, 2011
5. Rashid .M. H "power electronics Hand book", Academic press, 2001.

COURSE DESIGNERS

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17EEEC20	MATHEMATICAL MODELLING AND SIMULATION	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

PREAMBLE

Introduce the students to study the fundamentals of computing and modeling software environments for electrical engineering. This Course contains Programming in numerical computing and modeling software environments for electrical engineering. No prior programming experience or knowledge of SCILAB is assumed, and the course is structured to allow thorough assimilation of ideas through hands-on examples and exercises.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To study basic concepts of scientific programming using SCILAB.
2	To learn about the Basics of Program of SCILAB and related Mathematical Applications.
3	Analyze the concepts of Program of SCILAB.
4	To understand the different tools in SCILAB and ODE, DAE
5	To applya software program to Electrical circuits and solve the simulation based solutions.

COURSE OUTCOMES

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

CO1	Understand the main features of the SCILAB program development environment to enable their usage in the higher learning.	Understand
CO2	Understand the need for simulation/implementation for the verification of mathematical functions.	Understand and Analyze
CO3	Implement simple mathematical functions/equations in numerical computing environment such as SCILAB.	Analyze
CO4	Interpret and visualize simple mathematical functions and operations thereon using plots/display.	Create and Apply
CO5	Analyze the program for correctness anddetermine/estimate/predict the output and verify it under simulation environment using SCILAB tools	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Introduction to SCILAB – Constants – Data types – SCILAB Syntax – Data type related functions – Over

loading.

GRAPHICAL ANALYSIS USING SCILAB

The media – global plot parameters – 2D and 3D plotting – examples – printing graphics and exporting to Latex.

SCILAB PROGRAMMING

Linear algebra – Polynomial and rational function manipulation – Sparse matrices – random numbers – cumulative distribution functions and their inverse – building interface programs – inter SCI – dynamic linking – static linking.

SCILAB TOOLS

Systems and control toolbox – improper systems – system operation – control tools classical control – state space control – model reduction – identification – linear matrix inequalities – integrating ODEs – integrating DAEs.

APPLICATIONS

Resistive circuits – inductive and capacitive circuits – transients – steady state analysis – logics circuits – electronic devices - DC machines

TEXT BOOK

1. Claude Gomez Engineering and Scientific Computing with SCILAB, Birkhauser publications
2. Scilab: A Practical Introduction to Programming and Problem Solving, Tejas Sheth, CreateSpace Independent Publishing Platform, 2016, ISBN : 1539027848, 9781539027843

REFERENCES

1.Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering ApplicationsA. Vande Wouwer, P. Saucez, C. V. Fernández 2014ISBN: 978-3319067896

2. SCILAB(a Free Software to Matlab), Er. HemaRamachandran and Dr. Achutsankar Nair, S. Chand Publishers, ISBN-10: 8121939704,2011

3. http://in.mathworks.com/

4.https://www.scilab.org/resources/documentation/tutorials

5.http://www.scilab.org/

COURSE DESIGNERS

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17EEEC21	NON CONVENTIONAL ENERGY SOURCES	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

PREAMBLE

Non Conventional sources of energy are generally renewable sources of energy. This type of energy sources include anything, which provides power that can be replenished with increasing demand for energy and with fast depleting conventional sources of energy such as coal, petroleum, "natural gas etc.The non- conventional sources of energy such as energy from sun, wind, biomass, tidal energy, geo thermal energy and even energy from waste material are gaining importance. This energy is abundant, renewable, pollution free and eco-friendly.It can also be more conveniently supplied to urban, rural and even remote areas. Thus, it is also capable of solving the twin problems of energy supply in a decentralized manner and helping in sustaining cleaner environment. It concerned with development of the national grid system will focus on those resources that have established themselves commercially and are cost effective for on grid applications

PREREQUISITENIL

COURSE OBJECTIVES

1	To impart the knowledge of basics ofdifferent non conventional types of power generation & power plants
	To understand the need and role of Non-Conventional Energy sources.
2	To learn economical and environmental merits of solar energy for variety applications.
3	To learn modern wind turbine control & monitoring.
4	To learn various power converters in the field of renewable energy technologies.
5	To study and analyse different types of Power converters for Renewable energy conversion

COURSE OUTCOMES

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

CO1	Identify the different non conventional sources and the power generation techniques to generate electrical energy.	Understand
CO2	Explore the Solar Radiation, different Methods of Solar Energy Storage and its Applications.	Analyse
CO3	Familiarize the Winds energy as alternate form of energy and to know how it can be tapped	Understand
CO4	Explore the Geothermal Energy Resources and its methods.	Understand
CO5	Identify the Bio mass and Bio gas resources and its tapping technique	Analyze
CO6	Investigate the Tidal, Wave and OTEC Energy, Concepts of Thermo-Electric Generators and MHD Generators	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	-	M	M	-	L	L	-	L	-	-	M	-	-	-
CO2	S	L	M	L	M	M	S	L	M	M	M	S	-	-	

CO3	-	M	M	S	L	M	L	-	-	L	S	-	-	-	-
CO4	M	L	-	-	-	S	-	S	S	L	M	S	S	S	M
CO5	-	M	L	M	L	L	M	L	S	M	S	L	S	M	S
CO6	L	-	-	-	-	-	M	-	S	S	-	M	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Statistics on conventional energy sources, Classification of Energy Resources, Definition Concepts of NCES, Limitations of RES, Criteria for assessing the potential of NCES. - Solar, Wind, Geothermal, Bio-mass, Ocean Energy Sources, comparison of these energy sources

SOLAR ENERGY CONCEPT

Introduction to Solar Energy- Radiation and its measurement, Solar Energy conversion and its types - Introduction to Solar Energy Collectors and Storage, Applications of Solar Energy: Solar Thermal Electric Conversion Systems, Solar Electric power Generation, Solar Photo-Voltaic, Solar Cell Principle, Semiconductor Junctions, Conversion efficiency and power output, Basic Photo Voltaic System for Power Generation, Stand-alone, Grid connected solar power satellite

WIND ENERGY CONCEPT

Introduction- Basic Principles of Wind energy conversion-The nature of wind- The power in the wind (No derivations) - Forces on the Blades (No derivations)-Site Selection considerations-Basic components of a wind energy conversion system (WECS)-Advantages & Limitations of WECS-Wind turbines (Wind mill)-Horizontal Axis wind mill-Vertical Axis wind mill-performance of wind mills-Environmental aspects - Determination of torque coefficient, Induction type generators

GEOTHERMAL AND BIOMASS ENERGY

Geothermal Sources-Hydro thermal Sources- a. Vapor dominated systems b. Liquid dominated systems -Prime movers for geothermal energy conversion- Biomass Introduction- Biomass conversion techniques-Biogas Generation-Factors affecting biogas Generation-Types of biogas plants- Advantages and disadvantages of biogas plants-urban waste to energy conversion-MSW incineration plant.

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TIDAL AND OTEC ENERGY

Tidal Energy-Basic Principles of Tidal Power-Components of Tidal Power Plants- Schematic Layout of Tidal Power house-Advantages & Limitations of Tidal, Wave, OTEC energy- Difference between tidal and wave power generation, OTEC power plants, Design of 5 Mw OTEC pro-commercial plant, Economics of OTEC, Environmental impacts of OTEC.

TEXT BOOK

1. Ashok V Desai, Non-Conventional Energy, Wiley Eastern Ltd, New Delhi, 2003
2. K M, Non-Conventional Energy Systems, Wheeler Publishing Co. Ltd, New Delhi, 2003.
3. Non Conventional Energy Resources, Shobh Nath. Singh, Pearson Education India, 2016, e – ISBN : 978933255906 - 6

REFERENCES

1. Ramesh R & Kumar K U, Renewable Energy Technologies, Narosa Publishing House, New Delhi,

2004

2. Wakil MM, Power Plant Technology, Mc Graw Hill Book Co, New Delhi, 2004.
3. Non – Conventional Energy Sources. Rai.

COURSE DESIGNERS

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17ECEC06	MEMS AND SENSORS	Category	L	T	P	Credits
		EC (OE)	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	S	M	-
CO3	L	S	M	-	L	-	-	-	-	-	-	L	-	-	-
CO4	S	S	S	-	M	-	-	-	-	-	-	L	M	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

COURSE DESIGNERS

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2	Mr.G.Ramachandran	Assistant Professor	ECE	ramachandran@vmkvec.edu.in

17ECEC23	MACHINE VISION	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

PREAMBLE

In the current automated world, Machine Vision plays a major role in several significant applications such as imaging-based automatic inspection and analysis, Intelligent transportation system, Logistics, Robot guidance, Packaging industries and many. It provides an detailed view of the various process involved.

PREREQUISITE : Nil

COURSE OBJECTIVES

1	To understand the Image filtering operations, Morphological operationsThreholding Images.
2	To determine the concepts of Binary shape & Boundary Pattern analysis,Detection& Pattern matching techniques.
3	To examine the concepts of 3-D Vision, Image Transformations & Motion.
4	To illustrate the automated visual inception, in vehicle vision systems, inspection of cereal grains & surveillance.

COURSE OUTCOMES

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

CO1.Intrepret the Low Level Vision techniques and methods of Machine Vision	Understand
CO2.Demonstrate the Intermediate Level Vision techniques.	Apply
CO3.Paraphase the 3-D Vision and Motion procedures.	Apply
CO4.Infer the various Real-Time Pattern Recognition systems.	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS:

LOW-LEVEL VISION

Images and Imaging Operations, Basic Image Filtering Operations, Thresholding Techniques, Edge Detection, Corner and Interest Point Detection, Mathematical Morphology, Texture

INTERMEDIATE-LEVEL VISION

Binary Shape Analysis, Boundary Pattern Analysis , Line Detection, Circle and Ellipse Detection, The Hough Transform and Its Nature, Pattern Matching Techniques

3-D VISION AND MOTION

The Three-Dimensional World, Tackling the Perspective n-point Problem, Invariants and Perspective, Image Transformations and Camera Calibration, Motion

REAL-TIME PATTERN RECOGNITION SYSTEMS

Automated Visual Inspection, Inspection of Cereal Grains, Surveillance, In-Vehicle Vision Systems, Statistical Pattern Recognition, Image Acquisition, Real-Time Hardware and Systems Design Considerations

TEXT BOOK

1. Computer and Machine Vision: Theory, Algorithms, Practicalities,E.R.Davies,Fourth Edition,2012,Academic Press, Elsevier

REFERENCE BOOKS

1. Computer Vision: Algorithms and Applications, Richard Szeliski,Springer,2010
2. Machine Vision Algorithms and Applications, C Steger, M Ulrich Christian Wiedemann, Wiley-VCH, 2007, ISBN: 3527407340.
3. Hands-On Algorithms for Computer Vision, Amin Ahmadi Tazehkandi, Packt, 2018, ISBN:9781789130942

COURSE DESIGNERS

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1	Dr. D. Vijendra Babu	Professor	ECE	vijendrababu@avit.ac.in
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17ATEC18	ALTERNATIVE FUELS	Category	L	T	P	C
		EC(OE)	3	0	0	3

Preamble

Conventional fuels used in automotive are sourced from fossil fuels and in the current scenario, fossil fuels are depleting. Alternate fuels for use in internal combustion engines are increasing as a replacement of fossil fuels.

Prerequisite

Nil

Course Objectives

1	To provide the biochemistry of alternate fuels for use in automotive engines.
2	To detail on the different methods of generation of alternate fuels from various bio resources.
3	To describe the composition and properties of bio-diesel for use in automotive engines.
4	To elucidate the different options available for production of new alternate fuels.

Course Outcomes:

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

CO1.	Summarize on the biochemistry of alternate fuels that are used in automotive engine.	Understand
CO2.	Summarize on the various methods of production of alternate fuels for internal combustion engines.	Understand
CO3.	Appraise on the composition and properties of bio-diesel as an alternate fuel.	Apply
CO4.	Appraise on the various options for production of new alternate fuels.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	S	M	M	M	M	--	-	-	-	--	-	--	S	--	--
CO 2	S	M	M	M	M	--	-	--	-	--	-	-	S	--	--
CO 3	S	S	S	M	M	--	-	-	-	--	-	--	S	--	--
CO 4	S	S	S	M	M	--	-	--	-	--	-	-	S	--	--
CO 5	S	S	S	M	M	--	-	-	-	--	-	-	S	--	--

S- Strong; M-Medium; L-Low

Syllabus

INTRODUCTION
Chemistry, Biochemistry, and Microbiology of Lignocellulosic Biomass, Biomass as an Energy Source: Traditional and Modern Views, Structural and Industrial Chemistry of Lignocellulosic Biomass, Lignocellulose as a chemical resource, Physical and chemical pretreatment of lignocellulosic biomass, Biological pretreatments, Acid hydrolysis to saccharify pretreated lignocellulosic biomass,
BIOCHEMISTRY
Cellulases: Biochemistry, Molecular Biology, and Biotechnology, Enzymology of cellulose degradation by cellulases, Cellulases in lignocellulosic feedstock processing, Molecular biology and biotechnology of cellulase production, Hemicellulases: New Horizons in Energy Biotechnology, A multiplicity of hemicellulases, Hemicellulases in the processing of lignocellulosic biomass, Lignin-Degrading Enzymes as Aids in Saccharification, Commercial Choices of Lignocellulosic Feedstocks for Bioethanol Production, Biotechnology and Platform Technologies for Lignocellulosic Ethanols
BIOCHEMICAL ENGINEERING
Biochemical Engineering and Bioprocess Management for Fuel Ethanol, Biomass Substrate Provision and Pretreatment, Wheat straw — new approaches to complete saccharification, Switchgrass, Corn stover, Softwoods, Sugarcane bagasse, Other large-scale agricultural and forestry, biomass feedstocks, Fermentation Media and the "Very High Gravity" Concept, Fermentation media for bioethanol production, Highly concentrated media developed for alcohol fermentations,
COMPOSITION OF BIO DIESEL
Vegetable oils and chemically processed biofuels, Biodiesel composition and production processes, Biodiesel economics, Energetics of biodiesel production and effects on greenhouse gas emissions, Issues of ecotoxicity and sustainability with expanding biodiesel production, Fischer-Tropsch Diesel: Chemical Biomass–to–Liquid Fuel Transformations
DEVELOPMENT OF ALTERNATE FUELS
Radical Options for the Development of Biofuels, Biodiesel from Microalgae and Microbes, Biohydrogen, The hydrogen economy and fuel cell technologies, Bioproduction of gases, Production of H_2 by photosynthetic organisms, Emergence of the hydrogen economy, Microbial Fuel Cells: Eliminating the Middlemen of Energy Carriers Biofuels as Products of Integrated Bioprocesses

TEXT BOOK:
1. David M. Mousdale, Biofuel-Biotechnology, Chemistry, and sustainable Development, 1st Ed., CRC Press Taylor & Francis Group, 2008 2. Joseph M Norbeck, Hydrogen fuel for surface transportation, Society of Automotive Engineers, 1996.
REFERENCES:
1. Ayhan Demirbas, Green Energy and Technology, Biofuels, Securing the Planet's Future Energy Needs, 1st edition, Springer, 2009. 2. James D. Halderman, James Linder. Automotive Fuel and Emission Control system, Prentice Hall, 2005.

Course Designers

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17ATEC02	NEW GENERATION AND HYBRID VEHICLES	Category	L	T	P	C
		EC (OE)	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	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	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.

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17AREC03	UNMANNED AIRCRAFT SYSTEMS	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

Preamble

This course is designed to develop hands on skills in operation of unmanned aerial vehicles which is the latest demand of present situation.

Prerequisite

NIL

Course Objectives

1	To provide information on Unmanned Aerial Vehicles (UAV) and its types.
2	To create interest in developing and operating UAV.
3	To model and add additional features in unmanned vehicles.

Course Outcomes

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

CO1.	Define and label parts of unmanned aerial vehicles.	Remember
CO2.	Explain principle and operation of aerial vehicles.	Understand
CO3.	Demonstrate analytical skills to develop a new system.	Apply
CO4.	Categorise the systemfor highest reliability and performance.	Analyze
CO5.	Recommend modification in the system.	Evaluate
CO6.	Build a new vehicle with additional features.	Create

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

Syllabus

INTRODUCTION TO UNMANNED AIRCRAFT SYSTEMS	**9**
History of unmanned aerial vehicles- types- Introduction to Unmanned aircraft systems-Unmanned aerial vehicles –Micro aerial vehicles definitions, history, classification- applications-recent research and development in civil and defense applications – autonomous vehicles -future research in autonomous vehicles – design standards and regulatory aspects introduction to design and selection of systems.	
ASPECTS OF UNMANNED AIRCRAFT SYSTEMS	**9**
Involvement of different aspects in the development of UAV-aerodynamic configurations -Aspects of airframe design- Stealth design, payload types, communication, navigations & guidance systems, control & stability, launch, recovery and support systems, reliability design.	
MODELING AND CONTROL HELICOPTER MODEL	**9**
Modeling and control of small and miniature unmanned helicopters –single rotor helicopter design – coaxial rotor helicopter design - autonomous control of a mini quad-rotor vehicle using LQG controllers –	

linearization and identification of helicopter model.	
UNMANNED AERIAL VEHICLE DESIGN MODELING & CONTROL	**9**
Development of autonomous quad tilt wing – advanced flight control systems for rotorcraft UAV and MAV – mathematical modeling and non- linear control of VTOL aerial vehicles.	
DEPLOYMENT OF UAS/UAV SYSTEMS	**9**
Only application point of view of various UAS roles played in civil, defense applications -vision based navigation company trails- certification of UAS/UAV/MAV systems.	

TEXT BOOK:

1. Barnhart, Hottman, Marshall, Shappee, *Introduction to Unmanned Aircraft Systems*, CRC Press, Taylor and Francis Group
2. KenzoNonami, Farid Kendoul, Satoshi Suzuki, Wei Wang, Daisuke Nakazawa, Modeling and Control of Unmanned Small Scale Rotorcraft UAVs & MAVs, Springer, New York, 2010
3. Laurence R. Newcome, Unmanned Aviation: A Brief History of Unmanned Aerial Vehicles, American Institute of Aeronautics and Astronautics, New York, 2004

REFERENCES:

1. Reg Austin, *Unmanned Aircraft Systems*, Wiley and Sons Ltd, 2010.
2. Elizabeth Bone, Christopher Bolkcom, *Unmanned Aerial Vehicles*, Novinka Books, United Kingdom 2004
3. Rogelio Lozano, *Unmanned Aerial Vehicles Embedded Control*, John Wiley & Sons, 2010
4. Pedro Castillo, Rogelio Lozano, Alejandro E. Dzul, *Modelling and Control of Mini-Flying Machines, Advances in Industrial Control (Aic)*, Springer-Verlag, London,2005

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17MECC16	INDUSTRIAL AUTOMATION	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

Preamble

Tointroducetheneed,evolution, and motivationforIndustrialAutomation. Familiarization withbasic conceptsand differentautomation strategiesbeingused in practiceworldwide.

PrerequisiteNIL

CourseObjective

1	To explainthefactory automationandintegration
2	ToIllustrateabouthydraulics and pneumaticscircuits
3	To Designthevarious design ofpneumaticandelectro-pneumaticcircuits
4	TodesignaboutPLCanditsapplications
5	To illustrate theautomation intransfermachines&assembly.

CourseOutcomes:Onthesuccessfulcompletion of thecourse, studentswillbeableto

CO1.	Explain the factoryautomation, production system and integration technologies in manufacturing sector	Understand
CO2.	Explain the various Hydraulics and Pneumatics Elements used for the industrial applications	Understand
CO3.	Developthepneumaticand electro-pneumaticcircuits for the given applications using standard procedures.	Apply
CO4.	Develop PLCfor modern manufacturing applications using standard procedures	Apply
CO5.	Construct the automatictransfermachines&assembly automation	Apply

MappingwithProgramme OutcomesandProgrammeSpecific Outcomes

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

S-Strong;M-Medium;L-Low

SYLLABUS

INTRODUCTION TOFACTORYAUTOMATION ANDINTEGRATION

Basicconceptsandscopeofindustrialautomation,socio-economicconsiderations, moderndevelopments inautomationinmanufacturing anditseffecton globalcompetitiveness.-Needand implicationsof 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-Sequenceoperationofhydraulicand pneumaticactuators-Applicationsinmanufacturing-Hydraulic &pneumaticvalvesforpressure,flow&directioncontrol,servovalvesandsimpleservosystemswith mechanical feedback, solenoid-Differentsensors forhydraulic, pneumatic&electro-pneumatic systems.

DESIGNOF PNEUMATIC AND ELECTRO-PNEUMATIC LOGIC CIRCUITS

Logiccircuitstobedesignedforagiventimedisplacementdiagramorsequenceofoperation-Pneumatic safetyand controlcircuits and theirapplications toclamping, traversingandreleasingoperations.

PROGRAMMABLELOGIC CONTROLLERS (PLC)

PLC for design demonstration, programming and interface the hardware with software for modern manufacturingapplications.

AUTOMATIC TRANSFERMACHINES &ASSEMBLYAUTOMATION

Classifications,analysisofautomatedtransferlines,withoutandwithbufferstorage,grouptechnology andflexiblemanufacturing system-Typesofassembly systems,assembly linebalancing,performanceand economicsofassemblysystem.

TextBooks

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.

ReferenceBooks

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.

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17MESE03	HYDROGEN AND FUEL CELL TECHNOLOGY	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

PREAMBLE

To enlighten on various technological advancements, benefits and prospects of utilizing hydrogen/fuel cell for meeting the future energy requirements.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To 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	-	-	-	-	-	-	-	-	L		
CO3	M	S	M	M	L	-	-	-	-	-	-	-	L		
CO4	S	M	S	M	M	M	S	-	-	-	M	-	L		

S- Strong; M-Medium; L-Low

SYLLABUS

HYDROGEN – BASICS AND PRODUCTION TECHNIQUES: Hydrogen – physical and chemical

properties, salient characteristics. Production of hydrogen – steam reforming – water electrolysis – gasification and woody biomass conversion – biological hydrogen production – photo dissociation – direct thermal or catalytic splitting of water.

HYDROGEN STORAGE AND APPLICATIONS: Hydrogen storage options – compressed gas – liquid hydrogen – Hydride – chemical Storage – comparisons. Safety and management of hydrogen. Applications of Hydrogen.

FUEL CELLS: History – principle - working - thermodynamics and kinetics of fuel cell process – performance evaluation of fuel cell – comparison on battery Vs fuel cell.

FUEL CELL – TYPES: Types of fuel cells – AFC, PAFC, SOFC, MCFC, DMFC, PEMFC – relative merits and demerits.

APPLICATION OF FUEL CELL AND ECONOMICS: Fuel cell usage for domestic power systems, large scale power generation, Automobile, Space. Economic and environmental analysis on usage of Hydrogen and Fuel cell. Future trends in fuel cells**.**

TEXT BOOKS:

1. Viswanathan, B and M Aulice Scibioh, Fuel Cells – Principles and Applications, Universities Press (2006)
2. Rebecca L. and Busby, Hydrogen and Fuel Cells: A Comprehensive Guide, Penn Well Corporation, Oklahoma (2005).
3. Bent Sorensen, 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).

1.

COURSE DESIGNERS

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17MESE05	WASTE ENERGY CONVERSION TECHNOLONGY	Category	L	T	P	Credit
		EC(OE)	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 from waste.

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 the types 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	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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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17MESE06	BIO ENERGY TECHNOLOGY	Category	L	T	P	Credit
		EC(OE)	3	0	0	3

Preamble
To disseminate the technologies for utilizing bio-energy and its manifold benefits compared to conventional fossil fuels.

Prerequisite - NIL

Course Objective

1	To provide the students knowledge of the sources of biomass.
2	To make understand the students on different processes of biomethanation.
3	To study the application of combustion of bio fuels,
4	To study the application of gasification methods of biomass.
5	To provide the students application knowledge of liquefied biofuels.

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

CO1.	To gain the knowledge of the basic concepts of Biomass preparation and also fuel assessments.	Understand
CO2.	To obtain the methods of biogas production and biogas plants.	Understand
CO3.	To apply the concepts of combustion processes and fuel handling systems.	Apply
CO4.	To apply the techniques for preparation of biogases and coals.	Apply
CO5.	To apply the techniques for preparation of biodiesels from vegetables.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO 1	PSO 2	PSO 3
CO1	S	M	L	M	L	L							M	L	L
CO2	S	M	S	M	M	M							S	M	L
CO3	S	M	M	L	M	L							M	M	L
CO4	S	M	S	M	S	S							S	M	L

CO5	S	M	S	M	S	S							M	L	L

S- Strong; M-Medium; L-Low

SYLLABUS :

INTRODUCTION

Biomass: types – advantages and drawbacks – Indian scenario – characteristics – carbon neutrality – conversion mechanisms – fuel assessment studies – densification technologies – Comparison with coal – Proximate & Ultimate Analysis - Thermo Gravimetric Analysis – Differential Thermal Analysis – Differential Scanning Calorimetry

BIOMETHANATION

Microbial systems – phases in biogas production – parameters affecting gas production – effect of additives on biogas yield – possible feed stocks. Biogas plants – types – design – constructional details and comparison – biogas appliances – burner, luminaries and power generation – effect on engine performance

COMBUSTION

Perfect, complete and incomplete combustion - stoichiometric air requirement for biofuels - equivalence ratio – fixed Bed and fluid Bed combustion – fuel and ash handling systems – steam cost comparison with conventional fuels

GASIFICATION,PYROLYSIS AND CORBONISATION

Chemistry of gasification - types – comparison – application – performance evaluation – economics – dual fuelling in IC engines – 100 % Gas Engines – engine characteristics on gas mode – gas cooling and cleaning systems - Pyrolysis - Classification - process governing parameters – Typical yield rates. Carbonization Techniques – merits of carbonized fuels

LIQUID BIOFUELS

History of usage of Straight Vegetable Oil (SVO) as fuel - Biodiesel production from oil seeds, waste oils and algae - Process and chemistry - Biodiesel health effects / emissions / performance. Production of alcoholic fuels (methanol and ethanol) from biomass – engine modifications

TEXT BOOKS

1. Tom B Reed, Biomass Gasification – Principles and Technology, Noyce Data Corporation, 1981
2. David Boyles, Bio Energy Technology Thermodynamics and costs, Ellis Hoknood Chichester, 1984.
3. Khandelwal KC, Mahdi SS, Biogas Technology – A Practical Handbook, Tata McGraw Hill, 1986

Reference Books

1. Mahaeswari, R.C. Bio Energy for Rural Energisation, Concepts Publication,1997
2. Best Practises Manual for Biomass Briquetting, I R E D A, 1997 .
3. Eriksson S. and M. Prior, The briquetting of Agricultural wastes for fuel, FAO Energy and Environment paper, 1990
4. Iyer PVR et al, Thermochemical Characterization of Biomass, M N E S

Course Designers				
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1	R.VENKATESH	Assistant Professor	Mech / VMKVEC	rvenkatesh@vmkvec.edu.in
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CATEGORY ‘D’

PROJECT
(9 CREDITS)

&

INTERNSHIP + INDUSTRY ELECTIVES COURSES
(9 CREDITS)

TOTAL – 18 CREDITS

SL. NO	CODE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1	17PEPI01	PROJECT	PCE	PI	0	0	18	9	NIL

CATEGORY ‘D’

INTERNSHIP
+
INDUSTRY ELECTIVES

9 CREDITS

S. No	CODE	COURSE	OFFERING DEPT.	CATE GORY	L	T	P	C	PREREQ UISITE
1	17PEPI02	MINI PROJECT	PCE	PI	0	0	6	3	NIL
2	17PEPI03	VACCINE TECHNOLOGY	PCE	PI	3	0	0	3	NIL
3	17PEPI04	PHARMACEUTICAL PACKAGING TECHNOLOGY	PCE	PI	3	0	0	3	NIL
4	17PEPI05	REGULATORY REQUIREMENTS IN PHARMA INDUSTRIES	PCE	PI	3	0	0	3	NIL
5	17BTPI06	WASTE MANAGEMENT	BTE	PI	3	0	0	3	NIL
6	17BTPI07	PROCESS ECONOMICS AND INDUSTRIAL MANAGEMENT	BTE	PI	3	0	0	3	NIL

17PEPI03	VACCINE TECHNOLOGY	Category	L	T	P	Credit
		PI	3	0	0	3

PREAMBLE

This course will enrich the students about the elimination of communicable diseases with the sufficient levels of persons in the community. The public health officials have mandated vaccination and monitoring of the safety of vaccines during clinical trials. Also, the various types of preparation of vaccine for the disease. It can be done by using the computational tools for the production of vaccine through various technologies.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To define and to provide scientific basics of the life processes at the molecular level
2	To explain the structure, function and inter-relationships of bio-molecules and their deviation
3	To perform the various research to design the vaccine for interpreting and solving clinical problems.
4	To differentiate the various tools for the design of vaccine.
5	To check the developed vaccine for quality control and animal testing for marketing.

COURSE OUTCOMES

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

CO1. Demonstrate the immunological concepts in vaccinology	Understand
CO2.Describe the preparation and types of vaccines.	Understand
CO3. Illustrate a design and demonstrate the action of vaccine through research	Apply
CO4. Examine the computational tools for the design of vaccine	Analyze
CO5. Test the vaccine, regulatory aspects of vaccine and to commercialisation	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	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	M	M	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	S	M	S		S	-	-	-	-	-	-	L	M	-	-
CO4	M	L	S	-	S	-	L	-	-	-	-	-	-	M	-
CO5	L	L	L	L	M	S	-	L	-	-	-	-	-	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

IMMUNOLOGICAL CONCEPTS IN VACCINOLOGY

Short history of vaccination, requirements for induction of immunity, Epitopes, linear and conformational epitopes, characterisation and location of APC, MHC and immunogenicity, Rationale vaccine design based on clinical requirements: Hypersensitivity, Immunity to Infection, Autoimmunity, Transplantation, Tumor immunology, immunodeficiency, mechanism of adjuvantaction, Scope of future vaccine strategies

CLASSIFICATION OF VACCINES AND ITS PREPARATIONS

Active and passive immunization; Viral/bacterial/parasite vaccine differences, methods of vaccinepreparation – Live, killed, attenuated, sub unit vaccines; Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein-based vaccines, plant-based vaccines, edible vaccines, reverse vaccinology, combination vaccines, therapeutic vaccines; Peptide vaccines, conjugate vaccines; Antibody genes and antibody engineering- chimeric and hybrid monoclonal antibodies; Catalytic antibodies and generation of immunoglobulin gene libraries, Transfusion of immuno-competent cells; Cell based vaccines

VACCINE RESEARCH AND DESIGN

Fundamental research to rational vaccine design, Antigen identification and delivery, T-Cell expression cloning for identification of vaccine targets for intracellular pathogens, Fundamentals of Immune recognition, implications for manipulating the T-Cell repertoire, Targeting Dendritic cells; a rational approach for Vaccine development , Cellular basis ofT- Cell memory, Rational design of new vectors, CpG adjuvant activity, Transcutaneous immunisation, Vaccination studies and recent advances in Malaria, Tuberculosis , HIV

COMPUTATIONAL TOOLS FOR VACCINE DESIGN

Antigen Sequence analysis, Epitope Mapping, Predictions of Immunogenic peptides of T-Cell andB-Cells. Prediction of HLA binding peptides, Comparative Genomics as a tool for vaccine design,introduction to online epitope databases

ANIMAL TESTING, COMMERCIALISATION, QUALITY CONTROL

Quality control and regulations in vaccine research, In-vitro experimental validations for predictions of vaccines by software, Animal testing, Rational design to clinical trials, Large scale production, Commercialisation, ethics.

TEXTBOOKS

1. Male, David et al., “Immunology”, VIIEdition, Mosby Publication, 2007.
2. Kindt, T.J. etal., “Immunology”, VIEdition, W.H. Freeman, 2007.
3. Janeway, C.A. etal., “Immunology: The Immune Systems in Health and Diseases”,VIEdition,

Garland Science, 2005.
4. Lydyard, P.M. “Instant Notes in Immunology”, Viva Books Pvt. Ltd., 2000.

REFERENCES

1. S. Hockfield, S. Carlson, C. Evans, P. Levitt, J. Pintar, L. Silberstein, Selected methodsforAntibody and Nucleic Acid probes, Volume1, Cold Spring Harbor Ed Harlow, DavidLane,
   Antibodies Laboratory Manual, Cold Spring Harbor, Laboratory Press, 1993.
2. Coico, R. etal., “Immunology: A Short Course”, Vth Edition, Wiley – Liss, 2003.
3. Parham, Peter “The Immune System”, II Edition, Garland Science, 2005.
4. Abbas, A.K. etal., “The Cellular and Molecular Immunology”, VI Edition, Sanders / Elsevier,2007.
5. Weir, D.M. and Stewart, John “Immunology”, VIIIth Edition, Churchill Pvt. Ltd., 2000.

COURSE DESIGNERS

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17PEP104	PHARMACEUTICAL PACKAGING TECHNOLOGY	Category	L	T	P	C
		PI	3	0	0	3

PREAMBLE

Pharmaceutical packaging course covers all important aspects of the packing process and their associated Good Manufacturing Practice (GMP) and pharmaceutical quality system (PQS) challenges. This includes selection of suitable components, pack design, pack security and design/control of packing processes.

PREREQUISITE NIL

COURSE OBJECTIVES

1	To list on different packaging materials and their selection, uses control and impact on product stability.
2	To explain the concept, Formulation, evaluation and packaging of various semisolid dosage forms
3	To perform the collection, processing and storage of biological products like blood and plasma substitutes.
4	To categories the regulatory aspects of tablet, vial and bottle packaging.
5	To check Packaging operations and their risks and control.

COURSE OUTCOMES

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

CO1. Compare the concepts of quality control and quality assurance during entire manufacturing practices.	Understand
CO2. Explain the pharmacopoeia testing, defects and stability of blister and strip packaging materials.	Understand
CO3. Demonstrate sterilization of packaging materials used in parenteral, ophthalmic and aerosols as per their legal requirement.	Apply
CO4. Develop new concepts in pharmaceutical packaging and their control.	Analyse
CO5.Estimate the different samplings methods.	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	L	-	-	L	-	-	-	-	-	-	-	M	-
CO2	S	M	S	-	-	M	-	-	-	-	-	-	-	M	-
CO3	M	L	-	M	-	S	-	-	-	-	-	-	-	M	-
CO4	L	L	S	L	S	L	-	-	S	-	-	M	M	M	M
CO5	S	-	L	L	-	M	-	-	-	-	-	S	S	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

PHARMACEUTICAL PACKAGING

Introduction of packaging - classification of packaging - packaging essential requirements functions of packaging - importance / significance of pharma packaging - main packaging materials - ideal package material properties.

PRIMARY PACKAGING MATERIAL

Glass containers- introduction - selection of glass as packaging materials for the pharmaceutical products - properties of glass - production of glass - types of glass - test for glass containers advantages and disadvantages of glass containers. Metals containers- aluminium - aluminium foil - collapsible tubes and stainless steel. Polymers -and plastics- introduction to plastics - raw materials of plastics - types of plastics - resin identification code - plastics and packaging and testing of plastic containers.

SOLID DOSAGE FORM PACKAGING

Blister package- introduction to blister package - types of blisters - advantages and disadvantages of blister packaging - types of problems/ defects. Strip package- strip Packaging Process – packaging materials - child-resistant and multi-dose strip packaging.

LIQUID FORMULATION AND STERILE PRODUCT PACKAGING

Liquid Formulation - Factors influencing selection of liquid filling machinery - balanced and unbalanced constant level filling – volumetric – gravimetric - level sensing - time fill - peristaltic and overflow liquid filling machinery. Sterile product packaging- various types of containers used for sterile products like ampoules – vials - bottles for I.V. fluid, etc. Types of closures used for the sterile products. Sterile product filling and sealing machinery i.e. ampoule filling and sealing machine.

QUALITY CONTROL AND REGULATIONS OF PACKAGING MATERIALS

Specifications–quality control tests–methods and evaluation of packaging of materials– stability of packaging materials–law and regulations governing packaging.

TEXT BOOKS:

1. D.A. Deak, E.R. Evans, I.H. Hall, “Pharmaceutical Packaging Technology”, Taylorand Francis,2000.
2. Edward J. Bauer, Pharmaceutical Packaging Handbook. CRC Press, 2009.
3. S. Natarajan, M. Govindarajan, B. Kumar, “Fundamental of Packing Technology”, PHI Learning Pvt ltd., New Delhi, 2009.

REFERENCES:

1. Anonymous,“Quality Assurance of Pharmaceuticals:A Compendium of Guidelines and Related Materials”,2nd Edition, World Health Organization,2004.
2. U.K. Jain, D.C. Goupale, S. Nayak, “Pharmaceutical Packaging Technology”, 2nd Ed.,Pharma Med Press, Hyderabad, 2008.
3. Remington: The Science and Practice of Pharmacy. 21st ed., 2005.
4. James Swarbrick, “Encyclopedia of Pharmaceutical Science and Technology”,4th ed., CRC Press, 2013.

COURSE DESIGNERS

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17PEPI05	REGULATORY REQUIREMENTS IN PHARMA INDUSTRIES	Category	L	T	P	Credit
		PI	3	0	0	3

PREAMBLE

This course enables the students to know about the requirements for the good manufacturing practices currently followed in pharmaceutical industry,requirements related to Factories Acts and Rules, which is a Central Act, regulation related to water and air pollution and the regulation for handling and storage of inflammable materials etc.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To develop the knowledge on various legal regulations and governing bodies involved in the trade and practice of pharmaceutical and biopharmaceutical industries.
2	To enrich beginners in the principles involved in the practice of GMP, biosafety and ethical guidelines.
3	To prepare the documents for applying the patents.
4	To guidelines for validation process in the industry.
5	To document the results for the audit.

COURSE OUTCOMES

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

CO1. Recognize the concepts of quality control in pharma industries.	Remember
CO2. Discuss the pharmaceutical industry manufacturing practices and regulatory aspects of pharmacy products	Understand
CO3. Demonstrate the process of patenting activities	Apply
CO4. Test the guidelines and analytical procedures for the methodology	Analyze
CO5. Validate the quality guidelines followed for pharmaceutical products and few of the aspects involved in document preparation for pharmaceutical product registration	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
CO2	M	M	L	-	-	-	-	-	M	-	-	-	-	-	-
CO3	M	M	-	M	L	-	L	-	-	-	-	M	M	-	-
CO4	M	M	-	-	S	-	L	-	-	-	-	-	-	M	-
CO5	M	M	L	L	S	S	-	L	L	-	-	-	-	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

REGULATORY CONCEPTS

Quality assurance – Quality control – Practice of cGMP – Schedule M – USFDA.

REGULATORY ASPECTS

Pharmaceuticals: Bulk drug manufacture; Personnel, Buildings and Facilities, Process Equipment, Documentation and Records, Materials Management, Production and In-Process Controls, Packaging and Identification Labelling of API's and Intermediates, Storage and distribution, – Biotechnology derived products; Principles, Personnel, Premises and equipments, Animal quarters and care, production, labelling, Lot processing records and distribution records, quality assurance and quality control.

INTELLECTUAL PROPERTY RIGHTS

Patent system – Different types of patents – Filing process of application for patent – Infringement of patents – The patent rules 2003 as amended by the patents (amendment) rules 2016.

ICH GUIDELINES

Quality guidelines – Impurities in new drug substances (Q3A(R2)) – Impurities in newdrug products(Q3B(R2)) – Validation of analytical procedures text and methodology (Q2 (R1)).

QUALITY AUDIT AND SELF INSPECTIONS

SOPs – Documentation – Loan license auditing – Common technical documentation (CTD) – Drug

TEXT BOOKS:

1. C.V.Subbrahmanyam & J.Thimmasetty, Pharmaceutical regulatory affairs, 1st Edn., Vallabh Prakashan, New Delhi, 2012.

2. Willig, H., Tuckeman, M.M. and Hitchings, W.S., "Good Manufacturing Practices forPharmaceuticals", 5th Edition, Marcel Dekker Drugs and the Pharmaceutical Sciences, byCRC Press, New York, 2000.

3. N Udupa, Krishnamurthy Bhat, A Concise Textbook of Drug Regulatory Affairs, ManipalUniversity Press (MUP); First Edition, 2015.

REFERENCES:

1. Ira R. Berry,The Pharmaceutical Regulatory Process, marcel dekker Series: Drugs and the Pharmaceutical Sciences, by CRC Press, Newyork, 2004.

2. Mindy J. Allport-Settle, Current Good Manufacturing Practices: Pharmaceutical, Biologics,and Medical Device Regulations and Guidance Documents Concise Reference,Pharmalogika Inc., USA, 2009.

3. Sharma, P.P., "How to Practice GMPs", 3rd Edition, Vandana Publications, 2006.

COURSE DESIGNERS

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2	Mrs.G.Arthi	Assistant Professor	Biotechnology	arthi@vmkvec.edu.in

17BTPI06	WASTE MANAGEMENT	Category	L	T	P	Credit
		PI	3	0	0	3

PREAMBLE

Waste management are the activities and actions required to manage waste from its inception to its final disposal. This includes the collection, transport, treatment and disposal of waste, together with monitoring and regulation of the waste management process

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To state the basic knowledge on waste management
2	To discuss about the principle and properties of waste
3	To demonstrate the minimization of waste in Industries
4	To outline the handling and transport of waste in Industries
5	To develop the modern techniques for waste dispose

COURSE OUTCOMES

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

CO1. Summarize the characterisation of waste in society	Understand
CO2. Discuss the benefits and life cycle of waste	Understand
CO3. Illustrate the waste minimizing technique in Industries	Apply
CO4. Inspect the transport of waste in developing countries	Analyse
CO5.Measure the resource efficiency of waste	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	-	L	-	-	-	-	S	M	-	-
CO2	-	L	L	-	-	L	M	L	-	-	-	M	M	-	-
CO3	M	L	M	M	M	L	M	-	-	-	-	S	S	M	M
CO4	-	L	L	L	M	L	L	-	-	L	-	L	M	M	M
CO5	L	L	L	L	-	-	M	L	-	L	-	M	S	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

GENERATION AND CHARACTERISTICS OF WASTE

Types and characteristics of wastes- Domestic, Industry, Commercial, Agriculture, and Health care centre and e-waste.

PRINCIPLES OF WASTE MANAGEMENT

Waste hierarchy, Life cycle of Products, Resource efficiency, Polluter Pays principles, Waste to energy, Benefits of waste management.

WASTE MINIMIZATION AND MONITORING

Waste minimization techniques in the developed and developing countries. Waste minimization techniques adopted in few industries-Sugar, Paper, Textile, Leather, Breweries and Pharmaceuticals.

WASTE HANDLING AND TRANSPORT

Methods of waste handling, transport and disposal in various sectors of waste generation- Sugar, Paper, Textile, Leather, Breweries, health care centre and Pharmaceuticals

RESOURCE RECOVERY

Methods of resource3 recovery-3Rs, Landfills, Biological reprocessing, Energy recovery. Modern techniques of disposal-Incineration, Pyrolysis

TEXT BOOK:

1. Jacqueline Vaughn, Waste Management: A reference Handbook, Science, 2009

REFERENCE BOOKS:

1. Nicky Scott, Reduce, Reuse, Recycle, McGraw-Hill, 2007.
2. George Techobanoglous, Handbook of solid waste management, McGraw-Hill, 2002.

COURSE DESIGNERS

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17BTPI07	PROCESS ECONOMICS AND INDUSTRIAL MANAGEMENT	Category	L	T	P	Credit
		PI	3	0	0	3

PREAMBLE

The objective of this course is to teach principles of cost estimation, feasibility analysis, management, organization and quality control that will enable the students to perform as efficient managers

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To state the basics of measurement techniques involved in organization management
2	To describe the cost and budget analysis for building a process
3	To outline the analysis of project based on profitability /loss
4	To develop the concept of accounting based on the performance and growth
5	To assess the importance of economic balance

COURSE OUTCOMES

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

CO1: Summarize the basic information about cost and asset of accounting	Understand
CO2: Describe the time value of money and project feasibility	Understand
CO3: Analyses the alternative investment methods	Analyze
CO4: Assess the importance of financial ratios and rate of return	Evaluate
CO5: Validate the sensitivity and risks involved in the process plant	Evaluate

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

S- Strong; M-Medium; L-Low

SYLLABUS

PRINCIPLES OF MANAGEMENT AND ORGANISATION

Planning, organization, staffing, coordination, directing, controlling, communicating, organization as a process and a structure; types of organizations. Method study; work measurement techniques; basic procedure; motion study; motion economy; principles of time study; elements of production control; forecasting; planning; routing; scheduling; dispatching; costs and costs control, inventory and inventory control.

INVESTMENT COSTS AND COST ESTIMATION

Time Value of money; capital costs and depreciation, estimation of capital cost, manufacturing costs and working capital, capital budgeting and project feasibility.

PROFITABILITY, INVESTMENT ALTERNATIVE AND REPLACEMENT

Estimation of project profitability, sensitivity analysis; investment alternatives; replacement policy; forecasting sales; inflation and its impact.

ANNUAL REPORTS AND ANALYSIS OF PERFORMANCE

Principles of accounting; balance sheet; income statement; financial ratios; analysis of performance and growth

ECONOMIC BALANCE

Economic decisions in Chemical Plant - Economics of size - Essentials of economic balance – Economic balance approach, economic balance for insulation, evaporation, heat transfer

TEXT BOOK:

1. Allen, L.A., “Management and Organization”, McGraw Hill.

REFERENCE BOOKS:

2. Peters, M. S. and Timmerhaus, C. D. RE West, “Plant Design and Economics for Chemical Engineers”, III Edn, McGraw Hill, 2003.
3. Holand, F.A., Watson, F.A. and Wilkinson, J.K., "Introduction to process Economics", 2nd Edn, John Wiley, 1983.
4. Narang, G.B.S. and Kumar, V., “Production and Costing”, Khanna Publishers, New Delhi.
5. Banga T.R., and Sharma S.C., Industrial organisation and engineering economics, Khanna Publishers, New Delhi.

COURSE DESIGNERS

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CATEGORY ‘E’

EMPLOYABILITY ENHANCEMENT COURSES,

CO - CURRICULAR COURSES &

EXTRA CURRICULAR COURSES

CREDITS (9 - 18)

(i) EMPLOYABILITY ENHANCEMENT COURSES (EEC)

CREDITS (3 - 6)

17APEE01	PERSONALITY SKILLS DEVELOPMENT - I	Category	L	T	P	Credit
		EE	2 Weeks of Training			1

PREAMBLE

To enhance holistic development of students and improve their employability skills

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To improve aptitude, problem solving skills and reasoning ability
2	To collectively solve problems in teams & group
3	To know the concept of Quantitative analysis
4	To have a good knowledge in reasoning
5	To identify and solving the Mathematical Puzzles

COURSE OUTCOMES

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

CO1. Identify, formulate and solve aptitude problems	Apply
CO2. Apply the knowledge of Mathematics, Science and Engineering in mathematical problems	Apply
CO3. Use the Techniques & skills.	Apply
CO4. Engage in Life-Long Learning.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

NUMBERS-I

Types and Properties of Numbers, LCM, GCD, Surds and indices

ARITHMETIC – I

Percentages, Profit & Loss, Area and volume

QUANTITATIVE ANALYSIS-I.
Time and works, Pipes and cistern, Calendar and Clocks

REASONING-I
Mathematical operations, Coding and decoding , Blood relationship

PUZZLES-I
Classification type, Seating arrangements and Comparison types

TEXTBOOKS:
Agarwal.R.S – Quantitative Aptitude for Competitive Examinations, S.Chand Limited 2011

REFERENCES:

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Tata McGraw Hill, 3rd Edition, 2011
2. Edgar Thrope, Test Of Reasoning for Competitive Examinations, Tata McGraw Hill, 4th Edition, 2012

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

17APEE02	PERSONALITY SKILLS DEVELOPMENT - II	Category	L	T	P	Credit
		EE	2 WEEKS TRAINING			1

PREAMBLE: SM & S

Personality Skill Development provides a professional approach and makes the students ready for the industry as well as to make them to understand the entrepreneurial approach through various actions. It also breaks down the barriers between the institute and industry by anticipating the technology update.

PREREQUISITE: Not Required

COURSE OBJECTIVES:

1. To learn and practice the Soft skills.
2. To assess the importance of social skills.
3. To practice SWOT analysis for individual and group.
4. To build and enhance the self confidence
5. To apply and observe various personality skills for personality development.

COURSE OUTCOMES:

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

CO1: Understand the importance of Personality related to the working environment.	Understand
CO2: Inculcate relevant interpersonal skills for survival.	Apply
CO3: Analyse various skills of SWOT analysis.	Analyse
CO4: Applying assortment of soft skills for self assessment for both organisationally and socially.	Evaluate

CO5: Build self esteem and relevant personality skills according to goal.	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		L			L	M	L	L		M	S
CO2		M	M	L			L	M	M			L			
CO3						M		M		L	L	M	M	S	M
CO4		M						L	M	L	L	M			
CO5				L		M	S	M		S	M	S		M	S

S- Strong; M-Medium; L-Low

SYLLABUS:

- Importance of Personality and Skill Development.
- Interpersonal Vs Intrapersonal skill.
- Communication and barriers in Communication.
- SWOT analysis for identifying individual, group and organisation.
- Skills required to Win and influence people
- Seven essential habits of Effective people followed.
- Goal setting – Individual skill to act in a group dynamics.
- Team Building
- Group Discussion
- Role Play
- Time management
- Corporate Etiquettes.
- Personality Grooming
- Body Language
- Career Guidance.

- ❖ Resume preparation
- ❖ Interview Skill
- ❖ Self Assessment

TEXT BOOK:

1. Sharma. P.C., Communication Skills and Personality Development, Nirali Prakashan Pub. Pune

REFERENCE BOOK:

1. Narula S. S, Personality Development and Communication Skills, Taxmann Publications Pvt Ltd

COURSE DESIGNERS:

S.No	Name of the Faculty	Designation	Department	mail id
1.	A. Mani	Associate Professor	Management Studies	mani@vmkvec.edu.in
2	Dr.P.Saradha	Associate Professor	English	saradhap@vmkvec.edu.in
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