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

(Constituent Colleges of Vinayaka Mission's Research Foundation, Deemed to be University, Salem, Tamil Nadu, India)

(AICTE APPROVED AND NAAC ACCREDITED)

Faculty of Engineering and Technology

REGULATIONS 2017

DEPARTMENT OF BIOTECHNOLOGY

Programme:

B.Tech.BIOTECHNOLOGY

Full Time (4 Years)

STRUCTURED CHOICE BASED CREDIT SYSTEM (SCBCS)

CURRICULUM AND SYLLABUS

(Semester I to VIII)

PROGRAM OUTCOMES (POs) OR GRADUATE ATTRIBUTES

Engineering Graduates will be able to:

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

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

3. **Design/Development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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

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

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

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

(B) PROGRAM SPECIFIC OUTCOMES (PSOs)

Upon successful completion of the course the students are expected to:

PSO1: To identify, formulate, design, analyse and develop processes and technologies for biotechnological products for societal usage and economically sustainable for the present and future
PSO2: To expertise in implementation of modern biotechnological tools to address human health, complex engineering problems and to improve the research approach in interdisciplinary facet.
PSO3: To recognise the knowledge, need for and the importance of bioethics, environmental and social responsibilities for life long learning in the broadest context in technological changes.

(C) PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: To provide the biotechnology graduates to have expertise in biotechnological aspects which will enable them to have a career and professional achievements in public and private sector
PEO2: Address the nuances of biotechnology in real life on application of microorganisms in industrial production of enzymes and products, downstream processing, genetic engineering, tissue culture and applications.
PEO3: Identify, design and develop biotechnological process and technologies to meet the industrial challenges and produce tools which a sound and economically viable and sustainable.

Credit Structure of Course Category

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

**** - Mandatory, Credits would be mentioned in Mark sheets but not included for CGPA Calculations. Overall CGPA Calculations will be out of minimum 171 credits earned in categories A to D.**

CURRICULUM

B.TECH.–

BIOTECHNOLOGY

- SEMESTER

I TO VIII

<table>
<tr><th colspan="10">B.TECH. – BIOTECHNOLOGY - SEMESTER I TO VIII</th></tr>
<tr><th colspan="10">CATEGORY A – FOUNDATION COURSES - HSS, BS AND ES COURSES - CREDITS (54-63)</th></tr>
<tr><th colspan="10">(i) HUMANITIES AND SCIENCES (ENGLISH AND MANAGEMENT SUBJECTS) - CREDITS (12 - 21)</th></tr>
<tr><th>SL. NO</th><th>CODE</th><th>COURSE</th><th>OFFERING DEPT.</th><th>CATEGORY</th><th>L</th><th>T</th><th>P</th><th>C</th><th>PREREQUISITE</th></tr>
<tr><td>1.</td><td>17EGHS01</td><td>TECHNICAL ENGLISH</td><td>ENGLISH</td><td>FC (HS)</td><td>3</td><td>0</td><td>0</td><td>3</td><td>NIL</td></tr>
<tr><td>2.</td><td>17EGHS02</td><td>BUSINESS ENGLISH</td><td>ENGLISH</td><td>FC (HS)</td><td>3</td><td>0</td><td>0</td><td>3</td><td>NIL</td></tr>
<tr><td>3.</td><td>17MBHS04</td><td>TOTAL QUALITY MANAGEMENT</td><td>MANAGEMENT</td><td>FC (HS)</td><td>3</td><td>0</td><td>0</td><td>3</td><td>NIL</td></tr>
<tr><td>4.</td><td>17EGHS81</td><td>ENGLISH LANGUAGE LAB</td><td>ENGLISH</td><td>FC (HS)</td><td>0</td><td>0</td><td>4</td><td>2</td><td>NIL</td></tr>
<tr><td>5.</td><td>17YMHS82</td><td>YOGA & MEDITATION</td><td>PHYSICAL EDUCATION</td><td>FC (HS)</td><td>0</td><td>0</td><td>4</td><td>2</td><td>NIL</td></tr>
<tr><td>6.</td><td>17EGHS82</td><td>PROFESSIONAL COMMUNICATION AND PERSONALITY DEVELOPMENT</td><td>ENGLISH</td><td>FC (HS)</td><td>0</td><td>0</td><td>2</td><td>1</td><td>NIL</td></tr>
<tr><th colspan="10">(ii) BASIC SCIENCES (MATHS, PHYSICS AND CHEMISTRY SUBJECTS) - CREDITS (24 - 33)</th></tr>
<tr><td>1.</td><td>17MABS03</td><td>MATHEMATICS FOR BIO-ENGINEERING</td><td>MATHS</td><td>FC (BS)</td><td>2</td><td>2</td><td>0</td><td>3</td><td>NIL</td></tr>
<tr><td>2.</td><td>17PCBS02</td><td>PHYSICAL SCIENCES</td><td>PHYSICS & CHEMISTRY</td><td>FC (BS)</td><td>4</td><td>0</td><td>0</td><td>4</td><td>NIL</td></tr>
<tr><td>3.</td><td>17MABS07</td><td>BIOSTATISTICS</td><td>MATHS</td><td>FC (BS)</td><td>2</td><td>2</td><td>0</td><td>3</td><td>MATHEMATICS FOR BIO-ENGINEERING</td></tr>
<tr><td>4.</td><td>17PHBS05</td><td>SMART MATERIALS</td><td>PHYSICS</td><td>FC (BS)</td><td>3</td><td>0</td><td>0</td><td>3</td><td>NIL</td></tr>
<tr><td>5.</td><td>17CHBS03</td><td>BIOORGANIC CHEMISTRY</td><td>CHEMISTRY</td><td>FC (BS)</td><td>3</td><td>0</td><td>0</td><td>3</td><td>NIL</td></tr>
<tr><td>6.</td><td>17CHBS01</td><td>ENVIRONMENTAL SCIENCE AND ENGINEEIRNG</td><td>CHEMISTRY</td><td>FC (BS)</td><td>3</td><td>0</td><td>0</td><td>3</td><td>NIL</td></tr>
<tr><td>7.</td><td>17PHBS02</td><td>NANOTECHNOLOGY</td><td>PHYSICS</td><td>FC (BS)</td><td>3</td><td>0</td><td>0</td><td>3</td><td>NIL</td></tr>
<tr><td>8.</td><td>17PCBS81</td><td>PHYSICAL SCIENCES LAB</td><td>PHYSICS & CHEMISTRY</td><td>FC (BS)</td><td>0</td><td>0</td><td>4</td><td>2</td><td>NIL</td></tr>
<tr><td>9.</td><td>17CHBS81</td><td>BIOORGANIC CHEMISTRY LAB</td><td>CHEMISTRY</td><td>FC (BS)</td><td>0</td><td>0</td><td>4</td><td>2</td><td>NIL</td></tr>
<tr><th colspan="10">(iii) ENGINEERING SCIENCES (BASIC ENGINEERING COURSES) - CREDITS (18 - 27)</th></tr>
<tr><td>1.</td><td>17BTES04</td><td>FUNDAMENTALS OF BIOTECHNOLOGY</td><td>BTE</td><td>FC (ES)</td><td>3</td><td>0</td><td>0</td><td>3</td><td>NIL</td></tr>
<tr><td>2.</td><td>17CSES01</td><td>ESSENTIALS OF COMPUTING</td><td>CSE</td><td>FC (ES)</td><td>3</td><td>0</td><td>0</td><td>3</td><td>NIL</td></tr>
<tr><td>3.</td><td>17CSES06</td><td>PROGRAMMING IN C</td><td>CSE</td><td>FC (ES)</td><td>3</td><td>0</td><td>0</td><td>3</td><td>NIL</td></tr>
<tr><td>4.</td><td>17BMES01</td><td>BIOSENSORS & MEASUREMENT DEVICES</td><td>BME</td><td>FC (ES)</td><td>3</td><td>0</td><td>0</td><td>3</td><td>NIL</td></tr>
<tr><td>5.</td><td>17BMES02</td><td>MEDICAL INSTRUMENTATION</td><td>BME</td><td>FC (ES)</td><td>3</td><td>0</td><td>0</td><td>3</td><td>NIL</td></tr>
<tr><td>6.</td><td>17CSES85</td><td>PROGRAMMING IN C LAB</td><td>CSE</td><td>FC (ES)</td><td>0</td><td>0</td><td>4</td><td>2</td><td>NIL</td></tr>
<tr><td>7.</td><td>17BMES81</td><td>BIOSENSORS & MEASUREMENT DEVICES LAB</td><td>BME</td><td>FC (ES)</td><td>0</td><td>0</td><td>4</td><td>2</td><td>NIL</td></tr>
<tr><td>8.</td><td>17BMES82</td><td>MEDICAL INSTRUMENTATION LAB</td><td>BME</td><td>FC (ES)</td><td>0</td><td>0</td><td>4</td><td>2</td><td>NIL</td></tr>
</table>

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.	17BTCC04	CLASSICAL AND MOLECULAR GENETICS	BTE	CC	3	0	0	3	NIL
5.	17BTCC05	UNIT OPERATIONS IN PROCESS INDUSTRIES	BTE	CC	3	0	0	3	NIL
6.	17BTCC06	ADVANCED BIOCHEMISTRY	BTE	CC	3	0	0	3	ESSENTIALS OF BIOCHEMISTRY
7.	17BTCC07	ENZYME ENGINEERING AND TECHNOLOGY	BTE	CC	3	0	0	3	NIL
8.	17BTCC08	BIOINSTRUMENTATION	BTE	CC	3	0	0	3	NIL
9.	17BTCC09	MOLECULAR BIOLOGY	BTE	CC	3	0	0	3	CLASSICAL AND MOLECULAR GENETICS
10.	17BTCC10	PRINCIPLES OF CHEMICAL ENGINEERING	BTE	CC	3	0	0	3	UNIT OPERATIONS IN PROCESS INDUSTRIES
11.	17BTCC11	PLANT AND ANIMAL BIOTECHNOLOGY	BTE	CC	3	0	0	3	NIL
12.	17BTCC12	GENETIC ENGINEERING	BTE	CC	3	0	0	3	MOLECULAR BIOLOGY
13.	17BTCC13	THERMODYNAMICS FOR BIOTECHNOLOGY	BTE	CC	4	0	0	4	PRINCIPLES OF CHEMICAL ENGINEERING
14.	17BTCC14	IMMUNOLOGY	BTE	CC	3	0	0	3	NIL
15.	17BTCC15	FOOD PROCESSING TECHNOLOGY	BTE	CC	3	0	0	3	NIL
16.	17BTCC16	BIOPROCESS ENGINEERING	BTE	CC	3	0	0	3	ENZYME ENGINEERING AND TECHNOLOGY
17.	17BTCC17	DOWNSTREAM PROCESSING IN BIOTECHNOLOGY	BTE	CC	4	0	0	4	BIOPROCESS ENGINEERING
18.	17BTCC18	MASS TRANSFER OPERATIONS	BTE	CC	3	0	1	4	THERMODYNAMICS FOR BIOTECHNOLOGY
19.	17BTCC81	BIOCHEMISTRY LAB	BTE	CC	0	0	4	2	NIL
20.	17BTCC82	CELL BIOLOGY LAB	BTE	CC	0	0	4	2	NIL
21.	17BTCC83	MICROBIOLOGY LAB	BTE	CC	0	0	4	2	NIL
22.	17BTCC84	ADVANCED BIOCHEMISTRY LAB	BTE	CC	0	0	4	2	NIL
23.	17BTCC85	MOLECULAR BIOLOGY LAB	BTE	CC	0	0	4	2	NIL
24.	17BTCC86	CHEMICAL ENGINEERING LAB	BTE	CC	0	0	4	2	NIL
25.	17BTCC87	BIOINSTRUMENTATION LAB	BTE	CC	0	0	4	2	NIL
26.	17BTCC88	GENETIC ENGINEERING LAB	BTE	CC	0	0	4	2	NIL
27.	17BTCC89	IMMUNOLOGY LAB	BTE	CC	0	0	4	2	NIL
28.	17BTCC90	FOOD PROCESSING TECHNOLOGY LAB	BTE	CC	0	0	4	2	NIL
29.	17BTCC91	BIOPROCESS ENGINEERING LAB	BTE	CC	0	0	4	2	NIL
30.	17BTCC92	DOWNSTREAM PROCESSING ENGINEERING LAB	BTE	CC	0	0	4	2	NIL

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.	17BTEC01	PLANT AND ANIMAL DISEASES AND THEIR CONTROL	BTE	EC (PS)	3	0	0	3	MICROBIOLOGY
2.	17BTEC02	OCEAN SCIENCE	BTE	EC (PS)	3	0	0	3	NIL
3.	17BTEC03	PRINCIPLES OF BIOINFORMATICS	BTE	EC (PS)	3	0	0	3	NIL
4.	17BTEC04	DIAGNOSTICS AND THERAPEUTICS	BTE	EC (PS)	3	0	0	3	MICROBIOLOGY
5.	17BTEC05	CYTOGENETICS	BTE	EC (PS)	3	0	0	3	NIL
6.	17BTEC06	STEM CELL BIOLOGY AND TISSUE ENGINEERING	BTE	EC (PS)	3	0	0	3	NIL
7.	17BTEC07	GENETICALLY MODIFIED ORGANISMS AND ETHICAL ISSUES	BTE	EC (PS)	3	0	0	3	NIL
8.	17BTEC08	MOLECULAR EVOLUTION	BTE	EC (PS)	3	0	0	3	MOLECULAR BIOLOGY
9.	17BTEC09	MICROBIAL BIOTECHNOLOGY	BTE	EC (PS)	3	0	0	3	MICROBIOLOGY
10.	17BTEC10	CRYOPRESERVATION THEORY AND APPLICATIONS	BTE	EC (PS)	3	0	0	3	NIL
11.	17BTEC11	PROTEIN ENGINEERING	BTE	EC (PS)	3	0	0	3	NIL
12.	17BTEC12	NEUROBIOLOGY AND COGNITIVE SCIENCES	BTE	EC (PS)	3	0	0	3	NIL
13.	17BTEC13	FOOD MICROBIOLOGY	BTE	EC (PS)	3	0	0	3	NIL
14.	17BTEC14	ENDOCRINOLOGY	BTE	EC (PS)	3	0	0	3	NIL
15.	17BTEC15	BIOREMEDIATION TECHNOLOGY	BTE	EC (PS)	3	0	0	3	NIL
16.	17BTEC16	CANCER BIOLOGY	BTE	EC (PS)	3	0	0	3	MOLECULAR BIOLOGY
17.	17BTEC17	APPLIED BIOTECHNOLOGY	BTE	EC (PS)	3	0	0	3	PLANT AND ANIMAL BIOTECHNOLOGY
18.	17BTEC18	METABOLIC ENGINEERING	BTE	EC (PS)	3	0	0	3	ADVANCED BIOCHEMISTRY
19.	17BTEC19	CLINICAL TRIALS	BTE	EC (PS)	3	0	0	3	NIL
20.	17BTEC20	AGRICULTURAL BIOTECHNOLOGY	BTE	EC (PS)	3	0	0	3	NIL
21.	17BTEC21	GENOMICS AND PROTEOMICS	BTE	EC (PS)	3	0	0	3	GENETIC ENGINEERING
22.	17BTEC22	MOLECULAR MODELLING AND DRUG DESIGNING	BTE	EC (PS)	3	0	0	3	PRINCIPLES OF BIOINFORMATICS
23.	17BTEC23	NANOBIOTECHNOLOGY	BTE	EC (PS)	3	0	0	3	NIL
24.	17BTEC24	BIOFERTILIZER TECHNOLOGY	BTE	EC (PS)	3	0	0	3	NOT FOR BTE STUDENTS
25.	17BTEC25	BIOLOGY FOR NON BIOLOGISTS	BTE	EC (PS)	3	0	0	3	NOT FOR BTE STUDENTS
26.	17BTEC26	ECO-FRIENDLY MULTI-STOREY BUILDING	BTE	EC (PS)	3	0	0	3	NOT FOR BTE STUDENTS
27.	17BTEC27	RENEWABLE ENERGY AND CONSTRUCTION METHODS	BTE	EC (PS)	3	0	0	3	NOT FOR BTE STUDENTS
28.	17BTEC28	ENVIRONMENT FRIENDLY PRACTICES IN CIVIL ENGINEERING	BTE	EC (PS)	3	0	0	3	NOT FOR BTE STUDENTS
29.	17BTEC29	GREEN BUILDING AND SUSTAINABLE ENVIRONMENT	BTE	EC (PS)	3	0	0	3	NOT FOR BTE STUDENTS

30.	17BTEC30	NATURAL RESOURCES MANAGEMENT	BTE	EC (PS)	3	0	0	3	NOT FOR BTE STUDENTS
31.	17BTEC31	APPLICATIONS OF ENZYME IN WASTE MANAGEMENT	BTE	EC (PS)	3	0	0	3	NOT FOR BTE STUDENTS
32.	17BTEC32	BIOLOGICAL DATABASE	BTE	EC (PS)	3	0	0	3	NOT FOR BTE STUDENTS

(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.	17CSPI07	LEARNING IT ESSENTIALS BY DOING	CSE	EC (OE)	3	0	0	3	NIL
9.	17CSPI10	MOBILE APPLICATION DEVELOPMENT	CSE	EC (OE)	3	0	0	3	NIL
10.	17BMCC03	BIOSENSORS AND TRANSDUCERS	BME	EC (OE)	3	0	0	3	NIL
11.	17BMCC05	PATHOLOGY AND MICROBIOLOGY	BME	EC (OE)	3	0	0	3	NIL
12.	17BMEC01	MEDICAL OPTICS	BME	EC (OE)	3	0	0	3	NIL
13.	17BMEC02	BIOTELEMETRY	BME	EC (OE)	3	0	0	3	NIL
14.	17BMEC04	MEMS AND ITS BIOMEDICAL APPLICATIONS	BME	EC (OE)	3	0	0	3	NIL
15.	17BMEC09	DESIGN OF MEDICAL DEVICES	BME	EC (OE)	3	0	0	3	NIL
16.	17BMEC13	PRINCIPLES OF TISSUE ENGINEERING	BME	EC (OE)	3	0	0	3	NIL
17.	17BMEC22	MEDICAL ETHICS AND STANDARDS	BME	EC (OE)	3	0	0	3	NIL
18.	17BMSE23	MEDICAL WASTE MANAGEMENT	BME	EC (OE)	3	0	0	3	NIL
19.	17BMSE24	MEDICAL TECHNOLOGY AND ENTREPRENEURSHIP	BME	EC (OE)	3	0	0	3	NIL
20.	17BMSE28	NANO TECHNOLOGY IN MEDICINE	BME	EC (OE)	3	0	0	3	NIL
21.	17CVEC35	MUNICIPAL SOLID AND WASTE MANAGEMENT	CIVIL	EC (OE)	3	0	0	3	NIL
22.	17CVEC14	AIR POLLUTION MANAGEMENT	CIVIL	EC (OE)	3	0	0	3	NIL
23.	17CVEC06	HYDROLOGY	CIVIL	EC (OE)	3	0	0	3	NIL
24.	17CVEC07	DISASTER MITIGATION AND MANAGEMENT	CIVIL	EC (OE)	3	0	0	3	NIL
25.	17CVEC08	REMOTE SENSING TECHNIQUES AND APPLICATIONS	CIVIL	EC (OE)	3	0	0	3	NIL
26.	17EEEC18	RENEWABLE ENERGY TECHNOLOGY	EEE	EC (OE)	3	0	0	3	NIL
27.	17EEEC20	MATHEMATICAL MODELLING AND SIMULATION	EEE	EC (OE)	3	0	0	3	NIL
28.	17EEEC21	NON-CONVENTIONAL ENERGY SOURCES	EEE	EC (OE)	3	0	0	3	NIL
29.	17ATEC08	TRACTOR AND FARM EQUIPMENTS	AUTO	EC (OE)	3	0	0	3	NIL
30.	17ATEC18	ALTERNATIVE FUELS	AUTO	EC (OE)	3	0	0	3	NIL
31.	17MECC16	INDUSTRIAL AUTOMATION	MECH	EC (OE)	3	0	0	3	NIL

32.	17ECEC06	MEMS AND SENSORS	ECE	EC (OE)	3	0	0	3	NIL
33.	17ECEC23	MACHINE VISION	ECE	EC (OE)	3	0	0	3	NIL
34.	17MESE03	HYDROGEN AND FUEL CELL TECHNOLOGY	MECH	EC (OE)	3	0	0	3	NIL
35.	17MESE05	WASTE ENERGY CONVERSION TECHNOLOGY	MECH	EC (OE)	3	0	0	3	NIL
36.	17MESE06	BIO ENERGY TECHNOLOGY	MECH	EC (OE)	3	0	0	3	NIL

CATEGORY D
PROJECT + INTERNSHIP + INDUSTRY ELECTIVES (P + I + I) CREDITS (18)

SL. NO	CODE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1	17BTPI01	PROJECT	BTE	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.	17BTPI02	MINI PROJECT	BTE	PI	0	0	6	3	NIL
2.	17BTPI03	INDUSTRIAL ENZYMOLOGY	BTE	PI	3	0	0	3	NIL
3.	17BTPI04	BIOPHARMACEUTICALS	BTE	PI	3	0	0	3	NIL
4.	17BTPI05	INDUSTRIAL BIOSAFETY	BTE	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
7.	17BTPI08	FERMENTATION AND BREWING TECHNOLOGY	BTE	PI	3	0	0	3	NIL

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.	17BTEE01	TECHNICAL SKILLS -I	BTE	EE	2 WEEKS OF TRAINING			1	NIL
4.	17BTEE02	TECHNICAL SKILLS –II	BTE	EE	2 WEEKS OF TRAINING			1	NIL
5.	17BTEE03	TECHNICAL SKILLS –III	BTE	EE	2 WEEKS OF TRAINING			1	NIL
6.	17BTEE04	TECHNICAL SKILLS–IV	BTE	EE	2 WEEKS OF TRAINING			1	NIL
7.	17BTEE05	TECHNICAL SKILLS -V	BTE	EE	2 WEEKS OF TRAINING			1	NIL
8.	17BTEE06	TECHNICAL SKILLS–VI	BTE	EE	4 WEEKS OF TRAINING			2	NIL
9.	17BTEE07	TECHNICAL SKILLS –VII	BTE	EE	4 WEEKS OF TRAINING			2	NIL

10.	17BTEE08	TECHNICAL SKILLS -VIII	BTE	EE	4 WEEKS OF TRAINING	2	NIL
(ii) CO - CURRICULAR COURSES (CCC)							
1.	17APEE03	NCC	NCC	EE	2 WEEKS OF TRAINING	1	NIL
2.	17APEE04	NSS	NSS	EE	2 WEEKS OF TRAINING	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.	17BTEE06	EXTRA CURRICULARCOURSE - I	BTE	EE	15 HOURS	1	NIL
2.	17BTEE07	EXTRA CURRICULARCOURSE - II	BTE	EE	15 HOURS	1	NIL
3.	17BTEE08	EXTRA CURRICULARCOURSE - III	BTE	EE	15 HOURS	1	NIL
4.	17BTEE09	EXTRA CURRICULARCOURSE - IV	BTE	EE	15 HOURS	1	NIL
5.	17BTEE10	EXTRA CURRICULARCOURSE - V	BTE	EE	15 HOURS	1	NIL
6.	17BTEE11	EXTRA CURRICULARCOURSE - V	BTE	EE	30 HOURS	2	NIL
7.	17BTEE12	EXTRA CURRICULARCOURSE - V	BTE	EE	45 HOURS	3	NIL

FOR DEGREE WITH

SPECIALISATION

CATEGORY C –

PROGRAMME SPECIFIC

ELECTIVE COURSES -

CREDITS (12 - 15)

SPECIALISATION - INDUSTRIAL BIOTECHNOLOGY

SL. NO	CODE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1.	17BTSE01	INDUSTRIAL BIOTECHNOLOGY	BTE	EC (SE)	3	0	0	3	NIL
2.	17BTSE02	CHEMICAL REACTION ENGINEERING	BTE	EC (SE)	3	0	0	3	NIL
3.	17BTSE03	FERMENTER DESIGN AND ANALYSIS	BTE	EC (SE)	3	0	0	3	NIL
4.	17BTSE04	BIOSEPARATION TECHNOLOGY	BTE	EC (SE)	3	0	0	3	NIL
5.	17BTSE05	INDUSTRIAL WASTE MANAGEMENT	BTE	EC (SE)	3	0	0	3	NIL
6.	17BTSE06	FUNDAMENTALS OF FLUID MECHANICS	BTE	EC (SE)	3	0	0	3	NIL
7.	17BTSE07	BIOPROCESS ECONOMICS AND REACTOR DESIGN	BTE	EC (SE)	3	0	0	3	NIL
8.	17BTSE08	BIOREACTOR THEORY	BTE	EC (SE)	3	0	0	3	NIL
9.	17BTSE09	INDUSTRIAL BIOTECHNOLOGY LAB	BTE	EC (SE)	0	0	4	2	NIL
10.	17BTSE10	FERMENTATION LAB	BTE	EC (SE)	0	0	4	2	NIL
11.	17BTSE11	FLUID MECHANICS FOR BIOTECHNOLOGY LAB	BTE	EC (SE)	0	0	4	2	NIL

SPECIALISATION - MEDICAL AND PHARMACEUTICAL BIOTECHNOLOGY

SL. NO	CODE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1.	17BTSE12	INDUSTRIAL MANAGEMENT AND PHARMACEUTICAL MARKETING	BTE	EC (SE)	3	0	0	3	NIL
2.	17BTSE13	PHARMACEUTICAL PHYTO CHEMISTRY	BTE	EC (SE)	3	0	0	3	NIL
3.	17BTSE14	MEDICAL PHARMACOLOGY AND DRUG DELIVERY	BTE	EC (SE)	3	0	0	3	NIL
4.	17BTSE15	PHARMACEUTICAL ASPECTS OF MICROBIOLOGY	BTE	EC (SE)	3	0	0	3	NIL
5.	17BTSE16	PHARMACEUTICAL PROCESS CHEMISTRY	BTE	EC (SE)	3	0	0	3	NIL
6.	17BTSE17	PHARMACOGENOMICS	BTE	EC (SE)	3	0	0	3	NIL
7.	17BTSE18	HERBS AND DRUG ACTION	BTE	EC (SE)	3	0	0	3	NIL
8.	17BTSE19	SKILL BASED ETHANO MEDICINE	BTE	EC (SE)	3	0	0	3	NIL
9.	17BTSE20	PHARMACEUTICAL CHEMISTRY LABORATORY	BTE	EC (SE)	0	0	4	2	NIL
10.	17BTSE21	PHYTO CHEMISTRY LAB	BTE	EC (SE)	0	0	4	2	NIL
11.	17BTSE22	PHARMACEUTICAL MICROBIOLOGY LAB	BTE	EC (SE)	0	0	4	2	NIL
12.	17BTSE23	ANALYTICAL METHODS OF PHARMACEUTICAL LABORATORY	BTE	EC (SE)	0	0	4	2	NIL

B.TECH. – BIOTECHNOLOGY- 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**
7.	17EGHS01	TECHNICAL ENGLISH	ENGLISH	FC(HSS)	3	0	0	3	NIL
8.	17EGHS02	BUSINESS ENGLISH	ENGLISH	FC(HSS)	3	0	0	3	NIL
9.	17MBHS04	TOTAL QUALITY MANAGEMENT	MANAGEMENT	FC(HSS)	3	0	0	3	NIL
10.	17EGHS81	ENGLISH LANGUAGE LAB	ENGLISH	FC(HSS)	0	0	4	2	NIL
11.	17YMHS82	YOGA & MEDITATION	PHYSICAL EDUCATION	FC(HSS)	0	0	4	2	NIL
12.	17EGHS82	PROFESSIONAL COMMUNICATION AND PERSONALITY DEVELOPMENT	ENGLISH	FC(HSS)	0	0	4	2	NIL
(ii) BASIC SCIENCES (MATHS, PHYSICS AND CHEMISTRY SUBJECTS) - CREDITS (24 - 33)									
31.	17MABS03	MATHEMATICS FOR BIOENGINEERING	MATHS	FC(BS)	2	2	0	3	NIL
32.	17PCBS02	PHYSICAL SCIENCES	PHYSICS & CHEMISTRY	FC(BS)	4	0	0	4	NIL
33.	17MAB07	BIOSTATISTICS	MATHS	FC(BS)	2	2	0	3	NIL
34.	17PHBS05	SMART MATERIALS	PHYSICS	FC(BS)	3	0	0	3	NIL
35.	17CHBS03	BIOORGANIC CHEMISTRY	CHEMISTRY	FC(BS)	3	0	0	3	NIL
36.	17CHBS01	ENVIRONMENTAL SCIENCE AND ENGINEEIRNG	CHEMISTRY	FC(BS)	3	0	0	3	NIL
37.	17PHBS02	NANOTECHNOLOGY	PHYSICS	FC(BS)	3	0	0	3	NIL
38.	17PCBS81	PHYSICAL SCIENCES LAB	PHYSICS & CHEMISTRY	FC(BS)	0	0	4	2	NIL
39.	17CHBS81	BIOORGANIC CHEMISTRY LAB	CHEMISTRY	FC(BS)	0	0	4	2	NIL
(iii) ENGINEERING SCIENCES (BASIC ENGINEERING COURSES) - CREDITS (18 - 27)									
9.	17BTES04	FUNDAMENTALS OF BIOTECHNOLOGY	BTE	FC(ES)	3	0	0	3	NIL
10.	17CSES01	ESSENTIALS OF COMPUTING	CSE	FC(ES)	2	0	2	3	NIL
11.	17CSES06	PROGRAMMING IN C	CSE	FC(ES)	3	0	0	3	NIL

12.	17BMES01	BIOSENSORS & MEASURMENT DEVICES	BME	FC(ES)	3	0	0	3	NIL
13.	17BMES02	MEDICAL INSTRUMENTATION	BME	FC(ES)	3	0	0	3	NIL
14.	17CSES85	PROGRAMMING IN C LAB	CSE	FC(ES)	0	0	4	2	NIL
15.	17BMES81	BIOSENSORS & MEASURMENT DEVICES LAB	BME	FC(ES)	0	0	4	2	NIL
16.	17BMES82	MEDICAL INSTRUMENTATION LAB	BME	FC(ES)	0	0	4	2	NIL

CATEGORY A –
FOUNDATION COURSES -
HSS, BS AND ES COURSES -
CREDITS (54-63)

(i) HUMANITIES AND SCIENCES (ENGLISH AND MANAGEMENT SUBJECTS) - CREDITS (12 - 21)

17EGHS01	TECHNICAL ENGLISH	Category	L	T	P	Credit
		HSS	3	0	0	3

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

PREREQUISITE : NIL

COURSE OBJECTIVES

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

COURSE OUTCOMES

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

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

SELF INTRODUCTION

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

ARTICLES

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

TENSE FORMS

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

IMPERSONAL PASSIVE VOICE
Impersonal Passive Voice - Conditional Sentences - Technical and Non technical Report Writing (Attend a technical seminar and submit a report) - News Letters and Editing - Skimming- Scanning - How to Improve Reading Speed - Designing Invitations and Poster Preparation.
SENTENCE PATTERN
Sentence Pattern (SVOCA) - Statement of Comparison - Transcoding (Flow Chart, Bar Chart and Pie Chart) - Informal letters - Resume Writing- Difference between Bio data, Resume and Curriculum Vitae.

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

REFERENCES

1. 1. English for Effective Communication, Department of English, VMKV & AVIT, SCM Publishers, 2009.
2. Practical English Usage- Michael Swan (III edition), Oxford University Press
3. Grammar Builder- I, II, III, and Cambridge University Press.

4 Pickett and Laster. Technical English: Writing, Reading and Speaking, New York: Harper and Row Publications, 2002.

COURSE DESIGNER:

S.No.	**Name of the Faculty**	**Mail ID**
1.	Dr.P.Saradha / Associate Professor - English	saradhap@vmkvec.edu.in
2	Mr.S.K.Prem Kishor/Assistant Professor-English	Prem.english@avit.ac.in

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

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

PREREQUISITE : NIL

COURSE OBJECTIVES

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

COURSE OUTCOMES

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

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO10	PO11	PO1 2	PSO1	PSO 2	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

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

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

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

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

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

TEXTBOOK

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

REFERENCES

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

COURSE DESIGNER:

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Dr.P.Saradha	Associate Professor	English	saradhap@vmkvec.edu.in
2	Mr.S.K.Prem Kishor	Assistant Professor	English	Prem.english@avit.ac.in

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

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

PREREQUISITE: Not Required

COURSE OBJECTIVES:

1. To understand the Total Quality Management concepts.
2. To practice the TQM principles.
3. To apply the statistical process control
4. To analyze the various TQM tools
5. To adopt the quality systems.

COURSE OUTCOMES:

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

CO1: Understand the importance of quality and TQM at managerial level.	Understand
CO2: Practice the relevant quality improvement tools to implement TQM.	Apply
CO3: Analyse various TQM parameters with help of statistical tools.	Analysing
CO4: Assess various TQM Techniques.	Evaluate
CO5: Practice the Quality Management Systems in a different organization Environment.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS:

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

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

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

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

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

TEXT BOOKS:

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

REFERENCES:

1. James R.Evans & William M.Lidsay - The Management and Control of Quality- (5th 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
1	A. Mani	Associate Professor	Management Studies	mani@vmkvec.edu.in
2	Dr. V. Sheela Mary	Associate Professor	Management Studies	sheelamary@avit.ac.in

17EGHS81	ENGLISH LANGUAGE LAB	Category	L	T	P	Credit
		HSS	**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**				**M**
CO2	**M**								**M**	**S**		**M**	**M**		**M**
CO3	**M**									**S**		**M**			**M**
CO4	**M**									**M**			**M**		**M**
CO5	**M**			**S**						**M**			**M**		**S**
CO6		**M**	**M**							**M**			**M**	**M**	**S**

S- Strong; M-Medium; L-Low

SYLLABUS

MODULE I: 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 DESIGNER

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Dr.P.Saradha	Associate Professor	English	saradhap@vmkvec.edu.in
2	Mr.S.K.Prem Kishor	Assistant Professor	English	Prem.english@avit.ac.in

17EGHS82	PROFESSIONAL COMMUNICATION AND PERSONALITY DEVELOPMENT	Category	L	T	P	Credit
		HSS	0	0	2	1

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	PSO 3
CO1	**M**	**M**	-	-	-	**M**	**M**	-	**M**	**S**	-	-	**S**	**M**	**S**
CO2	**M**	-	-	-	-	-	-	-	**S**	**M**	-	-	**S**	**M**	**S**
CO3	-	-	-	-	-	-	**M**	-	**S**	**S**	-	-	**M**	**S**	
CO4	**S**	-	-	-	-	-	-	-	-	-	-	**M**			
CO5	-	-	-	-	-	-	-	-	-	-	-	-			
CO6	**S**	-	-	-	-	-	-	-	**M**	**S**	-	**M**	**M**	**S**	**M**

S- Strong; M-Medium; L-Low

SYLLABUS

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

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

UNIT – III. 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.

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

UNIT V 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

TEXTBOOK

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

REFERENCES

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 DESIGNER

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Dr.P.Saradha	Associate Professor	English	saradhap@vmkvec.edu.in
2	Mr.S.K.Prem Kishor	Assistant Professor	English	Prem.english@avit.ac.in

(ii) BASIC SCIENCES (MATHS, PHYSICS AND CHEMISTRY SUBJECTS) - CREDITS (24 - 33)

17MABS03	MATHEMATICS FOR BIO-ENGINEERING	Category	L	T	P	Credit
		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

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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
		CC	2	0	0	2

PREAMBLE

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

PREREQUISITE : NIL

COURSE OBJECTIVES

1	To recall the properties of laser and to explain principles of laser
2	To assess the applications of laser
3	To detail the principles of fiber optics
4	To study the applications of fiber optics
5	To explain various techniques used in Non-destructive testing

COURSE OUTCOMES

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

CO1.	Understand the principles laser, fiber optics and non-destructive testing	Understand
CO2.	Understand the construction of laser, fiber optic and Non-Destructive testing equipments	Understand
CO3.	Demonstrate the working of laser, fiber optic and Non-Destructive testing based components and devices	Apply
CO4.	Interpret the potential applications of laser, fiber optics and Non-Destructive testing in various fields.	Apply
CO5.	Differentiate the working modes of various types of laser, fiber optic and Non-Destructive testing based devices.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT-I

LASERS: Laser characteristics - Stimulated Emission – Population Inversion - Einstein coefficients – Lasing action – Types of Laser – Nd:YAG laser, CO2 laser, GaAs laser – Applications of Laser – Holography – construction and reconstruction of a hologram

UNIT-II

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

UNIT-III

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

TEXT BOOK

1. Engineering Physics, compiled by Department of Physics, Vinayaka Mission's Research Foundation (Deemed to be University), Salem.
2. P.K. Palanisamy, Engineering Physics, Scientific Publishers, 2011.
3. Dr.M. N. Avadhanulu, Engineering Physics, S.Chand & Co, 2010.

REFERENCE BOOKS

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

COURSE DESIGNRS

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

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

PREAMBLE

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

PREREQUISITE : NIL

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

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 BOOK

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

REFERENCES:

A text book of Engineering Chemistry by S.S. Dara, S.Chand & company Ltd., New Delhi

Engineering Chemistry by Jain & Jain, 15th edition Dhanpatrai Publishing Company (P) Ltd., New Delhi

A text book of Engineering Chemistry by Shashi Chawla, Edition 2012 Dhanpatrai & Co., New Delhi

Engineering Chemistry by Dr. A. Ravikrishnan, Sri Krishna Publications, Chennai.

COURSE DESIGNRS

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

17MABS07	**BIOSTATISTICS** (Statistical table permitted for Examination)	Category	L	T	P	Credit
		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
CO 1	S	S	M	S	M	--	--	--	--	--	--	M	S	M	--
CO 2	S	S	M	S	M	--	--	--	--	--	--	M	S	M	--
CO 3	S	S	S	S	S	--	--	--	--	--	--	S	S	S	S
CO 4	S	S	S	S	S	--	--	--	--	--	--	S	S	S	S
CO 5	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

17PHBS05	SMART MATERIALS	Category	L	T	P	Credit
		Basic Sciences	3	0	0	3

PREAMBLE

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

PREREQUISITE : NIL

COURSE OBJECTIVES

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

COURSE OUTCOMES

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

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO 3
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, 2018.
2. Senthilkumar G. Engineering Physics II. VRB Publishers, 2018.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. S. MOHAMMED HARSHULKHAN	Asst.Prof	Physics	harshulkhan@vmkvec.edu.in
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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

17CHBS03	BIOORGANIC CHEMISTRY	Category	L	T	P	Credit
		PC	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 BOOK

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. (1^{st} 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 DESIGNER

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

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

PREAMBLE

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

PREREQUISITE : NIL

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

S- Strong; M-Medium; L-Low

SYLLABUS

ENVIRONMENT AND NATURAL RESOURCES

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

ECOSYSTEMS AND BIO – DIVERSITY

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

ENVIRONMENTAL POLLUTION

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

SOCIAL ISSUES AND ENVIRONMENT

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

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

TEXT BOOK

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

REFERENCE BOOKS

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 Gilbert M. Masters : Introduction to Environmental Engineering and Science, Pearson Education Pvt Ltd., II Edition, ISBN 81-297-0277-0, 2004

COURSE DESIGNER

S.No	Name of the Faculty	Designation	Name of the College	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

17PHBS02	NANOTECHNOLOGY	Category	L	T	P	Credit
		CC	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
2. 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

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

PREAMBLE

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

PREREQUISITE: NIL

COURSE OBJECTIVES

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

COURSE OUTCOMES

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

CO6. Recognize the importance of units while performing the experiments, calculating the physical parameters and obtaining results	Understand
CO7. Operate the equipments with precision	Apply
CO8. Practice to handle the equipments in a systematic manner	Apply
CO9. Demonstrate the experiments through virtual laboratory	Apply
CO10. Calculate the result with accuracy	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

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

LAB MANUAL

Physical Sciences Lab: Part A – Real And Virtual Lab In Physics Manual compiled by Department of Physics, Vinayaka Missions Research Foundation (Deemed to be University), Salem.

COURSE DESIGNERS

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

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

Preamble

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

Prerequisite

Not required

Course Objectives

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

Course Outcomes

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

CO1.	Estimate the chemical properties of water	Apply
CO2.	Determine the presence of various elements in the water	Analyze
CO3.	Calculate the strength of acids, oxidizing and reducing agents	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	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
CO11.	S	M	M	-	L	M	M	S	-	-	-	M	S	M	S
CO12.	S	M	M	-	L	M	M	L	-	-	-	M	S	M	S
CO13.	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

1. Laboratory Manual on Engineering Chemistry prepared byVinayaka Mission's Research Foundation, Salem.

REFERENCE BOOKS

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

Course Designers:

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

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

PREAMBLE

The purpose of teaching Bioorganic Chemistry is a fundamental science and has contributed immensely to the improvement of the life of human beings by providing many of human requirements and essentialities. The developments in Bioorganic Chemistry during last few decades are phenomenal. It is also seen that these developments are crossing the traditional vertical boundaries of scientific disciplines; the more inclination is seen towards biological sciences. The practice of Bioorganic Chemistry at industrial scale also is undergoing radical changes and is more or more based on deep understanding the phenomena.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To Recognize the basics of stoichiometry
2	To Express the knowledge about measurements and units
3	To Demonstrate the students in preparation of bioorganic solutions and their material balance equations
4	To Organise the Students should be able to develop their skills in the inter-conversions of one bioorganic compound to desired products.

COURSE OUTCOMES

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

CO1. Describe about the basic bioorganic chemistry	Understand & Apply
CO2. Illustrate the importance of measurements and units in bioorganic reaction procedures	Apply
CO3. Estimate the basics steps involved in the synthesis of various bioorganic substances	Analyze
CO4. Evaluate their understanding skills in the inter-conversions	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	-	-	-	-	-	-	M	S	L	L
CO2	M	L	-	M	L	-	-	-	-	-	-		S	L	L
CO3	M	M	-	M	L	M	L	M	-	-	-	M	S	L	L
CO4	M	L	-	-	-	L	-	-	-	-	-	L	S	L	L

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 3,5 dinitrobenzoate.

REFERENCES:

1. Laboratory Manual.

COURSE DESIGNERS

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

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

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

17BTES04	FUNDAMENTALS OF BIOTECHNOLOGY	Category	L	T	P	Credit
		FC (ES)	3	0	0	3

PREAMBLE

Biotechnology is the Combination of biological sciences and engineering in order to understand and improve the lifestyle of living organisms. Bioprocesses and pathways, living microorganisms, plant and animal cells and/or cellular materials are exploited to develop new expertise. Advanced tools and technologies developed by biotechnologists are used in research and development, healthcare, agriculture, and the industry to further enhance organisms and bioprocesses. Fundamental principles of genetic engineering, rDNA technology helps to produce commercial manufacture of new recombinant DNA
derived products.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To acquire knowledge on principles of biotechnology.
2	To study in detail about mechanism and applications of genetic engineering in the food and agricultural industry.
3	To understand importance of biotechnology to develop genetically modified animals its applications.
4	To analyze in details about performance of drugs developed using rDNA technology.
5	To apply the knowledge of biotechnology to enhance the environment.

COURSE OUTCOMES

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

CO1. Knowledge about fundamental principles about biotechnology.	Understand
CO2. Acquired good knowledge on genetically modified products in food and agricultural field.	Understand
CO3. Understand in detail about the applications of genetically modified animals in research and development	Understand
CO4. Apply the knowledge of biotechnology to improve global environment.	Apply
CO5. Analyzing in detail about the performance of drugs produced by novel methods	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO 2	PO 3	PO 4	PO 5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO12	PSO 1	PSO 2	PSO3
CO1	(M)	L	M	L	M	M	M	S	L	M	S	S	S	M	M
CO2	S	M	M	L	M	M	S	M	S	M	M	S	S	M	M
CO3	S	S	M	S	M	M	M	L	S	M	M	S	S	M	M
CO4	S	S	S	M	S	M	M	M	S	M	M	M	S	S	M
CO5	S	M	M	S	M	M	M	M	M	M	M	M	M	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

FOOD BIOTECHNOLOGY

Scope and importance of Food Biotechnology, Arctic Apples, Golden Rice, Flavr – Savr Tomato, Bt- potatoes, Virus resistant Squash, Fermented Food, Single Cell Protein – Spirulina.

AGRICULTURAL BIOTECHNOLOGY

Basics of plant tissue culture – callus induction, organogenesis, embryogenesis – embryo rescue, somatic embryogenesis, somaclonal variation, artificial seeds, secondary metabolites and their uses, Protoplast technology – hybrids and Cybrids, Biofertilizer, Biological Pest Control.

ANIMAL BIOTECHNOLOGY

Transgenic animals – Knock out mice, chimeric mice, Baculoviruses and transgenic silkworm, Hybridoma Technique for Monoclonal antibodies, Pharmaceuticals from animal systems, Animal bioreactors to produce therapeutic proteins, Karyotyping, FISH – Fluorescent in situ hybridization.

MEDICINAL BIOTECHNOLOGY

Industrial Enzyme production: α-amylase, cellulase, protease and lipase, Recombinant protein production: Insulin and interferon, Antibiotic production: Penicillin- Synthetic and Semisynthetic and Bacitracin (Novartis and Genetech), Gene Therapy, Clinical Diagnosis using electronic devices (PCR, ELISA, Glucometer, RIA, Biosensor).

ENVIRONMENTAL BIOTECHNOLOGY

Molecular approaches towards bioremediation, Biosensors for detection of environmental pollutants, Ecofriendly & sustainable Environmental Technologies, Renewable energy technologies.

TEXT BOOKS

1. Gupta, P.K., “Elements of Biotechnology”, Rastogi Publications, 2nd Edition, 2010.
2. Satyanarayana.U., “Biotechnology”, Books and Allied Pvt Ltd., 2005.

REFERENCE BOOKS

1. John E. Smith., “Biotechnology”, Cambridge Press. 3rd Edition, 2005.
2. Glazer A and Nikaido H., “Microbial Biotechnology - Fundamentals of Applied Microbiology”, Cambridge University Press, 2nd Edition, 2007.
3. Jogdand S.N., “Environmental Biotechnology”, Himalaya Publishing House, 2003.
4. Kumar H.D., “Modern Concepts and Biotechnology”, Vikas Publishing House Pvt. Ltd, 1998.
5. R.C. Dubey., “Textbook of Biotechnology”, S. Chand Publishing., 2001.

COURSE DESIGNERS

S.No.	**Name of the Faculty**	**Designation**	**Department**	**Mail ID**
1	Mr.N.Jawahar	Assistant Professor	Biotechnology	jawahar@vmkvec.edu.in
2	Dr.M.Sridevi	Professor & Head	Biotechnology	sridevi@ vmkvec.edu.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

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
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

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

17BMES01	BIOSENSORS & MEASUREMENT DEVICES	Category	L	T	P	Credit
		FC-ES	3	0	0	3

PREAMBLE

This course is designed to acquire knowledge about the different components of biosensors, bio-amplifier, transducers and display units in biomedical equipment and its working principle and to measure various physiological parameters.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To understand the concepts of transducers and its classification.
2	To study the various types of transducers and classification of bio-sensors.
3	To know about bioelectric signals, electrodes and its types.
4	To know the various Bio potential amplifiers.
5	To study about various Physiological measurements.

COURSE OUTCOMES

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

CO1.	Explain the acquisition of various bio signals using various types of Electrodes.	Understand
CO2.	Describe about the biosensors and transducers for measuring biosignal.	Understand
CO3.	Utilize the electrode and amplifier for measuring biosignal.	Apply
CO4.	Record and analyze various physiological signals.	Analyze
CO5.	Examine the bio amplifiers and their 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	--	--	M
CO2	M	L	--	--	--	L	--	--	M	--	--	M	--	M	M
CO3	S	M	M	--	M	M	--	--	S	L	--	M	M	M	M
CO4	S	S	M	M	M	M	--	M	S	L	--	M	S	S	M
CO5	S	S	M	M	M	M	--	M	S	L	--	M	S	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

General measurement system – purpose, structure and elements – Transducers – Definition, Classification. Resistance transducers, strain gauges, resistance thermometers, potentiometers. Capacitive transducer, Inductive transducer, LVDT, Biomedical Applications.

TRANSDUCERS AND BIOSENSORS

Temperature transducers, flow transducer, optical transducer, photoelectric transducers, pressure transducer, Biomedical applications. Introduction, biological elements – Enzymes, antibodies, nucleic acids, receptors. Immobilization of biological components.

ELECTRODES AND BIO AMPLIFIERS

Basic medical instrumentation system, Origin of Bioelectric Potential, Recording electrodes – Electrodes: Tissue interface, Electrolyte – skin interface, Polarization, Skin contact impedance, motion artefacts. Electrodes – Silver – silver chloride electrodes, electrodes for ECG, EMG, EEG, Electrical conductivity of electrode jellies and creams, Types of electrodes.

Bio amplifier, Need for Bio amplifier, Basic operational amplifier circuits, differential amplifier, Instrumentation amplifier, Chopper amplifier, Isolation Amplifier.

BIO SIGNALS RECORDING

ECG – Anatomy and Electrical conducting system of heart, Genesis of ECG, Einthoven triangle, Lead system, Segments and intervals of ECG, Normal and abnormal ECG wave forms, ECG Machine, Recording set up of EMG and EEG. Heart sounds and PCG, ERG, EOG.

CARDIAC FUNCTION MEASUREMENTS

Blood pressure measurement – direct and indirect method, Respiration rate measurement, Measurement of heart rate and pulse rate, Plethysmography technique. Blood flow measurement – electromagnetic, ultrasonic. Cardiac output measurement – Indication dilution method and dye dilution method

TEXT BOOKS:

1. Khandpur R.S, **"Hand-book of Biomedical Instrumentation"**, Tata McGraw Hill, 2nd Edition, 2003.
2. Arumugam, M, **"Biomedical instrumentation"**, Anuradha Publications, 2008.
3. H.S. Kalsi, **"Electronic Instrumentation & Measurement"**, Tata McGraw Hill, 1995.
4. Brain R Eggins, **"Biosensors: An Introduction"**, John Wiley Publication, 1997.

REFERENCES:

1. Leslie Cromwell, Fred Weibell J, Erich Pfeiffer. A, **"Biomedical Instrumentation and Measurements"**, Prentice-Hall India, 2nd Edition, 1997.
2. K.Sawhney, **"A course in Electronic Measurements and Instruments"**, Dhapat Rai & Sons, 1991.
3. John P Bentley, **"Principles of Measurement Systems"**, 3rd Edition, Pearson Education Asia, (2000 Indian reprint).

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Mrs. S.Vaishnodevi	Assistant Professor	BME	vaishnodevi@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

CO6. Explain the different Bio signal or biopotential.	Understand
CO7. Discuss the working principles of diagnostic and therapeutic equipments.	Understand
CO8. Examine the various instruments like as ECG, EMG, EEG, X-ray machine.	Apply
CO9. Illustrate medical instruments based on principles and application used in hospital.	Analyze
CO10. 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	--	--
CO2	M	--	--	--	--	--	--	--	L	--	--	L	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

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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
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
   - vi) Factorial of a number
   - vii) Fibonacci series
   - viii) Generating prime numbers
   - ix) Generating Armstrong numbers
   - x) Greatest common divisor
3. Programs using arrays
   - vi) Merging of arrays
   - vii) Array order reversal
   - viii) Selection sort
   - ix) Bubble sort
   - x) Insertion sort
4. Programs using strings
   - v) Palindrome checking
   - vi) String sorting
   - vii) Linear pattern search
   - viii) Text line editing
5. Programs using functions
6. Programs using pointers
7. Programs using structures
8. Programs using file structure

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17BMES81	BIOSENSORS & MEASUREMENT DEVICES LAB	Category	L	T	P	Credit
		FC-ES	0	0	4	2

PREAMBLE

The curriculum of biosensors and measuring devices lab is concerned to enable the students to know and operate the various biomedical instruments for measuring and diagnosing biological signals using basic components such as sensors, amplifiers, signal processing and display unit.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To design of amplifiers for biological signals.
2	To recording and analysis of bio signals.
3	To measurement of Ph, blood pressure.
4	To study and measurement of various transducers like temperature, pressure, optical and piezoelectric.
5	To measurement of galvanic skin resistance.

COURSE OUTCOMES

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

CO11.	Examine the operational amplifier for inverting and non-inverting mode.	Apply
CO12.	Categorize Filters for bio signals.	Analyze
CO13.	Record and analyze EEG, ECG, EMG signals.	Analyze
CO14.	Test the PH value of a given solution.	Evaluate
CO15.	Measure temperature, pressure, optical and piezoelectric using different sensors.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

List of Experiments

1. Characteristics of temperature transducers.
2. Characteristics of pressure and optical transducers.
3. Characteristics of strain gauge.
4. Blood pressure measurement using sphygmomanometer.
5. Design of instrumentation amplifier.
6. Measurement PH using PH meter.
7. Galvanic Skin resistance measurement.
8. Recording of ECG using ECG simulator.
9. Recording of EEG using EEG simulator.
10. Recording of EMG using EMG simulator.

TEXT BOOKS:
Department Lab Manual

COURSE DESIGNERS

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2	Ms.R.Sandhiya	Assistant Professor (Gr-I)	BME	sandhiya@avit.ac.in
3	Mr. R. Ezhilan	Assistant Professor	BME	ezhilan@vmkvec.edu.in

17BMES82	MEDICAL INSTRUMENTATION LAB	Category	L	T	P	Credit
		FC-ES	0	0	4	2

PREAMBLE
To provide hands on training on measurement of physiological parameters, biochemical parameters measurement and biosignal analysis.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To study the application of optical isolation amplifier.
2	To recording and diagnosis using bio signals.
3	To understanding working principle of biotelemetry.
4	To study of galvanic skin resistance.
5	To study the human auditory response using audiometer.

COURSE OUTCOMES

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

CO1. Explain about the pH and conductivity.	Understand
CO2. Record and analyze EOG, ECG, EMG signals	Analyze
CO3. Measure the bio signals using biotelemetry	Analyze
CO4. Operate diathermy for cutting and coagulation	Apply
CO5. Calculate the human auditory response using audiometer	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	S	S	--	--	--	S	L	L	L	L	--	--
CO2	S	M	M	S	M	M	--	--	S	L	L	L	L	--	L
CO3	S	M	M	M	M	M	--	--	M	L	L	M	--	S	--
CO4	S	M	M	M	M	M	--	S	M	M	M	M	--	S	L
CO5	S	M	M	M	L	M	--	S	M	M	M	M	--	S	--

S- Strong; M-Medium; L-Low

SYLLABUS

List of Experiments

1. Design and analysis of biological pre amplifiers.
2. Plotting of human auditory response using audiometer.
3. Recording of ECG signal and analysis
4. Recording of EMG-Signal
5. Recording of EEG-Signal
6. Recording of various physiological parameters using patient monitoring system and telemetry units.
7. Measurement of pH and conductivity.
8. Study of ESU – cutting and coagulation modes
9. Study of characteristics of optical Isolation amplifier
10. Galvanic skin resistance (GSR) measurement

TEXT BOOKS:

Department Lab Manual

COURSE DESIGNERS				
S.No.	**Name of the Faculty**	**Designation**	**Department**	**Mail ID**
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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

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

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. Alberts B, 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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17BTCC03	MICROBIOLOGY	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Microbiology deals with the study of microbes. It will cover a 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	-	-
CO3	S	S	M	S	-	-	-	-	-	-	-	-	-	-	-
CO4	S	S	S	S	-	-	M	-	-	-	-	-	-	M	S
CO5	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. Cassida Pelza 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
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17BTCC04	CLASSICAL AND MOLECULAR GENETICS	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Genetics is a field of biology that deals with the study of genes, genetic variation, and heredity in living organisms that intersects with many other life sciences and information systems. Genetics is concerned with the problem of how the hereditary information in DNA controls, what an organism looks like and how it works. Classically this involved the use of genetic variants to upset the biological function of the cells or organisms and from the effect of these mutations, to make deductions about the way cells and organisms worked.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To define the basic principles of inheritance at the molecular, cellular and organismal levels.
2	To explain on how genes, work together in biological processes.
3	To discuss about the causal relationships between molecule/cell level phenomena (“modern” genetics) and organism-level patterns of heredity (“classical” genetics).
4	To correlate the concepts of linkage and crossing over and Genetic mapping of chromosomes.
5	To make the students to test and deepen their mastery of genetics by applying this knowledge in a variety of problem-solving situations.

COURSE OUTCOMES

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

CO1. Recall the development of genetic concepts, the differences between transmission genetics, molecular genetics and classical genetics	Remember
CO2. Explain the genetic data to determine the modes of inheritance, linkage and predict outcomes in future generations	Understand
CO3. Illustrate the various theories of how new species form and the molecular role of inheritance.	Apply
CO4. Determine the factors that play a role in the process of disease development and understand the genetic basis of evolutionary change.	Apply
CO5. Explain about various genetic transfer methods	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

BASICS OF GENETICS & GENES

Classical genetics, Mendelian laws, Mendel’s experiment monohybrid and dihybrid inheritance, Fine structure of genes, Gene as the unit of expression, Control sequences - promoter, operator, terminator and attenuator.

KARYOLOGY

Chromosome structure and organization in prokaryotes and eukaryotes, Extra chromosomes and their inheritance, Biology of plasmids, Giant chromosomes – Polytene and Lamp brush chromosome.

ALLELES

Classical concept of allelomorphs, Multiple alleles, Sex linkage in Drosophila, Sex determination in Human beings, Sex linkage in Human beings, Colour blindness, Haemophilia, Blood group antigens.

LINKAGE AND CROSSING OVER

Coupling and repulsion – Hypothesis, Test cross in maize and Crossing over, Sex chromosomes, Sex linked inherited disorders, Linkage, Crossing over and Genetic mapping of chromosomes.

MICROBIAL GENETIC TRANSFER

Identification of the genetic material – Classical experiments, Hershey Chase, Avery McLeod etc., Conjugation, Transduction and Transformation, Transposons- mechanism.

TEXT BOOKS:

1. Gardner, Simmons and Snustad, Principles of genetics, John wiley and Sons, inc. New York. 8^{th} Edition, 2005
2. Verma, P.S. and Agarwal, V.K., Genetics. S. Chand Publication, 2005.
3. Robert H. Tamarin, Principles of Genetics, 7^{th} Edition, Tata McGraw Hill, New Delhi, 2002.

REFERENCES:

1. David Freifelder., Microbial Genetics, Narosa Publishing House, New York, New Delhi, 2^{nd} Edition, 2001.
2. Stanly R. Maloy, John E. Cronan and David Freifelder, Jr., 2006. Microbial Genetics. Narosa Publishing House.
3. Brown, T. A. Genetics – A Molecular Approach.2011.
4. Snustad, D. P., 2008. Principles of Genetics. 6^{th} Edition., John Wiley & Sons

COURSE DESIGNERS

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17BTCC05	UNIT OPERATIONS IN PROCESS INDUSTRIES	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

In the Engineering related fields, a unit operation is a basic step in a process. Unit operations involve a physical change (or) a chemical transformation such as separation, crystallization, evaporation, filtration, polymerization, isomerization, and other reactions. For example, in milk processing, homogenization, pasteurization, and packaging are each unit operations which are connected to create the overall process. A process may require many unit operations to obtain the desired product from the starting materials, or feedstocks. Knowledge of various unit operation principles will enable students to understand to work in any biotechnology industries.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To describe the knowledge about the various modes of heat transfer.
2	To explain about the radiation, black bodies and its application
3	To outline about the heat exchanger and its operation
4	To discuss about the fluids, types and its measurement.
5	To evaluate the drying and other mechanical separation processes and its role in industries

COURSE OUTCOMES

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

CO1. Describe about basic concepts of various models of heat transfer, radiation, convection and black bodies and its application.	Understand
CO2. Practice the usage of heat exchanger, evaporators and its application	Apply
CO3. Demonstrate the fluid flow and its measurement.	Apply
CO4. Categorize about drying, mechanical separation techniques and its applications	Analyze
CO5. Evaluate various unit operations and heat transfer equipment in chemical and biochemical industries.	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		-	-	-	-	-	-	-	-	-	-
CO2	S	M	M	L	L	-	-	-	-	-	-	-	-	-	-
CO3	S	M	S	L	M	-	-	-	-	-	-	-	-	-	-
CO4	M	L	S	M	M	-	-	-	-	-	-	L	M	-	M
CO5	M	M	M	L	-	-	-	-	-	-	-	L	S	M	

S- Strong; M-Medium; L-Low

SYLLABUS

CONDUCTION

Modes of Heat Transfer – Heat conduction – Steady state conduction – Heat Conduction through composite wall, Hollow Sphere, Hollow cylinder, Combined Conduction-convection – Extended Surfaces, Critical Thickness of Insulation, individual and Overall Heat transfer Coefficient.

CONVECTION AND RADIATION

Convection – Dimensional Analysis – Forced Convection and Natural convection – Boiling and condensation, Concept of Radiation, Laws of Radiation, Grey & Black Bodies

HEAT EXCHANGER

Heat Exchanger – Types of Heat Exchangers – Types of Flows, LMTD, Fouling Factor, NTU concept, Types of Evaporators – Calculation for Single and Multiple Effects.

FLUID MECHANICS

Introduction – Nature of Fluids, Properties of Fluids, Types of Fluids, Fluid Statics, Pressure measurement, Measurement of Fluid flow – Venturimeter, orifice meter, rotameter, Fluidization – Mechanism, types and its applications

DRYING AND MECHANICAL SEPARATION

Drying – Air properties – Drying Equipment – Drying Rates and Drying time.

Classification of Mechanical Separation processes, Solid Liquid Separation – Filtration – Constant Pressure, Constant Volume, Batch and Continuous Filtration – Industrial Filter, Centrifugal Separation, Settling and Sedimentation.

TEXT BOOKS:

1. Warren McCabe, Julian Smith, Peter Harriott, 2005.Unit Operations of Chemical Engineering 7th Ed., McGraw Hill Inc., New York.
2. C.J. Geankoplis, 2003.Transport Processes and separation Principles: Includes Unit Operations, 4th Ed., Prentice-Hall Inc., New Jersey

REFERENCES:

1. R.E. Traybal, Mass Transfer Operations, 3rd Ed, McGraw-Hill, New York, 1981.
2. Frank P. Incropera, David T. Dewitt, Theoder l. Bergman. 2013. Fundamentals of Heat and Mass Transfer and Interactive Heat Transfer. *John Wiley & Sons.*
3. Gavahane.K. A. 2011 Heat and Mass Transfer. Vol. II.NiraliPrakashan

COURSE DESIGNERS

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1	Mr.N.Jawahar	Assistant Professor	Biotechnology	jawahar@vmkvec.edu.in
2	Dr.G.Karthigadevi	Assistant Professor	Biotechnology	karthigadevi@avit.ac.in

17BTCC06	ADVANCED BIOCHEMISTRY	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Advanced Biochemistry uses the knowledge and understanding gained in the prerequisite course and provides understanding of metabolism of macromolecules like carbohydrate, amino acid, lipids and nucleic acid. This course also highlights the process of Biological oxidation involved in the energy production by burning the food materials and give awareness to the various diseases associated with the errors of metabolism of the biomolecules.

PREREQUISITE

17BTCC01- ESSENTIALS OF BIOCHEMISTRY

COURSE OBJECTIVES

1	To Discuss the metabolic pathways of major bio-molecules
2	To Describe the starting, intermediate and ending molecule, enzymes and cofactors in the pathways
3	To Differentiate biochemical basis of various disease processes
4	To Outline the process of Biological oxidation involved in the energy production by burning the food materials

COURSE OUTCOMES

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

CO1. Explain the metabolic pathways of carbohydrates, amino acids, nucleic acids and lipids	Understand
CO2. Describe the causes of metabolic disorder	Understand
CO3. Examine the importance of molecules derived from amino acids	Apply
CO4. Illustrate the Integration of energy metabolism of macromolecules	Apply
CO5. Infer the bioenergetics and oxidative phosphorylation concepts	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	-	-	-	-	-	-	-	-	-	-	-
CO2	M	-	M	M	-	-	-	-	-	-	-	-	M	M	-
CO3	S	S	M	-	M	-	-	-	-	-	-	M	-	M	-
CO4	S	-	-	M	-	-	-	-	-	-	-	-	-	-	-
CO5	M	M	-	M	-	-	-	-	-	-	-	-	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

CARBOHYDRATE METABOLISM

Introduction to Metabolism- Glycolysis- Citric acid cycle-Gluconeogenesis- Glycogen Metabolism-Glycogenesis-Glycogenolysis- HMP Shunt. Carbohydrate disorder - Glycogen storage diseases, Diabetes mellitus.

AMINO ACID METABOLISM

Introduction-Metabolism of amino acids-Transamination-Deamination-Metabolism of ammonia-Urea Cycle-Biosynthesis and degradation of amino acids- Gly, Ser and Cys; Met, Thr, Lys, Ile, Val, Leu, aromatic amino acids. Important molecules derived from amino acids (auxins, DOPA, Serotonin, porphyrins, T3, T4, Adrenaline, Noradrenaline, histamine, GABA, polyamines etc). Amino acid disorder - Alkaptonuria, Albinism, Phenylketonuria, Gout, Cystinuria.

FATTY ACID METABOLISM

Introduction-Fatty acid oxidation-Ketone bodies &Ketogenesis-Biosynthesis of Fatty acids- Cholesterol Biosynthesis-Lipoproteins- Metabolism of glycolipids- Lipid disorder - Niemann Pick disease, Gaucher’s disease, Fabrys disease, Tay-sach’s disease.

NUCLEIC ACID METABOLISM

Nucleic acids: Biosynthesis of nucleotides, denovo and salvage pathways for purines and its regulation, Biosynthesis of pyrimidines & its regulatory mechanisms. Degradation of nucleic acid by exo and endo nucleases. Nucleic acid disorder - Xanthinuria, Oroticacidiuria, Leasch-Nyhan syndrome, Nucleoside Phosphorylase deficiency.

INTEGRATION OF METABOLISM & OXIDATIVE PHOSPHORYLATION

Integration of major Metabolic pathways of energy metabolism, Organ specialization and metabolic integration, metabolism in starvation.

Introduction-Bioenergetics, High energy compounds, Biological Oxidation-Electron transport chain, Oxidative phospholyration, Chemiosmotic theory-inhibitors of ETC & Oxidative phospholyration, Shuttle pathway – Glycerol phosphate Shuttle, Malate aspartate Shuttle.

TEXT BOOKS:

1. Principles of Biochemistry by Lehninger, D.L., Cox, M.M., McMillan Publishers (2008) 4th edition
2. Biochemistry by Stryer, Lubert. W.H Freeman & Co., (2000) 4th edition.
3. Fundamentals of Biochemistry by Donald Voet, Judith G. Voet and Charlotte W., John Wiley & Sons (2008), 3rd edition Pratt.

REFERENCES:

1. Fundamentals of Biochemistry by Jain, J L, Jain, Nitin, Sunjay Jain, S. Chand Group, ISBN: 8121924537
2. Text book of Biochemistry by Sathyanarayana, U. and Chakrapani, U., 2006, 3rd Edition, Uppala Author Publishers Interlinks.

COURSE DESIGNERS

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1	Dr.M.Sridevi	Professor and Head	Biotechnology	sridevim@vmkvec.edu.in
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17BTCC07	ENZYME ENGINEERING AND 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 Illustrate in detail about mechanism and kinetics of enzyme activity.
3	To Generalize about enzyme inhibition and enzyme immobilization and its applications.
4	To correlate in details about performance of immobilized enzymes in different types of bioreactors and their own design restrictions.
5	To examine the knowledge of enzymes to enhance bioreactions and to design sensors for diagnostic applications.

COURSE OUTCOMES

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

CO1. Classify about classification of enzymes and their characteristics.	Understand
CO2. Exemplify fundamental knowledge about enzyme kinetics and mechanism of enzyme activity.	Understand
CO3. Demonstrate the effect of enzyme inhibition and enzyme immobilization.	Apply
CO4. Utilize the enzyme kinetics to design biosensors.	Apply
CO5. Categorize in detail about consequences of immobilized enzymes and its effect in bioreactors.	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
CO	M	L	-	-	-	-	-	-	-	-	-	-	M	-	-
CO	M	-	M	-	M	-	-	-	-	-	-	-	M	-	-
CO	M	M	M	-	-	-	-	-	-	-	-	-	M	-	-
CO	S	S	S	M	S	-	-	-	-	-	-	S	S	M	-
CO	M	M	-	L	L	-	-	-	-	-	-	-	S	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

CLASSIFICATION, PURIFICATION AND CHARACTERIZATION OF ENZYMES FROM NATURAL SOURCES

Classification of enzymes, Production and purification of crude enzyme extracts from plants, Animals and microbial sources – Case studies (Isolation and purification of lipase and protease from microbial sources), Methods of characterization of enzymes, Overview of enzymatic assays.

MECHANISMS AND KINETICS OF ENZYME ACTION

Mechanisms of enzyme action, Concept of active site and energetics of enzyme substrate complex formation, Specificity of enzyme action, Kinetics of single substrate reactions –Michaelis – Menton kinetics, Determination of Km, Lineweaver – Burk plot, Eadie – Hofstee plot, Hanes – Woolf plot, Multi substrate reaction mechanisms (Ping – Pong, Bi – Bi and Random Bi – Bi), Monod Changeux Wyman model.

INHIBITION OF ENZYME ACTIVITY AND ENZYME IMMOBILIZATION

Types of enzyme inhibition – Competitive inhibition, Uncompetitive inhibition, Non- competitive inhibition, Mixed inhibition, Substrate inhibition, Allosteric inhibition, Irreversible inhibition, Physical and chemical techniques for enzyme immobilization – Adsorption, Matrix entrapment, Encapsulation, Cross - linking, Covalent binding etc., Advantages and disadvantages of different immobilization techniques, Application of immobilized enzyme systems.

IMMOBILIZED ENZYME REACTORS AND DIFFUSIONAL LIMITATIONS

Immobilized enzyme reactors – Packed bed, Fluidized bed, Membrane reactors, Air - lift bioreactors and CSTRs suited for immobilized enzymes. Diffusion effects in surface – bound enzymes on non-porous support materials, Diffusion effects in enzyme immobilized in a porous material.

APPLICATIONS OF ENZYMES

Applications of enzyme in disease diagnosis, Food industry, Pharmaceutical industry and Paper industry. Enzyme electrodes as biosensors – Calorimetric, Optical and Potentiometric biosensors, Applications of biosensors.

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

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1	Dr.R.Devika	Professor and Head	Biotechnology	devika@avit.ac.in
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17BTCC08	BIOINSTRUMENTATION	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Bioinstrumentation course includes the principle, instrumentation and applications of the analytical instruments applied in various fields in biotechnology industry. Students also gain knowledge about the methods to analyze Biomolecules. The course acts as a link between academics and industry.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To discuss about various instruments used in biotechnology.
2	To describe in detail about the Molecular spectroscopy
3	To summarize about different separation and purification techniques used in DNA and protein purification.
4	To distinguish the protein structure using thermal an X- ray based methods.
5	To perform various immunological techniques to identify biomolecules and to analyze different bioprocess techniques

COURSE OUTCOMES

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

CO1. Outline the basic principles and instruments in biotechnology.	Understand
CO2. Explain about spectroscopy and its principles along with instrumentation.	Understand
CO3. Demonstrate separation and purification techniques in biotechnology.	Apply
CO4. Identify the biomolecular structure by thermal and X- ray based analysis.	Apply
CO5. Analyze biomolecules by immunological 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	L	L	L	-	L	L	L	-	M	-	L	M	S	S
CO2	L	M	L	L	-	L	-	-	-	L	-	-	M	S	-
CO3	M	S	M	M	-	L	M	L	L	-	-	L	S	M	S
CO4	M	S	L	S	M	M	-	-	-	-	-	M	S	-	-
CO5	M	M	M	M	M	M	S	S	S	-	L	M	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

BASICS OF BIOINSTRUMENTION

Classification and calibration of instrumental methods, Principles and Instrumentation of pH meter & Electronic balance, Gel documentation system, Turbidimetric and Nephelometric titrations.

SPECTROSCOPY

General design and components of spectroscopy, Principles, Instrumentation and applications of colorimetry, UV – Visible – IR- Raman spectroscopy –NMR spectroscopy, Auger electron and Atomic absorption spectroscopy (AAS)

SEPARATION AND PURIFICATION TECHNIQUES

Principles and Instrumentation of centrifugation, Paper and column chromatography, Ion exchange, Size exclusion, Thin Layer Chromatography (TLC), High Performance Liquid Chromatography (HPLC), Gas chromatography, Electrophoresis of Nucleic acid and protein.

THERMAL AND X-RAY

Thermo-gravimetric methods, Differential thermal analysis, Differential scanning calorimetry. X-ray sources, absorption of X-rays, X-ray diffraction, X-ray detectors.

IMMUNOTECHNIQUES AND ANALYSIS OF BIOPROCESS

Radio Immuno Assay (RIA), Enzyme Linked Immunosorbent Assay (ELISA), Immunoblotting, Measurement of BOD and COD in waste waters, Gas analysis for O_2 and CO_2, Flow injection analysis.

TEXT BOOKS:

1. Chatwal and Anand, 2016. Instrumental Methods of Chemical Analysis, Himalaya Publishing House,5th Edition
2. Upadhyay, Upadhyay and Nath.,2017. Himalaya Publishing House. Biophysical Chemistry (Principles & Technology, 4th Edition.
3. Skoog, D., 2014. Instrumental Methods of Analysis, David Hariss, 6th Edition.
4. Willard, H.H., Merrit, J.A., Dean, L.L. and Setlle, F.A., 1986. Instrumental Methods of Analysis. CBS Publishers and Distributors.

REFERENCES:

1. Dinesh Kumar Chatanta and Prahlad Singh Mehra, 2012. Instrumental Methods of Analysis in Biotechnology. I K International Publishing House.
2. P.Asokan. 2003. Analytical Biochemistry. 2nd Edition. China publications.
3. Hobart H. Willard, Lynne L. Merrit, John, A. and Frank A. Settle, 1981. Instrumental Methods of Analysis. Van Nostrand.
4. Campbell, I.D. and Dwek, R.A., 1986. Biological Spectroscopy, Benjamin Cummins and Company.
5. Sewell, P.A. and Clarke, B., 1991. Chromatographic Separations. John Wiley and Sons.
6. Ewing, G.W., 1989. Instrumental Methods of Chemical Analysis. McGraw Hill Book Company.

COURSE DESIGNERS

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17BTCC09	MOLECULAR BIOLOGY	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Molecular Biology gives in-depth knowledge of basic principles and Structure of DNA, RNA, DNA Replication, Transcription, Translation, Gene regulation and Mutation and repair mechanism. Students will gain an understanding of chemical and molecular processes that occur in cell and between cells and also capable to explain mechanism which occur in the living organisms. The paper starts with the basic organization of the genome in prokaryotes and eukaryotes along with their discerning features. This is followed by chapters on prokaryotic and eukaryotic replication, transcription, translation processes, gene regulation and mutation.

PREREQUISITE

17BTCC04 - CLASSICAL AND MOLECULAR GENETICS

COURSE OBJECTIVES

1	To describe on Nucleic acids, structure, their characteristics and organization, biological importance, replication process etc.,
2	To discuss about the process of Transcription, mechanism, types of RNA and inhibitors involved in this process.
3	To interpret the relation of genetic code and translation mechanism, post translation modification, translation inhibitors.
4	To outline the mechanism of Gene regulation in prokaryotes and eukaryotes
5	To categorize the mutations, its types and repair mechanism.

COURSE OUTCOMES

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

CO1. Describe the basic concepts and principles of nucleic acids in prokaryotic and eukaryotic organisms. Discuss and distinguish the replication of prokaryotic and eukaryotic DNA	Understand
CO2. Explain the synthesis of RNA and post-transcriptional modifications	Understand
CO3. Interpret the genetic code and protein synthesis mechanism	Apply
CO4. Develop understanding about the molecular mechanisms behind different modes of gene regulation in bacteria and eukaryotes	Analyze
CO5. Examine about Mutations, DNA damage and repair mechanisms	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	-	-	-	-	-	-	-	-	-	-	-
CO2	M	M	-	M	-	-	-	-	-	-	-	-	M	-	-
CO3	S	M	-	-	-	-	-	-	-	-	-	-	-	M	-
CO4	M	M	L	S	M	-	-	-	-	-	-	-	M	-	-
CO5	M	M	-	S	M	-	M	-	-	-	-	M	M	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

NUCLEIC ACIDS AND DNA REPLICATION

Introduction to Nucleic acids – Primary, Secondary and Tertiary structures, Structure and physicochemical properties of elements in DNA and RNA, Chemical and structural qualities of 3’,5’-Phosphodiester bond, Replication in prokaryotes and eukaryotes – Different modes of replication, Inhibitors of replication.

TRANSCRIPTION

Structure and function of mRNA, rRNA and t RNA, Exon, Intron, Transcription in prokaryotes and eukaryotes, Inhibitors, Post transcriptional modifications, Reverse transcription.

TRANSLATION

Genetic code and its features, Wobble hypothesis and its importance, Colinearity of gene and polypeptide, Translation mechanism, Post translational modifications, Protein folding.

REGULATION OF GENE EXPRESSION

Organization of genes in prokaryotic and eukaryotic chromosomes, Regulation of gene expression with reference to λ phage life cycle. Gene regulation – Operons: Lac, trp, ara and gal.

MUTAGENESIS AND REPAIR

Mutagens, DNA Mutations and their mechanism, various types of DNA repair mechanism.

TEXT BOOKS:

1. Freifelder, D., "Molecular Biology", 2nd Edition, Narosa Publishing House, 1999.
2. Benjamin L., "Genes IX" Jones and Bartlett, 2008.
3. Jeremy M. Berg, John L. Tymoczko and LubertStryer, 2002 "Biochemistry". 5th Edition. W.H. Freeman and Company.

REFERENCES:

1. James Watson et al., 1987. Molecular Biology of Gene. The Benjamin / CummingsPublication Co. Inc., California.

COURSE DESIGNERS

S. No	Name of the Faculty	Designation	Department	Mail ID
1	Dr.R.Devika	Professor and Head	Biotechnology	devika@avit.ac.in
2	Mrs.C.Nirmala	Assistant Professor	Biotechnology	nirmala@vmkvec.edu.in

17BTCC10	**PRINCIPLES OF CHEMICAL ENGINEERING**	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

17BTCC05- UNIT OPERATIONS IN PROCESS INDUSTRIES

COURSE OBJECTIVES

1	To express words into diagrams and mathematical expressions.
2	To describe problem-solving skills, specifically the ability to think quantitatively by including numbers and units.
3	To interpret vague and ambiguous language in problem statements.
4	To implement judicious use of approximations and reasonable assumptions to simplify problems.
5	To compare principles of operation and design for a range of items of plant.

COURSE OUTCOMES

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

CO1. Demonstrate the engineering principles for problem solving in process industries, fundamental concepts of stoichiometry and laws of conservation of mass and energy.	Understand
CO2. Interpreting the problems in material and energy balances related to chemical and bioreactors	Understand
CO3. An ability to employ knowledge to spot and create simple engineering troubles linked to material balance, energy balance, thermodynamics and energy transformation	Apply
CO4. Practice material balances on unit operations and processes in various industries and to evaluate humidity with/without the use of psychrometric chart.	Apply
CO5. Formulating and optimizing various parameters with respect to the industrial processes.	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	-	-	-	-	-	-	-	-	M	M
CO2	L	L	-	-	L	-	L	-	L	M	-	-	M	-	-
CO3	S	S	M	M	M	M	-	-	M	-	-	-	M	M	-
CO4	S	M	S	S	L	M	L	-	M	-	L	L	S	S	M
CO5	S	M	M	S	L	S	L	L	L	S	L	M	M	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

OVERVIEW OF STOICHIOMETRY

Introduction, Units and dimensions, conversion factors, Stoichiometric principles, Composition relation - Atomic, Molecular, Equivalent weights, Molar concepts - Moles, Mole fraction, Mass fraction, Mixtures and solutions - Molarity, Molality and Normality, Density and specific gravity, Conversion factors, Ideal Gas law, Gaseous mixtures- Dalton's law of additive volumes, Dimensional analysis.

MATERIAL BALANCES

Material balances without chemical reactions - Overall and component balances; Material balances with chemical reactions - Limiting reactant, Excess reactant; Unit operations- Distillation, Evaporation, Drying, crystallization; Recycling and bypass; Material balance of unsteady state operations; Problems in industrial applications.

VAPOUR PRESSURE, HUMIDITY AND SOLUBILITY

Vapour pressure - Effect of temperature; Vapourization; Humidity and saturation; Condensation, Solubility, Dissolution

ENERGY BALANCE

Thermochemistry - Calculation of heat of reaction at other temperatures - Hess's law of summation, heat capacity, heat capacities of gases at constant pressure, heat capacities of gas mixture, heat capacities of liquid mixture, Latent heat - Heat of formation, Reaction, Mixing, Theoretical flame temperature.

FLUID MECHANICS

Fluids; fluid statics and applications in chemical engineering; fluid flow; laminar; turbulent pressure drops; compressible fluid flow concepts.

TEXT BOOKS:

1. Principles of Biochemistry by Lehninger, D.L., Cox, M.M., McMillan Publishers (2008) 4^{th} edition
2. Biochemistry by Stryer, Lubert. W.H Freeman & Co., (2000) 4^{th} edition.
3. Fundamentals of Biochemistry by Donald Voet, Judith G. Voet and Charlotte W., John Wiley & Sons (2008), 3^{rd} edition Pratt

REFERENCES:

1. George T. Austine, Shreeves chemical process industries, 1984, McGraw Hill International Edition, 5^{th} Edition.
2. Finlayson, B. A., Introduction to Chemical Engineering Computing, 2006, John Wiley & Sons, New Jersey.
3. Geankoplis, C.J., Transport Processes and Unit Operations, 2002. Prentice Hall India.

Nicholas Chopey, Handbook of Chemical Engineering Calculations Process Principles", Mc Graw Hill, 2004

COURSE DESIGNERS

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

17BTCC11	PLANT AND ANIMAL BIOTECHNOLOGY	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

The course is customized to provide a perceptive of the basic concepts, techniques and methods underlying plant and animal biotechnology. The learners will gain understanding of theoretical principles enabling them to employ the knowledge to solve problems related to plant protection and disease diagnosis through biotechnological approaches.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	Summarize about different types of cell culture methods
2	To develop an understanding on patenting genetically engineered animals and ethical issues
3	Describe about the genetic transformation in plants by the aid of different vector systems.
4	Outline cell culture technique, significance of its cultivation and its application in the disease diagnosis and protection

COURSE OUTCOMES

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

CO1. Explain the basics of tissue culture	Understand
CO2. Demonstrate the techniques for development of Hybrids, screening and selection procedure. Apply the techniques in production of Cybrids.	Apply
CO3. Appraise the plant tissue culture and genetic manipulation of plants	Analyze
CO4. Categorize about the different animal tissue culture and Molecular biological technique for rapid diagnosis of genetic disease.	Analyze
CO5. Inspect the animal gene transfer techniques and their ethical issues	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

BASICS OF TISSUE CULTURE

Tissue culture media – Composition and preparation, aseptic techniques, Organogenesis, Somatic embryogenesis, Shoot-tip culture, Embryo culture and embryo rescue, totipotency.

SOMATIC HYBRIDIZATION AND TRANSFORMATION TECHNIQUES

Protoplast isolation, Culture and fusion, hybrids and Cybrids, Plant vectors, basic features of vectors, Direct gene transfer methods, Agrobacterium mediated gene transfer, applications.

TRANSGENIC PLANTS AND MOLECULAR MARKERS

Herbicide resistance-use of herbicide in modern agriculture, pest resistance-nature, insect resistant crops-Bt approach to insect resistance and food safety. Molecular markers.

TRANSGENIC ANIMALS AND DISEASE DIAGNOSIS

Basic techniques of animal cell culture and their application, Gene cloning techniques for mammalian cells, Transgenic animals, *In-vitro* fertilization and embryo transfer, Molecular biological technique for rapid diagnosis of genetic disease and gene therapy.

TRANSFECTION METHODS, PATENT AND ETHICAL ISSUES

Gene transfer methods in animals, Xenotransplantation, Manipulation of Growth hormone, thyroid hormone, patenting genetically engineered animals- Ethical issues

TEXT BOOKS:

1. Gupta, P.K., 1996. Elements of Biotechnology. *Rastogi*and Co., Meerut.
2. Ranga, M.M., 2002. Animal Biotechnology. *Agrobios India Limited.*
3. Ignacimuthu, S., 1996. Applied Plant Biotechnology. *Tata McGraw Hill*.
4. Gamburg, O.L. and Philips, G.C., 1995. Plant Tissue and Organ Culture Fundamental Methods. *Narosa Publications.*
5. Singh, B.D., 1998. Text Book of Biotechnology. *Kalyani Publishers.*
6. Ramadas, P. and Meera Rani, S., 1997. Text Book of Animal Biotechnology. *Akshara Printers.*

REFERENCES:

1. Hamond, J., McGarvey, P. and Yusibov, V., 2000. Plant Biotechnology. *Springer Verlag.*
2. Mantal, S.H., Mathews, J.A. and Mickee, R.A., 1985. Principles of Plant Biotechnology. An Introduction of Genetic Engineering in Plants. *Blackwell Scientific Publication*

COURSE DESIGNERS

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1	Dr.M.Sridevi	Professor and Head	Biotechnology	sridevim@vmkvec.edu.in
2	Dr.A.Nirmala	Assistant Professor yse(Gr-II)	Biotechnology	nirmalabt@avit.ac.in

17BTCC12	GENETIC ENGINEERING	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Genetic engineering has developed genetic recombination techniques to manipulate gene sequences in plants, animals and other organisms to express specific traits. Applications of genetic engineering are increasing as engineers and scientists work together to identify the locations and functions of specific genes in the DNA sequence of various organisms. Once each gene is classified, engineers develop ways to alter them to create organisms that provide benefits such as cows that produce larger volumes of meat, fuel- and plastics-generating bacteria, and pest-resistant crops.

PRERQUISITE

17BTCC09-MOLECULAR BIOLOGY

COURSE OBJECTIVES

1	To understand the principle of nucleic acid isolation, PCR and their uses in genetic engineering, nucleic acid hybridization
2	The students after completing this course would be aware of how to clone commercially important genes
3	The students would be aware Analysis of Gene expression
4	To discuss the gene cloning methods and the tools and techniques involved in gene cloning
5	To explain the heterologous expression of cloned genes in different hosts,production of recombinant proteins and its applications

COURSE OUTCOMES

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

CO1. Choose the various recombinant DNA techniques and their applications.	Understand
CO2. Identify the problems they could encounter and how to troubleshoot and learn various types of host-vector systems and steps in creating a recombinant DNA molecule	Apply
CO3.Inspect both in-vitro and in-vivo activity of gene expression	Analyze
CO4. Utilize the functioning of Recombinant DNA molecules, their constructions, analysis and fine tuning.	Apply
CO5. Explain the rDNA Techniques in production of commercially important recombinant proteins.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

BASIC TOOLS IN GENETIC ENGINEERING

Role of genes and core techniques in gene manipulations; Restriction enzymes -Cutting and joining of DNA; Gene specific and degenerate primer design- DNA amplification using PCR, Types of PCR -RAPD, RT-PCR and applications of PCR; DNA sequencing - Maxam and Gilbert method and Sanger and Coulson enzymatic chain termination method; DNA labelling Methods; Nucleic acid hybridization techniques – Southern, Northern and Western.

CLONING AND EXPRESSION VECTORS

Vectors; Plasmid biology, Plasmids as vectors – pBR 322, Derivatives of pBR 322, pUC vectors, Lambda vectors, *In vitro* packaging, M13 vectors, Cosmids, Phasmids, Retroviral vectors, Baculovirus vectors, Cloning vectors in Gram positive bacteria (p1J101), Cloning vectors in Gram negative bacterium (Col E1, R1, pT181, pSC 101), Expression vectors – Prokaryotic expression vectors (*E. coli, Streptomyces*) and Eukaryotic expression vectors.

GENE LIBRARIES AND GENE MAPPING

Construction and screening of Genomic DNA and cDNA Library; Analysis of gene expression; Chromosome walking, Chromosome jumping; DNA probes; Molecular markers - Variable Nucleotide Tandem Repeats (VNTR's), Short Tandem Repeats (STR); Mini and Microsatellite sequences; Restriction mapping; Transcript mapping; Gene targeting.

CLONING STRATEGIES

Safety lines for recombinant DNA techniques; Construction of recombinant DNA; Preparation of competent cells- Transformation and Transfection; Selection and screening of recombinants; Gene transfer - Shotgun method, Nuclear injection method; Cloning in plants-Ti Plasmids of *Agrobacterium*, Structure and function of T-DNA

GENE MODIFICATIONS AND APPLICATIONS OF RECOMBINANT DNA TECHNOLOGY

Mutagenesis – Deletion mutagenesis, Oligonucleotide derived mutagenesis, Site directed mutagenesis and their applications; DNA Fingerprinting - RFLP analysis; Applications of recombinant DNA technology for the production of recombinant proteins – Insulin, Interferon and Growth hormones; Guidelines for the disposal of recombinant product wastes.

TEXT BOOKS:

1. Primrose SB and R. Twyman "Principles of Gene Manipulation &Geneomics Blackwell Science Publications, 2006.
2. Principles of Genome Analysis and Genomics by S.B.Primrose and R.M.Twyman, Third Edition (Blackwell Publishing), 2003.

REFERENCES:

1. Winnacker, Ernst – L. "From Genes to Clones: Introduction to Gene Technology", Panima, 2003.
2. Glover, D. M., 1984. Gene cloning: The mechanism of DNA manipulation. IRC Press, Oxford University.
3. Jose Cibelli, Robert P. Lanza, Keith H.S. Campbell, Michael D. West, 2002. Principles of cloning. Academic Press.
4. Glick, B.R. and J.J. Pasternak "Molecular Biotechnology: Principles and Applications of Recombinant DNA", 3rd Edition, ASM, 2003.
5. Ansubel FM, Brent R, Kingston RE, Moore DD, "Current Protocols in Molecular Biology "Greene Publishing Associates, NY, 1988.
6. Berger Sl, Kimmer AR, "Methods in Enzymology", Vol 152, Academic Press, 1987.
7. Genomes 3 by T.A.Brown, Third Edition (Garland Science Publishing), 2007
8. Sambrook and Elliot. Molecular Cloning. Vol. III.

COURSE DESIGNERS

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

17BTCC13	THERMODYNAMICS FOR BIOTECHNOLOGY	Category	L	T	P	Credit
		CC	4	0	0	4

PREAMBLE

Thermodynamics for Biotechnology deals with the basic laws and its application. This course deals with various laws, volumetric applications, Phase equilibria and Chemical Reaction Equilibria, Knowledge of this course will enable students to understand the importance of thermodynamics and its applications in the field of biotechnology.

PRERQUISITE

17BTCC10-PRINCIPLES OF CHEMICAL ENGINEERING.

COURSE OBJECTIVES

1	To list fundamental laws of thermodynamics.
2	To interpret its application to simple biological systems.
3	To discuss properties of pure fluids and property changes in fluid mixtures.
4	To implement the concepts to phase and reaction equilibria.
5	To formulate the equilibrium criteria for the chemical reactions

COURSE OUTCOMES

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

CO1. Summarize the fundamentals of thermodynamics and laws of thermodynamics.	Understand
CO2. Explain the laws of thermodynamics to different systems and processes	Understand
CO3. Describe the thermodynamics concepts to explain the properties of pure fluids and their	Understand
CO4. Deduce the concepts of thermodynamic to phase equilibrium.	Analyze
CO5. Appraise and adapt biochemical reaction equilibrium to biological systems.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

LAWS OF THERMODYNAMICS AND ITS APPLICATIONS

Introduction - Work, Energy, Heat, Internal energy, Extensive and intensive properties, State and path functions, First law of thermodynamics, Energy balance for closed systems, Equilibrium, The reversible process, Constant - v and Constant - p processes, Enthalpy, Heat capacity, Application of First law to Steady state flow processes, Entropy and Second law of thermodynamics – Limitations of First law, Third law of Thermodynamics. Heat engines, Thermodynamic temperature scale, Power cycles, Calculation of Ideal work.

VOLUMETRIC AND THERMODYNAMIC PROPERTIES OF FLUIDS

Ideal gas law, Isobaric, Isochoric, Isothermal, Adiabatic and Polytropic process. P-V-T relations of fluid, Equation of state for gases, Compressibility factors, Compressibility charts, The principles of corresponding states, Acentric factor. Thermodynamic properties of fluids – Reference properties, Energy properties, Derived properties, Maxwell’s relations. Heat capacity relations, Effect of pressure and volume on heat capacities.

SOLUTION THERMODYNAMICS

Partial molar properties, Concepts of chemical potential and fugacity; Activity and activity co-efficient, Gibbs Duhem equation, Margules activity model, Ideal and non-ideal solut ions, Excess properties of mixtures, Composition models.

PHASE EQUILIBRIA

Phase equilibrium – Criteria for phase equlilbria, Phase equilibria in single and multi-component systems, Vapour Liquid Equilibria (VLE), Liquid – Liquid Equilibria (LLE), Solid – Liquid Equilibrium.

CHEMICAL REACTION EQUILIBRIA

Equilibrium criteria for homogeneous chemical reactions, Evaluation of equilibrium constant, Effect of temperature and pressure on equilibrium constant, Calculation of equilibrium conversion for single and multiple reactions, Heterogeneous reaction equilibria.

TEXT BOOK:

1. Narayanan, K.V., 2001. A Text Book of Chemical Engineering Thermodynamics. Prentice Hall India.
2. Smith, J.M., Van Ness, H.C. and Abbot, M.M., 2001. Chemical Engineering Thermodynamics. 6^{th}Edn., McGraw- Hill.

REFERENCES:

1. Rao, Y.V.C. Chemical Engineering Thermodynamics.
2. Sandler, S.I., 1989. Chemical and Engineering Thermodynamics. John Wiley and Sons.
3. Roels, J.A., 1983. Kinetics and Energetics in Biotechnology. Elsevier.
4. Donald T. Haynie. Biological Thermodynamics. Cambridge.
5. Volker Hessel, 2005. Chemical Microprocess Engineering. John Wiley and Sons.
6. Irving J. Dunn and Eth Zurich, 2003. Biological Reaction Engineering. John Wiley.

COURSE DESIGNERS

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

17BTCC14	IMMUNOLOGY	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

The course aims in imparting the fundamental knowledge in the science of immunology and a detailed study of various types of immune systems and their classification, structure, and mechanism of immune activation. It discusses about the principles of microbial pathogenesis, production of new drugs and diagnostic methods.

PRERQUISITE - NIL

COURSE OBJECTIVES

1	To gain knowledge about the general concepts of immune system, immune organ and cells
2	To learn the mechanisms related to cell mediated immunity, complement system, hypersensitivity and transplantation immunology
3	To acquire knowledge on the principles of microbial pathogenesis the concepts and principle of immunoassay techniques in routine diagnosis, research
4	To demonstrate a capacity for problem-solving about immune responsiveness and be able to provide an overview of the interaction between the immune system and pathogens
5	Explore strategies to improve existing Immunotechnology.

COURSE OUTCOMES

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

CO1. Explain the general concepts of immune system, describe the cells and organs of the immune system, and describe the properties of antigens and antibodies	Understand
CO2. Illustrate the concept of cell mediated immunity and hypersensitivity	Understand
CO3. Identify the mechanisms behind transplantation immunology and autoimmunity	Apply
CO4. Identify the principles and molecular mechanisms involved in microbial pathogenesis and their applications in production of vaccines.	Apply
CO5. Inspect the various antigen-antibody interactions and techniques and explore the diagnostic methods	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO IMMUNE SYSTEM

Phylogenyofimmunesystem,Innateandacquiredimmunity,Clonalnatureofimmune response,Organizationandstructureoflymphoidorgans, antigens: chemical and molecular nature, haptens, adjuvants, Cells ofimmunesystem– Haematopoiesisanddifferentiation–B-Lymphocytes, T-Lymphocytes, Macrophages, Dendrite cells

ASSESSMENTOF CELLMEDIATEDIMMUNITY

Identificationoflymphocytesandtheirsubsetsinblood,Tcellactivation,Estimationof cytokines,Macrophagesactivation,Macrophage-microbicidalassays,Hypersensitivity.

TRANSPLANTATIONANDAUTOIMMUNITY

HLASystem,Transplantation–Organtransplantation,Grafting–graftrejectionand prevention, Immunosuppressive drugs, Autoimmunity–Autoantibodiesinhuman, Pathogenic mechanism, Experimentalmodelsof Autoimmunedisease, Treatmentof Autoimmunedisorders.

MOLECULAR IMMUNOLOGY

Immunity to virus, Bacteria, Parasites, Genetic control of immune response, MHC associated predisposition to disease, Principles and strategy for developing vaccines, Newer methods of vaccine production. Immunodeficiency diseases.

IMMUNOTECHNOLOGY

Antigen-antibodyinteraction,Agglutinationandprecipitation,complementfixationtest, Immunodiffusion,Immunoelectrophoretic, Purification andsynthesis ofantigen,Fluorescenceimmunoassay–ImmunoFluorescence(IF),SLFIA, DELFIA,FluorescenceActivatedCellSorter, Immunomics.

TEXT BOOKS:

1. Lydyard, P.M., Whelan, A. and Fanger, M.W., 2003. Instant Notes in Immunology. 2nd Edn., Viva Books Private Limited.
2. Dulsy Fatima and Arumugam N., 2014.

REFERENCES:

1. Talwar, G.P. and Gupta, S.K., 1992.A Handbook of Practical and Clinical Immunology. Volume 12., CBS Publications.
2. Richard A., Goldsby, Thomas J.Kindt and Barbara A, Osborne, Kuby, Immunology. IV Edition, W.H. Freeman and Company, New York.
3. Goding, J.W., 1983. Monoclonal Antibodies: Principles and Practice. Academic Press.
4. Benjamin, E. and Leskowitz, S., 1991. Immunology – A Short Course. Wiley Liss., New York.
5. Kuby J, Immunology, WH Freeman & Co., 7th Edition 2012.

COURSE DESIGNERS

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1	Dr.S.Vinoth	Assistant professor	Biotechnology	vinoth@avit.ac.in
2	Dr.M.Sridevi	Professor & Head	Biotechnology	sridevim@vmkvec.edu.in

17BTCC15	FOOD PROCESSING TECHNOLOGY	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Food Processing Technology deals with the study of food production, processing, packaging, preservation and the use of technology and Engineering techniques in aiding the above-mentioned stages. It also deals with artificial food, artificial edible items, nutrition science and its Chemistry. It allows students to learn about food and nutrients, role of functional foods and the strategies to produce specific food ingredients.

PRERQUISITE - NIL

COURSE OBJECTIVES

1.	To explain different types of foods, factors affecting food & food products and the micro-organisms which cause food borne diseases
2.	To explain the concepts of food spoilage and different food preservation methods, and their impact on the shelf life, quality, and other physical and sensory characteristics of foods
3.	To discuss the different food processing methods and its applicability in food product preparations
4.	To choose appropriate modern methods of food preservation for industrialization
5.	To Choose the materials and types of packaging for foods and its quality testing

COURSE OUTCOMES

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

CO1. Identify different microbes associated with foods, and food borne diseases.	Understand
CO2. Infer the role of microbes in food spoilage and food preservation	Apply
CO3. Illustrate all food processing methods and demonstrate its application in food product	Apply
CO4. Utilize the modern methods for foods preservation using biotechnology.	Apply
CO5. Inspect the packing methods, materials and factors affecting food packing.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

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

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17BTCC16	BIOPROCESS ENGINEERING	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

This course aims to develop the skills of students in the area of Bioprocess engineering. This will also help the students to undertake project in Bioprocess technology

PRERQUISITE

17BTCC07- ENZYME ENGINEERING AND TECHNOLOGY.

COURSE OBJECTIVES

1.	To Explain about the historical development of Bioprocess technology, Design and construction of fermenter.
2.	To Interpret the kinetics of Microbial growth and product formation
3.	To Summarize the knowledge on Design and operation of Bioreactors
4.	To Perform the Mass transfer principles in bioreactor and scale-up criteria.
5.	To Execute the Methods of Online and Offline monitoring of bioprocess.

COURSE OUTCOMES

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

CO1. Explain the appropriate bioreactor configurations, operation modes based upon the nature of Bio products, cell lines and other process criteria.	Understand
CO2. Illustrate about modelling and simulation of bioprocesses so as to reduce costs and to enhance the quality of products and systems.	Understand
CO3. Plan a research career to work in the biotechnology industry with strong foundation about bioreactor design and scale-up.	Apply
CO4. Develop a various integrations of unit operations in bioprocessing.	Apply
CO5. Examine the problems and seek practical solutions in research lab and Industry; for large scale implementation of Biotechnology.	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	-	-	-	-	-	-	-	-	-	-
CO2	L	L	-	-	L	-	-	-	-	-	-	-	-	-	-
CO3	S	S	M	M	M	M	-	-	-	-	-	L	M	M	-
CO4	S	M	S	S	L	M	-	-	-	-	-	L	S	S	M
CO5	S	M	M	S	L	S	L	L	-	-	-	M	M	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO BIOPROCESS AND FERMENTATION

Historical development of the fermentation industry, General requirements of fermentation process, Basic configuration of fermenter and ancillaries, Main parameters to be monitored and controlled in fermentation processes**.**

KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION

Kinetics of Batch, Fed batch and Continuous culture processes, Comparison of batch and continuous culture in industrial process, Introduction to structured and unstructured models – Using unstructured non-segregated models to predict specific growth rate – Substrate limited growth (Monod equation and alternatives to Monod equation), Models with growth inhibitors (Substrate, Product inhibition and Inhibition by toxic compounds).

DESIGN OF BIOREACTORS

Classification of bioreactors – Immobilized enzyme bioreactors, Packed bed bioreactors, Membrane bioreactors, Airlift loop reactor, Fluidized bed and Trickle bed bioreactors, Design of bioreactors – Aseptic operation and containment, Body construction, Aeration and agitation Types of agitators and spargers, Sterilization of Media, Fermentor, Air supply and Exhaust and Sterilization kinetics.

BIOREACTOR SCALE-UP AND MASS TRANSFER

Scale up of fermentation process – Factors involved in scale-up, Scale-up of aeration / agitation, Oxygen mass transfer in bioreactors, Determination of K_La values – Sulphite oxidation technique, Gassing out technique, Oxygen balance technique, Mass transfer correlations.

MONITORING OF BIOPROCESSES

Methods of measuring process variables – Online and offline analysis for measurement of important biochemical parameters, Biomass estimation, Control systems – Manual and automatic control.

TEXT BOOKS

1. Shuler and Kargi, 1992. Bioprocess Engineering. *Prentice Hall*.
2. James E. Bailey and David F. Ollis, 1986. Biochemical Engineering Fundamental. 2nd Edn. *Mc Graw Hill*.

REFERENCES:

1. Trevan, Boffey, Goulding and Stanbury. Biotechnology. *Tata Mc Graw Hill Publishing Co*. Anton Moser. Bioprocess Technology, Kinetics and Reactors. *Springer Verlag*.
2. James M. Lee. Biochemical Engineering. *PHI, USA*.
3. Atkinson. Handbook of Bioreactors.
4. Harvey W. Blanch, Douglas S. Clark. Biochemical Engineering. *Marcel Decker Inc*.

Pauline M. Doran, 2002. Bioprocess Engineering Principles. *Academic Press*

COURSE DESIGNERS

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17BTCC17	**DOWNSTREAM PROCESSING IN BIOTECHNOLOGY**	Category	L	T	P	Credit
		CC	4	0	0	4

PREAMBLE

Downstream processing is defined as various stages of cascade or non-cascade process that occurs after the completion of the fermentation or biotransformation to recover and purify synthetic bio products includes drugs, antibiotics, enzymes, hormones, etc., from fermentation broth. Downstream processing includes separation, purification, and packaging of the fermented products

PRERQUISITE

17BTCC16- BIOPROCESS ENGINEERING

COURSE OBJECTIVES

1	To interpret role of downstream processing in biotechnology.
2	To explain in detail about the physical methods of separation.
3	To summarize the knowledge on isolation of products.
4	To execute product fractionation and purification.
5	To implement the knowledge of formulation of the final product and finishing.

COURSE OUTCOMES

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

CO1. Explain the knowledge about Role and importance of Downstream processing in biotechnology	Understand
CO2.Summarize the fundamental knowledge about the physical methods of separation.	Understand
CO3.Apply the various downstream processing techniques for theisolation of products.	Apply
CO4.Select the methods for product fractionation and purification	Apply
CO5. Compare the various techniques to formulate the final product.	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
CO2	M	M	-	M	-	-	-	-	-	-	-	L	S	S	-
CO3	S	S	M	S	-	-	-	-	-	-	-	-	M	-	S
CO4	S	M	M	S	-	-	-	L	-	-	-	-	-	M	-
CO5	M	M	M	M	L	-	-	-	-	-	-		S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

DOWNSTREAM PROCESSING IN BIOTECHNOLOGY

Role and importance of Downstream processing in biotechnological processes, Characteristic of Biomolecules and Bioprocesses, Cell disruption for product release - Mechanical, Enzymatic and Chemical methods. Pre-treatment and stabilization of bioproducts.

PHYSICAL METHODS OF SEPARATION

Unit operation for solid liquid separation - Removal of Insoluble, Biomass, Flocculation, sedimentation, Centrifugation and Filtration methods.

ISOLATION OF PRODUCTS

Adsorption, Liquid - Liquid extraction, Aqueous two-phase extraction, Membrane separation - Ultra filtration and Reverse osmosis, Dialysis, Precipitation of proteins by Various methods – Salting out, Isoelectric point, Organic solvents, Polyelectrolytes, Polyvalent metallic ions and Non – ionic hydrophilic polymers.

PRODUCT FRACTIONATION / PURIFICATION

Partition Chromatography – single dimensional and Two-dimensional Chromatography –Thin layer chromatography, Gas liquid chromatography, Adsorption Chromatography – Column chromatography and, Ion Exchange Chromatography, High performance liquid Chromatography (HPLC) and Hybrid separation Technology.

PRODUCT FORMULATION AND FINISHING OPERATION

Crystallization - Basic concepts, Crystal size distribution, Batch crystallisation, Continuous crystallization of pharmaceuticals and Solution crystallization, Drying - Drying equipment - Conduction dryers, Adiabatic dryers, Drying rate and Drying time, Zone refining, Lyophilization in final product formulation.

TEXT BOOKS:

1. H. Sivasankaran. Bioseparation
2. Asenjo, J.M., 1993. Separation Processes in Biotechnology. Marcel Dekker Inc.
3. Belter, P.A., Cussler, E.L. and Wei - Houhu, 1988. Bioseparations - Downstream
4. Processing for Biotechnology. Wiley Interscience Publications.

REFERENCE BOOKS:

1. Wankat, P.C., 1990. Rate Controlled Separation. Elsevier.
2. Satinder Ahuja., 2000 Volume 2 Handbook of Bioseparations, Academic Press.
3. Janson, J.C. and Ryden, L., 1989. Protein Purification - Principles, High Resolution Methods and Applications. VCH Publication.
4. Scopes, R.K., 1994.Protein Purification - Principles and Practice. Narosa Publication.
5. Jenkins, R.O., 1992. Product Recovery in Bioprocess Technology - Biotechnology by Open Learning Series. Butterworth -Heinemann.

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17BTCC18	MASS TRANSFER OPERATIONS	Category	L	T	P	Credit
		CC	3	0	1	4

PREAMBLE

Mass transfer is the net movement of mass from one location, usually meaning stream, phase, fraction or component, to another. Mass transfer occurs in many processes, such as absorption, evaporation, drying, precipitation, membrane filtration, and distillation. Mass transfer is used by different scientific disciplines for different processes and mechanisms. The phrase is commonly used in engineering for physical processes that involve diffusive and convective transport of chemical species within physical systems. Mass transfer operations include separation of chemical components in distillation columns, absorbers such as scrubbers or stripping, absorbers such as activated carbon beds, and liquid-liquid extraction.

PREREQUISITE

17BTCC13-THERMODYNAMICS FOR BIOTECHNOLOGY.

COURSE OBJECTIVES

1	To Explain the Mass transfer principles
2	To Demonstrate the principles of adsorption, absorption, leaching and drying extraction
3	To Perform the distillation, crystallization operations
4	To Express the concept of Liquid – Liquid Extraction
5	To Study the concept of Solid – Fluid operation

COURSE OUTCOMES

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

CO1. Illustrate the principles of diffusion and apply the concepts of interphase mass transfer	Understand
CO2. Make use the concept of absorption in bioprocess industries and multi component system	Apply
CO3.Construct the distillation and multi stage tray tower	Apply
CO4.Examine the various principles of liquid-liquid equilibrium and Differential extractor	Analyze
CO5.Contrast the application process of extraction process in biotech industries	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	M	M
CO2	S	S	M	S	-	-	-	-	-	-	-	L	S	S	-
CO3	S	S	M	S	-	-	-	-	-	-	-	-	M	-	S
CO4	M	M	-	M	-	-	M	-	M	-	-	-	-	M	-
CO5	M	M	M	M	L	-	-	-	-	-	-		S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

DIFFUSION

Molecular diffusion in fluids, Mass transfer coefficients, Diffusion in solids, Inter phase mass transfer.

SOLID – FLUID OPERATION

Adsorption equilibria – Liquids, Single gases and vapours, Leaching – Unsteady state operation, Steady state continuous operation.

GAS – LIQUID OPERATION

Equipment for gas liquid operation, Principles of gas absorption, Equilibrium solubility of gases in liquid, One component transfer material balance, Counter current multistage operation, Continuous contact equipment, Multi component system, Absorption with chemical reaction.

DISTILLATION

Vapour – Liquid Equilibria, Single stage- Flash vaporization, Differential or simple distillation, Continuous rectification – Binary system, Multistage tray towers – Mc Cabe- Thiele and Ponchon Savarit principles.

LIQUID – LIQUID EXTRACTION

Liquid – Liquid Equilibria, Stage wise contact, Stage type extractor, Differential extractor

TEXT BOOKS

1. Treybal, R.E., 1981. Mass Transfer Operations. 3rd Edn., *Mc Graw Hill*.
2. Geankoplis, C.J., 2002. Transport Processes and Unit Operations. 3rd Edn., *Prentice Hall of India*.

REFERENCES:

1. Coulson and Richardson's, 1998. Chemical Engineering. Vol. I & II, *Asian Books Pvt. Ltd*.
2. Badger and Banchero. Introduction to Chemical Engineering. *Tata Mc Graw Hill*, New Delhi.
3. Mc Cabe, W.L., Smith, J.C., Harriot, P., 1993. Unit Operations in Chemical Engineering. 5th Edn., *McGraw Hill Book Co.*, New York.
4. Pauline M. Doran, 2002. Bioprocess Engineering Principles. *Academic Press*.
5. Butterworth - Heinemann, 1992. Bioprocess Technology: Modelling and Transport Phenomena.

COURSE DESIGNERS

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

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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

CO14. Demonstrate the basic concepts of sterilization techniques	Understand
CO15. Interpret the behaviour of cells in their microenvironment	Understand
CO16. Analyze scientific work and experimental results in cell biology	Analyze
CO17. Categorize the cell organelles	Analyze
CO5. Illustrate physiological processes of cell e.g. cell divisions	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	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	M	S	M	L	S	-	-	-	-	-	-	M	-	M	-
CO4	M	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", John wiley, 1996.
2. Davis, J.M. "Basic Cell Culture: A Practical Approach", IRL, 1994

COURSE DESIGNERS

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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	S	S
CO3	M	M	M	M	M	-	-	-	S	M	-	-	M	S	-
CO4	L	M	M	M	-	-	S	-	S	M	-	-	S	M	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: A laboratory Manual. 4th Edn, Addison - Wesley.
2. Collee, J. G., et al., 1996. Mackie and McCartney Practical Medical Microbiology. 4th Edn, Churchill Livingstone.
3. Sundararaj, T., 2007. Microbiology laboratory manual. Aswathy Sunndararaj.
4. Laboratory Manual

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17BTCC84	ADVANCED BIOCHEMISTRY LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

The course focuses on the general biochemical reactions for the identification of biomolecules. The students also learn about qualitative and quantitative analysis of macromolecules.

PREREQUISITE- NIL

COURSE OBJECTIVES

1.	Discuss about basic reactions of Biomolecules
2.	Calculate the different concentration of macro-molecules
3.	To distinguish the importance of blood sampling site and estimation of hemoglobin
4.	To perform various techniques for separation of pigments

COURSE OUTCOMES

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

CO1. Identify the reactions of proteins, carbohydrates and amino acids	Apply
CO2. Experiment with Hemoglobin concentration in the blood	Apply
CO3.Distinguish the plant pigments using chromatography	Analyze
CO4. Compare the various biomolecules	Analyze
CO5. Evaluate the Normal and abnormal constituents of Urine	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	S	S	M	-	-	-	M	-	-	-	-	-	-	S	S
CO3	M	-	M	M	-	-	-	-	S	M	-	-	M	S	-
CO4	L	M	M	M	-	-	S	-	S	M	-	-	S	M	M
CO5	L	-	L	-	M	S	M	-	-	S	-	M	-	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

1. Qualitative Analysis of Carbohydrates.
2. Qualitative Analysis of Amino acids.
3. Qualitative Analysis of Lipids.
4. Qualitatively analysis of Normal and abnormal constituents of Urine
5. Estimation of Glucose by O-toludine method.
6. Protein estimation by Biuret,
7. Estimation of Cholesterol by Zak's method.
8. Estimation of urea DAM method.
9. Estimation of Hemoglobin.
10. Separation of plant pigments by column chromatography (Demo).

REFERENCES:

1. Laboratory Manual.

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17BTCC85	MOLECULAR BIOLOGY LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE
The Molecular Biology laboratory has become a prominent and essential fixture in the training of undergraduate students for careers related to the molecular techniques.

PREREQUISITE - NIL

COURSE OBJECTIVES

1.	To discuss about sample preparation
2.	To perform the principle of isolation of DNA from bacterial, plant, human and mitochondria.
3.	Estimate the nucleic acids- RNA / DNA.
4.	Acquire laboratory skills in techniques such as micro pipetting, spectrophotometry and electrophoresis.

COURSE OUTCOMES

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

CO1. Explain the concepts and principles of sample preparation	Understand
CO2. Practice laboratory techniques used for the isolation of nucleic acids from bacterial, plant, human & mitochondria.	Apply
CO3. Illustrate the enzymatic action on nucleic acids & proteins	Apply
CO4. Quantify the nucleic acids	Analyze
CO5. Examine the Purification of biomolecules by electrophoresis	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	M	-
CO2	S	-	-	-	L	-	M	-	-	-	-	-	M	M	-
CO3	M	S	M	-	-	-	M	-	-	-	-	-	-	S	-
CO4	L	M	M	M	-	-	S	-	S	M	-	-	S	M	M
CO5	M	M	-	-	S	-	-	-	M	-	-	M	S	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

1. Isolation of Bacterial Genomic DNA
2. Isolation of DNA – Isolation of plant Genomic DNA
3. Isolation of Human genomic DNA
4. Isolation of Mitochondrial DNA.
5. Quantification of RNA / DNA.
6. Agarose gel electrophoresis
7. Extraction of DNA from agarose gel.

REFERENCES:

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.

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17BTCC86	CHEMICAL ENGINEERING LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE
Chemical engineering laboratory includes pilot and lab scaleexperimental 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 interpret chemical engineering principles and their practical applications in the areas of mass transfer, reaction engineering and particle mechanics.

2	To differentiate and categorize chemical processes that span molecular to macroscopic scales.
3	To assess different coefficients and factors involved in fluid flow
4	To construct the governing equations for designing and analyzing heat transfer equipment

COURSE OUTCOMES

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

CO1. Explain the terminology and knowledge of contemporary issues associated withchemical engineering.	Understand
CO2. Plan, co-ordinate, implement and validate laboratory procedures to conduct quantitative and qualitative Analyzes.	Apply
CO3. Apply process principles learnt in chemical engineering courses to practical situations.	Apply
CO4. Analyze the fundamental theoretical concepts of an experimental system	Analyze
CO5.Examine the industrial problems along with appropriate approximations and boundarycondition.	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	L	-	M	-	-	-	-	-	S	M	-
CO2	-	M	-	M	-	-	M	-	-	-	-	-	-	S	M
CO3	M	-	L	M	-	-	M	-	-	-	-	-	M	-	M
CO4	M	M	-	M	M	-	-	-	-	-	-	-	S	-	S
CO5	M	M	M	M	M	-	-	-	-	-	-	-	-	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. Fluidization.
6. Pressure drop in pipes and packed columns.
7. Distillation in packed column.
8. Liquid – liquid equilibria in extraction.
9. Solid liquid extraction
10. Adsorption equilibrium.
11. Jaw crusher.
12. Determination of Screen effectiveness.
13. Sedimentation.

REFERENCE BOOKS:

Laboratory Manual

COURSE DESIGNERS

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

17BTCC87	BIOINSTRUMENTATION LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

Bioinstrumentation is used to provide the understanding and knowledge of various instrumentation through handling and working. This course also highlights thevarious instruments used in the biotechnology industries for various analytical purpose.

PREREQUISITE - NIL

COURSE OBJECTIVES

1.	To understand the concepts of instrumentation used to measure factors that characterize biological systems and physical or chemical factors that have a profound effect on biological entities.
2.	To demonstrate the proper operation, maintenance and applications of common analytical laboratory instruments, including equipment for electrophoresis, spectrophotometry, and chromatography.
3.	To properly apply scientific mathematical skills to calculations relevant to the laboratory.
4.	To demonstrate qualitative and quantitative analytical skills with various common instruments using common biotechnology laboratory protocols.
5.	To develop critical thinking skills relevant to biotechnology rough data analysis, troubleshooting experiments and equipment, suggesting continuous improvements.

COURSE OUTCOMES

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

CO1. Interpret the purpose of measurement, the methods of measurements, errors associated with measurements.	Understand
CO2. Apply the principle of various instrumentation	Apply
CO3. Compare the various spectrometers for analysis purpose	Analyze
CO4. Inspect the various parameters by using Conductivity meter and Potentiometer.	Analyze
CO5. Measure the dissolved oxygen in the given solution	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	L	-	M	-	-	-	-	-	S	M	-
CO2	-	M	-	M	-	-	M	-	-	-	-	-	-	S	-
CO3	M	-	-	M	-	-	M	-	-	-	-	-	M	-	M
CO4	M	M	-	M	M	-	-	-	-	-	-	-	S	-	S
CO5	L	M	M	L	M	-	S	-	-	-	-	-	S	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

1. Validating Lambert – Beer's law using $KMnO_4$.
2. Determination of complementary color and complementary wavelength
3. Precision and Validity in an experiment using Absorption spectroscopy.
4. Finding the Stoichiometry of the Fe (1,10Phenanthroline Complex) using Absorption spectroscopy.
5. UV spectra of Nucleic Acid.
6. Estimation of Alizarin Aluminium complex
7. Estimation of Al^{3+} concentration using Alizarin in the spectrometer.
8. Estimation of Sulphate by Nephelometry.
9. Experiments on
    a. Conductivity meter
    b. Turbidity meter.
10. Estimation of Dissolved oxygen.
11. Determination of Fe^{2+} content in fruit juices

TEXT BOOKS:

1. 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.Subbaiya	Associate Professor	Biotechnology	subbaiya@avit.ac.in

17BTCC88	GENETIC ENGINEERING LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

To understand and develop the skills involved in rDNA Technology.

PRERQUISITE - NIL

COURSE OBJECTIVES

1.	To explain the preparation of recombinant DNA molecule
2.	To construct a method for amplifying a gene
3.	To perform DNA fingerprinting using RAPD
4.	To demonstrate gene cloning and screening of recombinants
5.	To differentiate proteins through SDS-PAGE

COURSE OUTCOMES

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

CO1. Articulate core Nucleic acid techniques such as extraction, nucleic acid separations and elution.	Apply
CO2. Illustrate DNA amplification using Polymerase Chain Reaction	Apply
CO3. Employ Gene cloning and screening of recombinants.	Apply
CO4. Categorize the methods of Nucleic acids characterization, through the application of gene probes	Analyze
CO5. Compare the proteins through SDS-PAGE.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

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

REFERENCES:

1. Laboratory Manual.

2. Sambrook, Joseph and David W. Russell "The Condensed Protocols: From Molecular Cloning; A Laboratory Manual" Cold Spring Harbor Laboratory Press, 2006.

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

17BTCC89	IMMUNOLOGY LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

The Immunology Laboratory provides hands on training on laboratory testing and simple experiments in evaluation of autoimmune disease, immune deficiencies etc., as well as having responsibility for some aspects of infectious disease serology. To develop skills of students in Immunological techniques by performing simple experiments in the laboratory.

PRERQUISITE – NIL

COURSE OBJECTIVES

1.	To define about immune system, their structure, classification and genetic control of antibody production
2.	To summarize the techniques like blood grouping, ELISA and identification of T-cell, Immunofluorescence etc.
3.	to execute skills in Isolation and purification of antibodies
4.	To compare the various Immunological techniques and its applications
5.	To evaluate and correlate test results with associated diseases or conditions.

COURSE OUTCOMES

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

CO1.Develop a comprehensive and practical knowledge of basic immunological principles involved in research and clinical science	Apply
CO2. Employ the knowledge for identification of immunological cells, their structure, function and Characteristics.	Apply
CO3. Apply principles of safety, quality assurance and quality control in Immunology.	Apply
CO4.Correlate the immunological disorders and the factors involved in it by various immunological assays.	Analyze
CO5.Assess the Immuno assay to understand complement fixation system and other diseased conditions.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

1. Handling of animals, immunization and raising antisera.
2. Identification of cells in a blood smear.
3. Identification of blood groups.
4. Immuno diffusion
5. Immunoelectrophoresis.
6. Testing for Typhoid antigens by Widal test.
7. Enzyme Linked Immuno Sorbent Assay (ELISA).
8. Isolation of pheripheral blood mononuclear cells.
9. Isolation of monocytes from blood.
10. Immunofluorescence

REFERENCE BOOKS:

1. Laboratory Manual

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Mrs.C.Nirmala	Assistant Professor	Biotechnology	nirmala@vmkvec.edu.in
2	Dr.B.Prabasheela	Associate Professor	Biotechnology	prabasheela@avit.ac.in

17BTCC90	FOOD PROCESSING TECHNOLOGY LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

The Course aims to promote the chances of entrepreneurial success and to create trained and skilled human resources well versed in engineering aspects of food processing to cater the needs of the rapidly growing food processing sector.

PRERQUISITE - NIL

COURSE OBJECTIVES

1.	Recognise the basic knowledge about the preparation of instant and Convenience food.
2.	Students can interpret the techniques to improve the nutritive value and minimize loss of essential nutrients during processing and preservation.
3.	Implementation of appropriate processing, preservation and packaging method.
4.	To differentiate and compare methods of fruits and vegetable processing.
5.	Formulate the principals involved in preparation of different Food stuffs

COURSE OUTCOMES

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

CO1. Schedule the process flow diagrams, combination and sequence within a process of food materials	Apply
CO2. Interpret the ability to process the different categories of food and mechanisms of preservation.	Apply
CO3. Categorize the properties of food materials and their processing methods	Analyze
CO4. Develop and analyze the processes, various unit operations and the scientific principles behind processing the food materials.	Analyze
CO5.Validate the changes occurring during various food processing techniques and during storage and preservation.	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	-	-	-	-	-	-	-	-	-	S	-	-
CO2	S	M	M	-	-	-	-	-	-	-	-	-	M	M	-
CO3	M	M	M	M	-	M	M	-	-	-	-	-	-	M	-
CO4	M	M	M	M	-	M	M	-	M	-	-	-	S	M	-
CO5	M	M	M	M	-	S	S	-	-	-	-	L	S	S	-

S- Strong; M-Medium; L-Low

SYLLABUS

1. Preparation of orange squash.
2. Preparation of mango jam and guava jelly.
3. Preparation of tomato ketchup
4. Preparation of canned peas/ pine apple.
5. Preparation of mango pickle /garlic pickle
6. Experiment on preparation of fruit bar.
7. Preparation of frozen prawn.
8. Experiment on preparation of sauce
9. Preparation of bread
10. Identification of Adulterants

REFERENCE BOOKS:

3. Ramaswamy H and Marcott M, Food Processing Principles and Applications CRC Press, 2006.
4. Laboratory Manual

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Mrs.C.Nirmala	Assistant Professor	Biotechnology	nirmala@vmkvec.edu.in
2	Dr.A.Nirmala	Assistant Professor Sr.Grade -II	Biotechnology	nirmalabt@avit.ac.in

17BTCC91	BIOPROCESS ENGINEERING LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

This bioprocess engineering lab course will provide practical training on upstream and downstream process operations, designing of fermentation medium, effect of varies parameters on fermentation and bioproduct production including recombinant protein synthesis.

PRERQUISITE - Nil

COURSE OBJECTIVES

1. To Interpret the Growth factors.
2. To Summarize the medium optimization.
3. To Describe Enzyme activity.
4. To Execute Enzyme Immobilized Reaction.
5. To Perform large scale production of bioproducts.

COURSE OUTCOMES

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

CO1. Produce information on behavior and growth of microorganisms in growth medium.	Apply
CO2. Develop knowledge about optimization on growth medium.	Apply
CO3. Report information on activity of enzyme and parameters affects enzyme activity.	Apply
CO4. Employ the knowledge of Enzyme Immobilized to exploit in bioreactors.	Apply
CO5. Focus the knowledge in producing bioproducts in reactors.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

1. Growth of microorganism – Estimation of Monod parameters.
2. Medium optimization – Plackett Burman design.
3. Enzyme activity – Effect of pH.
4. Enzyme activity – Effect of temperature.
5. Enzyme Immobilization – Gel Entrapment.
6. Enzyme Immobilization – Cross linking.
7. Production of Wine by Yeast.
8. Production of Amino acid.
9. Production of Yogurt.

TEXT BOOKS:

1. Pauline M. Doran, 2002. Bioprocess Engineering Principles. Academic Press.
2. James E. Bailey and David F. Ollis, 1986. Biochemical Engineering Fundamental. 2nd Edn. McGraw Hill.
3. Shuler, M.L. and Kargi, F. Bioprocess Engineering: Basic concepts, 2nd ed., Prentice-Hall, 2002.
4. Doran Pauline M, Bioprocess Engineering Principles, Academic Press, 1995.

REFERENCE BOOKS:

1. Jenkins, R.O., 1992. Product Recovery in Bioprocess Technology - Biotechnology by Open Learning Series. Butterworth -Heinemann.
2. Harvey W. Blanch, Douglas S. Clark. Biochemical Engineering. Marcel Decker Inc.

COURSE DESIGNERS				
S.No	Name of the Faculty	Designation	Department	Mail ID
1	Mr.N.Jawahar	Assistant Professor	Biotechnology	jawahar@vmkvec.edu.in
2	Dr.G.Karthigadevi	Assistant Professor	Biotechnology	karthigadevi@avit.ac.in

17BTCC92	DOWNSTREAM PROCESSING ENGINEERING LAB	Category	L	T	P	C
		CC	0	0	4	2

PREAMBLE

Downstream processing laboratory is used to provide the understanding and knowledge on techniques like Solid-liquid separation, Cell disruption, High resolution purification, Product polishing of bio-products from fermenter. This course provides deeper understanding about the techniques in downstream processing.

PRERQUISITE -Nil

COURSE OBJECTIVES

1	To explain the importance of downstream processing in biotechnology.
2	To describe in detail about the Solid-Liquid Separation methods such as Centrifugation, Microfiltration.
3	To describe the knowledge on cell disruption techniques to extract valuable biomolecules.
4	To demonstrate in detail about Chromatography techniques for product purification.
5	To demonstrate the knowledge of extraction techniques to separate biomolecules.

COURSE OUTCOMES

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

CO1. Illustrate the role and importance of downstream processing in biotechnology.	Apply
CO2. Apply the knowledge about the solid-liquid separation to acquire the product.	Apply
CO3. Compute the information on cell disruption techniques for separation of biomolecules.	Apply
CO4. Focus the knowledge about product fractionation and purification by chromatography Technique.	Analyze
CO5. Test the knowledge of flocculation and aqueous two phase extraction to extract living or non-living cells / intracellular materials such as enzymes, proteins, etc.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

1. Solid-Liquid Separation – Centrifugation, Microfiltration.
2. Mechanical cell disruption – homogeneizer
3. Cell Disruption Techniques – Ultra sonication.
4. Separation of Pigments by Thin Layer Chromatography.
5. Precipitation – Ammonium Sulphite Precipitation.
6. Ultra Filtration Separation.
7. Aqueous Two Phase Extraction of Biologicals.
8. Flocculation

TEXT BOOKS

1. Wankat, P.C., 1990. Rate Controlled Separation. Elsevier.
2. Satinder Ahuja., 2000 Volume 2 Handbook of Bioseparations, Academic Press.
3. Asenjo, J.M., 1993. Separation Processes in Biotechnology. Marcel Dekker Inc.
4. Belter, P.A., Cussler, E.L. and Wei - Houhu, 1988. Bioseparations - Downstream
5. Processing for Biotechnology. Wiley Interscience Publications.

REFERENCE BOOKS

1. Janson, J.C. and Ryden, L., 1989. Protein Purification - Principles, High Resolution Methods and Applications. VCH Publication.
2. Scopes, R.K., 1994.Protein Purification - Principles and Practice. Narosa Publication.
3. Jenkins, R.O., 1992. Product Recovery in Bioprocess Technology - Biotechnology by Open Learning Series. Butterworth -Heinemann.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Mr.N.Jawahar	Assistant Professor	Biotechnology	jawahar@vmkvec.edu.in
2	Dr.R.Subbaiya	Associate Professor	Biotechnology	subbaiya@avit.ac.in

CATEGORY ‘C’ – ELECTIVE COURSES - PROGRAMME SPECIFIC – 12-15 CREDITS GENERAL

17BTEC01	PLANT AND ANIMAL DISEASES AND THEIR CONTROL	Category	L	T	P	Credit
		EC (PS)	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	M	M	-
CO2	M	M	M	L	L	M	L	-	M	L	-	-	S	S	M
CO3	S	S	S	-	L	-	M	L	M	-	-	L	-	M	-
CO4	S	M	M	M	L	M	S	M	S	-	L	M	S	M	S
CO5	M	L	-	S	M	M	S	S	S	-	-	M	S	S	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

17BTEC02	OCEAN SCIENCE	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

Ocean science deals with the various aspects of marine ecosystem. It gives the basic knowledge about availability of the bio resources and its applications. It also deals with exploration of various culturing techniques of few marine organisms in the laboratory conditions. This study further facilitates the student to understand the economic importance of marine derived products.

PREREQUISITE –NIL

COURSE OBJECTIVES

1	To sate the art of marine ecosystem and their properties
2	To describe the about biodiversity in marine environment and their resources
3	To perform various culture techniques of marine organisms
4	To develop drug from marine compounds and their economic Values
5	To assess the human impact on marine environment

COURSE OUTCOMES

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

CO1. Outline the Marine ecosystem sources and their properties	Understand
CO2.Describe the biodiversity in marine environment	Understand
CO3. Demonstrate the different culture techniques of marine organisms	Apply
CO4. Assess the drug developed from natural marine derived compounds	Analyse
CO5. Examine the human impact on marine environment	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	L	-	-	-	-	L	M	-	M
CO2	L	-	-	L	-	M	-	-	-	L	-	L	-	-	M
CO3	S	M	M	M	M	-	M	-	M	L	L	-	M	M	-
CO4	S	S	S	S	S	M	S	M	S	L	M	L	S	M	S
CO5	S	L	M	M	M	S	S	M	S	M	M	M	M	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO MARINE ENVIRONMENT

Stratification of coastal environment- Bathymetric map, Thermo cline; components of marine ecosystem; Biotic and Abiotic and their interrelationships-Role in food chain, food web ;Tropic systems; Taxonomy of marine flora and fauna; Physico chemical properties of marine water.

BIODIVERSITY AND BIORESOURCES

Biodiversity of marine ecosystem – Phytoplankton; Algal bloom; Indicator organisms. Bio-geocycles; Bioresources and their economic importance; Adaptations of flora and fauna in marine & estuarine environment.

CULTURE TECHNIQUES

Culture Techniques of microalgae; seaweeds; tiger shrimp; lobsters; Common marine pathogens and symptoms; Transgenesis and cryopreservation.

ECONOMIC VALUE

Economic importance of marine products; Economic value - corals, sponges, pearls, oysters, molluscs; Drug development from natural marine derived compounds.

IMPACTS ON MARINE ENVIRONMENT

Human Impact on Marine Environment – Oil spill, Nuclear reactors, Thermal impact, Bio fouling; Heavy metal pollution.

TEXT BOOKS:

1. Milton Fingerman and Rachakonda Nagabhushanam, Recent Advances in Marine Biotechnology (Series) Biomaterials and Bioprocessing, Science Publishers 2009.
2. Proksch and Werner E.G.Muller, Frontiers in Marine Biotechnology. Horizon Bioscience, 2006

REFERENCES:

1. Le Gal, Y.Ulber, marine Biotechnology 1: Advances in Biochemical Engineering/Biotechnology (Series editor: T. Scheper) Springer – Verlag Berlin Heideberg. Vol. 96,97, 2007
2. Mun and Munn, Marine Microbiology Ecology & Applications. BIOS, Scientific Publisher. 1996

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. R. Subbaiya	Associate Professor	Biotechnology	subbaiya@avit.ac.in
2	Mr.N.Jawahar	Assistant Professor	Biotechnology	jawahar@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	-	M	M
CO2	L	L	-	-	L	-	L	-	L	M	-	-	M	-	-
CO3	S	S	M	M	M	M	-	-	M	-	-	L	M	M	-
CO4	S	M	S	S	L	M	L	-	M	-	L	L	S	S	M
CO5	S	M	M	S	L	S	L	L	L	S	L	M	M	M	-

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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1	Dr.R.Devika	Professor	Biotechnology	devika@avit.com
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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. Itcreates 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 andClassify infection and interpret the result.	Understand
CO2. Explain about the most appropriate infectious agent.	Understand
CO3. Identify the microorganism and its rolein disease diagnosis	Apply
CO4. Make use of the genomic knowledge.	Apply
CO5. Assume the tool for disease diagnosis andplan 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	S	S
CO2	L	M	L	L	-	L	-	-	-	L	-	-	M	S	-
CO3	M	S	M	M	-	L	M	L	L	-	-	L	S	M	S
CO4	M	S	L	S	M	M	-	-	-	-	-	M	S	-	-
CO5	M	M	M	M	M	M	S	S	S	-	L	M	M	M	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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17BTEC05	CYTOGENETICS	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

*Cytogenetics*is the branch of genetics that studies the structure and behaviour of chromosomes and their relation to human disease and disease processes. It also deals with chromosomes and their inheritance, particularly as applied to medical genetics.The application of cytogenetic is to monitor mutagenic and clastogenic exposures, and evaluates the importance of these tests for preventive health measures. Cytogenetics often use cutting-edge tool for the diagnosis of various genetic disorders, paving the way for possible treatment and management.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	State the basic concept of genetic material and their structural organization
2	Compare the structure of the gene and their genetic mapping
3	Differentiate the sex in plants and animals
4	Assess the effects of Structural changes in chromosomes and their translocations
5	Check the genetic material in population and their frequency of occurrence

COURSE OUTCOMES

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

CO1. Compare the Knowledge about concept of genotype and phenotype characters	Understand
CO2. Demonstrate the structure of gene and their mapping system	Understand
CO3. Identify, determine and differentiate Sex in plants and animals.	Apply
CO4. Relate the variations and changes in chromosome.	Apply
CO5. Analyzegene mutations and reproduction	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
CO2	L	L	-	-	-	-	-	-	L	M	-	-	M	-	-
CO3	M	S	S	S	L	L	L	-	M	-	-	-	S	M	S
CO4	M	S	M	S	M	L	L	-	M	-	-	L	M	S	S
CO5	M	M	L	M	M	M	S	M	S	-	M	L	S	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

GENETICS AND HEREDITY

Introduction to genetics. Genotype and phenotype, Mendelian laws of Inheritance, Test cross, back cross; Structural organization of eukaryotic chromosomes: Nucleosome structure, Euchromatin, heterochromatin, telomeres, Satellite DNA, centromeres, Types of chromosome on the basis of centromeres; Lampbrush chromosomes; polytene chromosomes; Extrachromosomal inheritance; maternal effects and cytoplasmic inheritance, Chi square analysis.

LINKAGE AND CROSSING OVER

Fine structure of the gene: cistron, recon, mutan; Linkage; crossing over: molecular mechanism - double strand break model, Holiday model, Genetic mapping of chromosomes: Diploid mapping - two point cross, three point cross, Haploid mapping; Lod score analysis.

SEX DETERMINATION AND DIFFERENTIATION

Theories of sex determination – chromosome theory and genic balance theory of sex determination, sex determination in dioecious plants {Marchantia, Ceratopteris, Silene (Melandrium), Humulus, Coccinia, Rumex, Papaya}, mouse and in man; genetic basis of sex differentiation (genes located on sex chromosomes and autosomes), single gene control of sex. Hormonal control of sex, sex reversal and gynandromorphs, human sex anomalies (Klinefelter's syndrome and Turner's syndrome); brief idea of dosage compensation and Lyon's hypothesis.

VARIATIONS AND CHANGES IN CHROMOSOME STRUCTURE

The origin and adaptive significance of duplications, deletions, inversions, and translocations, isochromosomes, ring chromosomes, centric fusions and fissions, Changes in chromosome number - aneuploidy and euploidy in both plants and animals, their origins, cytogenetic effects, evolution of the karyotype.

MUTATION AND REPRODUCTION

Types of gene mutation- insertion, deletion, missense, nonsense, Mutagens-physical, chemical, DNA repair mechanism, beneficial and harmful effects of mutations, transposable elements, Chromosome-asexual reproduction, modified sexual reproduction (various forms of parthenogenesis), chromosome diminution and elimination.

TEXT BOOKS:

3. Tamarin, R.H. 2008. “Principles of Genetics”, Tata McGraw Hill, New Delhi.
4. Verma, P.S. and Agarwal, V.K. 2006. “Cell Biology, Genetics & Evolution & Ecology”, S. Chand & Co., New Delhi.

REFERENCES:

6. Simmons, M.J, and Snustad, D.P. 2008. “Principles of Genetics”, John Wiley & Sons, New Delhi.
7. Strickberger, M.W. “Genetics”, Pearson Education India, New Delhi. 2015

COURSE DESIGNERS

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17BTEC06	STEM CELL BIOLOGY AND TISSUE ENGINEERING	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

Stem cells in regenerative medicine holds promise for improving human health by restoring the function of cells and organs damaged due to degeneration or injury. Stem cell biology has potential application in several areas of biomedical research that includes drug development, toxicity testing, developmental biology, disease modeling, tissue engineering etc.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To define topics related to stem cells and regenerative biology
2	To describe Stem cell basics and their applications for the benefit of mankind.
3	To execute technologies in engineering stem cells
4	To organize scaffold for tissue engineering
5	To Assess the ethical issues in stem cell research

COURSE OUTCOMES

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

CO1. To outline the basics of stem cell	Understand
CO2. To identify the basic applications of stem cell in regenerative medicine	Apply
CO3. To make use of the latest tissue engineering concepts	Apply
CO4. To develop the scaffold tissue using stem cell	Apply
CO5. To infer the research in tissue engineering.	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	M
CO2	M	L	M	M	-	L	L	-	M	-	-	-	S	M	M
CO3	S	M	S	S	M	M	M	M	-	-	M	M	M	M	S
CO4	S	S	S	S	M	M	M	M	M	-	M	M	S	S	S
CO5	M	M	M	L	M	-	S	M	S	M	-	L	M	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO STEM CELL BIOLOGY

Definition and concepts of stem cell terminology. Classification of stem cells. Basic biology of stem cells - Types & sources of stem cell with characteristics. Stem cells in embryonic and adult tissues. Overview of basic and translational research of stem cells modeling disease states, gene/cell therapies,

EMBRYONIC STEM CELLS AND INDUCED PLURIPOTENT STEM CELLS

Early steps in human reproduction (Zygote to blastocyst stage), Totipotent vs Pluripotent stem cells, Embryonic stem cells: Sources, characterization and experimental manipulations, Discovery of Induced pluripotent stem cells (iPSC) and its experimental differentiation into specific tissue types, Generation and characterization of pluripotent stem cells. Experimental breakthroughs and limitations.

ADULT STEM CELLS

Multipotent stem cells from adult tissues and organ systems, stem cell niches. Advantages and disadvantages for use, characterization, experimental manipulations, Immune markers and tissue/organ rejection, Hematopoietic stem cells -

characteristics and differentiation pathways, Lymphoid vs myeloid cell pathways and stem cells ,Cord blood transplantation, Mesenchymal stem cells – Isolation, characterization and functional assessment.

TISSUE REGENERATION AND BIOENGINEERING OF TISSUE AND ORGANS

Overview of regeneration and bioengineering of tissues. Role of stem cells in controlling tissue regeneration. Experimental strategies to bioengineer tissues and organs from cultured stem cells. 3-D organoid cultures and tissue scaffolds. Characterization of functional bioengineered organs.

ETHICAL, POLITICAL AND SOCIETAL IMPLICATIONS

Future innovations, trends and misconceptions of using human stem cells. Practicalities and feasibilities of using stem cells to treat human disease and injuries. Commercialization of stem cell-based therapies.

TEXT BOOKS:

1. Robert Lanza, John Gearhart, Brigid Hogan,Douglas Melton, Roger Pedersen, James ThomsonE and Donnall Thomas. Essentials of Stem cell Biology. Elsevier Academic press.
2. Robert Lanza, Robert Langer and Joseph Vacanti, “Principles of Tissue Engineering”, Academic Press, 2007

REFERENCES:

1. Scudellari, Megan “A decade of iPS cells” *Nature*, 534: 310-312.
2. Bredenoord, AL, Clevers, H, Knoblich J (2017) “Human tissues in a dish: The research and ethical implications of organoid technology” Science 355.
3. ThomsonE and Donnall Thomas.Essentials of Stem Cell Biology. Elsevier Academic press.
4. Stewart Sell. Stem Cell Handbook, 2004. *Humana Press*.
5. Freshney, R. and Ian. Alan, R. Culture of Animal Cells : A Manual of Basic Techniques. Liss Inc.
6. Modlinske, J.A., Reed, M., A., Wagner, T.E. and Karasiewicz, J., 1996. Embryonic Stem Cells: Developmental Capabilities and their Possible Use in Mammalian Embryo Cloning. *Animal Reproduction Science* 42: 437 – 446.

COURSE DESIGNERS

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17BTEC07	**GENETICALLY** MODIFIED **ORGANISMS AND ETHICAL ISSUES**	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

Genetically modified organisms and ethical issues course deals with the study of modified genes found in and around us. Genetically modified organisms classify the genetic modification and characteristics of modified genes and beneficial effects. Genetically modified organisms use pioneering techniques in science 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 state the knowledge on concept of Genetically modified organisms
2	To explain the principles of risk benefit analysis of genetically modified organisms
3	To study the sex in different oragnisms, sex linked inheritance and karyotyping
4	To determine structural changes and mutations in chromosomes.
5	To study about population genetics

COURSE OUTCOMES

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

CO1. Summarise about the genetically modified microbes and organisms	Understand
CO2. Discussthe modified gene copy number and chromosomal changes	Understand
CO3. Identify and differentiate Sex in plants, animals and other organisms.	Apply
CO4. Relate the Structural changes in chromosomes.	Apply
CO5. Analyze the genetic material, mutation and their frequency of occurrence in population for reproduction	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	-	M	M
CO2	L	L	L	M	L	-	-	-	-	L	-	-	-	M	M
CO3	S	M	S	S	M	L	L	L	-	-	M	-	M	S	M
CO4	S	S	M	M	L	M	M	M	-	-	L	L	S	S	S
CO5	M	M	L	-	L	M	S	S	S	L	L	M	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

GENETIC MODIFICATION

Generation of Genetic Modification- Genetically Modified Microbes (bacteria and yeast) and Genetically Modified Organism (plants and animals) - Recombinant DNA technology for GMOs with examples of applications in plants - applications of GMM and GMO within basic science- Biological and medical research.

DETECTION AND ANALYSIS OF GMOS AND GMO PRODUCTS

Modified gene copy number determination, detection of chromosomal changes, toxicological studies, residual DNA analysis, product analysis – microbial, biochemical and molecular, toxicological evaluation.

SEX DETERMINATION

Sex determination in plants and animals: Concepts of autosomes and allosomes, XX - XY, XX - XO, ZW - ZZ, ZO – ZZ Types; Sex differentiation; Dosage compensation; Sex linked inheritance, Sex influenced inheritance Multiple Alleles; Lethality and Interaction of genes. Karyotyping - amniocentesis; banding techniques.

CHROMOSOMAL ABERRATIONS & MUTATIONS

Structural changes: duplications, translocations, inversions; Numerical changes: aneuploidy; Euploidy; polyploidy; Types of mutations; Spontaneous & Induced mutation, lethal mutations, silent mutations, adaptive mutations, biochemical mutations & chemical mutagens, ionizing and non- ionizing radiations; Ames Test.

GENETIC MATERIAL IN POPULATIONS

Population genetics: gene pool, gene frequencies, Hardy - Weinberg law and its applications, factors affecting allele frequencies - selection, mutation, migration and genetic drift; Inbreeding depression; Heterosis; speciation; pedigree analysis.

TEXT BOOKS:

1. David E Newton. 2014. Genetically Modified Organisms food, Santa Barbara, California: ABC-CLIO
2. Debra A Miller, 2012, Genetically Engineered Food, Detroit Green haven press.
3. Tamara Thompson, 2015. Genetically modified food. Farmington Hills Mich, Greenhaven press, a part of Gale, Cengage learning.

REFERENCES:

1. Noel Merino, 2014. Genetically modified food. Farmington Hills, MI, Greenhaven press
2. Ronald Ross Watson and Victor Preedy, 2015, Genetically modified Organisms in Food, 1st edition Academic press
3. R. R. Vittal and R. Bhat, Biotechnology, Concepts and Applications (2009)
4. S. C. Rastogi, Biotechnology, Principles and Applications (2007)

COURSE DESIGNERS

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17BTEC08	MOLECULAR EVOLUTION	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

This course provides a review of current knowledge in molecular evolution, with attention to evolutionary theory, the patterns and mechanisms of molecular change, the reconstruction of evolutionary trees from gene sequences, the evolution of gene families and their functions, and the evolution of development.

PREREQUISITE

17BTCC09- MOLECULAR BIOLOGY

COURSE OBJECTIVES

1	To state the students about genes and its structure, and effect of mutation of genes
2	To describe the students about the classical models used to find out the changes in the nucleotide sequence during evolution
3	To demonstrate the students about the conventional method of sequence alignment and building the phylogenetic tree
4	To outline the gene duplication and dating of gene duplication
5	To develop and interpret phylogenetic trees

COURSE OUTCOMES

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

CO1. Describe the concept and processes of protein and genes in the molecular evolution	Understand
CO2. Explain how the evolutionary changes act at the molecular level	Understand
CO3. Employ the diversity of molecular evolution computational methods to analyze and interpret molecular evolutionary patterns	Apply
CO4. Correlate the bioinformatics tools to find out the evolutionary relationship.	Analyse
CO5. Deduce the domains of gene duplication and exon shuffling	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	S	L	L	M	-	M	-	-	L	-	-	-	M	-
CO2	L	S	L	L	M	-	M	-	-	L	-	-	M	-	M
CO3	S	M	M	M	S	S	M	L	M	-	L	-	M	M	M
CO4	M	L	L	S	L	M	L	-	L	M	-	M	S	S	S
CO5	M	L	L	S	L	M	L	-	L	M	-	M	-	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

GENES, GENETIC CODES, AND MUTATION

Genes and gene structure- Protein-coding genes, RNA-specifying genes, Un transcribed genes

Mutation- Substitution mutations, Recombination, Deletions and insertions, Inversions, Mutation rates, Spatial distribution of mutations.

EVOLUTIONARY CHANGE IN NUCLEOTIDE SEQUENCES

Nucleotide substitution in a DNA sequence- Jukes and Cantor's one-parameter model, Kimura's two-parameter model, Number of substitutions between two noncoding sequences, Substitution schemes with more than two parameters

ALIGNMENT OF NUCLEOTIDE AND AMINO ACID SEQUENCES

Manual alignment by visual inspection, The dot matrix method, Distance and similarity methods, Alignment algorithms, Multiple alignments

MOLECULAR PHYLOGENETICS

Impacts of molecular data on phylogenetic studies, Advantages of molecular data in phylogenetic studies, Rooted and unrooted trees, Scaled and unscaled trees, The Newick format, Number of possible phylogenetic trees, True and inferred trees, Gene trees and species trees, Taxa and clades. Methods of tree construction

GENE DUPLICATION, EXON SHUFFLING, AND CONCERTED EVOLUTION

Types of gene duplication, Domain duplication and Gene elongation**-** The ovomucoid gene, Enhancement of function in the allele of haptoglobin, Origin of an antifreeze glycoprotein gene, Dating of gene duplication.

TEXT BOOKS:

1. D. Graur and W-H Li. Fundamentals of Molecular Evolution. Sinauer, 1999.
2. D.B. Futuyma. Evolutionary Biology, Third Edition. Sinauer, 1997. This is an excellent general evolution textbook. While it is expensive, it is a great reference and learning tool for anyone interested in evolution in general.

REFERENCES:

1. RDM Page and LC Holmes. Molecular Evolution: A Phylogenetic Approach. Blackwell Science, 1998. A very good introduction with an emphasis on techniques and concepts in molecular systematics, one of the major weak points in Graur and Li.
2. D.B. Futuyma. Evolutionary Biology, Third Edition. Sinauer, 1997. This is an excellent general evolution textbook. While it is expensive, it is a great reference and learning tool for anyone interested in evolution in general.

COURSE DESIGNERS

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1	Dr. S. Vinoth	Assistant Professor	Biotechnology	vinoth@avit.ac.in
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17BTEC09	MICROBIAL BIOTECHNOLOGY	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

Microbial Biotechnology deals with the study of Microbial products, organization and function of prokaryotes. As the pioneering field in the area of microbial it clearly shows that the industrially important microbes and metabolites. Industrially important microbial metabolites were identified and they were taken to the different steps for the production of antibiotics. Genetically modified organisms are concerned with the application of microbial metabolites in pharma industry and also the types of drugs, how the biofertilizers and biopesticides are useful to the agriculture for the enormous amount of production. Classically recovery and purification of microbial products were analysed for the application in agriculture.

PREREQUISITE

17BTCC03- MICROBIOLOGY

COURSE OBJECTIVES

1	To learn the basic principles of isolation and purification of microbial products
2	To understand the kinetics of microbial metabolites and their actions
3	To understand the recovery and product identification from the microbes
4	To know the importance and application of microbial metabolites in the Parma industry
5	To make the students to test and deepen their mastery of microbial products by applying this knowledge in a variety of problem-solving situations.

COURSE OUTCOMES

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

CO1: Describe the historical background and cultural characteristics of microbes	Understand
CO2: Cite the differences between culturing techniques, product purification and recovery process	Understand
CO3: Choose the production process for microbial metabolites	Apply
CO4: Examine the production of primary and secondary metabolites	Apply
CO5: Correlate the factors that play a role in the production of antibiotics.	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	L	L	-	-	L	-	-	L	-	-	M	-	M
CO2	L	M	L	L	-	-	L	-	-	-	-	-	-	M	-
CO3	S	M	L	L	L	M	-	-	-	-	M	M	S	S	M
CO4	S	S	M	M	L	M	-	M	L	-	L	M	S	M	S
CO5	M	S	L	M	M	-	-	-	-	-	-	-	S	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

MICROBES AND APPLICATION

Introduction, aims and scope: Organization and function of prokaryotes, Isolation of industrially important microorganisms from different sources. Extremophiles and their applications: Characteristics of selected groups of microbes. Control of micro organisms- physical and chemical agents. Culture concept and cultural characteristics

ISOLATION OF INDUSTRIALLY IMPORTANT MICROBES

Methods in microbiology- Pure culture techniques, Microbial nutrition and growth principles. Growth measurement techniques: Isolation of microorganisms from various sources, long term preservation and improvement of cultures. Design and Preparation of Media- fermentation processes. Study of various methods of biomass measurement- Growth curve studies of microbes in Batch culture and continuous culture. Determination of yield coefficient and Monod’s constant

INDUSTRIALLY IMPORTANT MICROBIAL METABOLITES

Industrially important microbial metabolites- Process technology for the production of primary metabolites e.g. enzymes (Amylases, Proteases, Lactases, Pectinase and Lipases), baker's yeast, ethanol, citric acid, polysaccharides, nucleosides and bioplastics. Production of secondary metabolites- penicillin, Tetracycline, streptomycin, vitamins etc

APPLICATIONS OF GREEN CONCEPTS

Applications of microbial metabolites: Pharmaceutical industry, Therapeutics, and Clinical analysis- glucose isomerase, aminopeptidase; amylase, cellulase, penicillin acylase, lipase, oxido-reductase; protease etc. for the production of different types of drugs and drugs intermediates. Biogenic synthesis of nanoparticles from microbes-mechanism, characterization, and applications. Microbes in environmental management, Biocontrol, Biofertilizers, and biopesticides

RECOVERY AND PURIFICATION OF MICROBIAL PRODUCTS

Removal of microbial cells- Precipitation, filtration, centrifugation. Cell disruption- extraction and chromatography, Drying and crystallization

TEXT BOOKS:

1. Michael T. Madigan, John M. Martinko, Paul V. Dunlap, and David P. Clark "Brock Biology of microorganisms", Prentice Hall, 12th Edition, 2008
2. Michael J. Pelczar, S. Chan, and Noel R. Krieg "Microbiology", McGraw Hill, 7th Edition, 2011 3.
3. Richard Harvery, Cynthia Nau Cornelissen, Bruce D Fisher, 2011, Microbiology, Lippincott illustrated Reviews: Microbiology.
4. Stanier Y. Roger, Adelberg A. Edward, and Ingraham John "General Microbiology", Prentice Hall, 5th Edition, 1986.

REFERENCES:

1. Geo Brooks, Karen C. Carroll, Janet Butel, and Stephen Morse "Medical Microbiology", McGraw-Hill Medical, 26th Edition, 2012 6.
2. Lansing M. Prescott, Donald A. Klein, and John P. Harley, "Microbiology", McGraw Hill, 5th Edition, 2002 7.
3. G. Reed, Prescott and Dunn's, "Industrial Microbiology", 4th Edition, CBS Publishers, 2009.
4. P. E. Stanbury, A. Whitaker, and S. J. Hall, "Principles of Fermentation Technology", Indian Edition, Hall Books, 2007

COURSE DESIGNERS

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17BTEC10	CRYOPRESERVATION THEORY AND APPLICATIONS	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

Cryopreservation Theory and Applications subject deals with the basic knowledge in the preservation techniques. The course often use cutting-edge techniques and sophisticated machinery along with other applied fields of research to study how the eggs and sperm are preserved for later uses. Knowledge of these principles will enable students to understand the various free drying preservation techniques and its usefulness.

PREREQUISITE –NIL

COURSE OBJECTIVES

1	To recognise the basics of cryopreservation and effects caused by it.
2	Summarize about different types cryopreservation
3	To implement cryopreservation in fertilization process.
4	To outline the knowledge of cryopreservation in therapeutics and other fertilization process
5	To assess the role of cryopreservation in therapeutics.

COURSE OUTCOMES

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

CO1. Generalize the basic principle cryopreservation.	Understand
CO2. Discuss about different types of cryopreservation.	Understand
CO3. Practice the cryopreservation techniques in fertilization process	Apply
CO4. Illustrate the cryopreservation techniques for storage system	Apply
CO5. Establish the importance of cryopreservation process.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Cryopreservation – History and Definition, temperature factor – normal biochemical reaction leading to death, Damages caused by general freezing of cell and tissues, Natural cryopreservation, Gaia theory (James Love Lock), freezing and refrigeration.

VARIATION IN CRYOPRESERVATION

Cryobiology, Cryogenics, Frozen zoo, *ex situ* conservation, Long time preservation.

TECHNOLOGY OF CRYOPRESERVATION

General Biotechnology in cryopreservation, Cellular cryobiology and hydrobiology, Deep freezing damages, *in vitro* storage and cryopreservation.

CRYOPRESERVATION AND FERTILITY

Fertility failures, Embryo cryofreezing, techniques in embryo freezing, Storage thawing, retrieval, Cryoprotectant solution.

CRYOPRESERVATION MAN'S HOPE

Cryopreservation of egg, Sperm of *Homosapiens*, Techniques employed in aquaculture (Fish Plankton), Cawthron collection, Design and use of thermal transport containers for cryopreservation, Role of cryopreservation in therapeutics.

TEXT BOOKS:

1. Annamaria Pardo, John M. Baust and Todd Upton, 2005. Improving Quality in Cryopreserved Cells.
2. Gardner, Weissman, Howles and Shoham, 2009. Textbook of Assisted Reproductive Technology. Informa Health Care. 3rd Edn.

REFERENCES:

1. Walvekar, V. R., Jassawalla, M. J., Anjaria, P. H. And Wani, R. J., 2001. Reproductive Endocrinology. Federation of OGS of India. Jaypee Publications. 2nd Edn.
2. Benson, E., Paul T. Lynch and Glyn N. Stacey, 1998. Advance in Plant Cryopreservation Technology Current Application. Erica.
3. Peter R. Brinsden, 2005. Textbook of in vitro Fertilization and Assisted Reproduction – Guide to Clinical Lab Practice. Taylor & Francis. 3rd Edn.
4. Steven R. Bayer, Michael M. Alperand Alan S. Perzias, 2007. Handbook of Infertility. Informa Health Care. 2nd Edn.
5. Igor I. Katkov, 2012. Current Frontiers in Cryopreservation. Intech Publisher.

COURSE DESIGNERS

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1	Dr.R. Devika	Professor and Head	Biotechnology	devika@avit.ac.in
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17BTEC11	PROTEIN ENGINEERING	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

The aim of the course is to explain the molecular mechanisms at the basis of the structure-function relationships of proteins and the experimental approaches to modulate the protein functionality and to evolve a desired function or structure. The course is also aimed to provide the most updated knowledge/skills related to the production of recombinant proteins. This course is a blend of modern discoveries and applications in protein sciences.

PREREQUISITE –NIL

COURSE OBJECTIVES

1	To recall the translation and post translational modification processes.
2	To discuss the structure, functional correlation and the prediction of properties of protein based on its sequence.
3	To illustrate therole of analytical methods to determine protein structure and protein – protein interactions
4	To observe the similarities in structure at basal level in a group of having similar function, thereby predicting the strategies to modify and design novel proteins.
5	To provide updated knowledge about recombinant proteins and its application in therapeutics

COURSE OUTCOMES

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

CO1. Describe the structure and classification of proteins	Understand
CO2.Identify the amino acid sequence and structure of proteins, and relate this information to the function of proteins strategies.	Understand
CO3. Interpret the characteristics of individual amino acids and their effect on the solubility, structure and function of proteins	Apply
CO4. Develop biotechnical methods to construct plasmids for the expression of natural and modified genes	Apply
CO5. Employ new methodologies for protein engineering and protein design.	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	L	L	L	-	-	-	-	-	-	-	-	-	-
CO2	L	M	M	L	M	-	-	-	-	-	-	-	S	-	-
CO3	S	M	M	M	S	S	-	-	-	-	-	L	S	M	-
CO4	S	M	S	S	S	S	L	-	L	-	-	-	S	S	-
CO5	M	S	S	S	M	M	-	L	-	-	-	L	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

BONDS AND ENERGIES IN PROTEIN MAKEUP

Covalent and Non-covalent interactions in Protein structure, Translation and Post Translational Modifications

PROTEIN ARCHITECTURE

Primary structure, Secondary structures, Super secondary structures, Topology diagrams, Nucleotide binding folds, Tertiary structures, Modular nature and Formation of complexes in Quaternary structures.

PROTEIN FOLDING AND STRUCTURE DETERMINATION

Protein Denaturation and Renaturation, Protein folding pathways, Stability of folded conformation of proteins, Methods to determine primary, tertiary and quaternary structure - Peptide mapping, Peptide sequencing, Circular Dichroism, Mass spectroscopy and X-ray diffraction.

PROTEIN STRUCTURE - FUNCTION RELATIONSHIP

Helix-turn-Helix motifs, Cro, Lamda and Trp repressor, Zn fingers, Tata Box binding proteins, Homeodomain, Leucine zippers, Enzyme - Understanding the catalytic design by engineering trypsin, chymotrypsin and elastase.

PROTEIN ENGINEERING AND PROTEIN DESIGN

Site directed mutagenesis, Engineering of T4 Lysozyme and Recombinant Insulin, Protein design - Principles and examples.

TEXT BOOKS:

1. Branden, C. and Tooze,J., 1999.Introduction to Protein structure. 2nd Garland Publishing, NY, USA. Edn.,
2. Daniel C. Liebler, “Introduction to Proteomics – Tools for the New Biology,” Humana Press, 2001

REFERENCES:

1. Moody P.C.E. and Wilkinson A.J., 1990. Protein Engineer-ing. IRL Press,Oxford, UK.
2. DoanaldVoet and Judith Voet, G., 2001. Biochemistry. 3rd Edn., John Wiley and Sons, 2001.
3. Stefan Lutz and Uwe T. Bornscheuer, 2009. Protein Engineer-ing Handbook. Vol 1 & 2, 1st Edn., Wiley Publishers.
4. Berg, J. M., Tymoczko, J. L. and Stryer, L., 2002. Biochemis-try. 5th Edn., W.H. Freeman and Company.

COURSE DESIGNERS

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17BTEC12	NEUROBIOLOGY AND COGNITIVE SCIENCES	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

Neurobiology is the scientific study of the nervous system. It is a multidisciplinary branch of biology, that deals with the anatomy, biochemistry, molecular biology and physiology of neurons and neural circuits. It also drawn upon other fields, with the most obvious being pharmacology, psychology and medicine. The scope of neuroscience has broadened over time to include different approaches used to study the molecular, cellular, developmental, structural, functional, evolutionary, computational, psychological and medical aspects of the nervous system.

PREREQUISITE –NIL

COURSE OBJECTIVES

1	To learn the basic principles of nervous system and function of neurons
2	To develop knowledge on neurophysiology and synaptic transmission
3	To understand the basic concept of neuropharmacology and neuronal function
4	To understand the concepts of applied neurobiology and its mechanism
5	To make the students to test and deepen their mastery of neurobiology and the importance of behavioural science.

COURSE OUTCOMES

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

CO1: Discuss the anatomy and organization of nervous systems	Understand
CO2: Describe the function of nervous systems	Understand
CO3: Predictthe influence of drugs in the nervous system	Apply
CO4: Examine the basic mechanisms associated with behavioural science	Apply
CO5: Correlate the neurological responses associated with nervous system.	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

NEUROANATOMY

Central and peripheral nervous systems; Structure and function of neurons; types of neurons; Synapses; Glial cells; myelination; Blood Brain barrier; Neuronal differentiation; Characterization of neuronal cells; Meninges and Cerebrospinal fluid; Spinal Cord.

NEUROPHYSIOLOGY

Resting and action potentials; Mechanism of action potential conduction; Voltage dependent channels; nodes of Ranvier; Chemical and electrical synaptic transmission; information representation and coding by neurons.

NEUROPHARMACOLOGY

Synaptic transmission, neurotransmitters and their release; fast and slow neurotransmission; characteristics of neurites; hormones and their effect on neuronal function

APPLIED NEUROBIOLOGY

Basic mechanisms of sensations like touch, pain, smell and taste; neurological mechanisms of vision and audition; skeletal muscle contraction

BEHAVIOUR SCIENCE

Basic mechanisms associated with motivation; control of feeding, sleep, hearing and memory; Disorders associated with the nervous system

TEXT BOOKS:

1. Mathews G.G. Neurobiology, 2nd edition, Blackwell Science, UK, 2000.
2. Gordon M. Shepherd G.M, and Shepherd Neurobiology, 3rd Edition Oxford University Press, USA, 1994

REFERENCES:

1. Mason P., Medical Neurobiology, Oxford University Press, 2011.

COURSE DESIGNERS

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17BTEC13	FOOD MICROBIOLOGY	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

Food microbiology is the study of the microorganisms that inhibit, create, or contaminatefood, including the study of microorganisms causing food spoilage, pathogens that may cause disease especially if food is improperly cooked or stored, those used to produce fermented foods such as cheese, yogurt, bread, beer, and wine, and those with other useful roles such as producing probiotics. Knowledge of these principles will enable practice well in handling food substances carefully.

PREREQUISITE –NIL

COURSE OBJECTIVES

1	To recognize the basic knowledge on food safety levels.
2	To discuss various factors affecting the growth of microorganisms.
3	To classify the role of food preservation techniques
4	To categorise the fermented dairy products
5	To check and prevent the ways of food spoilage substances

COURSE OUTCOMES

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

CO1: Cite the various food safety levels.	Understand
CO2: Explain the various factors affecting growth of microorganisms	Understand
CO3: Articulate the role of food preservation techniques	Apply
CO4: Predict the risk involved in fermented dairy products	Apply
CO5: Able to discriminate the various food spoilage substancesand practice the safety procedures	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	L	L	-	L	-	-	-	-	L	-	M	M	-
CO2	L	L	L	L	-	L	-	-	-	L	-	L	S	-	M
CO3	S	M	S	M	M	M	M	M	-	-	M	-	S	S	M
CO4	S	S	M	S	M	M	M	M	L	-	M	-	S	M	S
CO5	M	M	M	M	M	M	S	M	L	L	M	L	M	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

SCOPE OF FOOD MICROBIOLOGY

The Scope of Food Microbiology. Microorganisms and Food, Food Spoilage/Preservation, Food Safety, Microbiological Quality Assurance**.** Micro-organisms and Food Materials- Diversity of Habitat, Micro-organisms in the Atmosphere - Airborne Bacteria, Airborne Fungi, Micro-organisms of Soil, Micro-organisms of Water, Micro-organisms of Plants, Micro-organisms of Animal Origin.

FACTORS AFFECTING THE GROWTH OF MICROORGANISMS

Factors Affecting the Growth and Survival of Micro-organisms in Foods. -Microbial Growth, Intrinsic Factors- Nutrient Content, pH and Buffering Capacity, Redox Potential, Antimicrobial Barriers and Constituents, Water Activity and Extrinsic Factors - Relative Humidity, Temperature and GaseousAtmosphere

FOOD PRESERVATION

The Microbiology of Food Preservation **-** Heat Processing, Irradiation, High-pressure Processing – Pasteurization, Low-temperature Storage and Chemical Preservatives.

FERMENTED DIARY PRODUCTS

Production of fermented dairy products: Cheese, yoghurt, butter milk, sour cream Fermented vegetables; Sauerkraut, pickles, olives and soy sauce. Fermented meat, Fermented Indian foods - leavening of bread.

FOOD SPOILAGE

Food spoilage**:** Spoilage of fruit and vegetables. Spoilage of cereal and cereal products – cereal grains, and bread. Spoilage of meat and meat products – Bacon and Ham. Spoilage of milk and milk products – butter and frozen desserts. Food borne diseases – indicators of pathogens & food poisoning

TEXT BOOKS:

1. Adams, M.R. and Moss, M.O. 2008. Food Microbiology, RSC Publishing, Cambridge, UK.
2. Benwart, G.J. 1987. Basic Food Microbiology, CBS Publishers & Distributors, New Delhi.
3. Blackburn C. de W. 2006, Food spoilage microorganisms, Woodhead Publishing, Cambridge,UK
4. Frazier, W.C., and Westhoff, D.C. 1988. Food Microbiology (Reprint 1995), Tata McGraw Hill Publishing Ltd., NewDelhi

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REFERENCES:

1. Garbutt, J. 1997. Essentials of Food Microbiology, Arnold – International Students edition,London.
2. Jay J.M. 2000. Modern Food Microbiology. 6th Edition. 2000. Chapman & Hall, New York.
3. Prescott, L.M., Harley, J.P. and Helin, D.A. 2008. Microbiology, Fifth Edition, McGraw Hill, New York.

COURSE DESIGNERS

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17BTEC14	ENDOCRINOLOGY	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

Endocrinology is a branch of biology and medicine dealing with the endocrine system, its diseases and its specific secretions known as hormones. It is also concerned with the integration of developmental events proliferation, growth and differentiation and the psychological or behavioural activities of metabolism, growth and developmental events proliferation, growth and differentiation, tissue function, sleep, digestion, respiration, excretion, mood, stress, lactation, movement, reproduction and sensory perception caused by hormones. Specializations include behavioural endocrinology and comparative endocrinology

PREREQUISITE –NIL

COURSE OBJECTIVES

1	To define the basic principles of endocrine system which consists of several glands
2	To explain about hormones and behavioural endocrinology
3	To Outline the basic concept of female reproductive tract and endocrine regulation of ovarian functions
4	To compare the concepts of fertilization and conception of sexual reproduction
5	To develop diagnostic method for detection of diseases related to endocrine system.

COURSE OUTCOMES

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

CO1:Enumerate about the background and development of endocrine system	Understand
CO2:Indicate the importance of sexual differentiation and the role of biochemical and hormonal aspects	Understand
CO3: Predict the sources of ovarian hormones and regulation of ovarian functions	Apply
CO4 Sketch the internal and external fertilization and genetic recombination.	Apply
CO5: Evaluate the role of hormones in developmental	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	-
CO2	L	L	L	L	-	L	-	-	L	-	-	L	M	M	M
CO3	M	S	M	S	M	-	L		L	-	-	L	M	S	-
CO4	S	M	-	S	M	M	-	-	-	L	-	-	-	S	-
CO5	M	M	L	M	M	M	S	L	M	-	M	M	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

GENERAL ENDOCRINOLOGY

Endocrine glands and hormones, Classification of hormone, Brief account of structural features of endocrine glands. Hormonal effects and regulation – basic concepts and methods. Biosynthesis and secretion of pancreas, adrenal, ovary, testis and thyroid hormones. Factors influencing secretion. Endocrine disorders- brief description.

GONADAL DIFFERENTIATION

Sexual differentiation: Genetic sex- gonadal sex- somatic sex. Differentiation of testis and Ovary: Morphological, biochemical and hormonal aspects. Development abnormalities of male and female sex organs: genetic and endocrine aspects. Hypothalamo- hypophyseal- gonadal axis.

FEMALE REPRODUCTIVE TRACT-I

Study of ovary Ovary: Structure, folliculogenesis, Ovulation. Sources of ovarian hormones, Ovarian androgen, inhibin, Endocrine regulation of ovarine functions

CONCEPTION
Fertilization, Conception, Parturition, Maternal- foetal placental hormones.

APPLIED ENDOCRINOLOGY
Hormones, growth and development, Hormones and human health. Production of hormones as Pharmaceuticals.

TEXT BOOKS:

1. Endocrinology: Adult and Pediatric 7th Edition) *J. Larry Jameson and Leslie J. De Groot* ISBN: 978-0-323-18907-1. 2011.
2. Endocrinology Adult and Pediatric: Reproductive Endocrinology 6th Edition. J. Larry Jameson David de Kretser John Marshall Leslie De Groot. 2013.

REFERENCES:

1. General Endocrinology 6th Edition, C. Donnell Turner and Joseph T. Bagnara. 2009
2. Endocrinology 6th Edition, Mac E Hadley and Jon E Levine, Pearson Publishers. 2010

COURSE DESIGNERS

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17BTEC15	BIOREMEDIATION TECHNOLOGY	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE
Bioremediation technology is one of the emerging technologies in the branch of biotechnology which deals with controlling the pollution with the help of microorganism. Bioremediation technology often use leading-edge techniques and sophisticated machinery along with other applied fields of research like biotechnology, genetics to study microbes and their complex mechanisms in degrading the waste materials. With the Knowledge of these principles students will enable to understand the different approaches to reduce the waste and turning them into valuable bio products.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To discuss the basics about the bioremediation and biodegradation.
2	To describe about the various techniques involved in bioremediation.
3	To outline the role of microorganism in decomposition process.
4	To categorise the different transformation process during bioremediation.
5	To develop a high value bioproducts from renewable sources.

COURSE OUTCOMES	
After the successful completion of the course, learner will be able to	
CO1. Explain about the concepts of bioremediation and biodegradation.	Understand
CO2. Explain about the usage of different techniques involved in bioremediation	Understand
CO3. Compare the aerobic and anaerobic mode of decomposition	Analyse
CO4. Compare the energy transformation process	Analyse
CO5. Appraise the product produced from the renewable sources	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

BASIC STUDIES ON BIOREMEDIATION

History, stages to set up study on bioremediation (Preliminary investigation, site evaluation, laboratory studies, start up, operational support), limitation of bioremediation, relative biodegradability, Process design of aerobic and anaerobic system – Activated sludge process – Trickling filter – Rotating biological contactors – Fluidized bed reactor – Up flow anaerobic sludge blanket reactor (UASB).

BIOREMEDIATION TECHNIQUES

Bioremediation types - In situ and ex situ bioremediation, biophiles, bioventing, land forming, bio stimulation, bioaugmentation, biosparging,biofilters, bio scrubbers and phytoremediation – bioleaching, bio precipitation, bioaccumulation and biosorption. Merits and demerits.

MICROBIAL METABOLISM IN BIODEGRADATION AND BIOREMEDIATION PROCESS

Aerobic and Anaerobic degradation of aliphatic and aromatic compounds – Biodegradation of herbicides and pesticides. Decomposition of organic compounds in natural ecosystems – Co-metabolic degradation of organo-pollutants - Hydrolysis of biopolymers by aerobic and anaerobic microorganisms – Anaerobic degradation of carbohydrates, proteins, lipids – Nitrogen removal – Ammonification, nitrification, denitrification.

BIOREMEDIATION PROCESS

Bioremediation process, metabolic process, energy transformation process, growth requirement, microbial and enzymatic biodegradable mechanism on heavy metals like cadmium and mercury nuclear waste, Bioremediation of greenhouse gas, hydrocarbons. Environmental variation in field.

BIOPRODUCTS FROM RENEWABLE SOURCES

Overview of renewable sources, Production of bio compost and vermicomposting, Production of biofertilizers and biopesticides, Production of biomethane, bioethanol, biohydrogen, biodiesel, Production of bioplastics and biopolymers, Bioelectricity generation and value-added products from renewable sources.

TEXT BOOKS:

1. Mohapatra P.K., 2016. Text Book of Environmental Biotechnology 5th edition, I.K. International Publishing House Pvt. Ltd., New Delhi.
2. Chatterji. A.K., 2011. Introduction to Environmental Technology, 3rd edition Prentice Hall of India Pvt. Ltd., New Delhi,
3. Evans, G.G. and Furlong, J., Environmental Biotechnology: Theory and Application, 2nd Edition, John Wiley & Sons, 2011.
4. Henze, M., Harremoes, P., Jansen, J.C. and Arvin, E., “Wastewater Treatment: Biological and Chemical Processes”, 2 nd Edition, Springer, 2013.

REFERENCES:

1. Popular Biotechnology Lecture Series Focus: Bioremediation by Division of Biotechnology, PSCST, 2013.
2. R.C. Dubey., 2014. A Text Book of Biotechnology by Fifth Revised *Edition* S. Chand Publications.
3. Wong J.W-C., Tyagi R.D., and Pandey. A., 2016. Current Developments in Biotechnology and Bioengineering Solid waste, Elsevier.

COURSE DESIGNERS

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17BTEC16	CANCER BIOLOGY	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

Cancer Biology is to learn the foundation principles in cancer mechanisms. It creates a broad base of knowledge to differentiate normal and cancerous cell and also about different types of agents leading to carcinogenesis. It aims to provide the strength to acquire an advanced knowledge and understanding of the molecular mechanism, diagnosis, prevention and therapeutic management

PRERQUISITE

17BTCC09-MOLECULAR BIOLOGY

COURSE OBJECTIVES

1	To define the basic principles in cancer biology.
2	To discuss about the carcinogens.
3	To demonstrate students on various genetic and molecular changes normal cells undergo during transformation into malignant cancer
4	To outline mechanism of cancer development and progression
5	To have an understanding in a multidisciplinary approach to *cancer treatment*

COURSE OUTCOMES

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

CO1. Summarize the hallmarks of cancer.	Understand
CO2. Discuss about the Carcinogens.	Understand
CO3. Identify the types of gene mutations and cancer formation	Apply
CO4. Utilize the molecular mechanisms underlying the development of cancer,	Apply
CO5. Infer about cancer progression, metastasis and new therapies.	Analyse

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

SYLLABUS

FUNDAMENTALS OF CANCER BIOLOGY

Cell cycle and check points, Cancer mechanism, Receptors, Signal molecules, Signal transduction – Modulation study, Tumour suppressor gene, Different forms of cancers, Diet and cancer. Detection using biochemical assays, Tumor markers, Molecular tools for early diagnosis of cancer.

PRINCIPLES OF CARCINOGENESIS

Theory of carcinogenesis, Chemical carcinogenesis, Metabolism of carcinogenesis, Principles of physical carcinogenesis – X – ray radiation, Mechanism of radiation carcinogenesis.

PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER

Signal targets and cancer, Activation of kinases, Oncogenes, Identification of Oncogenes, Retroviruses and oncogenes, Detection of oncogenes. Oncogenes / Proto oncogene activity. Growth factors related to transformation. Telomerases.

PRINCIPLES OF CANCER METASTASIS

Clinical significances of invasion, Heterogeneity of metastatic phenotype, Metastatic cascade, Basement membrane disruption, Three step theory of invasion, Proteinases and tumour cell invasion, Angiogenesis.

NEW MOLECULES FOR CANCER THERAPY

Different forms of therapy, Chemotherapy, Radiation therapy, Detection of cancers, Prediction of aggressiveness of cancer, Advances in cancer detection, Use of signal targets towards therapy of cancer, Gene therapy

TEXTBOOKS

1. Maly, B.W.J., 1987. Virology A Practical Approach. IRLI Press, Oxford.
2. Dunmock, N.J. and Primrose, S.B., 1988. Introduction to Modern Virology. Blackwell Scientific Publications, Oxford.

REFERENCES:

1. An Introduction Top Cellular and Molecular Biology of Cancer, Oxford Medical Publications, 1991.
2. Primrose, S.B. and Twyman, R.M., 2006. Principles of Gene Manipulation and Genomics. Blackwell Publishing.
3. Lewis J. Klein Smith, 2005. Principles of Cancer Biology. Benjamin Cummings.
4. MomnaHejmadi, 2000. Introduction to Cancer Biology. Asian Publishing Exchange Pvt. Ltd.
5. Leonard Maurice Franks L., Natalie N., 2007. Cellular and Molecular Biology of Cancer. Oxford University Press.

COURSE DESIGNERS

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17BTEC17	APPLIED BIOTECHNOLOGY	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

This is a multidisciplinary course deals with various aspects like plant and animal biotechnology, medical biotechnology, Biopharmaceutical technology, Bioprocess and Environmental biotechnology to educate students within the field of Biotechnology. Students will gain theoretical and practical competence within the broad field of Biotechnology, both in the molecular level as well as with its applications.

PREREQUISITE

17BTCC11-PLANT AND ANIMAL BIOTECHNOLOGY

COURSE OBJECTIVES

1	To list the basic techniques of plant tissue culture for crop improvement.
2	ToDescribethe novel techniques used in medical biotechnology
3	To outline the recombinant therapeutics in pharmaceutical industry
4	To distinguish the uses of different microbes in various industry
5	To execute theuse of genetically engineered organisms in environment

COURSE OUTCOMES

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

CO1. Outline the basic information about plant tissue culture techniques	Understand
CO2. Demonstrate the various novel techniques used in medical field	Understand
CO3. Apply the different methods for the production of therapeutic agents in pharmaceutical industry	Apply
CO4.Examine the uses of genetically engineered microbes in Industrial application	Apply
CO5. Employ the uses of genetically engineered organism in Environmental issues	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

PLANT AND ANIMAL BIOTECHNOLOGY

Plant tissue culture and application of transgenic for crop improvement in agriculture, horticulture and forestry, Plantibodies, plastic from plant, genetically modified soybean, transgenic animals and its uses.

MEDICAL BIOTECHNOLOGY

Gene therapy – gene delivery methods, New approaches, Applications of stem cell in the treatment for major diseases in reparative medicine, Hematopoietic Stem Cell transplantation, Applications of tissue engineering – reconstruction of connective tissues, epithelial and endothelial surfaces, DNA fingerprinting, DNA based diagnosis of Genetic disease.

BIOPHARMACEUTICAL TECHNOLOGY

Production of recombinant pharmaceutical products – Biotechnology derived products (Therapeutic proteins): Study of hematopoietic growth factor, Interferon’s and Interleukins, Insulin, Growth hormones, Vaccines and Monoclonal antibody-based pharmaceuticals, Recombinant coagulation factors and thrombolytic agents, Somatostatin, Somatotropin.

BIOPROCESS TECHNOLOGY

Application of microbes in industry – Industrial Processing, recovery, extraction and purification, Production of antibiotics, solvents, organic acids, amino acids, enzymes, vitamins, single cell protein, food substances from brewing and dairy industry.

ENVIRONMENTAL BIOTECHNOLOGY

Use of genetically engineered organisms, bioleaching and its applications in environmental science, Fuel technology – Ethanol and Biogas. Biotechnological applications in waste management, Novel methods for pollution control, Biosensors, Biodegradable plastics, Biotechnology in Pesticide, Tannery and Paper industry.

TEXT BOOKS

1.Gupta, P.K. , 2015. Elements of Biotechnology. *Rastogi Publications*.
2.Vaidyanath Pratap Reddy and Sathya Prasad, 2004. Introduction to Applied Biology and Biotechnology. 1st Edn., *B. S. Publications.* Hyderabad.
3. Gary Walsh. Biopharmaceutical: Biochemistry and Biotechnology. 2nd Edn., *John Wiley & sons Ltd.*
4. Samuel E. Lynch and Be Roberts J. Geng. Tissue Engineering.

REFERENCE BOOKS

1. Maulik and Patel, 1996. Molecular Biotechnology Therapeutic Applications and Strategies. *Wiley & Sons*.
2. Cruger, W. and Cruger, A., 2004. Biotechnology : A Text Book of Industrial Microbiology. 2nd Edn., *Panima Publishers*.
3. Kumar, H.D. Modern Concepts and Biotechnology. *Vikas Publication House Pvt. Ltd*.
4. Casida, L.E., 2000. Industrial Microbiology. *New Age International*, Delhi.
5. Bernhard Palsson, Jeffery A. Hubble, Robert P. Lonsey, Joseph D. Bronzino, 2005. Tissue Engineering, Principles and Applications in Engineering, *CRC Press*.
6. Sharma, B.K. Environmental Chemistry.

COURSE DESIGNERS

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17BTEC18	METABOLIC ENGINEERING	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

Metabolic engineering involves the redesign of metabolism to enable cells to produce new products such as valuable chemicals and biofuels, and/or remediate toxins. This field is growing rapidly in both academia and industry. The biotechnology industry requires skilled engineers with knowledge of how to apply engineering principles to metabolic pathways in order to analyse, design, and alter cell functions. The introduction of basic concepts, current technologies, and challenges within the field will provide students with a valuable toolset to address metabolic engineering problems that are relevant to the emerging biotechnology industry.

PREREQUISITE –

17BTCC06-ADVANCED BIOCHEMISTRY

COURSE OBJECTIVES

1	To define the appropriate host and/or metabolic pathways to produce a desired product or remediate a toxin
2	To describe and compare the potential metabolic engineering strategies using quantitative metabolic modeling – concepts
3	To analyze metabolic flux and to determine metabolic pathway utilization using 13C-labeling strategies
4	To assess and derive effective combinatorial metabolic engineering strategies
5	To produce those strategies to implement genetic manipulations

COURSE OUTCOMES

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

CO1.Translate the energetics of cellular metabolism	Understand
CO2.Describe the structure and regulation of metabolic networks	Understand
CO3. Establish the optimal strategy for introducing directed genetic changes in the	Apply
CO4. Relate the modern biology with engineering principles.	Apply
CO5. Write Case studies on metabolically engineered products and processes in	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	-	-	-	M	-
CO2	L	L	-	L	-	-	-	-	-	M	-	-	M	M	-
CO3	M	S	M	S	M	L	M	M	M	-	M	-	S	-	M
CO4	S	M	S	M	M	M	L	L	M	M	M	M	M	S	M
CO5	M	M	S	S	M	M	M	M	M	M	M	M	S	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Overview of metabolism, Basic concept of metabolic engineering, Cellular metabolism, Transport Processes-Active and passive transports, Biosynthetic and degradation pathways of amino acids, nucleotides, fats and nucleotides

METABOLIC FLUX ANALYSIS

Introduction to metabolic engineering, comprehensive models of cellular reactions with stoichiometry and reaction rates; metabolic flux analysis of exactly/over/under determined systems. Shadow price, sensitivity analysis.

CONSTRAINT BASED GENOMIC SCALE METABOLIC MODEL

Underdetermined systems- linear programming, sensitivity analysis, Development of Genomic scale metabolic model, Flux balance analysis, Regulatory on-off Minimization and Minimization of metabolic adjustments and Opt knock tool development, Elementary mode analysis, Extreme pathways.

METABOLIC FLUX ANALYSIS BY ISOTOPIC LABELLING

Methods for the experimental determination of metabolic fluxes by isotope labeling metabolic fluxes using various separation-analytical techniques. Validation of flux estimates by 13C labeling studies in mammalian cell culture

CASE STUDIES IN METABOLIC ENGINEERING

Metabolic engineering examples for bio-fuel, bio-plastic and green chemical synthesis. Study of genome scale model in various systems for the production of green chemicals using software tools. Validation of the model with experimental parameters

TEXTBOOKS

1. Smolke, C. (2009). “The Metabolic Pathway Engineering Handbook”, 1st Edn., CRC press.
2. Kholodenko, B. (2004). “Metabolic Engineering in the Post Genomic Era”, New edition Edn., Taylor & Francis.
3. Torres N. V. and Voit, E. O.(2002).“Pathway Analysis and Optimization in Metabolic Engineering”, 1st Edn., Cambridge University Press.
4. Cortassa, S, Aon, M.A. Iglesias, A.A. and Lloyd, D (2002). “An Introduction to Metabolic and Cellular Engineering”, 1st Edn., World Scientific Pub. Co.

REFERENCES

1. NéstorV.Torres and Eberhard O. Voit (2011) Pathway Analysis and Optimization in Metabolic Engineering Ist edition, Cambridge University Press.
2. Gregory N. Stephanopoulos, Aristos A. Aristidou, and Jens Nielsen (1998) Pathway Analysis and Optimization in Metabolic Engineering by Metabolic Engineering: Principles and Methodologies,Academic Press
3. Routledge Chapman &Hall and E. Goldberg (1997), Handbook of Downstream Processing , Inc Staff

COURSE DESIGNERS

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1	Mrs. G. Karthiga Devi	Assistant Professor	Biotechnology	karthigadevi@avit.ac.in
2	Mrs.C.Nirmala	Associate professor	Biotechnology	nirmala@vmkvec.edu.in

17BTEC19	CLINICALTRIALS	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

Clinical Trial is to expose the students to literature survey and to understand research objectives, learn the advanced instrumental techniques to be used in research, and computational application in Pharmaceutical and Medicinal Chemistry research. The students should also be made aware of the research ethics, principles and conduct of clinical trials for medical research and Intellectual Property Right.

PRERQUISITE –NIL

COURSE OBJECTIVES

1	To recognize the research objectives
2	To discuss with the essential components necessary to conduct clinical trial research
3	To Demonstrate the basic principles for design of clinical trials
4	To Execute toxicological studies
5	To Check the interventions

COURSE OUTCOMES

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

CO1. Review the research work.	Understand
CO2. Select the research component	Understand
CO3. Prepare the procedures for clinical trial	Apply
CO4. Appraise the role of toxicology in drug development	Analyze
CO5. Organize a Clinical trial	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	L	M	M	-
CO2	M	M	L	-	L	L	-	L	-	-	L	L	-	M	M
CO3	S	S	S	S	S	M	M	M	M	-	M	L	S	S	S
CO4	M	M	S	M	-	-	S	M	S	M	M	M	-	M	M
CO5	M	S	S	S	M	M	S	M	S	L	M	M	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

PURPOSEOF RESEARCH

Research –Meaning, Purpose,Types, (Educational, Clinical, Experimental, Historical Descriptive, Basic applied and Patent oriented research), Objectives of research, Literature survey –Use of Library, Books and Journals–Medlines–Internet, Patent Search and Reprints of articles as a source for Literature survey, Selecting a problem and preparing research proposals.

BASIC TERMINOLOGY USED IN CLINICAL RESEARCH

Research –Meaning, Purpose, Types,(Educational, Clinical, Experimental, Historical Descriptive, Basic applied and Patent oriented research), Objectives of research, Literature survey –Use of Library, Books and Journals–Medlines–Internet, Patent Search and Reprints of articles as a source for Literature survey, Selecting aproblem and preparing research proposals.

CLINICAL TRIALS

New drug discovery process – Purpose, Main steps involved in new drug discovery process, Timelines of each steps, Advantages and purposes of each steps, Ethics in clinical research, Unethical trials, Thalidomide tragedy, Phase – I, II, III, IV trials (Introduction and designing, Various phases of clinical trials, Post marketing surveillance, Methods, Principles of sampling, Inclusion and exclusion criteria, Methods of allocation and randomization, Informed consent process in brief, Monitoring treatment outcome, Termination of trial, Safety monitoring in clinical trials).

PRECLINICAL TOXICOLOGY

General principles, Systemic toxicology (Single dose and repeat dose toxicity studies), Carcinogenicity, Mutagenicity, Teratogenicity, Reproductive toxicity, Local toxicity, Genotoxicity, Animal toxicity requirements.

APPLICATIONS

Study of various clinical trials (completed or ongoing), Clinical trial applications in India Import and export of drug in India, Investigational New Drug application (IND), Abbreviated New Drug Application (ANDA), New Drug Application (NDA).

TEXTBOOKS

1. Katzung, B. G. Basic and Clinical Pharmacology. *Prentice Hall International*.
2. Laurence, D. R. And Bennet, P. N. Clinical Pharmacology. *Scientific Book Agency*.
3. Krishna, D. R. And Klotz, V. Clinical Pharmacokinetics. *Springer Verlab*.
4. Lippincott, Williams and Wilkins. Remington Pharmaceutical Sciences.
5. Kven Stockley and Hamsten. Drug interaction.

REFERENCES:

1. Ethical Guidelines for Biomedical Research on Human Subjects. *Indian Council of Medical Research*, New Delhi, 2000.
2. Rick, N.G., 2004. Drug from Discovery to Approval. *John Wiley & Sons Inc.*.
3. Mehra, J. K. Drug interaction. *Basic Bussiness Publication.*
4. Grahame smith and Aronson. Clinical Pharmacology and Drug Therapy.
5. Richard A. Helms. Text Book of Therapeutics Drug and Disease Management. Hardbound.
6. Herfindal, E. T., Hirschman, J. L., Williams and Wilkins. Clinical Pharmacy and Therapeut

COURSE DESIGNERS

S.No.	**Name of the Faculty**	**Designation**	**Department**	**Mail ID**
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17BTEC20	**AGRICULTURAL BIOTECHNOLOGY**	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

This course deals about the biology of plants, plant microbe's interaction, genetic manipulation of crops, different vectors and their applications and how plant act as factories for the production of various compounds. This course will prepare the students for a variety of careers, including modern plant biotechnology processes, breeding of healthy plants, plants with improved characteristics and plants for biomolecule production.

PREREQUISITE –NIL

COURSE OBJECTIVES

1	To state the basic of cell structure and function
2	To describe the interaction of microbes and plants
3	To perform the novel techniques used in genetic manipulation in crops
4	To categorise the uses of different vectors in biotechnology
5	To produce the different organic compounds using Plants as Factories

COURSE OUTCOMES

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

CO1. Summarize the basic information about cell structure and functions	Understand
CO2. Demonstrate the plant and microbes interactions	Understand
CO3. Apply the novel techniques used in genetic engineering and genetic manipulation in crop improvement	Apply
CO4. Identify the uses of different vectors and their application in biotechnology field	Apply
CO5. Examine the different organic compounds like vitamins, amino acids and proteins etc, using plant as a major source.	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	-	-	
CO2	L	M	L	L	-	L	-	-	-	-	-	L	-	-	M
CO3	S	S	M	S	M	M	M	-	-	-	-	-	M	S	S
CO4	S	S	M	S	M	M	M	L	-	-	-	-	M	S	S
CO5	M	S	M	M	M	L	S	L	L	M	-	-	M	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

BIOLOGY OF PLANTS

Plant cell structure and functions. Plant nutrition, Water and mineral availability and uptake. Growth regulators-Phytohormones, auxins, cytokines, Gibberellins, Abscisic acid, ethylene.

PLANT –MICROBES INTERACTIONS

Biotic and Abiotic stress. Plant response to pathogens. Toxins of fungi, algae and bacteria. Systemic and induced resistance, pathogen derived resistance. Genetic engineering for biotic stress resistance.

GENETIC MANIPULATION IN CROPS

Genetic engineering- scope and methods. Gene guns, electroporation, transformation, microinjections, CRISPR, TALEN. Types of modifications- Transgenic, cisgenic, subgenic. Stress resistance, pest resistance, herbicide tolerance and other modified traits.

PLASMIDS AND PROMOTERS

Ti and Ri plasmids, Antisense and RNAi in crop improvement. Disarming Ti plasmid, opines and their significance. Co integrate and binary vectors. Screenable and selectable markers. Promoters and poly A signals.

PLANTS AS BIO –FACTORIES
Seed storage proteins, essential amino acids, vitamins and minerals, heterologous protein production in transgenic plants for agriculture, industry and pharmaceuticals uses, biodegradable plastics.

TEXT BOOKS

1. Ahindra Nag. Textbook of Agricultural Biotechnology. PHI Publisher. 2008.

REFERENCE BOOKS

1. Adrian Slater, Nigel Scott and Mark Fowler. 2003. Plant Biotechnology: The genetic manipulation of plants. I edition, Oxford University Press.
2. Vidhyasekaran P. 2005. Bacterial disease resistance in plants. Molecular Biology and Biotechnological applications. Haworth food and agricultural products press. New York.
3. Pessarakti M. 1999. Handbook of planrt and crop stress, 2^{nd} edition. Marcel Dekkar Inc. New York.
4. Melvin J oliver. Agricultural Biotechnology. Wiley Blackwell. 2009

COURSE DESIGNERS

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2	Mrs.C.Nirmala	Associate professor	Biotechnology	nirmala@vmkvec.edu.in

17BTEC21	GENOMICS AND PROTEOMICS	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

Genomics and Proteomics deals with a rapidly evolving scientific area that introduces students into genomes, proteomes and databases that store various data about genes, proteins, genomes and proteomes. Students would learn about genomics, proteomics and bioinformatics and offer basic knowledge of genome sequencing, major differences between prokaryotic and eukaryotic genomes, basic proteomics and its applications. Students would gain skills in applied bioinformatics, comparative, evolutionary, human genomics and functional genomics. The acquired knowledge during the course would be helpful to those students who want to work in core facilities and commercial biological and medical laboratories as well as in their postgraduate studies.

PREREQUISITE –NIL

COURSE OBJECTIVES

1	To explain advanced theoretical knowledge on the organization and function of genomes
2	To execute different mapping techniques.
3	To Perform gene identification and gene expression studies
4	To outline the identification, separation and sequencing of proteins
5	To evaluate the principles of bioinformatics and databases

COURSE OUTCOMES

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

CO1. To describe the organisations genes in prokaryotes and eukaryotes	Understand
CO2. To illustrate various genome mapping techniques and its strategies.	Understand
CO3. To compute the flow of genetic information from DNA to RNA to protein	Apply
CO4. To determine the advantages and the drawbacks of various proteomics technologies with the emerging technologies	Apply
CO5. To evaluate the role of proteomics in drug discovery	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	-	-	-	M	-
CO2	L	L	L	L	-	L	L	-	L	L	L	L	M	M	M
CO3	M	S	S	S	M	-	L	-	-	M	M	-	M	S	M
CO4	-	M	S	S	-	M	M	-	M	-	M	M	-	S	-
CO5	M	M	M	M	M	M	M	L	S	-	M	M	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

OVERVIEW OF GENOMES OF PROKARYOTES, EUKARYOTES AND HUMAN

Organisation of genes, Coding and non-coding chromosomes and high order structures, Genome relatedness, Introduction of genomics.

MAPPING TECHNIQUES

Mapping strategies, Maps – Physical and Genetic maps, Comparative map, Integrated map, Top down and bottom up approach, linking and jumping of clones, STS maps, Human Genome Project

FUNCTIONAL GENOMICS

Gene identification and prediction, Annotation, Functional prediction, Gene expression and micro arrays, Substractive DNA library screening, differential display and representational difference analysis, SAGE.

PROTEOMIC TOOLS

Edman protein microsequencing, Proteome analysis, 2D gel electrophoresis, Metabolic labeling, Detection of protein on SDS gels. Mass spectrometry – MALDI - TOF, Tandem MS - MS, Peptide mass finger printing.

PROTEIN PROFILING AND APPLICATION OF PROTEOMICS

Protein – protein interaction, Post translational modification, Proteomics in drug discovery.

TEXT BOOKS:

1. Rastogi, S.C., Mendiratta, N. and Rastogi, P, 2008. Bioinformatics Methods and Applications. Prentice-Hall of India (Private), Limited.
2. Andreas D. Baxevanis and Francis Oueliette, B.F, 2004. Bioinformatics A Practical Guide to the Analysis of Genes and Proteins, 3rd Edition. *John Wiley and Sons Inc*.

REFERENCES:

1. David W. Mount, 2001. Bioinformatics, Sequence and Genome Analysis. *Cold Spring Harbor Laboratory Press*.
2. Pennington and Dunn, 2001. Proteomics. *BIOS Scientific Publishers*.
3. Liebler, 2002. Introduction to Proteomics. *Humana Prem*.
4. Primrose and Twyman, 2003. Principles of Genome Analysis and Genomics. *Blackwell Publishing Co*.
5. Westhead, D.R., Parish, J.H. and Twyman, R.M., 2003. Instant Notes Bioinformatics. 1stEdn.,*Viva Books Private Limited*.
6. Ignacimuthu, S., 2005. Basic Bioinformatics. *Narosa Publishing House*.

COURSE DESIGNERS

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1	Dr.S.Vinoth	Assistant Professor	Biotechnology	vinoth@avit.ac.in
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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 modelling
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	Understand
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	L	L	-	-	-	-	-	-	-	-	-	-	M	-	-
CO2	L	L	-	-	-	-	-	-	-	-	-	-		M	-
CO3	L	M	-	L	-	-	-	-	-	-	-	-	M	-	-
CO4	S	S	M	S	M	-	-	-	-	-	-	L	-	M	-
CO5	S	S	S	S	M	L	-	-	-	-	-	L	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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17BTEC23	NANOBIOTECHNOLOGY	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

One of major applications of nanoscience is in biotechnology field. In various disciplines, a single course which starts by sensitizing students from a varied background about the biological/biotechnological basics and culminates into modern day applications of nanoscience in biotechnology field will be highly useful. This course will act as a bridge between students from non-biology course at all levels

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To define about the basic concepts of Nanotechnology.
2	To explain about the Fabrication and Characterization of nanomaterials
3	To classify the nanoscale elements delivery in Biosystems
4	To outline the interaction of Microorganism in Nanobiotechnology.
5	To design the novel drug delivery system for *in vivo* studies

COURSE OUTCOMES

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

CO1. Explain the terms and properties of nanoparticles	Understand
CO2. Interpret and characterise the nanoparticles	Understand
CO3. Identify the properties of nanoparticle in signalling pathway	Apply
CO4. Examine the role of microorganisms in Nanobiotechnology	Analyse
CO5. Correlate the role of Nano particles in treatment of disease	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	-	-	-	-	-	-	L	-	-	-	-	M
CO2	L	L	M	L	-	-	L	-	L	L	L	-	S	M	M
CO3	S	S	M	S	M	-	-	-	-	-	M	L	M	S	M
CO4	M	M	M	M	M	-	S	-	M	S	M	M	S	M	M
CO5	M	M	M	M	M	M	S	L	M	S	M	M	S	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO NANOBIOTECHNOLOGY

Introduction to types and properties of nanoparticles, Overview of nanodevices and techniques, Inorganic nano scale systems for biosystems–Nanostructured materials–Fullerenes: Properties and characterization – Carbon nanotubes: Characterisation and application–Quantum dots and wires–Gold Nanoparticles –Nanopores

FABRICATION AND CHARACTERISATION

Synthesis –Top-down and Bottom-up Methods, Epitaxial growth, Characterization: X-Ray Diffraction(XRD), Transmission Electron Microscopy(TEM), Scanning Electron Microscopy (SEM), Scanning Tunneling Microscopy (STM), Atomic Force Microscopy (AFM), Energy Dispersive of X ray spectrum (EDS)

NANOMOLECULES IN BIOSYSTEMS

DNA, RNA, Proteins and Lipids–Nanoscale elements for delivery of materials into cells, Nanotechnology in cell –Cell motility: Nanomotors and cellular navigation– Chemotaxis –Transmembrane signallingand related proteins.

MICROORGANISMS AND NANOBIOTECHNOLOGY

Nanobiotechnology and microorganisms – Polyhydroxy alkanotes (PHA) Cyanophycin inclusions– Magnetosomes– Alginates s-layer proteins –Bacteriorhodopsin.

APPLICATIONS OF NANOBIOTECHNOLOGY

Nanomedicine, Nanobiosensor–Electrochemical DNA sensors, Nanobiochips, Nanocrystals in Biological Detection, Small scale systems for *in vivo* drug delivery, Nanotechnology for diagnosis and treatment (Cancer and Leprosy), Commercializing Nanobiotechnology. Nanotechnology for disaster relief – Decontamination Emergency equipment, Lab on a chip and sustainability.

TEXT BOOKS:

1. BhushanBharat (Ed.). Hand book of Nanotechnology. *Springer* 3rd Edition (2010)
2. Ajayan P.A. and Schadler L, Braun P. V., Nanocomposite Science and Technology. *Wiley– VCH* (2003).
3. Nlemeyer, C.M. (Ed.) andMirkin, C.A. (Ed.) Nanobiotechnology–Concepts, Applications and Perspectives. *Wiley–VCH* (2004)
4. GeoffOzin and Arsenault, A., Nanochemistry: A Chemical Approach to Nanomaterials. 1st Edn., *Royal Society of Chemistry* (2005)
5. Charles P. Poole and Junior Frank J. Owens, Introduction to Nanotechnology. *John Wiley and Sons* (2003).

REFERENCES:

1. Rosenthal, S.J. and Wright, D.W. Nanobiotechnology Protocols in methods in Molecular Biology Series. *Humana Press* (2005).
2. Michael Crichton. Understanding Nanotechnology. *Scientific American Publisher* (2002).
3. RalphS.Greco,FritzB.Prinz and LaneSmithm,R., Nanoscale Technology in Biological systems. *CRC Press* (2005).

COURSE DESIGNERS

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17BTEC24	BIOFERTILIZER TECHNOLOGY	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

This course will provide knowledge of comprehensive understanding of the biofertilizer technology and its current trends. It develops the entrepreneurship to catch with the current trends as well as creating the industry ready professionals.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To state the basic knowledge on biofertilizer in agriculture.
2	To discuss about the role of biofertilizer in crop production
3	To implement the production and application of biofertilizer technology
4	To outline the marketing strategies of biofertilizer.

COURSE OUTCOMES

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

O1. Explain the types and importance of biofertilizer.	Understand
CO2. Outline in detail about the different chemical fertilizer, green manuring and its role in crop production	Understand
CO3. Identify the functions of microorganism from various sources and their mass production	Apply
CO4. Inspect in detail about the application and limitation of biofertilizer in crop field	Apply
CO5. Examine the promotion and strategies improvement in distribution system.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

BIOFERTILIZER

Definition and types, importance of biofertlizers in agriculture, Characteristics of biofertilizers- *Rhizobium, Azotobactor*, *Azospirillum*, Phosphate solubilizing microorganisms, cyanobacteria, *Azolla*, Mycorrhizae. Symbiosis- Physiology, biochemistry and molecular genetics of symbiosis, Enzymes and their regulation: Nitrogenase, hydrogenase

BIOFERTILIZER AND ITS ROLE IN CROP PRODUCTION SYSTEM

Different chemical fertilizer, its function and effect on agriculture. Role of organic matter on crop production and soil health. Various type of bio-inocula and techniques application and keep soil environment free from pollution. Green manuring, its sources, use and role in cropping system.

FUNCTION AND MASS SCALE PRODUCTION

Total and differential count of microorganisms from soil, water and carrier material. Nitrogen cycle andnitrogen fixation technology. Isolation, purification, screening, selection, mass scale production and preservation of *Rhizobia/Bradyrhizobia*, *Azotobacter*, *Azospirillum*, PSB and KSB. General biology, function, use and important of green manuring, particularly Sesbania and Azolla.

APPLICATION TECHNOLOGY

Strain selection, sterilization, growth and fermentation, mass production of various biofertilizers. Application technology: Standards and quality control, application for field and tree crops, nursery plants and seedlings. Limitation of bio-fertilizer and bio-pesticide application in agriculture.

EXTENSION, PROMOTION AND MARKETING

Extension strategies, diagnosis for the effectiveness of inoculation, improvement in distribution system.

TEXT BOOKS:

1. Dr. HLS Tomdon, Fertilizers, organic manures, recyclable water and biofertilizer, Fertilizer development and consultation organization 204-204 A New Delhi.
2. S.L. Tisdale, J.D. Beaton, W.L. Nelson, J.L. Havling, Soil fertility and fertilizers, fifth edition, Mc millan publishing company 866 third avenue new yark.
3. R. Serraj, Symbiotic nitrogen fixation prospects for enhanced application in tropical agriculture, Oxford & IBH publishing Co Pvt. Ltd New Delhi.

REFERENCES:

1. HLS. Tandan, Biofertilizer technology marketing and uses, Fertilizer development.
2. N.S. Subba Rao, Biofertilizer in Agriculture, Oxford & IBH Publishing co.pot ltd.

COURSE DESIGNERS

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1	R. Deepa Priya	Assistant professor	Biotechnology	deepapriya.biotech@avit.ac.in
2	Dr M.Sridevi	Professor & Head	Biotechnology	sridevi@vkvec.edu.in

17BTEC25	BIOLOGY FOR NON BIOLOGISTS	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

The purpose of this course is to provide a basic understanding of biological mechanisms of living organisms from the perspective of engineers. In addition, the course is expected to encourage engineering students to think about solving biological problems with engineering tools.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To list out the students with the basic organization of organisms and subsequent building to a living being
2	To summarize about the machinery of the cell functions that is ultimately responsible for various daily activities.
3	To implement the knowledge about biological problems that requires engineering expertise to solve them.

COURSE OUTCOMES

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

CO1: Outline the structure and cell theory of living organism.	Understand
CO2: Infer about the biological diversity of life.	Understand
CO3: Utilize the application of enzymes in industrial level.	Apply
CO4: Identify the uses of Bioremediation and Biosensors using molecular machines.	Apply
CO5: Analyse in detail about the principles of cell signalling in nervous system and immune system.	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

SYLLABUS

INTRODUCTION TO BIOLOGY – CELL AND CELL STRUCTURE AND FUNCTION

Introduction, Scope, Disciplines of biology –An over View of plants, animal, Microorganism.

INTRODUTION TO BIOLOGY – BIO CHEMISTRY, ENZYME, INDUSTRIAL USE

Prokaryotes – Eukaryotes, Cell, Cell structure, Organelles and their functions, Yeast, Bacteria –Friends and Foe.

FOOD DIET NUTRITION

Major constituents of food – carbohydrate, protein, lipids, vitamins and minerals. Balanced diet-BI-Junk food, Fermented food, nutritional values.

ENVIRONMENT

Clean environment-Reduce, Recycle and Reuse-Renewable energy-Waste management –water-waste water management – personal hygiene, Global Climatic Changes -Tsunami, global warming, storms, vardha, Okhi. Recycled products -Paper, No to plastic, go green.

HEALTH, IMMUNE SYSTEM AND MEDICINE

Immunology- Blood Grouping – Antigen- Antibody. Antibiotics, Vaccines their significance. Diagnosis –Parameters in Urine and Blood. Instruments – ECG, ECHO, MRI, X-ray. Prophylaxis, Chemotherapy and Allergy.

TEXT BOOKS:

1. J.M.Berg, J.L.Tymosczko and L.Sryer. Biochemistry, W.H Freeman publication.
2. Student Companion to accompany Biochemistry, Fifth Edition-Richard I. Gum port.
3. Frank H.Deis, Nancy Count Gerber, Roger E.Koeppe, 2 Molecular motors

REFERENCE BOOKS:

1. Albert's, 2003, Molecular Biology of the cell
2. Lodish, 2004, Molecular cell Biology

COURSE DESIGNERS

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17BTEC26	ECO FRIENDLY MULTI STOREY BUILDING	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

The built environment is a major source of society's environmental impact, and is a major opportunity to find solutions. Recent attention to "green construction" emerges in many domains including energy systems, water use, construction processes, architectural design, site planning and brownfield development, At present, environmental issues can be considered in seemingly unlimited areas of the design and construction process.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To state about the infrastructure providing clean drinking water, clean air to breath and safe building to live in.
2	To explain the students about the threats due to pollution leading to sustainable infrastructure
3	To demonstrate the impact and aspects of green building and Architecture

COURSE OUTCOMES

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

CO1. Explain the concepts related to pollution problem during construction.	Understand
CO2. Classify the design of system for comfortable living	Understand
CO3. Apply geochemical transport model to maintain the thermodynamics equilibrium and kinetic control.	Apply
CO4. Model the Construction of buildings for economically, environmentally and socially sustainable to future.	Apply
CO5. Analyse the resources and sustainability of construction and green buildings	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	-	-	-	-	-	-	-	L	-	-	M	-	-
CO2	L	L	L	-	-	L	M	-	-	-	-	-	-	M	M
CO3	S	M	S	M	M	M	M	-	L	-	L	-	M	S	M
CO4	S	S	S	S	M	M	M	-	M	L	M	L	S	M	S
CO5	M	M	M	M	M	-	S	-	S	-	-	-	M	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

CONCEPTS OF CONSTRUCTING MULTI STOREY BUILDING

Study of water, soil, air and their related pollution problems in construction. Identification and development of technical solution to solve / control problems- legislative, economic and social concern.

CONCEPT OF HUMAN HABITAT

Design of systems – Living area, ventilation, electrical circuits (less consumption) technologies and structures to suit the growing population for comfortable living.

GEOCHEMICAL ASPECTS OF GREEN BUILDING

Geochemical transport model maintaining thermodynamics equilibrium and kinetic control-Hydrology transfer resources and impact of bioremediation, treatment plant design, problem solving techniques, civil and environmental application of engineering science and creative problems solving methods

ENGINEERING ARCHITECTURE

Impact of architecture, engineering and construction on individuals, communities and nation. Construction of buildings which are economically, environmentally and socially sustainable to future - knowledge, tools and materials that enhance the safety and cost effective

RESOURCES AND SUSTAINABILITY

Environmental chemistry, advanced air and water treatment technologies durability of construction, green building (sustainable buildings). Resource efficient building from planning to design, construction, maintenance, renovation and demolition.

TEXT BOOKS:

1. Adaptation and mitigation of climate change - Scientific Technical Analysis. Cambridge University Press, Cambridge, 2006
2. Arvind Krishnan et al. – Climate Responsive Architecture, Tata Mcgraw –Hill New Delhi 2001.

REFERENCE BOOKS:

1. Sandra Mendler, William Odell, The Guide Book Of Sustainable Design, John Wiley & Sons, 2000.
2. Lawson.B , Bulding Materials, Energy And The Environment; Towards Ecologically Sustainable Development Raia, Act, 1996

COURSE DESIGNERS

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1	Dr.S.Vinoth	Assistant Professor	Biotechnology	vinogenes@gmail.com
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17BTEC27	RENEWABLE ENERGY AND CONSTRUCTION METHODS	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

Course provides an introduction to energy systems and renewable energy resources, with a scientific examination of the energy field and an emphasis on alternate energy sources and their technology and application.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To list out the explore society's present needs and future energy demands.
2	To explain conventional energy sources and systems, including fossil fuels and nuclear energy.
3	To perform on alternate, renewable energy sources such as solar, biomass (conversions), wind power, geothermal, and hydro.
4	To outline the energy conservation methods will be emphasized.

COURSE OUTCOMES

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

CO1. Relate the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the environment.	Understand
CO2. Explain remedies/potential solutions to the supply and environmental issues associated with fossil fuels and other energy resources.	Understand
CO3. Identify and describe the primary renewable energy resources and technologies.	Apply
CO4. Choose the basic electrical concepts and system components.	Apply
CO5. Analyse and quantify energy demands and make comparisons among energy uses, resources, and technologies.	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	-	-	-	-	-	-	-	L	-	-	M	-	-
CO2	L	L	L	-	-	L	M	-	-	-	-	-	-	M	M
CO3	S	M	S	M	M	M	M	-	L	-	L	-	M	S	M
CO4	S	S	S	S	M	M	M	-	M	L	M	L	S	M	S
CO5	M	M	M	M	M	-	S	-	S	-	-	-	M	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

PRINCIPLES OF SOLAR RADIATION

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

SOLAR ENERGY COLLECTION STORAGE AND APPLICATIONS

Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors. Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

WIND ENERGY

Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria

BIO-MASS

Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C. Engine operation and economic aspects.

OCEAN ENERGY AND DIRECT ENERGY CONVERSION

OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.
Need for DEC, Carnot cycle, limitations, principles of DEC.

TEXT BOOKS:

1. GD Rai- Non-Conventional Energy Sources, Khanna Publishers, 2004
2. Twidell & Wier Renewable Energy Resources – 3rd Edition –, CRC Pres, Taylor & Francis, 2015

REFERENCES:

1. D.O.hall and R.P. Overeed - Biomass Renegerable Energy – John Wiley and Sons, New york, 1987.

COURSE DESIGNERS

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17BTEC28	ENVIRONMENT FRIENDLY PRACTICES IN CIVIL ENGINEERING	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

This course will make the student aware of the various construction techniques, practices and the equipment needed for different types of construction activities. At the end of this course the student shall have a reasonable knowledge about the various construction procedures for sub to super structure and also the equipment needed for construction of various types of structures from foundation to super structure.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To list out thestudents, who can work in a multi-disciplinary environment to anticipate and address evolving challenges of the 21st century.
2	To summarize the synthesize data with sound engineering principles, methodologies, and the latest technology into creative, sustainable, safe and economical engineering solutions to environmental engineering problems.
3	To classify the Characterize and mitigate natural and man-made hazards
4	To outline the fundamental knowledge of the inter-relationships between the built environment and natural systems.
5	To design the technological innovations needed to safeguard, improve, and economize infrastructure and society
6	To generate and apply high performance eco-friendly structural materials and systems.

COURSE OUTCOMES

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

CO1. Explain the function on multidisciplinary teams.	Understand
CO2. Illustrate, formulate, and solve engineering problems.	Understand
CO3. Identify the professional and ethical responsibility. An ability to communicate effectively.	Apply
CO4. Inspect the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.	Analyse
CO5. Examine the units of energy—to quantify energy demands and make comparisons among energy uses, resources, and technologies.	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	-	-	-	L	-	-	L	L	-	-	-	M	-
CO2	L	L	L	-	-	L	L	-	L	L	-	-	S	M	M
CO3	S	M	S	M	L	M	M	-	M	M	L	-	S	S	M
CO4	M	M	M	M	L	M	S	L	S	-	M	L	S	S	-
CO5	M	M	M	M	M	M	S	L	S	M	M	-	S	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

CIVIL ENGINEERING IN TWENTY FIRST CENTURIES

Essential skills and strategies- critical thinking, finance and economics, design skill, communication, law and ethics, heritage and future.

ENVIRONMENTAL IMPACT DESIGN (EID)

Definition, scope and strategies of EID, categorical types- Direct, indirect and cumulative and its impact. Focus on construction process, materialization and building efficiencies and its life cycle.

GEOCHEMICAL ASPECTS OF GREEN BUILDING

Geochemical transport model maintaining thermodynamics equilibrium and kinetic control-Hydrology transfer resources and impact of bioremediation, treatment plant design, problem solving techniques, civil and environmental application of engineering science and creative problems solving methods

ENVIRONMENTAL GEOLOGY

Introduction, definition, scope, geological factors- location, design, construction, operation and maintenance (residential, commercial and industrial development) stormwater drainage system, sewage treatment plant, geohazards.

ENVIRONMENTAL PUBLIC HEALTH PROTECTION

Definition, discipline - epidemiology, toxicology, exposure science, environmental engineering, law. Environmental health profession.

TEXT BOOKS

1.Prof. D. Venkat Reddy, NIT-Karnataka, Engineering Geology, Vikas Publishers, 2010 ISBN 978-81259-19032

2. Novice, Robert (editor) (1999-03-29). "Overview of the environment and health in Europe in the 1990s" *(PDF). World Health Organization.*

3. Neil S. Grigg, P.E.D.WRE, Marvin E. Crisus, P.E.Darrell, G. Fontune, J.Siller. 2001. Civil Engineering practice in twenty first century. ASCE Press.

REFERENCE BOOKS

1.Legget, Robert F., and Karrow, Paul F., 1983, Handbook of geology in civil engineering: McGraw-Hill Book Company, 1,340 pages, 50 chapters, five appendices, 771 illustrations. ISBN 0-07-037061-3

2.Price, David George, Engineering Geology: Principles and Practice, Springer, 2008 ISBN 3-540-29249-7

COURSE DESIGNERS

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1	Dr. R. Subbaiya	Associate Professor	Biotechnology	rsubbaiya80@gmail.com
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17BTEC29	GREEN BUILDING AND SUSTAINABLE ENVIRONMENT	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

Before starting with this course, one must get a clear knowledge on the basics of green building, learning the plan details of HVAC for a building, energy efficient modelling.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To define, develop and & Plan the details of Implementation.
2	To summarize the fundamentals of electric power systems and building electric wiring.
3	To demonstrate about the Bioclimatic design and concepts.
4	To construct the water conservation & water management systems.
5	To assess the key components of remodelling project.

COURSE OUTCOMES

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

CO1. Interpret the basics of green building	Understand
CO2. Explain the advantages and benefits of green building practices	Understand
CO3. Construct low energy architecture features in residential and commercial buildings	Apply
CO4. Develop proper water conservation systems to make up a healthy building	Apply
CO5. Analyse the green sustainable materials and practices	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	-	-
CO2	L	L	L	-	-	L	M	-	-	-	-	-	-	M	M
CO3	S	M	S	M	M	M	M	-	L	-	L	L	M	S	M
CO4	S	S	S	S	M	M	M	-	M	L	M	L	S	M	S
CO5	M	M	M	M	M	-	S	-	S	-	-	M	M	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

GREEN BUILDING BASICS AND PRACTICES:

Site Design / Development & Plan Implementation, Resource Efficiency, Energy Efficiency, Water Efficiency, Indoor Environmental Quality and Homeowner Education, Operation, Maintenance & Practices. Assessment of building design and construction, emission of CO_2, SO_2, and NO_2 of building materials, elements, and construction process.

ENERGY MANAGEMENT SYSTEM OF BUILDINGS

The objective of the course is to provide students the necessary tools to control, monitor and optimize the building's facilities, mechanical and electrical equipment for comfort, safety, and efficiency. It starts with the fundamentals of electric power systems and building electric wiring and then works through building automation systems (BAS) principles. The course allows students to acquaint applying BAS to commercial HVAC equipment, lighting systems, fire systems and security/observation systems.

LOW ENERGY ARCHITECTURE, PASSIVE BUILDING DESIGN

Solar geometry, climate/regional limitations, natural lighting, passive design and sustainability initiatives, insulating and energy storing material. Bioclimatic design and concepts. Case studies will be used extensively as a vehicle to discuss the success/failure of ideas and their physical applications.

WATER MANAGEMENT, BUILDING METHODS & MATERIALS

Water conservation, water management systems, water efficient landscaping, green roofing, rainwater harvesting, sanitary fixtures and plumbing systems, wastewater treatment and reuse, and process water strategies. AAC (Aerated Autoclave Concrete), ICF (Insulated Concrete Forms), new Advanced Framing & Insulation Techniques, SIPs (Structural Insulated Panels), Straw Bale and Pumice-crete Rammed Earth, Timber Frame, Straw Clay, and Earth ship buildings.

ENERGY EFFICIENT REMODELLING

Key components of remodelling projects-windows, walls, roofs, heating and ventilation, insulation, tighten up the building envelope, Advances in building technology and materials, incorporate active and passive solar into the home or commercial building, Mistakes to avoid, various improvements cost

TEXT BOOKS:

1.Kibert, C. J. “Sustainable Construction: Green Building Design and Delivery,” Second Edition, New York:

1. John Wiley & Sons, Inc., 2008.
2. Thermal analysis and design of passive solar buildings by A. K. Athienitis and Mat Santamouris.
3. Passive building desing by N.K. Bansal, G. Hauser, and G. Minke.

REFERENCES:

1. McDonough, W. and Braungart, M. “Cradle to Cradle: Remaking the Way We Make Things,” New York: Farrar, Straus and Giroux, 2002

COURSE DESIGNERS

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17BTEC30	NATURAL RESOURCES MANAGEMENT	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

Bioresource management showers the knowledge on importance of various resource available in the world and its economic importance. Students will gain the knowledge in wide spectrum of bioresource availability and its culturing method. This paper also deals with the conservation of wild resource and cultivation of valuable products for the sophistication of human life.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To state about the kinds and importance of bioresource management.
2	To describe about the various types of aquaculture and its breeding types.
3	To construct the characteristics of vermiculture and its scope and importance.
4	To categorise and preserve the afforestation process with certain conservation policies.
5	To develop the economic importance of value-added products.

COURSE OUTCOMES

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

CO1. Interpret the basic concepts and importance of Bioresource management	Understand
CO2. Explain the culturing process and various types of aquaculture.	Understand
CO3. Identify the scope and economic importance of vermiculture and sericulture.	Apply
CO4. Categorize the strategies on conservation and management of forest resource.	Analyze
CO5. Analyze the crop improvement technologies in the production of bioresource products.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

BASICS OF BIORESOURCE MANAGEMENT

Basics of Bioresources - Concept, kinds, importance. Human Resource: Management, scope and importance of human resource management (HRM) and personnel management; human development index (HDI). Animal Resources Conservation and Management: Concept on livestock and livestock production management; role in livelihood and nutritional securities; sustainable livestock production, problems and opportunities

AQUACULTURE

Introduction to aquaculture; Prawn culture, Methods of prawn fishing, Preservation and processing of prawn; Pearl culture and status of pearl culture in India; Economically important of fishes. Setting up of a fish farm, Monoculture and composite fish culture, Bundh breeding, Induced breeding, methods of fishing, Fish preservation and processing; Identification of fish diseases and their control.

VERIMICULTURE AND SERICULTURE

Introduction and scope, Species of earthworm, Characteristics features of earthworm. Overview of methods of vermicomposting, Role of earthworm in solid waste management. Vermiwash- its importance, Vermicompost as bio-fertilizer. Overview of scope, economic importance and the product of Sericulture.

FOREST MANAGEMENT AND PLANTS CULTIVATION

Classification and distribution of forests, current strategies of conservation and management of forest resource; agro-forestry, social forestry; Joint Forest Management; National Forest Policy; Forest (conservation) Act, 1980. A brief account of Harlan and Hawkes theories; practices of floriculture, agroforestry, BT crops (brief account).

VALUE ADDED BIORESOURCE PRODUCTS

Economic uses of important cereals, legumes (pulses and fodders), fruits and vegetables, spices and condiments, beverages, oils and fats, essential oils, medicinal plants, hallucinogens (psychotropic drugs), timber plants, fibre plants, natural rubber, resins, raw materials for paper. A brief account of crop improvement technologies, biosafety considerations, natural products.

TEXT BOOKS:

1. Manju Yadav. 2010. "Economic Zoology" Discovery publishing housePvt.Ltd., New Delhi
2. Trivedi, T, R. (2011) "Forest Management"Discovery Publishing Pvt.Ltd. New Delhi
3. Milton Fingerman, RachakondaNagabhushanam 2000. "Recent Advances in Marine Biotechnology" I[st]Edition Science Pub Inc.

REFERENCES:

1. Peter Bettinger Kevin Boston Jacek Siry Donald Grebner 2017. Forest Management and Planning 2nd Edition. Academic press.

COURSE DESIGNERS

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17BTEC31	APPLICATIONS OF ENZYME IN WASTE MANAGEMENT	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

This course explains about different waste generation in environment, management of waste, general characters of enzymes, their immobilization process, makes an attempt to bring students in direct contact with nature, to find the environmental problems and possible solutions. To empower the students to enrich their knowledge on waste treatment using biocatalyst to solve the environmental pollution.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To state the basic knowledge on different wastes
2	To discuss about the waste management methods
3	To perform the waste treatment using enzymes
4	To implement the basics of enzyme immobilization process
5	To outline the students to basic knowledge concerning biodegradation with the usage of enzymes

COURSE OUTCOMES

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

CO1. Illustrate and classify the different wastes in environment	Understand
CO2. Planthe waste management methods using enzyme engineering techniques	Apply
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	L	-	-	-	-	-	-	-	L	-	-	S	M	M
CO2	S	S	M	S	L	L	M	-	L	L	L	-	S	S	M
CO3	S	M	S	M	M	M	M	-	L	-	L	L	S	S	M
CO4	S	S	S	S	M	M	M	-	M	L	M	L	M	M	S
CO5	M	M	M	M	M	-	S	-	S	-	-	M	S	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

CLASSIFICATION AND TECHNOLOGIES IN REDUCING WASTE

Definition of waste, and its classification, Waste treatment technologies including waste incineration and energy from waste, advanced conversion technologies of pyrolysis and gasification, anaerobic digestion, composting and biological treatment of wastes.

WASTE AND RESOURCE MANAGEMENT

3 RS, Advances in waste recycling and recovery technologies to deliver added value products; Landfill engineering, Sustainability and resource efficiency with consideration for materials flow through the economy, steps towards designing out waste and maximizing the value of outputs from waste treatment processes.

ENZYME IN WASTE TREATMENT

Enzymes in enhanced oil recovery; treatment of wastewater of brewery, pharmaceutical, textile dyeing, metal processing, petrochemical, pulp and paper industry; role of natural/stimulated, dead/spent microbial cultures, GMOs, phytoremediation. Biological indicators of waste by enzyme.

ENZYME ACTION AND IMMOBILIZATION

Action of enzyme on xenobiotic compound, phenolic compounds, pesticides (organo chlorinated, organo phosphorous and carbonated) immobilization techniques.

BIOSENSOR AND OPTICAL INSTRUMENTS

Birth of biosensors, advantages and disadvantages, construction of biosensors- enzyme and microbial biosensor. Transducers- piezoelectric, potentiometric, amperometric and fiber optics.

TEXTBOOKS:

1. Instant Notes in Ecology by A. Mackenzie, A.S. Ball and S.R. Virdee, Bios Scientific Publishers Ltd., UK, 1999.
2. Biotechnology-Applications to Environmental Protection by M.M. Pandey, Himalaya Publishing House, 1993.
3. Pesticide Properties in the Environment by A.G. Hornsky, R.D. Wauchope and A.E. Herner, Springer-Verlag, New York Inc., 1996.
4. Basic Environmental Science by G.S.P. Iyer, Educational Publishers and Distributers, New Delhi, 1997.

REFERENCES:

1. Popular Biotechnology Lecture Series Focus: Bioremediation by Division of Biotechnology, PSCST, 2013.
2. Pesticide Properties in the Environment by A.G. Hornsky, R.D. Wauchope and A.E. Herner, Springer-Verlag, New York Inc., 1996.
3. Introduction to Environmental Technology by A.K. Chatterji, Prentice Hall of India Pvt. Ltd., New Delhi, 2002.

COURSE DESIGNERS

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1	Dr. A. Nirmala	Assistant professor (Gr-II)	Biotechnology	nimmi_aruna@yahoo.com
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17BTEC32	BIOLOGICAL DATABASE	Category	L	T	P	Credit
		EC (PS)	3	0	0	3

PREAMBLE

This course is designed to impart the knowledge on *Biological database* and they deals with libraries of life sciences information, collected from scientific experiments, published literature, high-throughput experiment technology, and computational analysis.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To state the knowledge on Bioinformatics and Database management
2	To explain the basics of Genome databases
3	To demonstrate the different methods of sequence databases
4	To outline the basics of homology modelling
5	To assess the regulatory of structural similarities

COURSE OUTCOMES

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

CO1: Explain the design and Database management	Understand
CO2: Infer the genome browsers and databases	Understand
CO3: Identify different methods of sequence databases	Apply
CO4: Distinguish the Molecular modelling and enzyme databases	Analyse
CO5: Inspect the sequence and motif -based search engines	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	-	-	-	L	-	-	L	L	-	-	-	M	-
CO2	L	L	L	-	-	L	L	-	L	L	-	L	S	M	M
CO3	S	M	S	M	L	M	M	-	M	M	L	L	S	S	M
CO4	M	M	M	M	L	M	S	-	S	-	M	L	S	S	-
CO5	M	M	M	M	M	M	S	-	S	M	M	M	S	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO BIOINFORMATICS DATA AND DATABASES

Types of Biological data:- Genomic DNA, Complementary DNA (cDNA), Recombinant DNA (rDNA), Expressed sequence tags (ESTs), Genomic survey sequences (GSSs). Primary Databases: - GenBank, EMBL, DDBJ, Composite Databases:-NRDB, UniProt, Literature Databases:- Open access and open sources, PubMed, PLoS, Biomed Central

GENOME DATABASES

Viral genome database (ICTVdb, VirGen), Bacterial Genomes database (Genomes OnLine Database –GOLD, Microbial Genome Database-MBGD), Organism specific Genome database (OMIM / OMIA, SGD, WormBase, PlasmoDB, FlyBase, TAIR), and Genome Browsers (Ensembl, VEGA genome browser, NCBI-NCBI map viewer, KEGG, MIPS, UCSC Genome Browser).

SEQUENCE DATABASES

Nucleotide sequence Databases (GenBank, EMBL, DDBJ).). Protein sequences Databases (Swiss-Prot, TrEMBL, UniProt Knowledgebase – UniProtKB, UniProt Archive –UniParc, UniProt Reference Clusters –UniRef, UniProt Metagenomic and Environmental Sequences –UniMES. Sequence motifs Databases:-Prosite, ProDom, Pfam, InterPro. Sequence file formats:-GenBank, FASTA, PIR, ALN/ClustalW2, GCG/MSF.

STRUCTURE AND DERIVED DATABASES

The primary structure databases (Protein Data Bank –PDB, Cambridge Structural Database –CSD, Molecular Modeling Database -MMDB). The secondary structure databases (Structural Classification of Proteins –SCOP, Class Architecture Topology Homology –CATH, Families of Structurally Similar Proteins –FSSP, Catalytic Site Atlas –CSA. Molecular functions/Enzymatic catalysis databases (KEGG ENZYME database, BRENDA).

BIOINFORMATICS DATABASE SEARCH ENGINES

Text-based search engines (Entrez, SRS, DBGET / LinkDB). Sequence similarity based search engines (BLAST and FASTA). Motif-based search engines (ScanProsite and eMOTIF). Structure similarity based search engines (VAST and DALI). Proteomics tools at the ExPASy server, GCG utilities and EMBOSS

TEXT BOOKS

1. Bioinformatics: Sequence and Genome Analysis by Mount D., Cold Spring Harbor Laboratory Press, New York. 2004
2. Bioinformatics- a Practical Guide to the Analysis of Genes and Proteins by Baxevanis, A.D. and Francis Ouellellette, B.F., Wiley India Pvt Ltd. 2009

REFERENCES BOOK

1. Introduction to bioinformatics by Teresa K. Attwood, David J. Parry-Smith. Pearson Education. 1999.

COURSE DESIGNERS

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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	-	-
CO4	S	M	M	M	S	-	-	-	-	-	M	L	M	-	-
CO5	S	M	M	M	M	-	-	-	-	-	M	L	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. B. Stroustrup, “The C++ Programming language”, Third edition, Pearson Education, 2004.

COURSE DESIGNERS

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

S- Strong; M-Medium; L-Low

SYLLABUS
OPERATING SYSTEM

Introduction & Structure: Basics, OS Architecture, OS Operations, System calls.

PROCESSES &SYNCHRONIZATION

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

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

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

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	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
CO1: Able to Understand basics in Cloud Computing	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

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.

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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	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 Infrastructur.

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.

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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

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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.

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

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17BMCC03	BIOSENSORS AND TRANSDUCERS	Category	L	T	P	Credit
		CC	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	--	M	--
CO2	M	L	--	M	--	M	--	--	L	--	--	M	--	M	--
CO3	S	M	L	S	--	S	M	M	M	--	--	M	M	M	M
CO4	S	S	L	S	--	S	M	M	S	--	--	M	M	M	S
CO5	S	S	L	S	--	S	M	M	S	--	--	S	M	M	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

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3	Dr.N.Babu	Professor	BME	babu@vmkvec.edu.in

17BMCC05	PATHOLOGY AND MICROBIOLOGY	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

The curriculum of pathology aims at preparing the students in basic understanding of diseases and their pathogenesis. The topics build the concepts of how human system works in altered and diseased stage under the influence of various internal and external stimuli. Thus the syllabi of pathology compliments and supplements the necessary knowledge, students have gained in physiology. The Microbiology course has been formulated to impart basic and medically relevant information on the microbes. The microbial structure, growth and development, methods and role of sterilization in the context of study of microbes are included.

PRERQUISITE : NIL

COURSE OBJECTIVES

1	To understand the basic concept in pathology.
2	To understand the altered state of human body in different diseased condition.
3	To illustrate the working principle of various microscopes and demonstrate the specimen preparation.
4	To outline the pathogenesis of viral and bacterial diseases and their control.
5	To categorize the various immunological and sterilization techniques.

COURSE OUTCOMES

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

CO1. Describe the cellular responses to stress, cell degeneration, cellular repair and concepts of tumour.	Understand
CO2. Explain the causes and pathophysiology of different fluid and Haemodynamic disorders.	Understand
CO3. Apply the knowledge to operate the different types of microscopes and prepare the specimens for observation.	Apply
CO4. Identify the causes and prevention method to control various infectious diseases due to bacteria, and viruses.	Analyze
CO5. Diagnose the infectious diseases using immunological techniques like Immunofluorescence, ELISA, RIA and compare the sterilization 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	M	--	--	--	--	--	--	--	M	--	--	M	M	S	M
CO2	M	--	--	--	--	--	--	--	S	--	--	S	M	S	M
CO3	S	S	M	--	--	--	--	--	S	--	--	S	M	S	M
CO4	S	S	S	--	M	M	M	--	S	--	--	S	S	S	S
CO5	S	S	S	--	M	M	--	--	S	--	--	S	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

CELL DEGENERATION, REPAIR AND NEOPLASIA: Introduction to pathology, Cellular responses to stress, Cellular adaptations, Cell injury and Necrosis – causes, mechanism and morphology, Apoptosis, Inflammation, Tissue repair, Neoplasia - Classification, Benign and Malignant tumours, Carcinogenesis, Etiology and Spread of tumours.

FLUID AND HEMODYNAMIC DERRANGEMENTS: Edema, Normal haemostasis and Thrombosis, Disseminated intravascular coagulation, Embolism, Infarction, Shock. Haematological disorders – Red cell Disorders, White cell disorders, Bleeding disorders.

STRUCTURE OF BACTERIA, VIRUSES AND MICROSCOPY: Morphological features and structural organization of bacteria, Bacterial growth and Nutrition, Growth curve, Culture media and its types, Culture techniques and observation of culture. Viruses – Structure, Classification and Replication. Light microscope, Bright field, Dark field, Phase contrast, Fluorescence and Electron microscope (TEM& SEM), Preparation of samples for electron microscope, Staining methods – Simple, Gram's staining and AFB staining.

IMMUNITY, INFECTION AND DISORDERS: Antigen, Antibodies and its types, Immunity – Innate and Adaptive immunity, Immunodeficiency diseases, Genetic disorders, Hypersensitivity diseases, Bacterial, Viral, Fungal, Protozoan and Helminthic diseases.

IMMUNOLOGICAL TECHNIQUES AND CONTROL OF MICROORGANISMS: Agglutination and Precipitation reactions, Immunofluorescence, ELISA, RIA. Diagnosis of Infectious Diseases. Methods of Sterilization and disinfection: Physical Methods **-** Dry heat, Moist heat, Filtration, Radiation, Chemical Methods – Alcohol, Aldehyde, Dyes, Halogens, Phenols, Ethylene oxide.

TEXT BOOKS:

1. Robbins & Cotran, **"Pathologic Basis of Disease"**, 9th Edition, Saunders Co. 2014.
2. Anatha Narayanan R & Jayaram Panicker C.K, "**Text Book of Microbiology"**, 10th Edition, Orient Longman, 2017.

REFERENCES:

1. Prescott, Harley, Klein, **"Microbiology"**, 7th Edition, Mc Graw Hill, 2008.
2. Janis Kuby, **"Immunology"**, 5th Edition, W.H. Freeman and Company, New York, 2003.

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17BMEC01	**MEDICAL OPTICS**	Category	L	T	P	Credit
		EC-PS	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 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	M	M
CO2	S	M	L	--	--	--	--	--	L	--	--	S	M	M	M
CO3	S	S	M	M	--	M	--	--	M	--	--	S	M	S	M
CO4	S	S	S	S	M	M	--	L	M	M	--	S	S	S	M
CO5	S	S	S	S	M	M	--	L	M	M	--	S	S	S	M

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

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17BMEC02	BIOTELEMETRY	Category	L	T	P	Credit
		EC-PS	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

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17BMEC04	MEMS AND ITS BIOMEDICAL APPLICATIONS	Category	L	T	P	Credit
		EC-PS	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

CO16.	Discuss the concepts of microfluidic systems.	Understand
CO17.	Explain about the basics of working of MOEMS Technology.	Understand
CO18.	Illustrate the working principle of MEMS & Microsystems.	Apply
CO19.	Analyze the nanomaterial in various biomedical applications.	Analyze
CO20.	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	M
CO3	S	M	M	--	--	--	--	--	M	--	--	S	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	M	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.

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3	Mr.S.Kannan	Assistant Professor	BME	kannan@vmkvec.edu.in

17BMEC09	DESIGN OF MEDICAL DEVICES	Category	L	T	P	Credit
		EC-PC	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

CO21.	Discuss the necessary steps to take an idea to a prototype.	Understand
CO22.	Utilize fundamental design principles, machine elements, manufacturing and assembly techniques.	Apply
CO23.	Analyze risk management concepts into the quality management system.	Analyze
CO24.	Assess the medical device regulatory framework for any given country based upon device type.	Evaluate
CO25.	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	M	M
CO4	S	S	M	M	M	S	--	M	S	--	M	S	S	S	M
CO5	S	S	S	M	M	S	--	M	S	--	M	S	S	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

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17BMEC13	PRINCIPLES OF TISSUE ENGINEERING	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

The goal of tissue engineering is to replace or even improve biological tissues and their functions by the use of engineering methods and life sciences.The fast-moving fields oftissue engineering are considered to have transformative implications for futurebiomedical applications and the future health care. This course gives an overview on the current state intissue engineering, for example cell culture, molecular aspects, and engineering biomaterialswith additional focus on case study.

PRERQUISITE: NIL

COURSE OBJECTIVES

1	To understand about the different types of tissues.
2	To illustrate the aspects of cell culture.
3	To illustrate the molecular aspects in tissue engineering.
4	To outline thebiomaterials for tissue engineering.
5	To analyse the case study and regulatory issues in tissue engineering.

COURSE OUTCOMES

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

CO1. Explain the structure and organization of tissues.	Understand
CO2. Describe the different cell types andaspects of cell culture.	Understand
CO3. Apply the engineering tissues for replacing bone, cartilage, tendons, ligaments, skin and liver.	Apply
CO4. Examine the case study in tissue engineering.	Apply
CO5. Analyze the molecular aspects in tissue engineering.	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	--	--	--	--	--	--	--	--	--	--	--	S	M	S
CO2	M	--	--	--	--	--	--	--	--	--	--	--	S	M	S
CO3	S	S	--	--	--	M	--	--	M	--	--	M	S	S	S
CO4	S	M	M	--	--	M	--	--	M	--	--	M	S	S	S
CO5	S	M	--	S	--	M	L	L	M	--	--	M	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Basic definition, Structural and organization of tissues: Epithelial, connective; vascularity and angiogenesis, basic wound healing, cell migration, current scope of development and use in therapeutic and in-vitro testing.

CELL CULTURE

Different cell types, progenitor cells and cell differentiations, different kind of matrix, cell-cell interaction. Aspects of cell Culture: cell expansion, cell transfer, cell storage and cell characterization, Bioreactors.

MOLECULAR BIOLOGY ASPECTS

Cell signaling molecules, growth factors, hormone and growth factor signaling, growth factor delivery in tissue engineering, cell attachment: differential cell adhesion, receptor-ligand binding, and Cell surface markers.

SCAFFOLD AND TRANSPLANT
Engineering biomaterials for tissue engineering, Degradable materials (collagen, silk and polylactic acid), porosity, mechanical strength, 3-D architecture and cell incorporation. Engineering tissues for replacing bone, cartilage, tendons, ligaments, skin and liver. Basic transplant immunology stems cells: introduction, hepatopoiesis.

CASE STUDY AND REGULATORY ISSUES
Case study of multiple approaches: cell transplantation for liver, musculoskeletal, cardiovascular, neural, visceral tissue engineering. Ethical, FDA and regulatory issues of tissue engineering.

TEXT BOOK:

3. Robat Lanza and Robert Langer, **"Principles of Tissue Engineering"**, Elsevier, 2007.

REFERENCES:

3. Bernhard O. Palsson, Sangeeta N. Bhatia, **"Tissue Engineering"**, Pearson Publishers 2009.
4. Ed. Joseph D. Bronzino, **"The Biomedical Engineering Hand Book"**, Second Edition, CRC Press LLC, 2000.

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17BMEC22	MEDICAL ETHICS AND STANDARDS	Category	L	T	P	Credit
		EC-PS	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	S
CO3	L	--	--	--	--	L	--	M	--	--	--	S	M	M	S
CO4	M	--	--	--	--	M	--	S	L	--	--	S	S	M	S
CO5	M	--	--	--	--	M	--	S	M	--	--	S	S	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.

COURSE DESIGNERS

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17BMSE23	MEDICAL WASTE MANAGEMENT	Category	L	T	P	Credit
		EC-SE	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	S	M	S
CO2	S	M	M	--	--	M	S	S	S	--	--	S	S	M	S
CO3	S	S	M	--	--	S	S	S	S	L	M	S	S	S	S
CO4	S	S	M	--	--	S	S	S	S	M	M	S	S	S	S
CO5	S	S	M	--	--	S	S	S	S	M	M	S	S	S	S

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-SE	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 knowledge about the Home Medicare in various clinical application.
2	To make the students understand the active control trials in the evaluation of new treatments.
3	To impart the knowledge about Legal issues and Health policies related to Biosciences.
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

CO26.	Explain the system description of different therapeutic & diagnostic equipments.	Understand
CO27.	Use the ethical and regulatory guidance.	Apply
CO28.	Categorize healthcare technologies and wireless technology related to healthcare system.	Analyze
CO29.	Illustrate the advancement in medical technologies.	Analyze
CO30.	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	M
CO2	S	S	M	M	--	M	--	S	S	--	--	S	--	--	S
CO3	S	S	S	M	M	M	--	M	S	--	--	S	M	S	S
CO4	S	S	S	S	M	S	--	M	S	M	--	S	M	M	M
CO5	S	S	S	S	M	S	S	M	S	M	--	S	S	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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17BMSE28	NANO TECHNOLOGY IN MEDICINE	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE
To study about Nano materials, fundamentals of nano technology & applications of Nanotechnology.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To know about the concept of Nanotechnology.
2	To study about the fundamentals of Nanoscience.
3	To study about materials and properties used for MEMS & NEMS.
4	To know about the medical use of nanomaterials.
5	To study about the medical applications.

COURSE OUTCOMES

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

CO31. Describe the basic science behind the properties of materials.	Understand
CO32. Explain the basics properties of NEMS.	Understand
CO33. Apply their knowledge of nanotechnology to identify how they can be exploited for new applications.	Apply
CO34. Outline the applications of nanomedicine.	Analyze
CO35. Analyze the biomolecular components like nanotubes with nanotechnology.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION
Introduction to Nanotechnology: Nanomaterials, Fullerenes and carbon forms. Nanoparticles and Colloids, structure and bonding in nanoparticles, Nanomaterials fabrication by Bottom-up and Top down approaches, Classification of nanodevices based on the characteristics, Quantum dots and their properties.

FUNDAMENTALS OF NANOSCIENCE
Size dependence of properties – Particle size determination – Bulk to nanotransition – Semiconducting nanoparticles – Carbon nanostructures – Mechanical properties (hardness, ductility, elasticity) – Optical properties of nanotubes – Electrical properties of nanotubes.

MEMS & NEMS

Definition of MEMS, materials for MEMS (Silicon, Polymers and metals) and their properties, Deposition processes, Photolithography, and etching processes, Limitations of MEMS, NEMS, difference between MEMS and NEMS, properties of NMES, fabrication processes, applications.

NANOMEDICINE

Nanomedicine: Medical use of Nanomaterials, Drug delivery systems. Cancer treatment, Surgery. Drug tracking systems. Targeted drug delivery systems.Applications of Nanomaterials in Medical imaging. Neuro-electronic interfaces.

BIO MOLECULAR NANOTECHNOLOGY

Nanorobots and their application, nanosensors based on biomolecules such as DNA and proteins, nanoparticles for gene delivery systems, Computational genes, Biosensors for Glucose and measurement, Optical biosensors and their application ,Preparation of Nanosystems: Introduction to nanolithography – Carbon nanotubes: preparation – Synthesis and preparation of nanomaterials (crystalline and thinfilm) - Physical and chemical methods - Control and stability (size, shape, composition).

TEXT BOOKS:

1. Lynn E. Foster, Foreword by George Allen, Foreword by Joe Lieberman, **“Nanotechnology’**.
2. Di Ventra, Massimiliano; Evoy, Stephane; Heflin, James R., **“Introduction to Nanoscale Science and Technology”**, Springer publications, 2004.

REFERENCES:

1. Chattopadhyay, **“Introduction to Nanoscience and Nanotechnology"**, PHI, 2009.
2. B.k. Parthasarathy, **“Nanoscience and Nanotechnology”**, Gyan Books, 2007.

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17CVEC35	MUNICIPAL SOLID WASTE MANAGEMENT	Category	L	T	P	Credit
		EC	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.

PRERQUISITE

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

S- Strong; M-Medium; L-Low

SYLLABUS

SOURCES AND TYPES OF MUNICIPAL SOLID WASTES

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.

ON-SITE STORAGE & PROCESSING

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.

COLLECTION AND TRANSFER

Methods of Collection – types of vehicles – Manpower requirement – collection routes; transfer stations – selection of location, operation & maintenance; options under Indian conditions.

OFF-SITE PROCESSING

Processing techniques and Equipment; Resource recovery from solid wastes – composting, incineration, Pyrolysis – options under Indian conditions.

DISPOSAL

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.

REFERENCES

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	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	Understand
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. The course offers 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	S
CO2	S	M	L	L	L	M	---	L	---	L	L	---	M	M	S
CO3	S	M	L	L	L	M	---	L	---	L	---	---	M	M	S
CO4	S	M	M	S	L	---	---	L	---	L	---	L	M	M	S
CO5	S	M	M	S	---	---	---	M	---	M	L	---	S	L	S

S- Strong; M-Medium; L-Low

SYLLABUS

SOURCES AND EFFECTS OF AIR POLLUTANTS : 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.

DISPERSION OF POLLUTANTS : Elements of atmosphere – Meteorological factors – Wind roses – Lapse rate - Atmospheric stability and turbulence – Plume rise – Dispersion of pollutants – Dispersion models – Applications.

AIR POLLUTION CONTROL : 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.

AIR QUALITY MANAGEMENT : 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

NOISE POLLUTION: 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	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	Analysis of Simple statistical and application of probability
4	Student will also learn simple methods of flood routing and ground water hydrology.
5	Distribution of rainfall and run off shall also be understood.

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	Create
CO4. Estimate floods and propose suitable control measures	Evaluate
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	L	L
CO2	S	M	L	L	-	-	S	-	-	-	-	M	L	L	-
CO3	S	M	L	L	-	-	M	-	-	-	-	L	L	L	-
CO4	S	M	-	L	-	-	S	-	-	-	-	L	L	L	-
CO5	L	-	L	-	-	L	M	L	L	L	-	L	L	L	S

S- Strong; M-Medium; L-Low

SYLLABUS

PRECIPITATION: 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.

ABSTRACTION FROM PRECIPITATION: Losses from precipitation – Evaporation process – Reservoir evaporation – Infiltration process – Infiltration capacity – Measurement of infiltration – Infiltration indices – Effective rainfall.

HYDROGRAPHS: Factors affecting Hydrograph – Baseflow separation – Unit hydrograph – Derivation of unit hydrograph – S curve hydrograph – Unit hydrograph of different deviations - Synthetic Unit Hydrograph

FLOODS AND FLOOD ROUTING: Flood frequency studies – Recurrence interval – Gumbel's method – Flood routing – Reservoir flood routing – Muskingum's Channel Routing – Flood control

GROUND WATER HYDROLOGY: 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., 2000

2. Raghunath, H.M., “Hydrology”, Wiley Eastern Ltd., 2000

REFERENCES:

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.

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17CVEC07	DISASTER MITIGATION AND MANAGEMENT	Category	L	T	P	Credit
		EC	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	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	-	-	L	-	-	-	-	-	-	-	-	L	-	-
CO2	M	M	L	L	-	M	-	-	-	-	-	-	L	-	-
CO3	S	M	S	M	-	L	-	M	-	-	-	-	M	L	-
CO4	S	M	S	-	L	-	-	-	-	-	-	-	M	L	-
CO5	L	L	-	L	-	-	-	-	-	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION: Concept of disaster; Different approaches; Concept of Risk; Levels of disasters; Disaster phenomena and events (Global, national and regional); Natural and man-made hazards

RISK ASSESSMENT AND VULNERABILITY ANALYSIS: 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

DISASTER MANAGEMENT MECHANISM: Concepts of risk management and crisis management ; Disaster management cycle ;Response and Recovery ; Development, Prevention, Mitigation and Preparedness; Planning for relief

DISASTER RESPONSE: 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.

DISASTER MANAGEMENT IN INDIA: 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.

REFERENCES:

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.

COURSE DESIGNERS

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17CVEC08	REMOTE SENSING TECHNIQUES AND APPLICATIONS	Category	L	T	P	Credit
		EC	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	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION: 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.

LAND USE STUDIES: 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.

WATER RESOURCES: 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.

AGRICULTURE, SOIL AND FORESTRY: 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.

EARTH SCIENCE: 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

REFERENCES:

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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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/

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17EEEC18	RENEWABLE ENERGY TECHNOLOGY	Category	L	T	P	Credit
		EC(PS)	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	To familiarize the student with the utilization methods of the renewable energy resources
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 – Thermal Energy 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 – Thermal Energy 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 cell array design concepts - PV system design - design process and optimization - detailed array design - storage autonomy - voltage regulation - maximum tracking - centralized and decentralized SPV systems - stand alone - hybrid and grid connected system - System installation - operation and maintenances - field experience - PV market analysis and economics of SPV systems.

DIRECT ROTOR COUPLED GENERATOR (MULTIPOLE) [VARIABLE SPEED VARIABLE FREQ.]

Excited Rotor Synch. Generator / PMG Generator, Control Rectifier, Capacitor Banks, Step Up / Boost Converter (DC-DC Step Up), Grid Tied Inverter, Power Management, Grid Monitoring Unit (Voltage and Current), Transformer, Safety Chain Circuits

MODERN WIND TURBINE CONTROL & MONITORING SYSTEM

Details of Pitch System & Control Algorithms, Protections used & Safety Consideration in Wind turbines, 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, PWM Inverters, 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

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.

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17ATEC08	TRACTOR AND FARM EQUIPMENTS	Category	L	T	P	C
		EC(PS)	3	0	0	3

Preamble

Tractors are equipments with automotive engines functioning with different design off the road for agricultural purpose. Most of the components are designed and developed based on a separate set of parameters.

Prerequisite

Nil

Course Objectives

1	To detail on the fundamental operation of tractors and its engine.
2	To describe about the various components of engine for a tractor and farm equipment.
3	To describe the design of engine framework and valve mechanism for tractors .
4	To describe engine cooling, lubrication and fuel supply system
5	To detail about various farm equipments

Course Outcomes:

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

CO1.	Summarize safety rules of tractors and their components.	Understand
CO2.	Classify operation of engine cycles and performance of tractors.	Understand
CO3.	Appraise on the engine framework design for tractors.	Apply
CO4.	Appraise on the cooling ,lubrication and fuel supply systems for a tractor.	Apply
CO5.	Appraise on the different farm equipments.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

yllabus

GENERAL DESIGN OF TRACTORS
Classification of tractors –Main components of tractor – safety rules, Control of the Tractor and Fundamentals of Engine Operation
CONTROL DESIGN OF THE TRACTOR AND FUNDAMENTALS
Tractor controls and the starting of the tractor engines – basic notions and definition – Engine cycles – operation of multi cylinder engines - General engine design – Basic engine performance characteristics.
ENGINE FRAME WORK AND VALVE MECHANISM OF TRACTORS
Cylinder and pistons –Connecting rods and crankshafts – Engine balancing – Construction and operations of the valve mechanism – Valve mechanism troubles
COOLING SYSTEM, LUBRICATION SYSTEM AND FUEL SYSTEMS OF TRACTOR
Cooling system – Classification – Liquid cooling systems – Components, Lubricating system servicing and troubles – Air cleaner and turbo charger – Fuel tanks and filters – Fuel pumps
FARM EQUIPMENTS
Working attachment of tractors –Farm equipments – Classification – Auxiliary equipment – Trailers and body tipping mechanism.

TEXT BOOK:

1. Rodichev and G.Rodicheva, Tractor and Automobiles, MIR Publishers, 1987
REFERENCES:
1. Kolchin A., an dV.Demidov, Design of Automotive Engines for Tractor.

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17ATEC18	ALTERNATIVE FUELS	Category	L	T	P	C
		EC(PS)	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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	M	M	--	-	-	-	--	-	--	S	--	--
CO2	S	M	M	M	M	--	-	--	-	--	-	-	S	--	--
CO3	S	S	S	M	M	--	-	-	-	--	-	--	S	--	--
CO4	S	S	S	M	M	--	-	--	-	--	-	-	S	--	--
CO5	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.

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

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

Prerequisite NIL

Course Objective

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

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

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

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	-	-	-	-	-	-	-	-	-	-	-	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 TO FACTORY AUTOMATION AND INTEGRATION
Basic concepts and scope of industrial automation, socio-economic considerations, modern developments

in automation in manufacturing and its effect on global competitiveness.-Need and implications of automation in manufacturing- Different types of production systems and automation-Hard/fixed automation
INTRODUCTION TO HYRDAULICS AND PNEUMATICS
Basic elements of hydraulics and pneumatics, electro-pneumatic controls and devices, electro-pneumatic systems, fluid power control elements and standard graphical symbols for them, construction and performance of fluid power generators, hydraulic and pneumatic actuators, their design and control devices-Sequence operation of hydraulic and pneumatic actuators-Applications in manufacturing-Hydraulic
DESIGN OF PNEUMATIC AND ELECTRO-PNEUMATIC LOGIC CIRCUITS
Logic circuits to be designed for a given time displacement diagram or sequence of operation-Pneumatic safety and control circuits and their applications to clamping, traversing and releasing operations.
PROGRAMMABLE LOGIC CONTROLLERS (PLC)
PLC for design demonstration, programming and interface the hardware with software for modern manufacturing applications.
AUTOMATIC TRANSFER MACHINES & ASSEMBLY AUTOMATION
Classifications, analysis of automated transfer lines, without and with buffer storage, group technology and flexible manufacturing system- Types of assembly systems, assembly line balancing, performance and economics of assembly system.

Text Books

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

Reference Books

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

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

PREAMBLE

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

PREREQUISITE: Nil

COURSE OBJECTIVES

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

Course Outcomes

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

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

5. Tai Ran Hsu," MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002. Liu,"MEMS", Pearson education, 2000.
6. 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

S.No	Name of the Faculty	Designation	Dept	Mail ID
1	R. Karthikeyan	Assistant Professor (Gr-II)	ECE	rrmdkarthikeyan@avit.ac.in
2	Mr.G.Ramachandran	Assistant Professor	ECE	ramachandran@vmkvec.edu.in

17ECEC23	MACHINE VISION	Category	L	T	P	Credit
		EC(PS)	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
CO1.Intrepret the Low Level Vision techniques and methods of Machine Vision	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	L	-	-	-	-	-	-	-	-	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.
Hands-On Algorithms for Computer Vision, Amin Ahmadi Tazehkandi, Packt, 2018, ISBN: 9781789130942.

COURSE DESIGNERS

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2	Mr. P. subramanian	Associate Professor	ECE	Subramanian@avit.ac.in

17MESE03	HYDROGEN AND FUEL CELL TECHNOLOGY	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

PREAMBLE

To enlighten on various technological advancements, benefits and prospects of utilizing hydrogen/fuel cell for meeting the future energy requirements.

PREREQUISITE

THERMAL ENGINEERING

COURSE OBJECTIVES

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

COURSE OUTCOMES

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

CO1. Retrieve hydrogen properties and its thermodynamic performance.	Remember
CO2. Known the Hydrogen production and working of fuel cells.	Understand
CO3. Known the different types of fuel cells and their applications.	Understand
CO4. Analyze the cost effectiveness and eco-friendliness of fuel cells.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO 1	PO 2	PO 3	PO4	PO 5	PO6	PO 7	PO8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO 2	PSO3
CO1	S	M	L	L	-	-	-	-	-	-	-	-	L		
CO2	S	M	L	M	-	-	-	-	-	-	-	-	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).

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department / Name of the College	Mail ID
1	R.CHANDRASEKAR	Assistant Professor	MECH / VMKVEC	chandrasekar@vmkvec.edu.in
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17MESE05	WASTE ENERGY CONVERSION TECHNOLONGY	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble

This subject deals with various techniques involved in waste treatment, waste disposal and how to convert energy from that waste. Detailed study extends to the method of thermo chemical and bio chemical conversion techniques. Also deals a case study of environmental and health impact due to energy conversion 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	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	M	M	L	L	-	-	-	-	-	-	-	-	L	-	-
CO2	S	S	M	M	-	-	-	-	-	-	-	-	L	-	-
CO3	S	S	M	M	-	-	-	-	-	-	-	-	L	-	-
CO4	S	S	M	L	-	-	-	-	-	-	-	-	L	-	-
CO5	S	S	S	M	-	-	M	-	-	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO WASTE & WASTE PROCESSING

Definitions, sources, types and composition of various types of wastes; Characterisation of Municipal Solid Waste (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 health impacts of waste to energy conversion, case studies of commercial waste to energy plants, waste to energy- potentials and constraints in India, eco-technological alternatives for waste to energy conversions - Rules related to the handling, treatment and disposal of MSW and BMW in India.				
Text Books				
1	Parker, Colin, & Roberts, “Energy from Waste An Evaluation of Conversion Technologies”, Elsevier Applied Science, London, 1985.			
2	Shah, Kanti L., “Basics of Solid & Hazardous Waste Management Technology”, Prentice Hall, 2000.			
Reference Books				
1	Robert Green, From Waste to Energy, Cherry Lake Publication, 2009.			
2	Velma I Grover and Vaneeta Grover, “Recovering Energy from Waste Various Aspects”, Science Pub Inc, 2002.			
Course Designers				
S.No	**Faculty Name**	**Designation**	**Department/Name of the College**	**Email id**
1	R.CHANDRASEKAR	Assistant Professor	MECH / VMKVEC	chandrasekar@vmkvec.edu.in
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17MESE06	BIO ENERGY TECHNOLOGY	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

Preamble
To disseminate the technologies for utilizing bio-energy and its manifold benefits compared to conventional fossil fuels.

Prerequisite – RENEWABLE SOURCES OF ENERGY

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

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Dr.A.K.Thamizhsudar	Asso.Prof. grade II	AVIT	thamizhsudar@avit.ac.in

17APEE02	**PERSONALITY SKILL DEVELOPMENT - II**	Category	L	T	P	Credit
		HSS	2 WEEKS TRAINING	0	0	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.	Analysing
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	
CO2		M	M	L			L	M	M			L			
CO3						M				L	L	M	M	S	M
CO4		M						L	M	L	L	M		M	
CO5				L		M	S	M		S	M	S			S

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:

COURSE DESIGNERS:

S.No	Name of the Faculty	Designation	Department	mail id
1.	A. Mani	Associate Professor	Management Studies	mani@vmkvec.edu.in
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3	Dr. V. Sheelamary	Associate Professor	Management Studiec	sheelamary@avit.ac.in

CATEGORY ‘C’ – ELECTIVE COURSES - PROGRAMME SPECIFIC – 12-15 CREDITS SPECIALISATION

SPECIALISATION –INDUSTRIAL BIOTECHNOLOGY

17BTSE02	CHEMICAL REACTION ENGINEERING	Category	L	T	P	Credit
		EC (SE)	3	0	0	3

PREAMBLE

Principles of Chemical Engineering deals with the material and elemental balance in a reaction. A chemical engineers have a broad knowledge on ideal and non- reactor flow models. This paper also impart the knowledge on reaction rate of the reaction and its kinetics gas liquid reactions. Knowledge of these principles will enable students to understand vital role of engineer in a process industry.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To explain the basic knowledge on the material balance equations.
2	To discuss the performance of ideal reactors
3	To demonstrate the difference between ideal flow and non- ideal flow.
4	To outline the heterogeneous reaction of gas- liquid and solid.
5	To explain the basic knowledge on the material balance equations.

COURSE OUTCOMES

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

CO1. Describe the basics of material balance in chemical reaction	Understand
CO2. Explain the effectiveness of an ideal reactor	Understand
CO3. Classify the various flow pattern of fluids	Apply
CO4. Differentiate the various ideal and non – ideal fluid model	Analyze
CO5. Predict the heterogeneous reactions.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO	PO2	PO3	PO	PO	PO6	PO	PO8	PO	PO1	PO1	PO1	PSO	PSO2	PSO
CO1	M	M	M	M	L	-	-	-	-	-	-	L	S	L	M
CO2	M	M	M	M	L	-	-	-	-	-	-	-	S	M	-
CO3	S	S	S	S	M	L	-	-	-	-	-	-	S	M	M
CO4	M	M	M	M	L	M	-	-	-	-	L	M	M	-	-
CO5	M	M	L	M	M	L	-	-	-	-	-	L	M	L	-

S- Strong; M-Medium; L-Low

SYLLABUS

MATERIAL BALANCE

Overall and component balances; material balances without and with chemical reactions; degrees of freedom; steady and unsteady state; unit operations; recycle and by pass; humidity calculations.

IDEAL REACTORS

Ideal reactors- Definition Isothermal - batch reactor, Continuous flow reactor, semi-batch reactors; performance equations for single reactors; multiple reactor systems; multiple reactions.

IDEAL FLOW AND NON IDEAL FLOW

Conditions for a non-ideal reactors, RTD in non-ideal flow; E- Curve, F- curve. Non-ideal flow model- – laminar flow; turbulent flow, pressure drops; compressible fluid flow concepts. Reactor performance with non-ideal flow.

GAS-SOLID, GAS-LIQUID REACTIONS

Resistances and rate equations; heterogeneous catalysis; reactions steps; resistances and rate equations.

FIXED BED AND FLUID BED REACTORS

Broad outline of chemical reactors; Industrial scale reactors. Gas liquid reactions on solid catalysis; trickle bed, slurry reactors; three phase-fluidized beds; reactors for fluid-fluid reactions; tank reactors

TEXT BOOKS:

1. Levenspiel O. 2006. Chemical Reaction Engineering. 3rd Edition. John Wiley.
2. Fogler H.S. 2016 Elements of Chemical Reaction Engineering.5th Edition Prentice Hall India.
3. Hill, Jr., C.G.; Root, T.W. 2014. Introduction to chemical engineering kinetics and reactor design. 2nd Edition. Wiley.

REFERENCES:

1. Missen R.W., Mims C.A., Saville B.A. 1999. Introduction to Chemical Reaction Engineering and Kinetics. John Wiley.
2. Froment, G.F.; Bischoff, K.B.; De Wilde, J. 2011. Chemical reactor analysis and design. 3rd Edition. John Wiley & Sons

COURSE DESIGNERS

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17BTSE03	FERMENTER DESIGN AND ANALYSIS	Category	L	T	P	Credit
		EC (SE)	3	0	0	3

PREAMBLE

Fermentation design and analysis deals with the basic design of fermentor and its concepts. This paper also deals with the aeration and agitation equipments which were used for proper mixing substrate with the microorganisms. Fermenter design often use cutting-edge techniques and sophisticated machinery for the scale up and scale down issues for their complex mechanisms. Knowledge of these principles will enable students to understand the flow mechanisms, biomass growth and inlet and outlet gas analysis

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To label the body construction and types of fermenter.
2	To describe the power requirement for aerated and non-aerated fermenter.
3	To construct the various designs for studying the heat and mass transfer in the fermenter.
4	To predict the various problems related to scale up and scale down process.
5	To outline the various instrumentation involved in the monitoring and control of fermentation process.

COURSE OUTCOMES

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

CO1. Recall how to construct the fermenter and the materials used for it.	Remember
CO2. Interpret the power requirement for aerated and non-aerated fermenter	Understand
CO3. Classify the various design of heat transfer mechanism in fermenter design	Apply
CO4. Categorize the issues involved in scale up and scale down process	Analyze
CO5. Examine the parameters involved in the instrumentation and control	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO	PO	PO	PO8	PO	PO1	PO	PO1	PSO	PSO2	PSO3
CO1	L	L	L	L	L	-	-	-	-	-	L	M	S	M	L
CO2	M	M	M	M	L	-	-	-	-	-	L	M	S	S	-
CO3	S	S	M	S	L	-	-	-	-	-	L	L	S	S	L
CO4	M	M	M	M	L	-	-	-	-	L	L	M	S	S	-
CO5	M	M	M	M	M	-	-	-	-	-	L	M	S	S	L

S- Strong; M-Medium; L-Low

SYLLABUS

BASIC FERMENTER CONCEPTS

Define Fermenter, body construction of fermenter, Bioreactor Operation, Batch operation, fed-batch operation and Continuous Operation, Chemostat, turbidostat, Microbiological reactors, Enzyme reactors, Tank-type, Column-type biological reactors.

AERATION AND AGITATION IN BIOPROCESS SYSTEMS

Mass transfer in agitated tanks, Effect of agitation on dissolved oxygen, Correlations with kLa in Newtonian and non - Newtonian liquid, Power number, Power requirement for mixing in aerated and non - aerated tanks for Newtonian and non-newtonian liquid-Agitation rate studies, Mixing time in agitated reactor, residence time distribution, Shear damage, bubble damage, Methods of minimizing cell damage, Laminar and Turbulent flow in stirred tank bioreactors

SELECTION AND DESIGN OF BIOPROCESS EQUIPMENT

Materials of construction for bioprocess plants, Design considerations for maintaining sterility of process streams processing equipments, selection, specification, Design of heat and mass transfer equipment used in bioprocess industries, Requirements, design and operation of bioreactor for microbial, plant cell and animal cell

SCALE UP AND SCALE DOWN ISSUES

Effect of scale on oxygenation, mixing, sterilization, pH, temperature, inoculum development, nutrient availability and supply, Bioreactor scale-up based on constant power consumption per volume, mixing time, impeller tip speed (shear), mass transfer co-efficients, Scale up of downstream processes, Adsorption (LUB method), Chromatography (constant resolution etc.), Filtration (constant resistance etc.), Centrifugation (equivalent times etc.), Extractors (geometry based rules), Scale–down related aspects.

FERMENTER INSTRUMENTATION AND CONTROL

Bioreactor controlling probes, Characteristics of bioreactor sensors, Methods of measuring process variables, Temperature, Flow measurement and control, Pressure measurement and control, Agitation, shaft power, rate of stirring. Detection and prevention of foam, Measurement of Microbial biomass, Measurement and control of Dissolved oxygen, Inlet and outlet gas analysis, pH measurement and control - Biosensors.

TEXT BOOKS:

1. Impre, J.F.M.V., Vanrolleghem, P.A. and Iserentant, D.M., "Advanced Instrumentation, Data Interpretatio Control of Biotechnological Processes", Kluwer Academic Publ 2010.
2. Panda, T. 2011. Bioreactors analysis and design, Tata McGraw Hill, New Delhi, New York.
3. Mann, U., "Principles of Chemical Reactors Analysis & Design: New tools for Industrial Chemical Reactor Operations", Willey–VCH, 2009.

REFERENCES:

1. Mansi, E.M.T.EL., Bryce, C.F.A., Demain, A.L. and Allman, A.R., "Fermentation Microbiology and Biotechno 3rd edition Taylor and Francis, 2012.
2. Towler, G. and Sinnott, R., "Chemical Engineering Design: Principles, Practice, Econ of Plant and Process Design", 2nd edition, Butterworth – Heinemann ltd., Elsevier, 2012.

COURSE DESIGNERS

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17BTSE04	BIOSEPARATION TECHNOLOGY	Category	L	T	P	Credit
		EC (SE)	3	0	0	3

PREAMBLE

Bioseparation technology deals with the economics and importance of bioproducts purification process. In this subjects the purification process comprises various unit operation in levels of purification process. Bioseparation technology often use pioneering techniques and sophisticated machinery along with other applied field's chemical engineering and instrumentation for purification of biological products. Knowledge of these principles will enable students to understand various steps involved in purification process of biological products.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To summarize the downstream processes employed in the biotechnology industry.
2	To classify the physical and chemical separation processes in DSP.
3	To demonstrate separation processes by means of membrane separation techniques in DSP.
4	To distinguish the various types of chromatography for the separation process.
5	To outline the concepts for separation and purification.

COURSE OUTCOMES

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

CO1. Describe the need of downstream processing in biotechnology industry	Understand
CO2. Identify the importance of separation process involved in the downstream processes	Understand
CO3. Illustrate the various types of membrane separation process employed in the DSP	Apply
CO4. Categorize the various parameters that governs chromatography techniques	Apply
CO5. Examine the various finishing operations involved in the DSP	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

DOWNSTREAM PROCESSING IN BIOTECHNOLOGY

Role and importance of downstream processing in biotechnological processes – Problems and requirements of bio product purification – Economics of downstream processing in Biotechnology, cost-cutting strategies – Separation characteristics of proteins and enzymes – size, stability, properties – Flocculation and conditioning of broth – Process design criteria for various classes of bio products (high volume, low value products and low volume, high value products) – Upstream production methods affect downstream purification strategies.

PHYSICO-CHEMICAL BASIS OF BIO-SEPARATION PROCESSES

Cell disruption methods for intracellular products – Physical, chemical, mechanical – Removal of insoluble, biomass and particulate debris separation techniques – Filtration at constant pressure and at constant rate – Empirical equations for batch and continuous filtration – Types of filtration -

Centrifugal and cross – flow filtration – Types of filtration equipments – Centrifugation – Basic principles, design characteristics – Types of centrifuge and applications – Sedimentation

MEMBRANE SEPARATIONS AND ENRICHMENT OPERATIONS

Theory, Design consideration and configuration of membrane separation processes – Reverse osmosis, microfiltration, ultra filtration and dialysis – Structure and characteristics of membranes – Membrane modules – Enrichment Operations – Extraction–equipment for extraction – Aqueous two-phase extraction process – Evaporators – Types of evaporators – Adsorption isotherms and techniques – Protein precipitation – Methods of precipitational

MECHANISM AND MODES OF CHROMATOGRAPHIC SEPARATION

Chromatography – Classification of chromatographic techniques – General description of column chromatography – Chromatographic terms and parameters – Practice of chromatography – Partition, normal-phase, displacement, reversed-phase, size exclusion, ion exchange, hydrophobic, affinity chromatography – Scale-up of chromatography – Process considerations in Preparative liquid chromatography and HPLC

FINISHING OPERATIONS AND FORMULATIONS

.Drying – Mechanism, methods and applications, Types of dryers – Tray, spray, rotary, belt, disc – Crystallization – Nucleation , growth – Types of crystallizers – Tank, scrapped surface, Oslo, Circulating-magma evaporator – Freeze drying – Principle, process, applications

TEXT BOOKS:

1. Belter, P.A., Gussler, E.L. and Hu, W.S., “Bioseparation: Downstream Processing for Biotechnology”, John Wiley and Sons, 2011.
2. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, 2013. Principles of Fermentation Technology, Science & Technology Books 2nd edition. Pergamon Press.
3. Sivasankar, B., 2009. Bioseparations: Principles and Techniques. PHI Learning Private Limited, New Delhi.

REFERENCES

1. Ghosh, R., “Principles of Bioseparation Engineering”, World Scientific Publishers, 2006.
2. Ladisch, M.R., “Bioseparation Engineering: Principles, Practice, and Economics”, John Wiley & Sons, 2001.
3. Roger, H., 2015. “Bioseparation Science and Engineering”, 2nd Edition Oxford University Press

COURSE DESIGNERS

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17BTSE05	INDUSTRIAL WASTE MANAGEMENT	Category	L	T	P	Credit
		EC (SE)	3	0	0	3

PREAMBLE

This course will provide an overview of management techniques for industrial wastes, as well as State and Central Pollution Board regulations for waste management. The course will also highlight the business profitability, legal framework, and the economic feasibility of the environmentally sustainable technologies for waste management.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To discuss the present scenario of industrial waste management in India
2	To explain the knowledge on sources and characteristics of various industrial wastes and strategies for its prevention and control
3	To execute about the onsite pollution from major industries
4	To outline the various effects and disposal options for the industrial waste.
5	To outline the maintenance of hazardous waste

COURSE OUTCOMES

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

CO1: Summarise the insight into the pollution from major industries including the sources and characteristics of pollutants	Understand
CO2: Identify the plan minimization of industrial wastes	Understand
CO3: Illustrate the facilities for the processing and reclamation of industrial waste water	Apply
CO4: Correlate the various treatments for disposals of industrial waste.	Analyse
CO5: Examine the physio chemical treatment for hazardous waste.	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO	PO4	PO	PO6	PO	PO8	PO9	PO1	PO1	PO1	PSO	PSO2	PSO
CO1	M	-	-	M	L	M	S	-	-	M	-	M	S	M	-
CO2	M	-	-	M	L	M	M	-	-	S	L	M	-	-	-
CO3	S	S	-	-	L	-	-	-	-	-	L	M	M	M	M
CO4	M	M	M	M	M	M	M	-	M	M	M	M	-	-	-
CO5	M	M	M	-	M	M	-	S	-	L	M	M	S	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO INDUSTRIAL POLLUTION

Types of Industries And Industrial Pollution, Characteristics Of Industrial Wastes, Population Equivalent, Bioassay Studies, Effects Of Industrial Effluents On Streams, Sewer, Land, Sewage Treatment Plants And Human Health Environmental Legislations Related to Prevention And Control Of Industrial Effluents And Hazardous Wastes

CLEANER PRODUCTION

Waste Management Approach, Waste Audit, Volume And Strength Reduction, Material And Process Modifications, Recycle, Reuse And Byproduct Recovery – Applications.

POLLUTION FROM MAJOR INDUSTRIES

Sources, Characteristics, Waste Treatment Flow Sheets For Selected Industries Such As Textiles, Tanneries, Pharmaceuticals, Electroplating Industries, Dairy, Sugar, Paper, Distilleries, Steel Plants, Refineries, Fertilizer, Thermal Power Plants, Wastewater Reclamation Concepts

TREATMENT TECHNOLOGIES

Equalisation, Neutralisation, Removal of Suspended and Dissolved Organic Solids, Chemical Oxidation, Adsorption, Removal of Dissolved Inorganics, Combined Treatment Of Industrial And Municipal Wastes, Residue Management, Dewatering, Disposal.

HAZARDOUS WASTE MANAGEMENT

Hazardous Wastes, Physico Chemical Treatment, Solidification, Incineration, Secure Land Fills.

TEXT BOOKS

1. Rao M. N. & Dutta A. K. “Wastewater Treatment”, Oxford - IBH Publication, 1995.
2. Eckenfelder W.W. Jr., “Industrial Water Pollution Control”, McGraw Hill Book Company, New Delhi, 2000.
3. Patwardhan. A.D., Industrial Wastewater Treatment", Prentice Hall of India, New Delhi 2010.

REFERENCES

1. Shen T.T., “Industrial Pollution Prevention”, Springer, 1999.
2. Stephenson R.L. and Blackburn J.B., Jr., “Industrial Wastewater Systems Hand book”, Lewis Publisher, New York, 1998
3. Freeman H.M., “Industrial Pollution Prevention Hand Book”, McGraw Hill Inc., New Delhi, 1995.
4. Bishop, P.L., “Pollution Prevention: Fundamental & Practice”, McGraw Hill, 2000.
5. Pandey, "Environmental Management" Vikas Publications, 2010.
6. Industrial Wastewater Management, Treatment and Disposal",(WEF - MOP - FD3) McGraw Hill, 2008

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17BTSE06	FUNDAMENTALS OF FLUID MECHANICS	Category	L	T	P	Credit
		EC (SE)	3	0	0	3

PREAMBLE

Fundamentals of fluid mechanics deals with fundamental concepts of fluid flow with Newtonian laws and application of fluid static equation. This papers also deals with the need of dimensional analysis and dimensionless parameter. Helps to regain the knowledge in type of flow and flow measurement in pipes. Fundamentals of fluid mechanics often use cutting-edge techniques and sophisticated machinery along with other applied fields of research like biotechnology, mechanical engineering and chemical engineering. Knowledge of these principles will enable students to understand various types of fluid flow and their importance in the industry.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To acquire knowledge about the fundamentals concepts of fluid flow.
2	To apply the knowledge on fluid static equation.
3	To analyze the need for dimension analysis and dimensionless parameter.
4	To understand the various type of flow through pipes.
5	To analyze the various types of pumps with its working principle.

COURSE OUTCOMES

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

CO1: Recall the concepts of fluid flow	Remember
CO2: Report the fluid static equation based on fluid flow	Understand
CO3: Compare the dimension and dimensional analysis water	Apply
CO4: Calculate the types flow measurement in pipes.	Analyse
CO5: Illustrate the boundary layer concepts	Analyse

COS	P	PO2	PO3	PO4	PO	PO	PO	PO	PO9	PO1	PO1	PO1	PSO1	PSO2	PSO3
CO1	L	-	L	L	L	-	L	-	-	M	-	-	S	-	-
CO2	M	M	M	-	L	-	M	-	-	S	-	-	-	M	-
CO3	S	M	L	S	-	L	-	-	-	L	-	-	M	M	-
CO4	M	M	M	M	L	M	M	-	M	M	-	-	-	S	-
CO5	M	M	M	M	-	M	M	M	-	L	-	-	S	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

FUNDAMENTAL CONCEPTS

Definition of Fluid, Continuum concept of fluid, Terminologies of fluid flow, velocity – local, average, maximum, flow rate – mass, volumetric, velocity field; dimensionality of flow; flow visualization – streamline, pathline, streak line, stress field; viscosity; Newtonian fluid; Non-Newtonian fluid; Reynold’s number—its significance, laminar, transition and turbulent flows: Prandtl boundary layer, compressible and incompressible flows

FLUID STATICS

Fluid statics – basic equation – equilibrium of fluid element – pressure variation in a static fluid – application to manometry – Differential analysis of fluid motion – continuity, equation of motions, Euler’s equation, Bernoulli equation, and Navier- Stokes equation.

DIMENSIONAL ANALYSIS

Formal procedure for *dimensional analysis* – Dimensional homogeneity – Buckingham’s Pi theorem – Need for dimensional analysis – methods of dimensional analysis – Similitude –types of similitude – Dimensionless parameters-application of dimensionless parameters – Model analysis

FLOW MEASUREMENT

Reynolds number regimes, internal flow – flow through pipes – pressure drop under laminar and turbulent flow conditions – major and minor losses; Line sizing; External flows – boundary layer concepts, boundary layer thickness under laminar and turbulent flow conditions- Flow over a sphere – friction and pressure drag – flow through fixed and fluidized beds.

PUMPS

Impact of jets – Euler's equation – Theory of roto-dynamic machines – various efficiencies– velocity components at entry and exit of the rotor- velocity triangles – Centrifugal pumps– working principle – work done by the impeller – performance curves – Reciprocating pump- working principle – Rotary pumps –classification

TEXT BOOKS:

1. Bansal R. K. 2016. "A Text book of Fluid Mechanics" Laxmi Publications
2. Modi P.N. and Seth, S.M. 2004."Hydraulics and Fluid Mechanics", Standard Book House, New Delhi.
3. Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011.

REFERENCES:

1. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2010
2. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi, 2004
3. Robert W.Fox, Alan T. McDonald, Philip J.Pritchard, "Fluid Mechanics and Machinery", 2011

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17BTSE07	BIOPROCESS ECONOMICS AND REACTOR DESIGN	Category	L	T	P	Credit
		EC (SE)	3	0	0	3

PREAMBLE

The aim of this course is to develop in students the ability to synthesise design solutions for the biochemical engineering sector that take into account consideration of good design practice, that are inherently safe and that are most economically viable.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To define economic evaluation of Bioprocess technology
2	To discuss cost estimation analysis of process design and development
3	To describe and synthesise a design in terms of safety and provide measures for its safe operation
4	To demonstrate a design using best practice economic principle
5	To perform experimental design for screening & optimizing the process parameters.

COURSE OUTCOMES

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

CO1. Recall the economic evaluation concepts involved in bioprocess techniques	Remember
CO2.Describe the different costs involved in the total product for a typical Chemical Process plant	Understand
CO3. Explain the optimal strategy for design and analysis of various Bioreactors	Understand
CO4. Demonstrate the instrumentation and control of bioprocess using engineering principles.	Apply
CO5. Illustrate case studies on screening designs and optimization of various bioprocess	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	-	-	-	-	-	-	-	-	-	M	-	M
CO2	S	M	S	S	L	-	-	-	-	-	-	-	M	-	
CO3	M	L	-	M	L	S	M	M	-	M	-	-	-	M	S
CO4	L	L	L	-	-	-	-	-	-	-	M	-	S	S	-
CO5	S	M	L	L	-	-	-	-	M	-	-		-	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

ECONOMIC EVALUATION

Capital cost of a project; Interest calculations, nominal and effective interest rates; basic concepts in tax and depreciation; Measures of economic performance, rate of return, playout time; Cash flow diagrams; Cost accounting-balance sheet and profit loss account; Break even and minimum cost analysis.

BIOPROCESS ECONOMICS

Cost Estimation: Capital investments (Fixed and working capital), Types of capital cost estimates, Cost Indexes, Estimating equipment costs by scaling 6/10 Factor Rule, Purchase Equipment Installation, Insulation costs, Instrumentation & Control, Piping , Electrical Installation , Service facilities, Land, Engineering . & Supervision, Start –up expenses. Methods of Estimating Capital Investment, Estimation of total product cost, Different costs involved in the total product for a typical Chemical Process plant. Interest & Investment Costs: Types of interest (simple & compound interest), Nominal & Effective Rates of interest, Continuous interest, Present worth & discounts, perpetuities, capitalized costs, Interest & Investment costs.

DESIGN AND ANALYSIS OF BIOREACTORS

Chemostat model with cell growth kinetics, Plug flow reactor for microbial processes; optimization of reactor systems; Multiphase bioreactors, packed bed with immobilized enzymes or microbial cells; three phase fluidized bed trickling bed reactor; Component of Fermenter and their design, a sceptic operations, RTD studies in bioreactors, Design and analysis of the above reactor systems; Gas liquid reactors; Reactor with non-ideal mixing; dispersion model; Tanks in series Model; Bubble column reactors, airlift fermenters etc. Air and medium sterilization Mechanical fittings in a bioreactor: vessel, agitation system materials, welds, finish, valves, piping and valves for biotechnology, cleaning

INSTRUMENTATION AND CONTROL OF BIOPROCESSES

Physical and chemical sensors for the medium and gases. Online sensors for cell properties, off-line analytical methods; Biosensors.

DESIGN OF EXPERIMENTS – SCREENING DESIGNS, OPTIMIZATION

Screening designs: Fractional factorial design – General 2k-p design, Placket-Burman design, confounding and aliasing, resolution of design, main effects, interaction effects, screening criteria, Numerical. Optimization: Response surface methodology, Linear model (method of steepest ascent), Second order models (CCD, CCRD, Taguchi design); generation of experimental design; response variables; model terms: linear, quadratic & interaction terms; ANOVA table, data diagnostics & outlier analysis, contour & surface plots, optimization criteria, D-optimal design, Numerical.

TEXTBOOKS

1. Stanbury P F and Whitaker A, "Principles of Fermentation Technology," Pergamon Press (1995)
2. Bailey J E and Ollis D F, "Biochemical Engineering Fundamentals", McGraw Hill (1986)
3. Peters, M S & Timmerhaus K D,"Plant Design and Economics for Chemical Engineers", McGraw Hill, New York , 4^{th} Edition (2003)
4. Ulrich, G D,"A Guide to Chemical Engineering Process Design and Economics", John Wiley (1984)

REFERENCES:

1. Aiba S, Humphrey A E and Millis N F,"Biochemical Engineering" , Academic Press (1973
2. Peters, M S & Timmerhaus K D,"Plant Design and Economics for Chemical Engineers", McGraw Hill, New York , 4^{th} Edition (2003
3. Biochemical Engineering–Atkinson

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17BTSE08	BIOREACTOR THEORY	Category	L	T	P	Credit
		EC (SE)	3	0	0	3

PREAMBLE

Bioreactor theory subject deals with the basic knowledge in the construction of bioreactor and its working principles. This subject also provides a wide knowledge on various types of bioreactor and with its merits and demerits. Bioreactor theory often use cutting-edge techniques and sophisticated machinery along with other applied fields of research to study how the nutrients are up taken by microbes and converted into products with the elemental balances. Knowledge of these principles will enable students to understand the different kinetic models of microbes to fit into a microbial growth and product formation kinetics.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To recognize knowledge on the basic principle and components of bioreactors
2	To classify the different types of bioreactors and its working principle
3	To implement the design for fermentation process for biomass growth and product formation.
4	To evaluate the stoichiometric elemental balance.
5	To analyze kinetics model on the microbial growth

COURSE OUTCOMES

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

CO1. Recall the basic principle and components of bioreactors.	Remember
CO2. Discuss about different types of bioreactors with its working principle.	Understand
CO3. Demonstrate for fermentation process for biomass growth and product formation.	Apply
CO4. Estimate the microbial growth and product formation.	Analyze
CO5. Validate the stoichiometric elemental balance with microbial growth.	Analyze
CO6. Create a kinetic model for microbial growth.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

OVER VIEW OF BIOREACTOR

Definition of Bioreactor, Chronological development of bioreactor design, Basic principles of Bioreactor, Classification of bioreactors, body construction of basic bioreactor, configuration of bioreactors and ancillaries parts, Removal of Heat in bioreactor main parameters to be monitored and controlled in fermentation process.

BIOREACTOR TYPES

Unconventional bioreactors, Packed bed reactor, slurry bioreactor, Hollow fibre reactor. , Multiphase Bioreactor - Air lift Bioreactors, bubble column bioreactor, fluidised bioreactor, Hydrodynamic three phase flow, Perfusion reactor for animal and plant cell culture. Merits and demerits.

DESIGN OF FERMENTATION PROCESSES
Kinetics of substrate utilization, biomass growth and product formation, inhibition on cell growth and product formation. Design and operation of continuous cultures, chemostat in series, batch and fed batch cultures, total cell retention cultivation.

METABOLIC STOICHIOMETRY AND ENERGETICS
Stoichiometry of cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients, energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth.

KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION
Batch cultivation and continuous cultivation. Morphologically structured model, genetically structured models, cybernetic model, modelling of recombinant systems. Simple unstructured models for microbial growth, Monod model, growth of filamentous organisms, product formation kinetics, Leudeking-Piret models, substrate and product inhibition on cell growth and product formation. Biomass estimation - Direct and Indirect methods.

TEXT BOOKS

1. Doran M Pauline, 2012. “Bioprocess Engineering Principles”. 2 nd Edition, Elsevier.
2. Bailey, James E. and David F. Ollis, 2010. “Biochemical Engineering Fundamentals”, 2 nd Edition. Mc Graw Hill India.
3. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, 2013. Principles of Fermentation Technology, Science & Technology Books 2nd edition. Pergamon Press.
4. Ghasem D.Najafpour, 2009. “Biochemical Engineering and Biotechnology”, Elsevier.

REFERENCES

1. Tapobrate Panda, 2011. “Bioreactors: Analysis and Design”, Tata McGraw Hill,
2. Villadsen, John, Nielsen, Jens, Lidén, Gunnar, Bioreaction Engineering Principles, Springer 3rd edition 2011.

COURSE DESIGNERS

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17BTSE09	INDUSTRIAL BIOTECHNOLOGY LAB	Category	L	T	P	Credit
		EC (SE)	0	0	4	2

PREAMBLE

The curriculum of Industrial Biotechnology Lab involves in the steps of production of Citric acid, ethanol from yeast and the production of wine from black grapes. As the application part it may deals with the production of beer form cereals and the antibiotics using *streptomyces* species.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To describe and recognize the morphology of different microbes.
2	To Interpret and analyse the different types of media
3	To differentiate, the biochemical characters of microorganisms
4	To assess the quality of biotechnology products
5	To Check preservation procedure for microorganisms

COURSE OUTCOMES

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

CO1. Determine the production of citric acid	Understand
CO2. Outline the steps involved in the production of ethanol from yeast	Understand
CO3. Illustrate the mechanism of wine produced from black grapes	Analyse
CO4.Understand the process of production of antibiotics from *Streptomyces* species.	Evaluate
CO5. Outline the process involved in the production of protease from different sources	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
CO1	M	M	L	-	-	M	M	-	L	-	M	-	S	M	-
CO2	M	-	M	-	M	M	-	-	L	-	-	M	S	M	-
CO3	M	L	M	-	M	L	-	-	M	-	M	-	S	M	-
CO4	L	L	L	L	M	-	L	-	-	-	-	-	S	-	-
CO5	L	L	L	L	M	-	M	-	-	-			S	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

1. Production of Citric acid
2. Production of ethanol from black grapes
3. Production of Beer from cereals
4. Production of Protease
5. Production of Antibiotics using *Streptomyces* species
6. Production of Vitamins
7. Production of growth regulators
8. Production of Biofertilizers (N – Fixers & P - Solubilizers)
9. Production of Biocontrol Agents
10. Production of Single cell Protein (Spirulina)
11. Production of Vermicompost

REFERENCE BOOKS

1. Cruger, W., Cruger, A., “Biotechnology: A textbook of Industrial Microbiology”, Panima Publishing Corporation, New Delhi, 2000

COURSE DESIGNERS				
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17BTSE10	FERMENTATION LAB	Category	L	T	P	Credit
		EC (SE)	0	0	4	2

PREAMBLE

The curriculum of Fermentation Lab involved in the steps of production of primary and secondary metabolites for various industrial applications. It determine the growth kinetics of microorganisms in fermentation process. These study may understand the important aspects in fermentation engineering

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To describe and recognize the morphology of different microbes.
2	To Interpret and analyse the different types of media
3	To differentiate, the biochemical characters of microorganisms
4	To assess the quality of biotechnology products
5	To check preservation procedure for microorganisms

COURSE OUTCOMES

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

CO1.Determine growth of bacterial yeast and to estimate biomass specific growth rate and yield coefficient	Understand
CO2. Outline the steps involved in the production process of ethanol and wine	Understand
CO3. Illustrate the mechanism of Solid state fermentation for the production of metabolites	Analyse
CO4. Evaluate process for production of antibiotics using *Streptomyces* species	Evaluate
CO5. Evaluate the process involved in the production of protease from different sources	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO06	PO07	PO08	PO09	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	S	M	-	-	L	M	-	L	-	-	-	M	M	-
CO2	L	-	M	-	L	L	-	-	L	-	-	-	M	M	-
CO3	M	M	L	-	M	M	-	-	M	-	-	-	S	M	-
CO4	L	L	L	L	M	-	L	-	-	-	-	-	S	-	M
CO5	L	L	L	L	M	-	M	-	-	-			M	-	M

S- Strong; M-Medium; L-Low

SYLLABUS

1.Growth of Bacterial yeast-Estimation of Biomass, Calculation of μ and Yp/s
2. Production of ethanol from yeast
3. Production of wine from black grapes
4. Growth Kinetics in Fermentation
5. Solid State Fermentation (Production of Metabolite Primary & Secondary)
6. Production of Antibiotics using Streptomycin species
7. Residence Time Distribution
8. Production of Protease
9. Production of Biofertilizers(N – Fixers & P - Solubilizers)
10. Production of Microbial Biomass
11. Production of Single cell Protein (Spirulina)
12. Production of Vermicompost

REFERENCE BOOKS

1. Irwin H.Segel, “Biochemical Calculations”, John Wiley & Sons, 2nd Edition, Wiley Publishers, New Delhi. 2011.
2. Pierre-Yves Bouthyette, “Fermentation Technologies”, 2nd edition, Rai University, Ahmedabad, 2005.

COURSE DESIGNERS				
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17BTSE11	FLUID MECHANICS FOR BIOTECHNOLOGY LAB	Category	L	T	P	Credit
		EC (SE)	0	0	4	2

PREAMBLE

This lab course is designed to impart good knowledge in fluid mechanics concepts

PRERQUISITE - Nil

COURSE OBJECTIVES

1	To learn calibration of flow meters
2	To describe in detail about the pressure loss for fluid flows
3	To describe about pump characteristics
4	To demonstrate in detail about hydrodynamic concepts.

COURSE OUTCOMES

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

CO1. Students will be familiar with various variable area flow meters and variable head flow meters	Understand
CO2. Identify the fundamental knowledge about the open channels	Understand
CO3. Demonstrate the techniques for analysing the flow of fluids through closed conduits	Apply
CO4. Employ the knowledge of pumps for the transportation of fluids based on process conditions/requirements and fluid properties	Apply
CO5. Test the pressure drop studies in packed column	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO 5	PO 6	PO7	PO 8	PO 9	PO10	PO1 1	PO1 2	PSO 1	PSO 2	PSO3
CO1	M	M	M	M	L	-	-	-	-	-	-	-	M	M	M
CO2	M	M	M	M	L	-	-	-	-	-	-	-	M	-	M
CO3	S	S	M	S	L	-	-	-	-	-	-	-	M	M	-
CO4	M	M	M	M	-	-	-	-	-	-	-	-	S	-	M

S- Strong; M-Medium; L-Low

SYLLABUS

1. Viscosity measurement of non- Newtonian fluids
2. Calibration of constant and variable head meters
3. Calibration of weirs and notches
4. Open drum orifice and draining time
5. Flow through straight pipe
6. Flow through annular pipe
7. Flow through helical coil and spiral coil
8. Losses in pipe fittings and valves
9. Characteristic curves of pumps
10. Pressure drop studies in packed column
11. Hydrodynamics of fluidized bed
12. Drag coefficient of solid particle

TEXT BOOKS

1. Frank M. White, Fluid Mechanics (Sixth Edition), Tata McGraw-Hill, New Delhi (2008).

2. J. O. Wilkes, Fluid Mechanics for Chemical Engineers, Prentice Hall (1999).
3. W. L. McCabe, W. L. Smith, and P. Harriot, Unit Operations of Chemical Engineering, McGraw-Hill International Edition (Sixth edition) (2001).

REFERENCE BOOKS

1. R. B. Bird, W. L. Stewart and E. L. Lightfoot, Transport Phenomena (Secondedition), Wiley Singapore (2002).
2. M. M. Denn, Process Fluid Mechanics, Prentice Hall (1980).
3. Ron Darby, Chemical Engineering fluid Mechanics, Marcel Dekker Inc, NY (1996).

COURSE DESIGNERS

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SPECIALISATION - MEDICAL AND PHARMACEUTICAL BIOTECHNOLOGY

17BTSE12	INDUSTRIAL MANAGEMENT AND PHARMACEUTICAL MARKETING	Category	L	T	P	Credit
		SE (PS)	3	0	0	3

PREAMBLE

This course is designed to impart advanced knowledge and skills required such as Industry plant location, lay out, to learn the concept of pharmaceutical industry, drug manufacture and marketing, various regulatory affairs.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To explain the knowledge about industry layout and Design
2	To explain the basics of industry production, storages, quality control and Personnel management
3	To demonstrate the different methods of Product planning, method of marketing Distribution polices
4	To outline the basics of industrial accountancy and Principles of Costing, Estimating Balance sheet and Profit and Loss Account etc.,
5	To examine the regulatory affairs which involved in pharmaceutical industry

COURSE OUTCOMES

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

CO1: Describe the industry layout and Design	Understand
CO2: Discuss the industry production and observe the quality control and Personnel management	Understand
CO3: Classify different methods in marketing and distribution	Apply
CO4: Infer industry accountancy, costing, profit and loss	Analyse
CO5: Examine the regulatory affairs which involved in pharmaceutical industry	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	-	-	-	-	-	-	-	-	-	-	-
CO2	S	L	L	L	L	-	L	-	-	-	-	L	M	M	M
CO3	M	L	-	L	L	L	-	-	-	-	-	-	-	M	-
CO4	S	L	L	-	L	-	L	-	L	-	-	-	M	-	-
CO5	S	M	L	L	-	-	-	-	L	-	-	-	S	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

PLANT LOCATION AND LAY-OUT OF AN INDUSTRY

Various factors affecting locational aspect, layout of building and equipment product lay-out v/s process layout, drug store location and selection of premises, drug store management.

PRODUCTION PLANNING AND CONTROL

Scientific purchasing, quality control, problems of productivity, stores organization, location of stores, receiving, inspection of materials, issue from the store, control of stores and stocks, Store Accounting and Records. Personnel management: Selection, Appointment, training, transfer, Promotion, demotion policies, remuneration, job evaluation, human relations.

SALES ORGANISATION

Market, definition–Determent approaches to the study of marketing, institutional approach, Market planning – Product planning, method of marketing, wholesale retailers, functional approach, cost and efficiency in marketing commodity approach. Distribution polices: pharmaceutical product marketing, sales promotion policies-Detailing to physician, professional persons, sampling, window and interior display, product advertising, sales promotion, publicity.

ELEMENTARY INDUSTRIAL ACCOUNTANCY

Elements of Double entry book Keeping, Books of Accounts-Journal and ledger, cash book. Balance sheet, Profit and Loss Account, Principles of Costing and Estimating.

REGULATORY AFFAIRS

Schedule M of Drugs and Cosmetics act, Drug Development Stages - NDA and NADA filing, ICH guidelines - Introduction.

TEXT BOOKS

1. New Drug Approval Process: Accelerating Global Registrations by Richard A Guarino, MD,5th edition, Drugs and the Pharmaceutical Sciences, Vol.190.

2. Guidebook for drug regulatory submissions / Sandy Weinberg. By John Wiley & Sons.Inc

REFERENCES BOOK

1. FDA regulatory affairs: a guide for prescription drugs, medical devices, and biologics/edited By Douglas J. Pisano, David Mantus.

2. Guidebook for drug regulatory submissions / Sandy Weinberg. By John Wiley & Sons.Inc.

3. FDA regulatory affairs: a guide for prescription drugs, medical devices, and biologics/edited By Douglas J. Pisano, David Mantus.

COURSE DESIGNERS

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17BTSE13	PHARMACEUTICAL PHYTO CHEMISTRY	Category	L	T	P	Credit
		SE (PS)	3	0	0	3

PREAMBLE

The subject is designed to impart knowledge about recent advances in the field of medicinal chemistry at the molecular level including different techniques involved in rational drug design, pro drug and analog design, pharmaceuticals derived from medicinal plants and their applications.

PREREQUISITE- NIL

COURSE OBJECTIVES

1	To list the Medicinal plants, constituents, isolation, Characterization and purification of phyto constituents.
2	To interpret the basic concepts involved in drug discovery
3	To execute the different mechanism of action involved in pro drug design and analog design
4	To categorise the phyto constituents derived from the medicinal plants
5	To outline the monographs of herbal drugs

COURSE OUTCOMES

CO1.Recall the basic information of different medicinal plants ,estimation of phyto constituents, isolation procedure and characterization of phytoconstituents	Remember
CO2.Demonstrate the concepts involved in drug discovery	Understand
CO 3.Practice the prodrug design and analog design	Apply
CO 4.Estimate the different phytoconstituents derived from the medicinal plants	Analyse
CO 5. Develop the monographs of herbal drugs	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

MEDICINAL PLANTS

Medicinal plants constituents & their Biosynthesis, Isolation, Characterization and purification with a special reference to their importance in herbal industries of following phyto-pharmaceuticals containing drugs- Alkaloids, Glycosides, Steroids and Terpenoids:

DRUG DISCOVERY

Stages of drug discovery, lead discovery; identification, validation and diversity of drug targets. Biological drug targets: Receptors, types, binding and activation, theories of drug receptor interaction, drug receptor interactions, agonists vs antagonists, artificial enzymes

PRO DRUG DESIGN AND ANALOG DESIGN

Prodrug design: Basic concept, Carrier linked pro drugs / Bio precursors, Pro drugs of functional group, Pro drugs to improve patient acceptability, Drug solubility, Drug absorption and distribution, site specific drug delivery and sustained drug action.

Analog Design: Introduction, Classical & Non classical, Bio isosteric replacement strategies, rigid analogs, alteration of chain branching, changes in ring size, ring position isomers, design of stereo isomers and geometric isomers, fragments of a lead molecule, variation in inter atomic distance

PHARMACEUTICALS FROM MEDICINAL PLANTS

New pharmaceuticals for the following class of drugs- Drugs Affecting the Central Nervous System: Morphine Alkaloids, Anticancer Drugs: Paclitaxel and Docetaxel, Etoposide Cardiovascular Drugs: Lovastatin, Teprotide and Dicoumarol.

MONOGRAPHS OF HERBAL DRUGS

General parameters of monographs of herbal drugs and comparative study in IP, USP, Ayurvedic Pharmacopoeia, Siddha and Unani Pharmacopoeia. WHO guidelines in quality assessment of herbal drugs.

TEXT BOOKS

1. Herbal drug industry by R.D. Choudhary (1996), Eastern Publisher, NewDelhi.
2. GMP for Botanicals - Regulatory and Quality issues on Phytomedicine by
Pulok K Mukharjee (2003), Ist Edition, Business horizons Robert Verpoorte, New Delhi.
3. Text book of Pharmacognosy and Phytochemistry by Vinod D. RangarI (2002), Part I & II, Career Publication, Nasik, India.

REFERENCE BOOKS

1. Drug Formulation Manual by D.P.S.Kohli and D.H.Shah (1998), Eastern Publisher, New Delhi.
2. Quality control of herbal drugs by Pulok K Mukarjee (2002), Business Horizons Pharmaceutical Publisher, New Delhi.

COURSE DESIGNERS

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17BTSE14	MEDICAL PHARMACOLOGY AND DRUG DELIVERY	Category	L	T	P	Credit
		SE (PS)	3	0	0	3

PREAMBLE

This course is designed to impart knowledge on the area of pharmacology and advances in novel drug delivery systems, contraindications and clinical use of drugs in treatment of disease, formulation, evaluation of novel drug delivery systems, merits, demerits and its applications.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To describe the knowledge on Molecular and Cellular mechanism of action of hormones
2	To summarize the basic concepts of chemotherapy agents
3	To demonstrate the different mechanism of action of immune response and hypersensitivity reactions
4	To construct the Rate Controlled Drug Delivery Systems and their feedback regulation
5	To implement the Novel Drug Delivery Systems and their merits and demerits

COURSE OUTCOMES

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

CO1. Recognize the molecular and cellular mechanism of action of hormones and their regulation.	Understand
CO2. Discuss the basics of chemotherapy, Antifungal and antiviral drugs	Understand
CO3. Illustrate the different mechanism of action of immune response and hypersensitivity reactions	Apply
CO4. Employ the rate controlled drug delivery system and their feedback regulated Drug Delivery Systems	Apply
CO5. Demonstrate the different kind of novel drug delivery system	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO	PO	PO	PO	PO	PO7	PO8	PO	PO1	PO1	PO12	PSO1	PSO	PSO3
CO1	S	M	L	-	L	-	-	-	-	-	L	S	M	M	M
CO2	S	-	-	L	M	L	-	-	-	-	L	M	S	-	-
CO3	M	L	-	S	S	L	-	-	-	-	M	L	M	M	M
CO4	S	M	L	S	S	-	-	-	-	-	M	-	-	-	-
CO5	S	M	-	M	S	-	M	-	-	L	-	M	M	M	

S- Strong; M-Medium; L-Low

SYLLABUS

ENDOCRINE PHARMACOLOGY

Molecular and cellular mechanism of action of hormones such as growth hormone, prolactin, thyroid, insulin and sex hormones. Anti-thyroid drugs, Oral hypoglycaemic agents, Oral Contraceptives, Corticosteroids. Drugs affecting calcium regulation.

CHEMOTHERAPY

Cellular and molecular mechanism of actions and resistance of antimicrobial agents such as ß-lactams, aminoglycosides, quinolones, Macrolide antibiotics. Antifungal, antiviral, and anti-TB drugs

IMMUNOPHARMACOLOGY

Cellular and biochemical mediators of inflammation and immune response. Allergic or hypersensitivity reactions. Pharmacotherapy of asthma and COPD. Immuno suppressants and Immuno stimulants

RATE CONTROLLED DRUG DELIVERY SYSTEMS

Principles & Fundamentals, Types, Activation; Modulated Drug Delivery Systems; Mechanically activated, pH activated, Enzyme activated, and Osmotic activated Drug Delivery Systems Feedback regulated Drug Delivery Systems; Principles & Fundamentals.

NOVEL DRUG DELIVERY SYSTEMS

Introduction, formulation, merits, demerits, Application and evaluation of following— Mucosal drug delivery system, Transdermal drug delivery system (TDDS), Parenteral implants, ophthalmic inserts, Intrauterine drug delivery system (IUDs), Liposomes, Probiotics and Prebiotics. Gastro retentive drug delivery system, Colon targeted drug delivery system, externally modulated devices and delivery

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, Editor- Edith Mathiowitz, Published by WileyInterscience Publication, John Wiley and Sons, Inc, New York, Chichester/Weinheim

REFERENCES:

1. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997.
2. Laurence Brunton, Bruce A. Chabner, Bjorn Knollman, "Goodman and Gillman's The Pharmacological basis of therapeutics", 12th Edition, 2011, Publisher: McGraw Hill Education.
3. David E Golan, Armen H. Tashjian Jr., Ehrin J. Armstrong, April W. Armstrong, "Principles of Pharmacology. The Pathophysiologic basis of drug therapy", 3rd Edition, 2011, Publisher: LWW.
4. Katzung , Bertram, "Basic and Clinical Pharmacology", 14th Edition, 2018, Publisher: McGraw-Hill.

COURSE DESIGNERS

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17BTSE15	PHARMACEUTICAL ASPECTS OF MICROBIOLOGY	Category	L	T	P	Credit
		SE (PS)	3	0	0	3

PREAMBLE

This subject is designed to provide the advanced knowledge to the students in invaluable areas of advanced microbiology which plays a crucial role in determining its future use and applications in medicine, drug discovery, mechanism of action of antibiotics, and uses in pharmaceutical industry.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To discuss the knowledge about industrially important microorganism and their application
2	To summarize the basic concepts of Antibiotics and Synthetic antimicrobial agents action
3	To outline the Mechanism and action of antibiotics
4	To outline the Mechanisms and action of Bacterial Virulence
5	To check the disease causing microorganisms and the corresponding diseases

COURSE OUTCOMES

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

CO1: Recall the basic information of industrially important microorganism and their application	Understand
CO2: Describe the difference between the Antibiotics and Synthetic antimicrobial agents action	Understand
CO3: Predict the Mechanism of action of antibiotics	Analyze
CO4: Detect Bacterial Virulence	Analyze
CO5: Validate the disease causing microorganism and their related disease	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO	PO2	PO3	PO4	PO5	PO6	PO	PO8	PO9	PO1	PO1	PO1	PSO	PSO	PSO3
CO1	S	M	L	-	L	-	-	-	-	-	L	S	-	-	-
CO2	S	-	-	L	M	L	-	-	-	-	L	M	-	-	-
CO3	M	L	-	S	S	L	-	-	-	-	M	L	-	-	-
CO4	S	M	L	S	S	-	-	-	-	-	M	-	-	-	-
CO5	L	L	L	L	M	S	M	S	-	-	L	-	S	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

MICROBIOLOGY

Introduction –Bacteria, fungi, actionmycetes and virus - structure, chemistry and morphology, cultural, physiological and reproductive features. Methods of isolation, cultivation and maintenance of pure cultures. Industrially important microorganisms - examples and applications

ANTIBIOTICS AND SYNTHETIC ANTIMICROBIAL AGENTS

Mechanism of action; microbial resistance; therapeutic, prophylactic usage and adverse reactions; Antibiotic and Synthetic antimicrobial agents: β- lactam, aminoglycosides, tetracyclines. Antifungal antibiotics: Griseofulvin; Antiviral drugs: Amantidines; Nucleoside analogues, Interferons, Peptide antibiotics.

MECHANISM OF ACTION OF ANTIBIOTICS

Inhibition of cell wall synthesis; nucleic acid and protein synthesis. Bacterial resistance to antibiotics; Penetration of antimicrobial agents (cellular permeability barrier, cellular transport system and drug diffusion). Mode of action of non–antibiotic antimicrobial agents; Mode of action of bacterial killing by quinolinones; Bacterial resistance to quionolinones.

MECHANISMS OF BACTERIAL VIRULENCE

A step wise process of infection – Crossing physical, chemical and biological barriers, Colonization, Association, Adhesion and Invasion of host tissue and toxigenesis with details account of virulence factors.

MICROBIAL PATHOLOGY

Identifying the features of pathogenic bacteria, fungi and viruses. Mechanism of microbial pathogenicity, etiology and pathology of common microbial diseases and currently recommended therapies for common bacterial, fungal & viral infections.

TEXT BOOKS

1. Agarwal S. S. and Paridhavi M., (2007), Herbal Drug Technology, Universities Press (India) Pvt. Ltd
2. Altreuter D., and D S. Clark, (1999), Combinatorial Biocatalysis: Taking the Lead From Nature, Curr. Opin. Biotechnol. 10, 130.
3. Burn J. H. (1957) Principles of Therapeutics, Blackwell Scientific Pub. O. Ltd. Oxford.

REFERENCES:

1. Bentley's Textbook of Pharmaceutics, Editior E. A. Rawlins, 8th Ed. (2002), Publisher: Bailliere Tindall, London
2. Burn J. H. (1957) Principles of Therapeutics, Publisher: Blackwell Scientific Pub. O. Ltd. Oxford.

COURSE DESIGNERS

S.No.	**Name of the Faculty**	**Designation**	**Department**	**Mail ID**
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17BTSE16	PHARMACEUTICAL PROCESS CHEMISTRY	Category	L	T	P	Credit
		SE (PS)	3	0	0	3

PREAMBLE

This subject is designed to impart knowledge on the development and optimization of a synthetic drugs, various stages of process in pharmaceutical industry, Different methods involved in Unit operations and Industrial safety measures.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To acquire knowledge on basics of Process chemistry in industry
2	To know the techniques of Extraction, Filtration, Distillation and Evaporation process
3	To discriminate the Aerobic and anaerobic fermentation
4	To outline the Impurities in Active Pharmaceutical Ingredient
5	To understand the basics of Industrial Safety measures and Occupational Health

COURSE OUTCOMES

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

CO1: Know the basic knowledge on Process chemistry	Understand
CO2: Operate the techniques of Extraction, Filtration, Distillation and Evaporation process in industry	Understand
CO3: Compare and differentiate the Aerobic and anaerobic fermentation process	Apply
CO4: Validate the Impurities in **Active Pharmaceutical Ingredient**	Analyze
CO5: Perform the Industrial Safety measures and Occupational Health in work place	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

PROCESS CHEMISTRY

Introduction, Synthetic strategy Stages of scale up process: Bench, pilot and large scale process.
In-process control and validation of large scale process. Case studies of some scale up process.

UNIT OPERATIONS

a) Extraction: Liquid equilibria, extraction with reflux, extraction with agitation, counter current extraction.
b) Filtration: Theory of filtration, pressure and vacuum filtration, centrifugal filtration,
c) Distillation: steam distillation.
d)Evaporation: Types of evaporators, factors affecting evaporation.

UNIT PROCESSES

Fermentation: Aerobic and anaerobic fermentation. Production of Antibiotics- Penicillin and Streptomycin .Vitamins: B2 and B12

IMPURITIES IN API (ACTIVE PHARMACEUTICAL INGREDIENT)

Impurities in API and their types including genotoxic impurities. Isolation, characterization and profiling of impurities in APIs with at least one example

INDUSTRIAL SAFETY

MSDS (Material Safety Data Sheet), hazard labels of chemicals and Personal Protection Equipment, Fire hazards, Occupational Health, Effluents and its management.

TEXT BOOKS:

1. Burger A., A Guide to the Chemical Basis of Drug Design, Volume 1-8, Wiley Interscience Publication (John Wiley & Sons), New York.
2. Sharma A.M., Safety and Health in Industry A Handbook, BS Publications Hyderabaad.

REFERENCES:

1. Pharmaceutical Manufacturing Encyclopedia, Volume 2.
   Gadamasetti K., Process Chemistry in the Pharmaceutical Industry: Challenges in an Ever- Changing Climate-An Overview, Vol-2, CRC Press, London

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.S.Vinoth	Assistant Professor	Biotechnology	vinoth@avit.ac.in
2	Mr.N.Jawahar	Assistant Professor	Biotechnology	jawahar@vmkvec.edu.in

17BTSE17	PHARMACOGENOMICS	Category	L	T	P	Credit
		SE (PS)	3	0	0	3

PREAMBLE

The course provides fundamental knowledge in pharmacogenomics and implementation of pharmacogenomic studies. The detailed study on human drug response, drug metabolizing enzymes, methods and applications will be focused.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To study about impact of polymorphism in human genome and applications.
2	To know about functional analysis of gene variation
3	To understand the drug dose response relationships with pharmacogenetics.
4	To understand the genomics of biotech products
5	To study about the pharmacogenomics application in diseases

COURSE OUTCOMES

CO1: Know about the different method of analysing the gene variation	Understand
CO2: Discuss the response of gene towards drug	Understand
CO3: Analyse the techniques in biotech products	Apply
CO4: Analyse the techniques in medicine	Analyze
CO5: Outline the genomics of disease	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO PHARMACOGENOMICS

Historical perspectives and current status, Human Genome and Genomic Applications, Genetic Polymorphism of Metabolic Reactions, SNPs, Association Studies in Pharmacogenomics, Study on industries developing pharmacogenomic research

FUNCTIONAL ANALYSIS OF GENE VARIATION

Transfection Assays With Allele-Specific Constructs: Functional Analysis of UDP- Glucuronosyltransferase Variants, CYP 2D6, CYP2C19 in drug metabolism, Snapshot of the Allele-Specific Variation in Human Gene Expression, Genome-Wide Analysis of Allele-Specific Gene Expression Using Oligo Microarrays, Roche Ampli Chip, HaploChIP: An In Vivo Assay.

HUMAN DRUG RESPONSE

Pharmacological profile of Human drug response, pharmacokinetics in pharmacogenetics, Drug-dose response relationships in pharmacogenetics, the genetic profile of Human drug response, Twin studies in pharmacogenomics

BIO-TECH PRODUCTS

Biotechnology and Related Techniques: Protein engineering, peptide chemistry and peptidomimetics, nucleic acid technology, catalytic antibodies and glycobiology ; Present products in medicine: Insulin, GH, Vaccines, Monoclonal antibodies, FSH, Tissue plasminogen activator (t-PA) ; Pharmacokinetics and dynamics of the peptide and protein drugs.

PHARMACOGENOMICS IN MEDICINE

Pharmacogenomics of Cardiovascular Diseases, Pharmacogenomics of Cancer treatment(Herceptin as model), Pharmacogenomics of Neurodegenerative Diseases, Inflammatory bowel syndrome, Pharmacogenomics in Depression, Pharmacogenomics and Respiratory diseases, Pharmacogenomics in AIDS, Pharmacogenomics in Antibiotics.

TEXT BOOKS:

1. Pharmacogenomics: Methods and Protocols (Methods in Molecular Biology) First Edition (2005) Federico Innocenti, Humana Press Inc, New Jersey, USA.
2. Pharmacogenomics and Personalized Medicine (Methods in Pharmacology and Toxicology) First Edition (2005) Nadine Cohen, Humana Press Inc, New Jersey, USA

REFERENCES:

1. An A-Z Guide to Pharmacogenomics, First Edition (2006) M.C. Catania, Published by American Association for Clinical Chemistry
2. Pharmacogenomics: Social, Ethical, and Clinical Dimensions, First Edition (2003) Mark A. Rothstein, Wiley-Liss Publications.

COURSE DESIGNERS

S.No.	**Name of the Faculty**	**Designation**	**Department**	**Mail ID**
1	Dr.S.Vinoth	Assistant Professor	Biotechnology	vinoth@avit.ac.in
2	Mr.N.Jawahar	Assistant Professor	Biotechnology	jawahar@vmkvec.edu.in

17BTSE18	HERBS AND DRUG ACTION	Category	L	T	P	Credit
		SE (PS)	3	0	0	3

PREAMBLE

This course is one of the most advanced introductions in Herbs and drug action that is offered. Students will learn about classification of Medicinal Plants, drugs and allergic reactions, their Science and mechanism of action of drugs, different medicinal plants used for various diseases etc. How herbs influence our physiology and can be helpful against several disorders.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To explain knowledge about the medicinal plants and classification.
2	To describe the basic concepts of allergens involved in allergic reaction
3	To execute, different mechanism of action of drugs in living system
4	To understand the effects of various medicinal plants used for treatment of common disease
5	To elucidate the uses of medicinal plants for various illness

COURSE OUTCOMES

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

CO1. To Know the basic information of different medicinal plants their uses	Understand
CO2. To Gain information about allergens involved in allergic reactions	Understand
CO3. To Evaluate the mechanism action of drugs in living system	Apply
CO4. To categorise the various medicinal plants used for treatment of common disease	Analyze
CO5. To develop the disease manifestation and treatment with medicinal plants	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	-	S	S	L	L	M	S	M	M	S
CO2	-	M	-	L	L	-	M	L	L	M	M	S	M	S	-
CO3	S	M	-	L	M	L	M	M	M	L	M	M	S	S	-
CO4	S	M	-	S	S	L	M	L	M	M	L	M	S	M	S
CO5	-	M	-	S	S	L	L	L	-	-	-	M	M	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO MEDICINAL PLANTS

Terminologies – Definitions – Classification of medicinal plants based on their effects – Ecological status with special reference to India.

ALLERGENS

Allergens – types – sources – active principles – Chemical nature – Cell modifiers – Lectins – mutagens, teratogens – Allergic reactions with known examples

MECHANISM OF DRUG ACTION

Drugs acting on brain and nervous system – Rheumatic arthritis – Psychoactive drugs – Depressants, Stimulants, hallucinogens – sources, effects, basic mechanism of action

DRUGS FROM MEDICINAL PLANTS

Cardiovascular diseases – blood pressure – cardiac drugs of plant origins – alkaloids, anticoagulants – basic mechanism of action. Pulmonary / respiratory disorders – asthma – bronchitis – common cold – allergy – Remedy from plants.

DISEASE MANIFESTATION AND COMMONLY USED MEDICINAL PLANTS

Drugs for urinogenital disorders – roots of *Withania somnifera* – Memory stimulants – *Centella asiatica* – Drugs for dissolving kidney stones – *Musa paradisica* (pseudo stem) – Anti-inflammatory drugs – Cardiospermum – Anticancer drugs – *Catharanthus roseus*

TEXT BOOKS:

1. R. Cassileth, K. Simon Yeung, Jyothirmai Gubili , 2010. Herb-Drug Interactions in Oncology, 2nd edition 2nd Edition, People\'s Medical Publishing House

REFERENCES:

1. 1. Kumar, N.C. (1993). An Introduction to Medical botany and Pharmacognosy. Emkay Publications, New Delhi.
2. Rao, A.P. (1999). Herbs that heal. Diamond Pocket Books (P) Ltd., New Delh

COURSE DESIGNERS

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

17BTSE19	SKILL BASED ETHNO MEDICINE	Category	L	T	P	Credit
		EC(SE)	3	0	0	3

PREAMBLE

Ethno medicine course deals with the interaction of people and plants with a broad survey on diversity of plants described both scientifically and culturally. Students learn about the social impact of plants on culture and also gain knowledge on identification, characterization and the uses of different medicinal plants in treating various diseases.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To state the scope and history of people and plant interaction from the past
2	To explain the functions and uses of plants
3	To demonstrate the different tribal medicine used for disease diagnosis and treatment.
4	To develop an understanding of the importance of plants in our daily lives
5	To produce cosmetics using medicinal plants

COURSE OUTCOMES

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

CO1. Recall the basic information and ethnic knowledge about plants	Remember
CO2. Demonstrate the knowledge about the uses of medicinal plants	Understand
CO3. Illustrate the uses of different tribal medicine for disease diagnosis and treatment	Apply
CO4. Appraise the traditional knowledge and utility of some commonly used medicinal plants	Analyze
CO5. Develop the cosmetics using medicinal plants	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	M	M	--	--	--	M	-	-	-	-	-	-	-	-	-
CO3	M	---	M	--	-	-	-	-	-	-	-	-	-	-	-
CO4	M	--	---	S	M	S	-	-	-	-	-	-	M	S	S
CO5	M	--	--	S	M	S	-	-	-	-	-	-	S	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INRODUCTION TO ETHNOMEDICINE

Ethno medicine – definition, history and its scope – Inter disciplinary approaches in ethno botany – Collection of ethnic information.

MEDICINAL PLANTS AND HEALTH CARE

Importance of medicinal plants – role in human health care – health and balanced diet (Role of proteins, carbohydrates, lipids and vitamins).

TRIBAL MEDICINE

Tribal medicine – Plants in folk religion – *Aegle marmelos*, *Ficus benghalensis*, *Curcuma domestica*, *Cyanodon dactylon and Sesamum indicum*- methods of disease diagnosis and treatment.

MEDICINAL PLANTS IN DAY TO DAY LIFE

Traditional knowledge and utility of some medicinal plants in Tamilnadu – *Solanum trilobatum, Cardiospermum halicacabum, Vitex negundo, Adathoda vasica, Azadirachta indica, Gloriosa superba, Eclipta alba, Aristolochia indica, Phyllanthus fraternus and Boerhaavia diffusa. Ocimum sanctum, Centella asiatica, Solanum trilobatum, Cassia auriculata, Aloe vera.*

HERBAL PLANTS USED IN COSMETICS

Plants used as a cosmetics-Almond (*Prunus dulcis*), Aloe (*Aloe vera*), Argan Tree (*Argania spinosa*), Buriti Palm (*Mauritia flexuosa*), Cinnamon (*Cinnamomum verum*), Grape (*Vitis vinifera*), Lemonbalm (*Melissa officinalis*), Malabar Tamarind (*Garcinia cambogia)*

TEXT BOOKS:

1. Ethnobiology – R.K.Sinha & Shweta Sinha – 2001. Surabhe Publications – Jaipur.
2. Swapan Kumar Kolay, Ethno-medicine for Traditional Health Care, 2016,
   Publisher B.R. Publishing Corporation

REFERENCES:

1. Tribal medicine – D.C. Pal & S.K. Jain 1998, Naya Prakash, 206, Bidhan Sarani, Calcutta – 700 006.
2. Contribution to Indian ethnobotany – S.K. Jain 1995, 3rd edition, Scientific publishers, P.B.No. 91, Jodhpur, India.
3. A Manual of Ethnobotany – S.K.Jain, 1995, 2nd edition.

COURSE DESIGNERS

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1	Dr. A.Nirmala	Assistant Professor	Biotechnology	nimmi_aruna@yahoo.com
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17BTSE20	PHARMACEUTICAL CHEMISTRY LABORATORY	Category	L	T	P	Credit
		SE (PS)	0	0	4	2

PREAMBLE

The course is focused on analysis of properties of raw material used for drug preparation and development of pharmaceutical products like Syrups, powders, suppositories, gargles and mouth washes

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To know certain properties of raw materials used in drug preparations
2	To classify compound based on the reactions
3	To formulate syrup, powders, suppositories, gargles and mouth washes
4	To distinguish the reactions in drug preparations
5	To outline the drug based reactions

COURSE OUTCOMES

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

CO1. Understand the different types of reaction during drug preparation	Understand
CO2. Demonstrate about the reaction in drug preparations	Apply
CO3. Test the melting and boiling point of the given sample	Analyze
CO4. Distinguish the reactions in drug preparations	Analyze
CO5. Prepare the drug based on type of reaction	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	S	M	-	-	-	-	-	-	M	-
CO2	S	S	M	-	-	-	-	-	-	-	-	-	-	S	-
CO3	S	S	S	M	S	-	-	-	-	-	-	-	M	S	-
CO4	S	S	S	-	S	-	-	-	-	-	-	-	-	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

1. To analyze the presence of acid radicals (anions) in the given mixture.
2. To perform detection of group I and group II radicals
3. To perform determination of melting point and boiling points.
4. Preparation of simple organic compounds based on different types of reactions

a) N-Acetylation : Preparation of Acetanilide from Aniline
b) O-Acetylation : Preparation of Aspirin from Salicylic acid
c) Bromination : Preparation of p-Bromoacetanilide from Acetanilide
d) Hydrolysis : Preparation of p-Bromoaniline from p-Bromoacetanilide
e) Nitration : Preparation of m-dinitrobenzene from Nitrobenzene/picric acid from phenol
f) Reduction : Preparation of m-nitro aniline from m-dinitro benzene.
g) Oxidation : Preparation of Benzoic acid from benzyl chloride / benzyl alcohol.
h) Esterification : Preparation of Benzyl benzoate from benzoyl chloride.

REFERENCES:

1. Laboratory Manual.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.B.Prabasheela	Associate Professor	Biotechnology	prabasheela@avit.ac.in
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17BTSE21	PHYTOCHEMISTRY LAB	Category	L	T	P	Credit
		SE (PS)	0	0	4	2

PREAMBLE

The course aims to provide students with the necessary skills for separation of the active constituents obtained from natural sources (alkaloids – glycosides – Coumarins- Tannins) in addition to the different methods of separation (chromatography) and then identify these active ingredients either in pure form of a mixture- as well as the different methods to evaluate these components.

PREREQUISITE – Biochemistry

COURSE OBJECTIVES

1	To discuss and recognize the basics of sample collection,identify plant powder.
2	To explain and analyse the routine phytochemical analysis test
3	To demonstrate, the compounds like Alkaloids, Steroids, Triterpenoids and their glylosides using different methods
4	To categorise the phyto chemical constituents of plants
5	To outline and formulate different phyto constituents from plants

COURSE OUTCOMES

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

CO1.Recall the basic information of sample collection, process and storage methods	Understand
CO2. Demonstrate the routine phytochemical constitutes of plants	Understand
CO3. Distinguish the compounds like Alkaloids, Steroids, Triterpenoids and their glylosides using different methods	Apply
CO4.Test, Extract, isolates and identifies the active substances of the medicinal plants.	Analyse
CO5. Validate the different phyto constituents from plants	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO11	PO12	PSO1	PSO 2	PSO 3
CO1	M	L	L	-	-	M	M	-	L	-	M	-	M	-	-
CO2	M	M	M	M	-	M	-	-	L	-	-	M	M	-	-
CO3	M	L	S	-	-	L	-	-	M	-	S	-	-	-	-
CO4	-	M	L	L	M	-	L	-	-	-	-	-	S	-	-
CO5	L	-	M	L	M	-	M	-	-	-			S	M	-

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

SYLLABUS

I. Preparation of extracts of Organized crude drugs/Herbs by successive solvent extraction method to record the percentage yield and physical status of the respective extracts and for subjecting them to phytochemical screening.
II. Detection of Phytoconstituents such as i) Alkaloids, ii) Steroids, Triterpenoids and their glylosides and Saponins iii) Flavonoids and their glycosides iv) Anthracene Glycosides v) Coumarins vi) Tannins by Test Tube and TLC methods.
III. a) Identification of alkaloids in a mixture by TLC b) Colour reactions of different groups of Alkaloids.
IV) Detection, extraction and estimation of volatile oils by Clevenger's method (Hydro distillation method) TLC of Volatile oils and their pure constituents.
V) Identification of mono saccharides by paper chromatography
VI) Analysis of recorded spectra of some simple phytochemicals.

TEXT BOOKS

1. Principles and Practice of Phototherapy: Modern Herbal Medicine" (2000) by Mills S., Bone K., Corrigan D., Duke J.A. and Wright J.V. Churchill Living Stone, Edinburgh; New York.

REFERENCE BOOKS

1. Medicinal Plant Constituents” (1981), 3rd ed. by Balbaa S., Hilal S.H. and Zaki A.Y., Egyptian Dar El-kotob, Cairo.

2. The Systemic Identification of Flavonoids" (1970) by Mabry T.J., Markham K.R. & Thomas M.B., Springer-Verlag, Berlin–Heidelberg– New York.

COURSE DESIGNERS

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17BTSE22	PHARMACEUTICAL MICROBIOLOGY LAB	Category	L	T	P	Credit
		SE (PS)	0	0	4	2

PREAMBLE

The course aims to provide students with the necessary skills for the research and development of anti-infective agents, the use of microorganisms to detect mutagenic and carcinogenic activity in prospective drugs, and the use of microorganisms in the manufacture of pharmaceutical products like insulin and human growth hormone.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To discuss and recognize the morphology of different microbes.
2	To Interpret and analyse the different types of media
3	To classify the biochemical characters of microorganisms
4	To check the pure cultures by different streaking methods
5	To assess preservation procedure for microorganisms

COURSE OUTCOMES

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

CO1. Recall the basic information of morphology and preparation of various culture media	Understand
CO2. Describe the motility of bacteria and biochemical methods	Understand
CO3. Estimate the pour plate and microscopic count methods	Apply
CO4. To distinguish the extract, isolates and identifies the microbes.	Analyse
CO5. To categorise the disinfectant and oligodynamic action	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	S	L	-	-	M	M	-	L	-	M	-	-	-	-
CO2	L	-	M	-	S	M	-	-	L	-	-	M	-	-	-
CO3	M	L	S	-	S	L	-	-	M	-	S	-	-	M	-
CO4	-	M	L	L	S	-	L	-	-	-	-	-	M	M	M
CO5	L	-	M	L	S	-	M	-	-	-			M	S	-

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

SYLLABUS

1. Introduction to equipment and glassware used in microbiology laboratory.
2. Study of morphology of different microbes
3. Preparation of various culture media, cultivation of microbes and observation of colony characteristics.
4. Sterilization techniques (moist and dry heat) and their validations.
5. Aseptic transfer of culture into different types of media.
6. Characterisation of microbes by staining techniques (simple, gram’s, acid fast and negative staining).
7. Study of motility of bacteria by hanging drop method.
8. Characterization of microbes through Bio chemical reactions:

   a. Indole test.

   b. Methyl red test.

c. Voges proskauer test.

d. Starch hydrolysis test.

e. Fermentation of carbohydrates.

9. Isolation of pure cultures by streak plate, spread plate & pour plate techniques.
10. Enumeration of bacteria by pour plate/spread plate technique
11. Enumeration of bacteria by direct microscopic count.
12. Evaluation of any disinfectant by phenol coefficient test
13. Study of Oligodynamic action (of metals on bacteria)
14. Preservation of microrganisms (slant and stab cultures)
15. Microbiological Analysis of Water.

REFERENCE BOOKS

1. Garg,F C Experimental Microbiology
2. Gaud.R.S, Gupta G.D, Practical Microbiology
3. Vanitha Kale and kishore Bhusari, Pratical microbiology principles and Techniques

COURSE DESIGNERS:

S.No.	Name of the faculty	Designation	Department	Mail ID
1.	Dr. S. Vinoth	Assistant Professor	Biotechnology	vinogenes@gmail.com
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17BTSE23	ANALYTICAL METHODS IN PHARMACEUTICAL LABORATORY	Category	L	T	P	Credit
		SE (PS)	0	0	4	2

PREAMBLE

This lab course is designed to impart good knowledge in various analytical techniques in pharmaceutical industry

PRERQUISITE

Nil

COURSE OBJECTIVES

1	To interpret the importance of calibration in apparatus
2	To express the different types of Titration processes
3	To summarize the knowledge on gravimetric methods
4	To demonstrate the Chromatographic techniques for product purification.
5	To outline the extraction techniques to separate biomolecules.

COURSE OUTCOMES

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

CO1. Express the various titration techniques used in pharmaceutical Industry.	Understand
CO2. Identify the fundamental knowledge about the gravimetric analysis	Understand
CO3. Demonstrate the techniques for the separation of aminoacids	Understand
CO4. Employ the separation using chromatographic techniques	Apply
CO5. Practice the spectroscopic techniques	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	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	L	-	-	-	-	-	-	-	-	L	M	-	M
CO2	S	M	S	-	-	-	-	-	-	-	-	L	M	-	M
CO3	M	L	M	-	-	-	-	-	-	-	-	L	S	-	S
CO4	L	L	L	-	-	-	-	-	-	-	M	-	M	M	S
CO5	S	M	L	-	-	-	-	-	-	-	L	-	S	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

9. Standardization of analytical weights and calibration of volumetric apparatus.
10. Acid Base Titrations ; Preparation and standardization of acids and bases, some exercise related with determination of acids and bases separately in mixture form, some official assay procedure e.g. boric acid should also be covered.
11. Oxidation reduction titrations ; Preparation and standardization of some redox titrants e.g. potassium permanganate, potassium dichromate, iodine, sodium thiosulphate, etc., some exercises related to determination of oxidizing and reducing agents in the sample shall be covered. Exercises involving potassium iodate, potassium bromate, iodine solution, titanous chloride, sodium 2,6,-di chlorophenol indophenol, ceric ammonium sulphate be designed.
12. Precipitation Titrations ; Preparation and standardization of titrants like silver nitrate and ammonium thiocyanate, titrations according to Mohrs Volhards and Fajans methods.
13. Gravimetric Analysis : Preparation of Gooch crucible for filtration and use of sintered glass crucible, determination of water of hydration, some exercises related to gravimetric analysis should be covered.
14. Non-aqueous Titrations ; Preparation and standardization of perchloric acid and sodium/ potassium/lithium methoxides solutions, Estimations of some pharmacopoeial products.
15. Complexometric titrations ; Preparations and standardization of EDTA solution, some exercises related to pharmacopoeial assays by complexometric titrations.

16. Separation & identification of amino acids by paper chromatography
17. Separation & identification of alkaloids by TLC
18. UV spectrometric determination of Ibuprofen

TEXT BOOKS

6. Atherden, L.M. "Bentley and Driver's Textbook of Pharmaceutical Chemistry". 8th Edition, Oxford University Press, 1977.
7. Siddiqui, Anees A. "Pharmaceutical Analysis". Vol.I & II, CBS, 2006.
8. Parimoo, P. "Pharmaceutical Analysis". CBS, 1998.
9. Higuchi, Tekeru and Brochmann, Einar "Pharmaceutical Analysis". CBS Publishers, 1997.

REFERENCE BOOKS

4. Gennaro, Alfonso R. "Remington : The Science and Practice of Pharmacy" Vol. I & II, 20th Edition, Lippincott Williams & Wilkins / B.I. Publication, 2000.
5. Connors, Kenneth A. "A Textbook of Pharmaceutical Analysis". 3rd Edition, Johnwiley & Sons, 1982.
6. Ohannesian, Lena and Streeter, A.J. "Handbook of Pharmaceutical Analysis". Marcek Dekker, 2002.
7. Stahl, Egon "Thin – Layer Chromatography : A Laboratory Handbook". 2nd Edition, Springer, 2005

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