



**AARUPADAI VEEDU
INSTITUTE OF TECHNOLOGY**
OMR, PAIYANOOR, CHENNAI - 603104



**VINAYAKA MISSION'S
RESEARCH FOUNDATION**
(Deemed to be University under section 3 of the UGC Act 1956)



B.Tech - Biotechnology

Regulations 2017

**DEPARTMENT OF BIOTECHNOLOGY
AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY
VINAYAKA MISSION'S RESEARCH FOUNDATION
PAIYANOOR – 603 104**

**AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY,
PAIYANOOR**

&

**VINAYAKA MISSION'S KIRUPANANDA VARIYAR
ENGINEERING COLLEGE, SALEM**

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

NAAC Accredited



Faculty of Engineering and Technology

Department of Biotechnology

Programme :B.Tech - Biotechnology

Full Time (4 Years)

STRUCTURED CHOICE BASED CREDIT SYSTEM (SCBCS)

Curriculum & Syllabus

(Semester I to VIII)

Regulations 2017

ANNEXURE I

(A) PROGRAM OUTCOMES

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of problems in the area of Biotechnology.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex biotechnology-oriented problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex bio-based 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 in the area of biotechnology.
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 practice.
7. **Environment and sustainability:** Understand the impact of the professional biotechnological 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 technology 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 technology audience 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:

PO1: To identify, formulate, design, analyse and develop processes and technologies for biotechnological products for societal usage and economically sustainable for the present and future.

PO2: To assess the human health and environmental issues and provide relevant professional mitigation measures and implementation of biotechnological tools.

PO3: To function in a multi-disciplinary team and understand the professional ethics and responsibilities and equip themselves for higher learning for addressing technological challenges.

(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 are sound and economically viable and sustainable.

Credit Requirement for Course Categories

Sl. No.	Category of Courses	Credits
01	A. Foundation Courses (FC)	54 - 63
	i. Humanities and Sciences (English and Management Subjects)	12 – 21
	ii. Basic Sciences (Maths, Physics and Chemistry Subjects)	24 – 33
	iii. Engineering Sciences (Basic Engineering Courses)	18 - 27
02	B. Core courses (CC) relevant to the chosen programme of study.	81
03	C. Elective Courses (EC)	18 - 27
	i. Programme Specific (Class Room or Online)	12 – 15
	ii. Open (Class Room or Online)	6 - 9
04	D. Project + Internship + Industry Electives (P + I + I)	18
	i. Project	9
	ii. Internship / Industry Supported Courses	9
05	E. Employability Enhancement Courses + Co - Curricular Courses + Extra Curricular Courses (EEC)**	9 - 18
Minimum Credits to be earned		180
** - Mandatory, Credits would be mentioned in Mark sheets but not included for CGPA Calculations.		

B.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
1.	17EGHS01	TECHNICAL ENGLISH	ENGLISH	FC(HSS)	3	0	0	3	NIL
2.	17EGHS02	BUSINESS ENGLISH	ENGLISH	FC(HSS)	3	0	0	3	NIL
3.	17MBHS04	TOTAL QUALITY MANAGEMENT	MANAGEMENT	FC(HSS)	3	0	0	3	NIL
4.	17EGHS81	ENGLISH LANGUAGE LAB	ENGLISH	FC(HSS)	0	0	4	2	NIL
5.	17YMHS82	YOGA & MEDITATION	PHYSICAL EDUCATION	FC(HSS)	0	0	4	2	NIL
6.	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)

1.	17MABS03	MATHEMATICS FOR BIOENGINEERING	MATHS	FC(BS)	2	2	0	3	NIL
2.	17PCBS02	PHYSICAL SCIENCES	PHYSICS & CHEMISTRY	FC(BS)	4	0	0	4	NIL
3.	17MAB07	BIOSTATISTICS	MATHS	FC(BS)	2	2	0	3	NIL
4.	17PHBS05	SMART MATERIALS	PHYSICS	FC(BS)	3	0	0	3	NIL
5.	17CHBS03	BIOORGANIC CHEMISTRY	CHEMISTRY	FC(BS)	3	0	0	3	NIL
6.	17CHBS01	ENVIRONMENTAL SCIENCE AND ENGINEERING	CHEMISTRY	FC(BS)	3	0	0	3	NIL
7.	17PHBS02	NANOTECHNOLOGY	PHYSICS	FC(BS)	3	0	0	3	NIL
8.	17PCBS81	PHYSICAL SCIENCES LAB	PHYSICS & CHEMISTRY	FC(BS)	0	0	4	2	NIL
9.	17CHBS81	BIOORGANIC CHEMISTRY LAB	CHEMISTRY	FC(BS)	0	0	4	2	NIL

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

1.	17BTES04	FUNDAMENTALS OF BIOTECHNOLOGY	BTE	FC(ES)	3	0	0	3	NIL
2.	17CSES01	ESSENTIALS OF COMPUTING (Theory + Practice)	CSE	FC(ES)	2	0	2	3	NIL
3.	17CSES06	PROGRAMMING IN C	CSE	FC(ES)	3	0	0	3	NIL
4.	17BMES01	BIOSENSORS & MEASUREMENT DEVICES	BME	FC(ES)	3	0	0	3	NIL
5.	17BMES02	MEDICAL INSTRUMENTATION	BME	FC(ES)	3	0	0	3	NIL
6.	17CSES85	PROGRAMMING IN C LAB	CSE	FC(ES)	0	0	4	2	NIL
7.	17BMES81	BIOSENSORS & MEASUREMENT DEVICES LAB	BME	FC(ES)	0	0	4	2	NIL
8.	17BMES82	MEDICAL INSTRUMENTATION LAB	BME	FC(ES)	0	0	4	2	NIL

B.TECH. – BIOTECHNOLOGY - SEMESTER I TO VIII
DETAILS OF CORE COURSES FOR DEGREE WITH SPECIALISATION
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	MICROBIOLOGY
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	4	0	0	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
31.	17BTCC93	BIOINFORMATICS LAB	BTE	CC	0	0	4	2	NIL

B.TECH. – BIOTECHNOLOGY - SEMESTER I TO VIII

DETAILS OF ELECTIVE COURSES FOR DEGREE WITH SPECIALISATION

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

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

SL. NO	CODE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1.	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	GENETIC ENGINEERING
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 PROCESS ENGINEERING	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	BIO FERTILIZER 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-STORY 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 TREATMENT	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
SPECIALISATION – INDUSTRIAL BIOTECHNOLOGY									
1.	17BTSE01	INDUSTRIAL BIOTECHNOLOGY	BTE	SE - PS	3	0	0	3	NIL
2.	17BTSE02	CHEMICAL REACTION ENGINEERING	BTE	SE - PS	3	0	0	3	NIL
3.	17BTSE03	FERMENTER DESIGN AND ANALYSIS	BTE	SE - PS	3	0	0	3	NIL
4.	17BTSE04	BIOSEPARATION TECHNOLOGY	BTE	SE - PS	3	0	0	3	NIL
5.	17BTSE05	INDUSTRIAL WASTE MANAGEMENT	BTE	SE - PS	3	0	0	3	NIL
6.	17BTSE06	FUNDAMENTALS OF FLUID MECHANICS	BTE	SE - PS	3	0	0	3	NIL
7.	17BTSE07	BIOPROCESS ECONOMICS AND REACTOR DESIGN	BTE	SE - PS	3	0	0	3	NIL
8.	17BTSE08	BIOREACTOR THEORY	BTE	SE - PS	3	0	0	3	NIL
9.	17BTSE09	INDUSTRIAL BIOTECHNOLOGY LAB	BTE	SE - PS	0	0	4	2	NIL
10.	17BTSE10	FERMENTATION LAB	BTE	SE - PS	0	0	4	2	NIL
11.	17BTSE11	FLUID MECHANICS FOR BIOTECHNOLOGY LAB	BTE	SE - PS	0	0	4	2	NIL
SPECIALISATION – MEDICAL AND PHARMACEUTICAL BIOTECHNOLOGY									
1.	17BTSE12	INDUSTRIAL MANAGEMENT AND PHARMACEUTICAL MARKETING	BTE	SE - PS	3	0	0	3	NIL
2.	17BTSE13	PHARMACEUTICAL PHYTO CHEMISTRY	BTE	SE - PS	3	0	0	3	NIL
3.	17BTSE14	MEDICAL PHARMACOLOGY AND DRUG DELIVERY	BTE	SE - PS	3	0	0	3	NIL
4.	17BTSE15	PHARMACEUTICAL ASPECTS OF MICROBIOLOGY	BTE	SE - PS	3	0	0	3	NIL
5.	17BTSE16	PHARMACEUTICAL PROCESS CHEMISTRY	BTE	SE - PS	3	0	0	3	NIL
6.	17BTSE17	PHARMACOGENOMICS	BTE	SE - PS	3	0	0	3	NIL
7.	17BTSE18	HERBS AND DRUG ACTION	BTE	SE - PS	3	0	0	3	NIL
8.	17BTSE19	SKILL BASED ETHANO MEDICINE	BTE	SE - PS	3	0	0	3	NIL
9.	17BTSE20	PHARMACEUTICAL CHEMISTRY LABORATORY	BTE	SE - PS	0	0	4	2	NIL
10.	17BTSE21	PHYTO CHEMISTRY LAB	BTE	SE - PS	0	0	4	2	NIL
11.	17BTSE22	PHARMACEUTICAL MICROBIOLOG LAB	BTE	SE - PS	0	0	4	2	NIL

12.	17BTSE23	ANALYTICAL METHODS OF PHARMACEUTICAL LABORATORY	BTE	SE - PS	0	0	4	2	NIL
(ii) OPEN ELECTIVE (CLASS ROOM OR ONLINE) - CREDITS (6 - 9)									
1.	17CSCC02	OBJECT ORIENTED PROGRAMMING	CSE	EC - OE	3	0	0	3	NIL
2.	17CSCC07	OPERATING SYSTEM	CSE	EC -OE	3	0	0	3	NIL
3.	17CSCC09	JAVA PROGRAMMING	CSE	EC-OE	3	0	0	3	NIL
4.	17CSCC16	CLOUD COMPUTING	CSE	EC - OE	3	0	0	3	NIL
5.	17CSCC17	CYBERSECURITY	CSE	EC - OE	3	0	0	3	NIL
6.	17CSEC30	UNIX INTERNALS	CSE	EC - OE	3	0	0	3	NIL
7.	17CSEC34	WEB DESIGN AND MANAGEMENT	CSE	EC - OE	3	0	0	3	NIL
8.	17CSP107	LEARNING IT ESSENTIALS BY DOING	CSE	EC - OE	3	0	0	3	NIL
9.	17CSP110	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	INTRODUCTION TO 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 TECHNOLOGIES	MECH	EC - OE	3	0	0	3	NIL
36.	17MESE06	BIO ENERGY TECHNOLOGY	MECH	EC - OE	3	0	0	3	NIL

B.TECH. – BIOTECHNOLOGY - SEMESTER I TO VIII

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

SL. NO	CODE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1	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

B.TECH. – BIOTECHNOLOGY - SEMESTER I TO VIII

CATEGORY E – EMPLOYABILITY ENHANCEMENT COURSES, CO - CURRICULAR COURSES AND EXTRA CURRICULAR COURSES (EE)** - 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	0	0	2	1	NIL
4	17BTEE02	TECHNICAL SKILLS –II	BTE	EE	0	0	2	1	NIL
5	17BTEE03	TECHNICAL SKILLS –III	BTE	EE	0	0	2	1	NIL
6	17BTEE04	TECHNICAL SKILLS–IV	BTE	EE	0	0	2	1	NIL
7	17BTEE05	TECHNICAL SKILLS -V	BTE	EE	0	0	2	1	NIL

(ii) CO - CURRICULAR COURSES (CCC)

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

**(DEEMED TO BE UNIVERSITY, SALEM)
AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY, CHENNAI**

&

**VINAYAKA MISSION'S KIRUPANANDA VARIYAR ENGINEERING COLLEGE, SALEM
FACULTY OF ENGINEERING AND TECHNOLOGY
STRUCTURED CHOICE BASED CREDIT SYSTEM**

BOARD : BIOTECHNOLOGY

REGULATION : 2017

PROGRAM : B.Tech., – BIOTECHNOLOGY (FULL TIME - REGULAR)

CURRICULUM AND SYLLABUS

SEMESTER – I									
S.NO	COURSE CODE	COURSE TITLE	OFFERING DEPARTMENT	CATEGORY	L	T	P	C	PREREQUISITE
THEORY									
1	17EGHS01	TECHNICAL ENGLISH	ENGLISH	FC(HS)	3	0	0	3	NIL
2	17MABS03	MATHEMATICS FOR BIO-ENGINEERING	MATHEMATICS	FC(BS)	2	2	0	3	NIL
3	17PCBS02	PHYSICAL SCIENCES	PHYSICS & CHEMISTRY	FC(BS)	4	0	0	4	NIL
4	17CSES01	ESSENTIALS OF COMPUTING (Theory + Practice)	CSE	FC(ES)	2	0	2	3	NIL
5	17BTES01	FUNDAMENTALS OF BIOTECHNOLOGY	BTE	FC(ES)	3	0	0	3	NIL
PRACTICAL									
6	17EGHS81	ENGLISH LANGUAGE LAB	ENGLISH	FC(HS)	0	0	4	2	NIL
7	17PCBS81	PHYSICAL SCIENCES LAB	PHYSICS & CHEMISTRY	FC(BS)	0	0	4	2	NIL
8	17YMHS82	YOGA & MEDITATION	PHYSICAL EDUCATION	FC (HS)	0	0	4	2	NIL
TOTAL					14	2	14	22	
L – LECTURE HOUR					T – TUTORIAL HOUR P – PRACTICAL HOUR C – CREDIT				

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

17EGHS01	TECHNICAL ENGLISH	Category	L	T	P	Credit
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SYLLABUS

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 - 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- 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 - 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 (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. “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 IV”, Cambridge University Press.
4. Pickett and Laster, “Technical English: Writing, Reading and Speaking”, New York: Harper and Row Publications, 2002.

COURSE DESIGNERS:

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

17MABS03	MATHEMATICS FOR BIOENGINEERING		Category	L	T	P	Credit								
			FC (BS)	2	2	0	3								
PREAMBLE															
This course offers the knowledge of solving 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- NIL															
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 tools 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	S	M	M	--	--	M	--	--	--	--	--	--	--
CO2	S	S	M	M	M	--	--	M	--	--	--	--	--	--	--
CO3	S	S	S	M	M	--	--	M	--	--	--	--	--	--	--
CO4	S	S	M	S	M	--	--	M	--	--	--	M	--	--	--
CO5	S	S	M	S	M	--	--	M	--	--	--	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 derivatives – 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 ($\exp(ax)$, $\cos ax$, $\sin ax$).															
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. W.Ewans & G.Grant, “Statistical Methods in Bio informatics – An Introduction”, (2005).

COURSE DESIGNERS:

S.No	Name of the Faculty	Designation	Mail ID
1	Dr.P.Sasikala	Professor	sasikalap@vmkvec.edu.in
2	Mrs.V.T.Lakshmi	Asso.Prof	lakshmi@vmkvec.edu.in

17PCBS02	PHYSICAL SCIENCES PART A - ENGINEERING PHYSICS										Category	L	T	P	Credit
											FC(BS)	2	0	0	2
PREAMBLE Engineering Physics is the application of the concepts of physics to various technological applications. Understanding the concepts of laser, types of lasers, the propagation of light through fibers, applications of optical fibers in communication and different types of non-destructive techniques will help an engineer to analyze and design various equipments.															
PREREQUISITE – NIL															
COURSE OBJECTIVES															
1	To recall the properties of laser and to explain principles of laser.														
2	To examine the applications of laser.														
3	To outline the principles of fibre optics.														
4	To examine the applications of fibre optics.														
5	To explain various techniques used in Non-destructive testing.														
COURSE OUTCOMES															
On the successful completion of the course, students will be able to															
CO1. Define the principles of laser.														Understand	
CO2. Use laser in designing equipments.														Apply	
CO3. Explain the principles of fiber optics & the propagation of light in optical fibers.														Understand	
CO4. Utilize fibre optics in communication systems and sensors.														Apply	
CO5. Inspect materials using non-destructive testing techniques.														Analyze	
MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES															
COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	M	L	L	--	--	--	--	--	--	--	--	--	--	--
CO2	S	S	M	M	S	M	--	--	L	--	--	M	--	--	--
CO3	L	M	L	L	--	--	--	--	--	--	--	--	--	--	--
CO4	S	S	M	M	S	M	--	--	L	--	--	M	--	--	--
CO5	S	S	M	M	S	M	--	--	M	--	--	M	--	--	--
S- Strong; M-Medium; L-Low															
SYLLABUS															
LASERS: Laser characteristics - Stimulated Emission – Population Inversion - Einstein coefficients – Lasing action – Types of Laser – Nd:YAG laser, CO2 laser, GaAs laser – Applications of Laser – Holography – construction and reconstruction of a hologram															
FIBRE OPTICS: Principle and propagation of light in optical fibres – numerical aperture and acceptance angle – types of optical fibres (material, refractive index, mode) – Applications: Fibre optic communication system – fibre optic displacement sensor and pressure sensor.															
NON-DESTRUCTIVE TESTING: Introduction – Types of NDT - Liquid penetrant method – characteristics of penetrant and developer - ultrasonic flaw detector – X-ray Radiography: displacement method – X-ray Fluoroscopy.															

TEXT BOOK:

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

REFERENCES:

1. Beiser, Arthur, Concepts of Modern Physics, 5th Edition, 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, Dhanpat Rai publishers, New Delhi, 2001.
4. Avanadhanulu. M. N., Arun Murthy. T. V. S, Engineering Physics Vol. I, S. Chand, 2014.
5. Rajendran. V, Engineering Physics, Tata Mc Graw Hill Publication and Co., New Delhi, 2009.
6. Baldev Raj et al. Practical Non-Destructive Testing, Narosa Publications, 2017.

COURSE DESIGNERS

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

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

PREAMBLE

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

PREREQUISITE - NIL

COURSE OBJECTIVES

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

COURSE OUTCOMES

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

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	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	--	--	--	--	S	--	--	--
CO3	M	S	M	--	--	S	M	--	--	--	--	S	--	--	--
CO4	M	M	M	--	--	M	M	--	--	--	--	S	--	--	--
CO5	M	M	L	--	--	M	S	--	--	--	--	S	--	--	--
CO6	M	M	M	--	--	M	M	--	--	--	--	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 (H₂-O₂ 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 & ReverseOsmosis).

FUELS AND CHEMISTRY OF ADVANCED MATERIALS

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

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

TEXTBOOK:

1. “Engineering Chemistry”, Department of Chemistry, Vinayaka Missions University, Salem.

REFERENCES:

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

COURSE DESIGNERS

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

17CSES01	ESSENTIALS OF COMPUTING	Category	L	T	P	CREDIT									
		FC(ES)	2	0	2	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.															
PREREQUISITE - NIL															
COURSE OBJECTIVES															
1	To provide basic knowledge of hardware and software components of computers.														
2	To introduce and demonstrate various software application packages.														
3	To study Problem solving Techniques and program development cycle.														
4	To learn about various algorithm and identifying the algorithm efficiency.														
5	To learn different algorithm for various application														
COURSE OUTCOMES															
On the successful completion of the course, students will be able to															
CO1. Basic knowledge on hardware and software terminologies.					Remember and Understand										
CO2. Demonstration about various Application Packages like MS-word, MS-Excel etc.					Apply										
CO3. Understand Program Devolvement Cycle and apply various Problem Solving Techniques.					Understand, Apply.										
CO4. Identifying and analyzing the efficiency of Algorithms.					Understand.										
CO5. Implementation of Algorithms for various concepts.					Understand and Apply										
MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES															
COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	-	-	-	-	-	-	-	-	-	-	-	S	M	
CO2	S	M	-	-	-	-	-	-	-	-	-	-	S	M	L
CO3	S	S	S	-	M	-	-	-	-	-	-	-	S	L	
CO4	S	S	S	-	S		-	-	-	-	-	-	S	M	
CO5	S	M	M	-	M	-	-	-	-	-	-	-	S	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	Dr.V.Amirthalingam	Associate Professor	Computer science and engineering	amirthalingam@vmkvec.edu.in
2	Mrs.T.Geetha	Assistant Professor	Computer science and engineering	geetha@vmkvec.edu.in

17BTES01	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 analyse 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. Analyzing in detail about the performance of drugs produced by novel methods											Analyze				
CO5. Apply the knowledge of biotechnology to improve global environment.											Apply				
MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES															
COS	PO1	PO2	PO3	PO4	PO5	PO06	PO07	PO08	PO09	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	M	L	M	L	S	L	M	L	S	S	S	M
CO2	S	M	S	S	M	M	S	M	S	M	M	S	S	M	M
CO3	S	S	S	S	M	M	M	M	S	M	M	S	S	M	M
CO4	S	S	S	S	S	M	M	S	S	M	M	M	S	S	S
CO5	S	M	M	S	M	M	S	S	M	M	M	M	S	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

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

PREAMBLE

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

PREREQUISITE – NIL

COURSE OBJECTIVES

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

COURSE OUTCOMES

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

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	P O4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	--	S	M	S	--	L	--	--	S	S	M	--	--	--	--
CO2	M	--	--	--	--	--	--	--	M	S	--	M	--	--	--
CO3	M	--	--	--	--	--	--	--	--	S	--	M	--	--	--
CO4	M	--	--	--	--	--	--	--	--	M	--	--	--	--	--
CO5	M	--	--	S	--	--	--	--	--	M	--	--	--	--	--
CO6	--	M	M	--	--	--	--	--	--	M	--	--	--	--	--

S- Strong; M-Medium; L-Low

SYLLABUS

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

Influence of mother tongue, videos, understanding nuances of English language (video) puzzle to solve, Activity.

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.

Telephone Etiquette, Dining Etiquette, Meeting Etiquette.

Case study of Etiquette in different scenario.

COURSE DESIGNERS:

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

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

PREAMBLE

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

PREREQUISITE – NIL

COURSE OBJECTIVES

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

COURSE OUTCOMES

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

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

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

COURSE DESIGNERS

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

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

PREAMBLE

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

PREREQUISITE – NIL

COURSE OBJECTIVES

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

COURSE OUTCOMES

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

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

1. Engineering Chemistry Lab Manual by VMU.

COURSE DESIGNERS

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

**VINAYAKA MISSION'S RESEARCH FOUNDATION
(DEEMED TO BE UNIVERSITY, SALEM)
AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY, CHENNAI**

&

**VINAYAKA MISSION'S KIRUPANANDA VARIYAR ENGINEERING COLLEGE, SALEM
FACULTY OF ENGINEERING AND TECHNOLOGY
STRUCTURED CHOICE BASED CREDIT SYSTEM**

BOARD : BIOTECHNOLOGY

REGULATION : 2017

PROGRAM :B.Tech., – BIOTECHNOLOGY (FULL TIME - REGULAR)

CURRICULUM AND SYLLABUS

SEMESTER – II									
S.NO	COURSE CODE	COURSE TITLE	OFFERING DEPARTMENT	CATEGORY	L	T	P	C	PREREQUISITE
THEORY									
1	17MAB07	BIostatISTICS	MATHEMATICS	FC(BS)	2	2	0	3	17MABS03
2	17CSES06	PROGRAMMING IN C	CSE	FC(ES)	3	0	0	3	NIL
3	17BTCC02	CELL BIOLOGY	BTE	CC	3	0	0	3	NIL
4	17PHBS05	SMART MATERIALS	PHYSICS	FC(BS)	3	0	0	3	NIL
5	17BTCC01	ESSENTIALS OF BIOCHEMISTRY	BTE	CC	3	0	0	3	NIL
PRACTICAL									
6	17CSES85	PROGRAMMING IN C LAB	CSE	FC(ES)	0	0	4	2	NIL
7	17BTCC81	BIOCHEMISTRY LAB	BTE	CC	0	0	4	2	NIL
8	17BTCC82	CELL BIOLOGYLAB	BTE	CC	0	0	4	2	NIL
TOTAL					14	2	12	21	
L – LECTURE HOUR T – TUTORIAL HOUR P – PRACTICAL HOUR C – CREDIT									

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

17MAB07	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

COURSE OBJECTIVES

1	Develop skills in presenting quantitative data using appropriate diagrams, tabulations and summaries
2	Gain fundamental knowledge of the probability concepts with respect to how they are applied to the fundamental interpretation of statistical data.
3	To acquire knowledge of Testing of Hypothesis useful in making decision and test them by means of the measurements made on the sample.
4	To be 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. Identify and perform statistical significance tests for small, large samples and interpret the test results appropriately.	Apply
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.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

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:

2. S.P. Gupta, “Statistical Methods”, 34th Edition, Sultan Chand & Sons Publishers (2006).
3. 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	Department	Mail ID
1	Dr.P.Sasikala	Professor	Mathematics	sasikalap@vmkvec.edu.in
2	Ms.M.Usha	Assistant Professor	Mathematics	usha@vmkvec.edu.in

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

PREAMBLE

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

PREREQUISITE - NIL**COURSE OBJECTIVES**

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

COURSE OUTCOMES

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

CO1. To understand the basics of C Data types, scope of variables, different types of Operators	Understand
CO2. Demonstrate the difference between iteration and recursion in terms of C programming	Understand
CO3. Develop C programs for arrays and structure	Apply
CO4. Develop C programs for functions	Apply
CO5. Develop C programs for File Management concept	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	L												S	L	
CO2	S	S	S	M	S	M	S			M			S	M	L
CO3	S	S	S	M	S				M				S	L	L
CO4	S	S	S	M	S		M						S	M	
CO5	S	S	S	M	S								S	M	

S- Strong; M-Medium; L-Low

SYLLABUS**BASICS OF C**

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

CONTROL STRUCTURES

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

ARRAYS, STRING, STRUCTURE & UNION

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

FUNCTIONS AND POINTERS

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

MEMORY AND FILE MANAGEMENT

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

TEXT BOOK:

1. Balaguruswami. E, "Programming in C", TMH Publications, 1997

REFERENCES:

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

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Mr. B. Sundharamurthy	Assistant Professor	Computer science and engineering	sundharamurthy@vmkvec..edu.in
2	Mr. S. Senthilkumar	Assistant Professor	Computer science and engineering	senthilkumars@vmkvec.edu.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.

PREREQUISITE - 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 understand 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. List the 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 understand the specific processes and proteins involved in membrane transport	Understand
CO3. To understand about intercellular chemical messengers, receptor subclasses and their possible uses in cell signalling.	Understand
CO4. To analyze the mechanisms by which different messenger-receptor interactions bring about long or short-term changes in cell state.	Apply
CO5. To Integrate the different levels of biological organization, from molecules to cells to organisms.	Apply
CO6. To apply critical thinking and logical analysis in the assessment and evaluation of issues in cell biology and genetics.	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	S	L	L	-	-	-	-	-	-	-	-	-
CO2	L	M	M	L	L	L	-	-	-	-	-	-	-	-	-
CO3	L	M	M	L	M	L	M	-	-	-	-	-	-	-	-
CO4	M	M	S	S	M	L	-	-	-	-	-	-	S	M	M
CO5	M	M	S	S	M	M	M	-	-	-	-	L	-	M	-
CO6	M	M	S	S	S	S	-	-	-	-	-	-	-	S	M

S- Strong; M-Medium; L-Low

SYLLABUS**CELL AND FUNCTIONS OF THE ORGANELLES**

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

CELL MEMBRANE AND PERMEABILITY

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

CELL SIGNALING MOLECULES AND THEIR RECEPTORS

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

PATHWAYS AND INTRACELLULAR SIGNAL TRANSDUCTION

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

CELL CULTURE

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

TEXT BOOKS:

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

REFERENCES:

1. B Alberts, A Johnson, J Lewis, M Raff, K Roberts and P Walter, “Molecular Biology of the Cell”, (4th Edition) New York: Garland Science, 2002.
2. Kimball, T.W., “Cell Biology”, Addison 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

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

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

PREAMBLE

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

PREREQUISITE - NIL**COURSE OBJECTIVES**

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

COURSE OUTCOMES

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

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	S	M	S				M			M			
CO2	S	M	S	M	S				M			M			
CO3	S	S	S	S	S				S			M			
CO4	S	M	S	M	S				M			M			
CO5	S	S	S	S	S				S			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 T_c Superconductors – Applications of superconductors.

TEXT BOOK:

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

REFERENCES:

1. Pillai S.O., Solid State Physics, New Age International (P) Ltd., publishers, 2009.
2. Senthilkumar G. Engineering Physics II. VRB Publishers, 2011.

COURSE DESIGNERS

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

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

PREAMBLE

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

PREREQUISITE - NIL**COURSE OBJECTIVES**

1	To understand the basic structure, properties and functions of Biomolecules
2	To emphasize the role of biomolecules by providing basic information on specific metabolic diseases.

COURSE OUTCOMES

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

CO1. Explain the classification properties and biological importance of carbohydrates	Understand
CO2. Discuss the classification, nomenclature, structure and properties of fatty acids	Understand
CO3. Knowledge about amino acids and proteins	Understand
CO4. Know about the importance of nucleic acid	Apply
CO5. Distinguish the vitamins and its deficiency	Understand
CO6. Know about the importance of minerals	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	-	L	-	-	-	-	-	-	-	-	-	L	L	-
CO2	S	-	L	-	-	-	-	-	-	-	-	-	L	L	-
CO3	S	-	L	-	-	-	-	-	-	-	-	-	L	L	-
CO4	S	-	L	-	-	-	-	-	-	-	-	-	L	L	-
CO5	S	-	L	-	-	M	-	-	-	-	-	-	L	L	-
CO6	S	-	L	-	-	M	-	-	-	-	-	-	L	L	-

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”, Ambika Shanmugham, 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

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

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

PREAMBLE

This Laboratory course will enable students to identify, formulate and solve real world engineering problems that require usage of algorithms in C. The course serves as a foundation laboratory for improving the problem solving skills of students.

PREREQUISITE - Nil**COURSE OUTCOMES**

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

CO1: Design algorithms for the given problem specifications	Analyze
CO2: To write simple programs and understand the basics of C.	Apply
CO3: Develop C programs for array sorting, searching and structure	Apply
CO4: To write C programs for matrix multiplication using functions	Apply
CO5: To write C programs for read, write and manipulate data using file concept.	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	-	-	-	-	-	-	-	-	-	-	-	S	L	L
CO2	S	S	S	-	S	-	M	-	-	M	-	-	S	M	
CO3	S	S	S	-	S	-	-	-	M	-	-	-	S	L	L
CO4	S	S	S	-	S	-	M	-	-	-	-	-	S	M	
CO5	S	S	S	-	S	-	-	-	-	--	-	-	S	M	

S- Strong; M-Medium; L-Low

LIST OF EXPERIMENTS

- Write a C Program to Implementation of Sine and cosine series.
- Write a C Program to calculate Simple Interest.
- Write a C Program to generate Fibonacci Series using for loop.
- Write a C program to calculate factorial using while loop.
- Write a C Program to
 - Find the greatest of three numbers using if condition.
 - Find the greatest of three numbers using conditional operator.
- Write a C program for finding the roots of a given quadratic equation using conditional control statements.
- Write a C program to
 - Compute matrix multiplication using the concept of arrays.
 - Illustrate the concept of string handling functions.
- Write a C program to find the largest element in an array using pointers.
- Write a C program to read and write data using file concepts.
- Write a C program to store employee details using the concept of structures.

REFERENCES:

- Laboratory Reference Manual.
- Balaguruswami. E, "Programming in C", TMH Publications, 1997
- Gottfried, "Programming with C", schaums outline series, TMH publications, 1997.
- Mahapatra, "Thinking in C", PHI publications, 2nd Edition, 1998.
- Subbura.R, "Programming in C", Vikas publishing, 1st Edition, 2000.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Mr. B. Sundharamurthy	Assistant Professor	Computer science and engineering	sundharamurthy@vmkvec.edu.in
2	Mr. S. Senthilkumar	Assistant Professor	Computer science and engineering	senthilkumars@vmkvec.edu.in

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

PREAMBLE

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

PREREQUISITE - NIL**COURSE OBJECTIVES**

1	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. Demonstrate safe laboratory practices and handle the equipment safely	Apply
CO2. Prepare solutions and biological buffers	Apply
CO3. Isolate biomolecules from various source	Analyze
CO4. 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	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. 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 oil.
5. Determination of Iodine value of Oil.

BIOCHEMICAL PREPARATIONS

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

REFERENCES:

1. Laboratory Manual.

COURSE DESIGNERS

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

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

PREAMBLE															
To offer hands on training in the areas of cell culture, cell identification and to demonstrate various techniques to learn the morphology, identification and propagation of cells.															
PREREQUISITE - NIL															
COURSE OBJECTIVES															
1	Demonstrate working principles of microscopy														
2	Perform the basic techniques to work with cells.														
3	Differentiate the cells by staining techniques.														
4	Categorize the various stages of mitosis.														
5	Differentiate the types of blood cells.														
COURSE OUTCOMES															
On the successful completion of the course, students will be able to															
CO6. Demonstrate the basic concepts of sterilization techniques														Understand	
CO7. Interpret the behaviour of cells in their microenvironment														Understand	
CO8. analyze scientific work and experimental results in of cell biology														Analyze	
CO9. Categorize the cell organelles														Analyze	
CO5. Examine 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	S	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	S	M	-	-	-	-	-	-	-	-	-	-	-	M	-
CO3	M	S	-	L	-	-	-	-	-	-	-	-	L	L	-
CO4	S	M	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	M	L	-	-	-	-	-	-	-	-	-	-	-	-	-
S- Strong; M-Medium; L-Low															
SYLLABUS															
<ol style="list-style-type: none"> 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															
<ol style="list-style-type: none"> 1. Rickwood, D. and J.R. Harris “Cell Biology: Essential Techniques”, Johnwiley, 1996. 2. Davis, J.M. “Basic Cell Culture : A Practical Approach”, IRL, 1994 															
COURSE DESIGNERS															
S.No.	Name of the Faculty	Designation	Department	Mail ID											
1	Mrs.C.Nirmala	Assistant Professor	Biotechnology	nirmala@vmkvec.edu.in											
2	Dr.M.Sridevi	Professor & Head	Biotechnology	sridevi@vmkvec.edu.in											

&
VINAYAKA MISSION'S KIRUPANANDA VARIYAR ENGINEERING COLLEGE, SALEM
FACULTY OF ENGINEERING AND TECHNOLOGY
STRUCTURED CHOICE BASED CREDIT SYSTEM

BOARD : BIOTECHNOLOGY

REGULATION : 2017

PROGRAM : B.Tech., – BIOTECHNOLOGY (FULL TIME - REGULAR)

CURRICULUM AND SYLLABUS

SEMESTER – III									
S. N O	COURSE CODE	COURSE TITLE	OFFERING DEPARTMENT	CATEGORY	L	T	P	C	PREREQUISITE
THEORY									
1	17BTCC03	MICROBIOLOGY	BTE	CC	3	0	0	3	NIL
2	17BTCC04	CLASSICAL AND MOLECULAR GENETICS	BTE	CC	3	0	0	3	NIL
3	17BTCC05	UNIT OPERATIONS IN PROCESS INDUSTRIES	BTE	CC	3	0	0	3	NIL
4	17BTCC06	ADVANCED BIOCHEMISTRY	BTE	CC	3	0	0	3	17BTCC01
5	17BTCC07	ENZYME ENGINEERING AND TECHNOLOGY	BTE	CC	3	0	0	3	NIL
6	17CHBS03	BIOORGANIC CHEMISTRY	CHEMISTRY	FC(BS)	3	0	0	3	NIL
7	17BTCC08	BIOINSTRUMENTATION	BTE	CC	3	0	0	3	NIL
8	17BTCC11	PLANT AND ANIMAL BIOTECHNOLOGY	BTE	CC	3	0	0	3	NIL
PRACTICALS									
9	17BTCC83	MICROBIOLOGY LAB	BTE	CC	0	0	4	2	NIL
10	17BTCC84	ADVANCED BIOCHEMISTRY LAB	BTE	CC	0	0	4	2	NIL
11	17CHBS81	BIOORGANIC CHEMISTRY LAB	CHEMISTRY	FC(BS)	0	0	4	2	NIL
TOTAL					24	0	12	30	
L – LECTURE HOUR T – TUTORIAL HOUR P – PRACTICAL HOUR C – CREDIT									

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

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

PREAMBLE															
Microbiology deals with the study of microbes. It will cover wide spectrum of classification, cellular organization and characteristics of microscopic organisms, diseases caused and beneficial effects, environmental damage or stress. Microbiologists often use cutting-edge techniques and sophisticated machinery along with other applied fields of research like biotechnology, genetics to study microbes and their complex mechanisms. Knowledge of these principles will enable students to understand how they react under different conditions and how they cause different diseases and their control.															
PREREQUISITE - NIL															
COURSE OBJECTIVES															
1	To describe about the evolution of microorganisms and microscopy.														
2	To Explain the Structure and replication in microorganisms – concepts.														
3	To interpret the effects of Microbes in food and the clinical importance of microorganisms.														
4	To explain about the various Control measures and assessing the environmental impacts.														
5	To outline the requirements of Microbial nutrition for growth of microorganisms and the impact of environment on its growth.														
COURSE OUTCOMES															
After the successful completion of the course, learner will be able to															
CO1. Recall about historical perspective of microbiology and its developments														Remember	
CO2. Describe the fundamental structure and functions of a cell														Understand	
CO3. Explain the control of microbes using physical and chemical methods														Understand	
CO4. Demonstrate the microbial nutritional requirements for growth														Apply	
CO5. Demonstrate the microorganism have an indispensable role in the environment														Apply	
CO6. 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	M	S	-	-	-	-	-	-	-	-	-	-	-
CO2	L	M	L	M	-	-	-	-	-	-	-	-	-	-	-
CO3	L	L	M	M	-	-	-	-	-	-	-	-	L	L	-
CO4	L	S	M	S	-	-	-	-	-	-	-	-	-	-	-
CO5	S	S	S	S	-	-	M	-	-	-	-	-	-	L	-
CO6	L	M	S	M	-	-	M	-	-	-	-	-	M	L	L
S- Strong; M-Medium; L-Low															
SYLLABUS															
WORLD OF MICROORGANISMS 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 Jayaram Paniker, 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. 5th Edn.
3. Frazier, W.S. and Weshoff, D.C., 1988. Food Microbiology, 4th Edn., 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

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

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 about the historical background and development of genetic concepts													Remember		
CO2. Describe the differences between transmission genetics, molecular genetics and classical genetics													Understand		
CO3. Use of genetic data to determine the modes of inheritance, linkage and predict outcomes in future generations													Understand		
CO4. Illustrate the various theories of how new species form and the molecular role of inheritance.													Apply		
CO5. Generalize the factors that play a role in the process of evolution and understand the genetic basis of evolutionary change.													Apply		
CO6. Illustrate 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	M	L	-	-	-	-	-	-	-	-	-	-	-
CO2	L	M	M	L	-	-	-	-	-	-	-	-	-	-	-
CO3	M	S	M	S	M	M	-	-	-	-	-	-	M	-	-
CO4	M	M	S	M	M	-	L	-	-	-	-	-	-	M	-
CO5	M	M	M	L	L	-	-	-	-	-	-	L	-	-	-
CO6	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 organisation in prokaryotes and eukaryotes, Extra chromosomes and their inheritance, Biology of plasmids, Giant chromosomes – Polytene and Lampbrush chromosome.

ALLELES

Classical concept of allelomorphism, 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. 8th Edition, 2005
2. Verma, P.S. and Agarwal, V.K.,. Genetics. S. Chand Publication, 2005.
3. Robert H. Tamarin, Principles of Genetics, 7th Edition, Tata McGraw Hill, New Delhi, 2002.

REFERENCES:

1. David Freifelder., Microbial Genetics, Narosa Publishing House, New York, New Delhi, 2. th 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. 6th Edn., John Wiley & Sons

COURSE DESIGNERS

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1	Mrs.C.Nirmala	Assistant Professor	Biotechnology	nirmala@vmkvec.edu.in
2	Dr.M.Sridevi	Professor & Head	Biotechnology	sridevi@ vmkvec.edu.in

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 , blackbodies 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														Understand	
CO2. Discuss the concepts of radiation, convection and black bodies and its application.														Understand	
CO3. Practice the usage of heat exchanger, evaporators and its application														Apply	
CO4. Demonstrate the fluid flow and its measurement.														Apply	
CO5. Categorise about drying, mechanical separation techniques and its applications														Analyze	
CO6. Test and operate various unit operations and heat transfer equipment in chemical and biochemical industries.														Evaluate	
MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES															
COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	L	L	L	-	-	-	-	-	M	-	-	-
CO2	S	-	L	M	M	-	-	-	-	-	-	-	-	-	-
CO3	S	M	M	L	L	-	-	-	-	-	S	M	M	-	-
CO4	S	M	S	L	M	-	-	-	-	-	-	L	M	-	-
CO5	S	L	S	M	M	-	-	-	-	-	-	L	L	-	-
CO6	S	M	M	L	-	-	-	-	-	-	S	M	S	-	L
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 7 th Ed., McGraw Hill Inc., New York.
2. C.J. Geankoplis, 2003. Transport Processes and separation Principles: Includes Unit Operations, 4 th Ed., Prentice-Hall Inc., New Jersey

REFERENCES:

1. R.E. Treybal, Mass Transfer Operations, 3 rd Ed, McGraw-Hill, New York, 1981.
2. Frank P. Incropera, David T. Dewitt, Theoder I. 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. Nirali Prakashan

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Mrs.G.Arthi	Assistant Professor	Biotechnology	arthi@vmkvec.edu.in
2	Mr.N.Jawahar	Assistant Professor	Biotechnology	jawahar@vmkvec.edu.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	Discuss the metabolic pathways of major bio-molecules														
2	Describe the starting, intermediate and ending molecule, enzymes and cofactors in the pathways														
3	Differentiate biochemical basis of various disease processes														
4	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 and metabolic disorders associated them														Understand	
CO2. Exemplify the importance of molecules derived from amino acids														Understand	
CO3. Discuss the fatty acid metabolic pathways and its metabolic disorders														Understand	
CO4. Explain about the synthetic and degradative pathways of nucleic acid and its metabolic disorders														Understand	
CO5. Illustrate the Integration of energy metabolism of macromolecules														Apply	
CO6. Generalize the bioenergetics and oxidative phosphorylation 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	L	-	L	-	-	-	-	-	-	-	M	-	-	-
CO2	M	-	-		-	-	-	-	-	-	-	-	-	-	-
CO3	S	L	-	L	-	-	-	-	-	-	-	M	-	-	-
CO4	S	M	-		-	-	-	-	-	-	-	M	-	M	-
CO5	S	-	-	L	-	-	-	-	-	-	-	-	-	-	-
CO6	S	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, Fabry 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, Orotic aciduria, Lesch-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 phosphorylation, Chemiosmotic theory-inhibitors of ETC & Oxidative phosphorylation, 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

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

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 Describe about the different classes of enzymes and their characteristics.
- 2 Illustrate in detail about mechanism and kinetics of enzyme activity.
- 3 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.	Understand
CO4. Illustrate about 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

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	S	M	L	-	-	-	-	-	-	-	-	-	-	-	-
CO3	S	S	M	-	-	-	-	-	-	-	-	-	-	-	-
CO4	S	-	-	-	M	-	-	-	-	-	-	L	S	M	-
CO5	S	S	-	-	L	-	-	-	-	-	-	-	S	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, 4Edn.
5. Bailey and Ollis, D.F..2017. Biochemical Engineering Fundamentals. McGraw Hill. New York. 2 Edn.

REFERENCES:

1. M. Y. Khan & Farha Khan, 2015. Principles of Enzyme Technology. PHI Learning.
2. Butterworth, 1995. Technological Applications of Biocatalysts. BIOTOL Series.
3. Cornish-Bowden, A., 1996. Analysis of Enzyme Kinetic Data. Oxford University Press.
4. Wiseman, A., Blakeborough, N. and Dunnill, P., 1981. Enzymatic and Nonenzymatic catalysis. Vol. 5, Ellis and Harwood, UK
5. Wiseman, A. Topics in Enzyme and Fermentation Biotechnology. Vol.5 Ellis and Harwood, UK.
6. Kolot, F.B. 1998 Immobilized Microbial Systems, Principles, Techniques and Industrial applications. R.R Krieger Publications.

COURSE DESIGNERS

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

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

PREAMBLE

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

PREREQUISITE - NIL

COURSE OBJECTIVES

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

COURSE OUTCOMES

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

CO1. Discuss about the chemistry of living cells	Understand
CO2. Describe the Proximity effects in organic chemistry, molecular recognition and the supramolecular systems - concepts	Understand
CO3. Generalize the importance of enzyme catalysis in the living cells.	Apply
CO4. Employ the various reactions of metal ions in proteins and biological molecules	Apply
CO5. Use the knowledge of designing in molecular theft and enzymes	Apply
CO6. Recognize the biomodels of photosynthesis and energy transfer.	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	-	-	M	-	-	-	-	-	S	L	-	-
CO2	M	S	M	L	M	M	-	-	-	-	-	M	-	M	-
CO3	S	L	M	L	L	S	M	-	-	-	-	M	-	-	-
CO4	M	-	L	-	M	M	L	-	-	-	-	-	-	L	L
CO5	M	L	S	M	M	-	-	-	-	-	-	S	M	-	-
CO6	S	-	S	L	S	-	-	-	-	-	-	M	-	-	M

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 AND PEPTIDES

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

ENZYME MODELS

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

METAL IONS IN BIOLOGICAL SYSTEMS

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

TEXT BOOKS:

1. Zubay, G., 1987. Biochemistry. 2nd Edn., Maxwell Macmillan International Editions.
2. Dugas, H., 1989. Bio-organic Chemistry - A Chemical Approach to Enzyme Action. Springer Verlag.
3. David Van Vranken, Gregory A. Weiss., 2012. Introduction to Bioorganic Chemistry and Chemical Biology. (1st Edition) New York: Garland Science.

REFERENCES:

1. Mathew, Van Holde and Athern, 2000. Biochemistry. Pearson Publishers Ltd.
2. Page, M. I. and Williams, A., 1997. Organic and bio-organic mechanisms. Pearson India Edition.
3. Ariya, K. and Kumtake T., 2006. Supramolecular chemistry : Fundamentals and applications. Springer India Edition.
4. Palmer, Trevor, 2004. Enzymes : Biochemistry, biotechnology, clinical chemistry. East - West Press Pvt. Ltd.
5. Fersht, Alan, 1998. Structure and Mechanism in Protein Science: A Guide to Enzyme Catalysis and Protein Folding. W. H. Freeman.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.T.Shanthi	Professor & Head	Chemistry	shanthi@vmkvec.edu.in
2	Mr.A.Gilbert sunderraj	Assistant Professor	Chemistry	gilbertsunderraj@vmkvec.edu.in

17BTCC08	BIOINSTRUMENTATION					Category	L	T	P	Credit					
						CC	3	0	0	3					
PREAMBLE															
The Bioinstrumentation course acts as to link between academics and industry. Knowledge gained in this course applied on varies fields in biotechnology industry. The techniques studied in this course include principle, instrumentation and applications of the instrument.															
PREREQUISITE - NIL															
COURSE OBJECTIVES															
1	Discuss about varies instruments used in biotechnology.														
2	Describe in detail about the Molecular spectroscopy														
3	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. Knowledge about basic principles and instruments in biotechnology.										Understand					
CO2. Explain about spectroscopy and its principles along with instrumentation.										Apply					
CO3. Demonstrate separation and purification techniques in biotechnology.										Apply					
CO4. Distinguish the biomolecular structure by thermal and X- ray based analysis.										Analyze					
CO5. Evaluate biomolecules by immunological techniques										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	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	M	L	L	-	-	-	-	-	-	-	-	L	-	-
CO3	-	L	M	S	-	-	-	-	-	-	-	-	M	M	-
CO4	-	L	S	S	L	-	-	-	-	-	-	-	S	-	-
CO5	-	L	M	S	L	-	-	-	-	-	-	S	S	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 O₂ and CO₂, 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 Settle, 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

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Mr.N.Jawahar	Assistant professor	Biotechnology	jawahar@vmkvec.edu.in
2	Mrs.C.Nirmala	Assistant Professor	Biotechnology	nirmala@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 itscultivation 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. Present an outline of plant tissue culture and genetic manipulation of plants											Evaluate				
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	PSO2	PSO3
CO1	S	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	S	M	M	-	-	-	-	-	-	-	-	-	-	-	-
CO3	S	S	S	M	S	-	M	L	-	-	-	-	M	-	-
CO4	M	S	S	M	L	-	-	L	-	-	-	-	S	S	-
CO5	L	S	S	M	L	-	-	L	-	-	-	-	S	S	-
CO6	S	L	-	-	-	-	-	-	-	-	-	-	-	-	-
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, <i>In-vitro</i> 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

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

- a. Staining techniques-Simple-Gram-Spore-Hanging drop
- b. Biochemical identification
- 7. Quantification of Microorganisms
 - Microscopy
 - a. Serial dilution and plating
- 8. Environmental Sample Analysis-.MPN Test
- 9. Food Microbiology
 - Milk
 - Fermented food
- 10. Clinical Microbiology
 - Blood and Urine Culture
 - Antibiotic Disc test Assay.

REFERENCES:

- 1.Cappuccino, J. G. and Sherman, N., 1999. Microbiology : Alaboratory Manual. 4th Edn., Addison - Wesley.
- 2.Collee, J. G., et al., 1996. Mackie and McCartney PracticalMedical Microbiology. 4th Edn., Churchill Livingstone.
- 3.Sundararaj, T., 2007. Microbiology laboratory manual. AswathySunndararaj.
- 4.Laboratory Manual

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Mrs.G.Arthi	Assistant Professor	Biotechnology	arthi@vmkvec.edu.in
2	Dr.M.Sridevi	Professor & Head	Biotechnology	sridevi@vmkvec.edu.in

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. Examine the reactions of proteins, carbohydrates and amino acids	Analyze
CO2. Estimate Hemoglobin concentration in the blood	Analyze
CO3. Separate plant pigments using chromatography	Apply
CO4. Estimate the various biomolecules	Analyze
CO5. Differentiate the Normal and abnormal constituents of Urine	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	S	L	L	-	-	-	-	-	-	-	-	-	-	-
CO3	S	S	M	S	S	-	-	-	-	-	-	-	L	M	-
CO4	S	S	M	-	-	M	M	-	-	-	-	-	-	M	-
CO5	S	S	M	S	-	S	-	-	-	-	-	-	-	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:

2. Laboratory Manual.

COURSE DESIGNERS

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

17CHBS81	BIOORGANIC CHEMISTRY LAB					Category	L	T	P	Credit					
						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													Evaluate 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															
<ol style="list-style-type: none"> 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-Cyclohexylidene-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

**VINAYAKA MISSION'S RESEARCH FOUNDATION
(DEEMED TO BE UNIVERSITY, SALEM)
AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY, CHENNAI**

**&
VINAYAKA MISSION'S KIRUPANANDA VARIYAR ENGINEERING COLLEGE, SALEM
FACULTY OF ENGINEERING AND TECHNOLOGY
STRUCTURED CHOICE BASED CREDIT SYSTEM**

BOARD : BIOTECHNOLOGY

REGULATION : 2017

PROGRAM : B.Tech., – BIOTECHNOLOGY (FULL TIME - REGULAR)

CURRICULUM AND SYLLABUS

SEMESTER – IV									
S.NO	COURSE CODE	COURSE TITLE	OFFERING DEPARTMENT	CATEGORY	L	T	P	C	PREREQUISITE
THEORY									
1		PROGRAMME ELECTIVE-I	BTE						
2	17BTCC09	MOLECULAR BIOLOGY	BTE	CC	3	0	0	3	CLASSICAL AND MOLECULAR GENETICS
3	17BTCC10	PRINCIPLES OF CHEMICAL ENGINEERING	BTE	CC	3	0	0	3	UNIT OPERATIONS IN PROCESS INDUSTRIES
4		INTERDISCIPLINARY ELECTIVE -I							
5	17CHBS01	ENVIRONMENTAL SCIENCE AND ENGINEERING	CHEMISTRY	FC(BS)	3	0	0	3	NIL
6	17BTCC08	BIOINSTRUMENTATION	BTE	CC	3	0	0	3	NIL
PRACTICALS									
9	17BTCC85	MOLECULAR BIOLOGY LAB	BTE	CC	0	0	4	2	NIL
10	17BTCC86	CHEMICAL ENGINEERING LAB	BTE	CC	0	0	4	2	NIL
11	17BTCC87	BIOINSTRUMENTATION LAB	BTE	CC	0	0	4	2	NIL
TOTAL									
L – LECTURE HOUR T – TUTORIAL HOUR P – PRACTICAL HOUR C – CREDIT									

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

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. Describe the genetic code and protein synthesis mechanism	Understand
CO4. Develop understanding about the molecular mechanisms behind different modes of gene regulation in bacteria and eukaryotes	Analyse
CO5. Examine about Mutations, DNA damage and repair mechanisms	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

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 Lubert Stryer, 2002 “Biochemistry”. 5th Edition. W.H. Freeman and Company.

REFERENCES:

7. James Watson et al., 1987. Molecular Biology of Gene. The Benjamin / Cummings Publication Co. Inc., California.

COURSE DESIGNERS

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

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. Explain about correlation of mathematics, science and engineering principles for problem solving in process industries.	Understand
CO2. Demonstrate the fundamental concepts of dimensions, units, psychometry, steam properties and law of conservation of mass and energy.	Understand
CO3. Interpreting the problems in material and energy balances related to chemical and bioreactors	Understand
CO4. An ability to employ knowledge to spot and create simple engineering troubles linked to material balance, energy balance, thermodynamics and energy transformation	Apply
CO5. Practice material balances on unit operations and processes in various industries and to evaluate humidity with/without the use of psychrometric chart.	Apply
CO6. Formulating and optimizing various parameters with respect to the industrial processes.	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	-	-	-	-	-	-	-	-	M	-	-
CO2	M	M	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	S	S	-	M	L	L	-	-	-	-	-	-	-	-	-
CO4	S	S	S	L		-	-	-	-	-	-	-	-	-	-
CO5	S	M	-	M	L	-	-	-	-	-	-	L	-	-	-
CO6	S	M	M	L	L	L	-	-	-	-	-	S	-	M	L

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) 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. George T. Austine, Shreeves chemical process industries, 1984, McGraw Hill International Edition, 5th 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.
4. 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	Mrs.C.Nirmala	Assistant Professor	Biotechnology	nirmala@vmkvec.edu.in
2	Mrs.G.Arthi	Assistant Professor	Biotechnology	arthi@vmkvec.edu.in
3	Avit staff			

17CHBS01	ENVIRONMENTAL SCIENCE & ENGINEERING (Common to All Branches)	Category	L	T	P	Credit
		BS	3	0	0	3
<p>Environmental science is an interdisciplinary field that integrates physical, chemical, biological, information and atmospheric sciences. Environmental studies also incorporate the social sciences for understanding human relationships and a solution to the environmental and social related problems.. Environmental engineering focuses on sustainable development for improving environmental quality in every aspect.</p>						
<p>PREREQUISITE</p> <p style="text-align: center;">NIL</p>						
<p>COURSE OBJECTIVES</p>						
1	To create the awareness of environment studies and its scope					
2	To inculcate the knowledge of significance and conserving the natural resources.					
3	To helps the learners to know the value of ecosystem and food chain.					
4	To assess the importance of biodiversity					
5	To familiarizes the different pollution sources, consequences and its control measures.					
6	To appraise the methods of solid waste management.					
7	To make them to bring into the applications of Laws of environmental conservation.					
8	To educate the ways and means to manage natural calamities.					
9	To help the learners to know the urban energy related problems and social issues.					
10	To impart the fundamental knowledge on human welfare measures this includes child welfare and women education.					
11	To acquaint the IT field in the environment and medical field.					
<p>COURSE OUTCOMES</p>						
On the successful completion of the course, students will be able to						
CO1. Discuss and appreciate the unity of life in all its forms,the implications of life style on the environment.		Understand				
CO2. Initiate the awareness and recognize the social responsibility in environmental issues.		Apply				
CO3. Practice comprehensive insight in natural resources and protect natural resources and Paraphrase the importance of conservation of resources.		Apply				
CO4. Illustrate the importance of ecosystem and biodiversity		Apply				
CO5. Interpret the society on the various pollutions and their impact.		Apply				
CO6 Generalize polymers and smart materials		Apply				
CO7.Demonstrate the Solid waste and disaster management.		Apply				
CO8.List the importance of environmental laws.		Remember				

CO9 Recognize the issues of environment and sustainable development	Understand
CO10. Schedule the urban problems and social issues.	Apply
CO11. Develop a healthy environment for future generations	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO 2	PSO3
CO1	S	M	L	-	-	S	S	S	-	-	-	S			
CO2	S	M	M	-	-	S	S	S	-	-	-	S			
CO3	S	M	S	-	-	S	S	S	-	-	-	S			
CO4	S	L	M	-	-	S	S	S	-	-	-	S			
CO5	S	S	S	L	-	S	S	S	-	-	-	S			
CO6	S	S	S	M	-	S	S	S	-	-	-	S			
CO7	S	S	S	M	-	S	S	S	-	-	-	S			
CO8	L	L	L	-	-	L	S	S	-	-	-	S			
CO9	S	S	S	M	-	S	S	S	-	-	-	S			
CO10	S	S	S	M	-	S	S	S	-	-	-	S			
CO11	S	M	S	M	-	S	S	S	-	-	-	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.

REFERENCES:

- 1.Wager K.D. "Environmental Management", W.B. Saunders Co. Philadelphia, USA, 1998.
- 2.Bharucha Erach "The Biodiversity of India" Mapin Publishing Pvt Ltd, Ahmedabad, India.
3. Trivedi R.K. "Handbook of Environmental Laws", Rules, Guidelines,Compliances and Standards Vol I & II, Enviro media.
4. Environmental Science and Engineering by Dr. J. Meenambal ,MJP Publication , Chennai Gilbert M. Masters : Introduction to Environmental Engineering and Science , Pearson EducationPvtLtd., II Edition, ISBN 81-297-0277-0,2004.
- 5.Miller T.G. Jr Environmental Science Wadsworth Publishing Co.
6. Townsend C. Harper J. and Michael Begon, Essentials ofEcology,Blackwell Science.

COURSE DESIGNERS

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

17BTCC08	BIOINSTRUMENTATION	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

The Bioinstrumentation course acts as to link between academics and industry. Knowledge gained in this course applied on varies fields in biotechnology industry. The techniques studied in this course include principle, instrumentation and applications of the instrument.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	Discuss about varies instruments used in biotechnology.
2	Describe in detail about the Molecular spectroscopy
3	Demonstrate 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 assess 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. Discuss about 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. Distinguish the biomolecular structure by thermal and X- ray based analysis.	Analyze
CO5. Evaluate biomolecules by immunological techniques	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	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	M	L	L	-	-	-	-	-	-	-	-	L	-	-
CO3	-	L	M	S	-	-	-	-	-	-	-	-	M	M	-
CO4	-	L	S	S	L	-	-	-	-	-	-	-	S	-	-
CO5	-	L	M	S	L	-	-	-	-	-	-	S	S	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

BASICS OF BIOINSTRUMENTATION

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 O₂ and CO₂, 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 Settle, F.A., 1986. Instrumental Methods of Analysis. CBS Publishers and Distributors.

REFERENCES:

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

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Mr.N.Jawahar	Assistant professor	Biotechnology	jawahar@vmkvec.edu.in
2	Mrs.C.Nirmala	Assistant Professor	Biotechnology	nirmala@vmkvec.edu.in
3	Avit staff			

17BTCC85	MOLECULAR BIOLOGY LAB								Category	L	T	P	C		
									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 micropipetting, 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	S	-	-	-	-	-	-	-	-	-	-	-	L	-	-
CO2	S	-	-	-	L	-	-	-	L	-	-	-	-	L	-
CO3	M	-	-	-	-	-	-	-	-	-	-	-	-	-U	-
CO4	S	L	-	-	-	-	-	-	-	-	-	-	L	-	-
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.

COURSE DESIGNERS

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

17BTCC86	CHEMICAL ENGINEERING LAB		Category	L	T	P	Credit								
			CC	0	0	4	2								
PREAMBLE															
Chemical engineering laboratory includes pilot and lab scale experimental set-up on Fluid mechanics, Unit Operations, Mass Transfer and Heat Transfer. It helps students for the development of their skills in understanding and operating basic and more complex industrial systems.															
PREREQUISITE															
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. Exemplify the terminology and knowledge of contemporary issues associated with chemical engineering.						Understand									
CO2. Perform, co-ordinate, implement and validate laboratory procedures to conduct quantitative and qualitative analyses.						Apply									
CO3. Apply process principles learnt in chemical engineering courses to practical situations.						Apply									
CO4. Identify and analyse the fundamental theoretical concepts of an experimental system						Analyze									
CO5. Ability to analyze industrial problems along with appropriate approximations and boundary condition.						Analyze									
MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES															
COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	-	M	S	-	-	-	-	-	-	-	S	L	L
CO2	-	M	-	L	S	-	-	-	-	-	-	-	M	L	L
CO3	M	-	L	M	S	-	-	-	-	-	-	-	M	L	L
CO4	M	M	S	S	S	-	-	-	-	-	-	-	S	L	L
CO5	M	M	S	S	M	-	-	-	-	-	-	-	S	L	L
S- Strong; M-Medium; L-Low															
SYLLABUS															
<ol style="list-style-type: none"> Flow measurement a) Orifice meter b) Venturimeter, c) Rotameter Filtration. Heat exchangers. Simple and Steam distillation. Fluidization. Pressure drop in pipes and packed columns. 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:

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	Mrs.G.Arthi	Assistant Professor	Biotechnology	arthi@vmkvec.edu.in

17BTCC87	BIOINSTRUMENTATION LAB	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Bioinstrumentation is used to provide the understanding and knowledge of various instrumentation through handling and working. This course also highlights the various instrumentation 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. Understand the purpose of measurement, the methods of measurements, errors associated with measurements.	Understand
CO2. Employ the principle of various instrumentation	Apply
CO3. Compare the various spectrometers for analysis purpose	Analyse
CO4. Estimate the various parameters by using the like Conductivity meter and Potentiometer.	Analyse
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	S	-	-	-	-	-	-	M	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	M	-	-	-	-	-	-	-
CO3	-	S	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	M	S	-	S	-	-	-	-	-	-	-	-	-	-	-
CO5	M	-	-	-	-	-	S	-	-	-	-	-	-	-	S

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 (1,10 Phenanthroline Complex) using Absorption spectroscopy.
5. UV spectra of Nucleic Acid.
6. Estimation of Alizarin Aluminium complex
7. Estimation of Al³⁺ 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 Fe²⁺ content in fruit juices

TEXT BOOKS:

2. 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	Mrs.C.Nirmala	Assistant Professor	Biotechnology	nirmala@vmkvec.edu.in
3	AVIT staff			

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

**BOARD : BIOTECHNOLOGY
REGULATION : 2017
PROGRAM : B.Tech., – BIOTECHNOLOGY (FULL TIME - REGULAR)
CURRICULUM AND SYLLABUS**

SEMESTER – V									
S. N O	COURSE CODE	COURSE TITLE	OFFERING DEPARTMENT	CATEGORY	L	T	P	C	PREREQUISITE
THEORY									
1	17BTCC11	PLANT AND ANIMAL BIOTECHNOLOGY	BTE	CC	3	0	0	3	NIL
2	17BTCC12	GENETIC ENGINEERING	BTE	CC	3	0	0	3	MOLECULAR BIOLOGY
3	17BTCC13	THERMODYNAMICS FOR BIOTECHNOLOGY	BTE	CC	4	0	0	4	PRINCIPLES OF CHEMICAL ENGINEERING
4	17BTCC14	IMMUNOLOGY	BTE	CC	3	0	0	3	NIL
5		PROGRAMME ELECTIVE-II							
6		BIOMEDICAL INSTRUMENTATION							
PRACTICALS									
9	17BTCC88	GENETIC ENGINEERING LAB	BTE	CC	0	0	4	2	NIL
10	17BTCC89	IMMUNOLOGY LAB	BTE	CC	0	0	4	2	NIL
11		BIOMEDICAL INSTRUMENTATION LAB							
TOTAL									
L – LECTURE HOUR T – TUTORIAL HOUR P – PRACTICAL HOUR C – CREDIT									

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

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 itscultivation 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. Present an outline of plant tissue culture and genetic manipulation of plants										Evaluate					
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	PSO2	PSO3
CO1	S	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	S	M	M	-	-	-	-	-	-	-	-	-	-	-	-
CO3	S	S	S	M	S	-	M	L	-	-	-	-	M	-	-
CO4	M	S	S	M	L	-	-	L	-	-	-	-	S	S	-
CO5	L	S	S	M	L	-	-	L	-	-	-	-	S	S	-
CO6	S	L	-	-	-	-	-	-	-	-	-	-	-	-	-
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, <i>In-vitro</i> 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:

7. Gupta, P.K., 1996. Elements of Biotechnology. *Rastogiand Co.*, Meerut.
8. Ranga, M.M., 2002. Animal Biotechnology. *Agrobios India Limited*.
9. Ignacimuthu, S., 1996. Applied Plant Biotechnology. *Tata McGraw Hill*.
10. Gamburg, O.L. and Philips, G.C., 1995. Plant Tissue and Organ Culture Fundamental Methods. *Narosa Publications*.
11. Singh, B.D., 1998. Text Book of Biotechnology. *Kalyani Publishers*.
12. Ramadas, P. and Meera Rani, S., 1997. Text Book of Animal Biotechnology. *Akshara Printers*.

REFERENCES:

3. Hamond, J., McGarvey, P. and Yusibov, V., 2000. Plant Biotechnology. *Springer Verlag*.
4. 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

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

PREREQUISITE

NIL

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. Gain knowledge on various recombinant DNA techniques and their applications.	Understand
CO2. Familiar with the problems they could encounter and how to trouble shoot them learn various types of host-vector systems and steps in creating a recombinant DNA molecule	Understand
CO3. Monitor both in-vitro and in-vivo activity.	Analyze
CO4. Give insight into the functioning of Recombinant DNA molecules, their constructions, analysis and fine tuning.	Apply
CO5. Know about the production of commercially important recombinant proteins.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

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 (pIJ101), 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 SI, 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

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Mrs.G.Arthi	Assistant professor	Biotechnology	arthi@vmkvec.edu.in
2	Dr.M.Sridevi	Professor & Head	Biotechnology	sridevim@vmkvec.edu.in
3.	AVIT staff			

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.

PREREQUISITE

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 and how to approach these.

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. Explain the concept of cell mediated immunity and hypersensitivity	Understand
CO3. Illustrate the mechanisms behind transplantation immunology and autoimmunity	Apply
CO4. Students understand principles and molecular mechanisms involved in microbial pathogenesis and learn the principle and production of vaccines	Apply
CO5. Demonstrate various antigen-antibody interactions and techniques and explore the diagnostic methods	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO IMMUNE SYSTEM

Phylogeny of immune system, Innate and acquired immunity, Clonal nature of immune response, Organization and structure of lymphoid organs, antigens: chemical and molecular nature, haptens, adjuvants, Cells of immune system – Hematopoiesis and differentiation – B-Lymphocytes, T-Lymphocytes, Macrophages, Dendrite cells

ASSESSMENT OF CELL MEDIATED IMMUNITY

Identification of lymphocytes and their subsets in blood, T cell activation, Estimation of cytokines, Macrophage activation, Macrophage-microbicidal assays, Hypersensitivity.

TRANSPLANTATION AND AUTOIMMUNITY

HLA System, Transplantation – Organ transplantation, Grafting – graft rejection and prevention, Immunosuppressive drugs, Autoimmunity – Auto antibodies in human, Pathogenic mechanism, Experimental models of Autoimmune disease, Treatment of Autoimmune disorders.

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-antibody interaction, Agglutination and precipitation, Complement fixation test, Immunodiffusion, Immunoelectrophoresis, Purification and synthesis of antigen, Fluorescence immunoassay – ImmunoFluorescence (IF), SLFIA, DELFIA, Fluorescence Activated Cell Sorter, 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. Roitt and Roitt. Immunology.
3. Richard, A., Goldsby, Thomas J. Kindt and Barbara A. Osborne, Kuby. Immunology. IV Edition, W.H. Freeman and Company, New York.
4. Goding, J.W., 1983. Monoclonal Antibodies: Principles and Practice. Academic Press.
13. Benjamin, E. and Leskowitz, S., 1991. Immunology – A Short Course. Wiley Liss., New York.
14. Kuby J, Immunology, WH Freeman & Co., 7th Edition 2012.

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.M.Sridevi	Professor & Head	Biotechnology	sridevim@vmkvec.edu.in
3.	AVIT staff			

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.

PREREQUISITE

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

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

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

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2	Dr.M.Sridevi	Professor & Head	Biotechnology	sridevim@vmkvec.edu.in
3.	AVIT staff			

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.

PREREQUISITE

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. Underline a comprehensive and practical understanding of basic immunological principles involved in research and clinical science	Remember
CO2. Interpret the knowledge for identification of immunological cells, their structure, function and Characteristics.	Understand
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	-	L		-	-	-	-	-	-	-	-	-	L	-	-
CO2	-	M		-	-	-	-	-	-	-	-	-		M	-
CO3	-		M	-	-	-	-	-	-	-	-	-	-	L	-
CO4	-	S		S	-	-	-	-	-	-	-	-	L	-	-
CO5	-	-	-	S	-	-	-	-	-	-	-	-	S	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

1. Handling of animals, immunization and raising antisera.
2. Identification of cells in blood smear.
3. Identification of blood groups.

4. Immunodiffusion
5. Immuno electrophoresis.
6. Testing for Typhoid antigens by Widal test.
7. Enzyme Linked Immuno Sorbent Assay (ELISA).
8. Isolation of peripheral 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.M.Sridevi	Professor & Head	Biotechnology	sridevi@vmkvec.edu.in
3.	AVIT staff			

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

BOARD : BIOTECHNOLOGY

REGULATION : 2017

PROGRAM : B.Tech., – BIOTECHNOLOGY (FULL TIME - REGULAR)

CURRICULUM AND SYLLABUS

SEMESTER – VI									
S.NO	COURSE CODE	COURSE TITLE	OFFERING DEPARTMENT	CATEGORY	L	T	P	C	PREREQUISITE
THEORY									
1	17BTCC15	FOOD PROCESSING TECHNOLOGY	BTE	CC	3	0	0	3	MICROBIOLOGY
2	17BTCC16	BIOPROCESS ENGINEERING	BTE	CC	3	0	0	3	ENZYME ENGINEERING AND TECHNOLOGY
3		NANOTECHNOLOGY							
4		PROGRAMME ELECTIVE-III							
5		BUSINESSENGLISH							
6		PROGRAMME ELECTIVE-IV							
PRACTICALS									
9	17BTCC90	FOOD PROCESSING TECHNOLOGY LAB	BTE	CC	0	0	4	2	NIL
10	17BTCC91	BIOPROCESS ENGINEERING LAB	BTE	CC	0	0	4	2	NIL
11		PROFESSIONAL COMMUNICATION AND PERSONALITY DEVELOPMENT							
TOTAL									
L – LECTURE HOUR T – TUTORIAL HOUR P – PRACTICAL HOUR C – CREDIT									

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

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

Microbiology

COURSE OBJECTIVES

- To explain different types of foods, factors affecting food & food products and the micro-organisms which cause food borne diseases
- 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
- To discuss the different food processing methods and its applicability in food product preparations
- To choose appropriate modern methods of food preservation for industrialization
- To Choose the materials and types of packaging for foods and its quality testing

COURSE OUTCOMES

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

CO1. Identify different microbes associated with foods, and food borne diseases.	Understand
CO2. Describe the role of microbes in food spoilage and food preservation	Understand
CO3. Summarize all food processing methods and demonstrate its application in food product preparation	Understand
CO4. Illustrate the modern methods to modify foods using biotechnology.	Apply
CO5. Demonstrate packing methods, materials and factors affecting food packing.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

FUNDAMENTALS OF FOOD MICROBIOLOGY

Microbiology of different types of foods-Vegetables, fruits, milk and milk products, meat and meat products. Factors affecting the food products. Food borne diseases and causative organisms.

FOOD SPOILAGE AND PRESERVATION

Spoilage of foods and Shelf –life-Milk and milk products, meat and meat products. Factors influencing food spoilage. Methods of food preservation-Pickling, salting, drying, freezing, refrigeration, use of food additives and irradiation.

PROCESSING OF FOODS

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

INDUSTRIALIZATION/ MODERN FOOD PRESEVERVATION

Pasteurization, Vaccum packing, food additives, irradiation, biopreservation, Modified atmosphere packing, cryopreservation.

PACKAGING AND QUALITY TESTING

Methods of packaging of foods-Solid, liquid, semi solids, Modified atmosphere packing. Factors affecting packaging. Packaging materials.

REFERENCES:**TEXT BOOKS**

1. Frazier. Food Microbiology. McGraw Hill Publication.4th Edition.2001
2. Sivashankar.B.Food processing Preservation, Prentice Hall of India.Pvt.Ltd.2002

REFERENCE BOOKS

1. James M Jay, Martin J, Loessner and David A Golden. Food Microbiology, Springer Publication, 7th Edition. 2005
2. Shetty K, Paliyath, Food Microbiology, 2nd Edition, Taylor and Francis, 2006

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Mrs.C.Nirmala	Assistant Professor	Biotechnology	nirmala@vmkvec.edu.in
2	Dr.M.Sridevi	Professor& Head	Biotechnology	sridevi@vmkvec.edu.in
3.	Dr. R. Subbaiya	Associate Professor	Biotechnology	rsubbaiya80@gmail.com

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

PREREQUISITE

17BTCC07- ENZYME ENGINEERING AND TECHNOLOGY

COURSE OBJECTIVES

- | | |
|---|---|
| 1 | To explain about the historical development of Bioprocess technology, Design and construction of fermenters |
| 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. Identify the appropriate bioreactor configurations and operation modes based upon the nature of Bio products and 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. Review a research career or to work in the biotechnology industry with strong foundation about bioreactor design and scale-up. | Understand |
| CO4. Demonstrate theory, principle, design, application and possible integrations of unit operations in bioprocessing. | Apply |
| CO5. Initiate the research lab and Industry; identify problems and seek practical solutions for large scale implementation of Biotechnology. | Apply |

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

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 fermentor 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.

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

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

17BTCC91	BIOPROCESS ENGINEERING LAB		Category	L	T	P	Credit								
			CC	0	0	4	2								
PREAMBLE This bioprocessing 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.Discuss information on behavior and growth of microorganisms in growth medium.						Understand									
CO2. Summarize knowledge about optimization on growth medium.						Understand									
CO3. Review information on activity of enzyme and parameters affects enzyme activity.						Understand									
CO4.Utilize the knowledge of Enzyme Immobilized to use in bioreactors.						Apply									
CO5. Employ the know-how to produce bioproducts in reactors.						Apply									
MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES															
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	S	-	-	-	-	-	-	-	L	-	L
CO2	-	-	-	-	S	-	-	-	-	-	-	-	M	-	L
CO3	-	-	-	-	S	-	-	-	-	-	-	-	M	-	L
CO4	-	-	-	-	S	-	-	-	-	-	-	-	L	-	M
CO5	-	-	-	-	S	-	-	-	-	-	-	-	M	-	M
S- Strong; M-Medium; L-Low															

SYLLABUS

1. Growth of microorganism – Estimation of Monod parameters.
2. Medium optimization – PlackettBurman design.
3. Enzyme activity – Effect of pH.
4. Enzyme activity – Effect of temperature.
5. Enzyme Immobilization – Gel Entrapment.
6. Enzyme Immobilisation – 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.M.Sridevi	Professor& Head	Biotechnology	sridevi@vmkvec.edu.in
3	AVIT staff			

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.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	Recognize 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. Define the properties of food materials and their processing methods	Remember
CO2. Interpret the ability to process the different categories of food and mechanisms of preservation.	Understand
CO3. Schedule the process flow diagrams, combination and sequence within a process of food materials	Apply
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.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

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2	Mrs.G.Arthi	Assistant Professor	Biotechnology	arthi@vmkvec.edu.in
3	AVIT Staff			

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

**BOARD : BIOTECHNOLOGY
REGULATION : 2017
PROGRAM : B.Tech., – BIOTECHNOLOGY (FULL TIME - REGULAR)
CURRICULUM AND SYLLABUS**

SEMESTER – VII									
S.NO	COURSE CODE	COURSE TITLE	OFFERING DEPARTMENT	CATEGORY	L	T	P	C	PREREQUISITE
THEORY									
1		PROGRAMME. ELECTIVE-.V	BTE						
2	17BTCC17	DOWNSTREAM PROCESSING IN BIOTECHNOLOGY	BTE	CC	4	0	0	4	BIOPROCESS ENGINEERING
3	17BTCC18	MASS TRANSFER OPERATIONS	BTE	CC	4	0	0	4	THERMODYNAMICS FOR BIOTECHNOLOGY
4		INDUSTRIAL ELECTIVE –I							
5	17CHBS01	BIOSENSORS & TRANSDUCERS							
6	17BTCC08	INTERDISCIPLINARY ELECTIVE –II	BTE	CC	3	0	0	3	NIL
PRACTICALS									
9	17BTCC92	DOWNSTREAM PROCESSING ENGINEERING LAB	BTE	CC	0	0	4	2	NIL
10		BIOTRANSDUCERS LAB							
		BIOINFORMATICS LAB							
11	17BTCC87	MINI PROJECT	BTE	CC	0	0	4	2	NIL
TOTAL									
L – LECTURE HOUR T – TUTORIAL HOUR P – PRACTICAL HOUR C – CREDIT									

HS	HUMANITIES AND SOCIAL SCIENCES	CC	CORE COURSES
BS	BASIC SCIENCES	EC	ELECTIVE COURSES

ES	ENGINEERING SCIENCES	SE	SPECIALISATION ELECTIVES
PI	PROJECT + INTERNSHIP + INDUSTRY ELECTIVES	EE	EMPLOYABILITY ENHANCEMENT COURSES + EXTRA CURRICULAR COURSES + CO - CURRICULAR COURSES

17BTCC17	DOWNSTREAM PROCESSING IN BIOTECHNOLOGY					Category	L	T	P	Credit					
						CC	3	0	0	3					
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															
PREREQUISITE															
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. Express in detail knowledge on isolation of products.										Understand					
CO4. Implement know-how to product fractionation and purification by chromatography and Hybrid separation Technology.										Apply					
CO5. Implement the knowledge to formulate the final product using crystallization, drying,										Apply					
MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES															
COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	-	-	-	-	-	-	-	-	-	L	L	-	-
CO2	S	L	-	-	-	-	-	-	-	-	-	L	M	-	-
CO3	S	L	-	-	-	-	-	-	-	-	-	L	M	-	-
CO4	S	L	-	-	-	-	-	-	-	-	-	-	L	-	-
CO5	S	L	-	-	-	-	-	-	-	-	-	-	M	-	-

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. Pretreatment 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:

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

COURSE DESIGNERS

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2	Mrs.C.Nirmala	Assistant Professor	Biotechnology	nirmala@vmkvec.edu.in

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

S- Strong; M-Medium; L-Low

SYLLABUS

DIFFUSION

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

GAS-LIQUID OPERATION

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

DISTILLATION

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

LIQUID-LIQUID EXTRACTION

Liquid-Liquid Equilibria, Stagewise contact, Stage type extractor, Differential extractor

SOLID-FLUID OPERATION

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

TEXTBOOKS

1. Treybal, R.E., 1981. Mass Transfer Operations. 3rd Edn., *McGraw 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 McGraw Hill*, New Delhi.
3. McCabe, 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: Modeling and Transport Phenomena.

COURSE DESIGNERS

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1	Mrs. C. Nirmala	Assistant Professor	Biotechnology	nirmala@vmkvec.edu.in
2	Mr. N. Jawahar	Assistant Professor	Biotechnology	jawahar@vmkvec.edu.in
3	AVIT Staff			

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

PREAMBLE

Downstream processing laboratory is used to provide the understanding and knowledge 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.

PREREQUISITE

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 describe in detail about Chromatography techniques for product purification.
5	To describe the knowledge of extraction techniques to separate biomolecules.

COURSE OUTCOMES

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

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO3	
CO1	S	L	M	-	-	-	-	-	-	-	-	L	L	-	L	
CO2	S	L	M	-	-	-	-	-	-	-	-	L	M	-	L	
CO3	S	L	M	-	-	-	-	-	-	-	-	L	M	-	L	

CO4	S	L	S	-	-	-	-	-	-	-	-	-	S	-	M
CO5	S	L	S	-	-	-	-	-	-	-	-	-	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
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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 – 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. To recall the epidemiology of diseases caused by pests in plant and animals	Remember
CO2. Discuss about the common plant pathogens in agriculture.	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. Validate the different samplings methods	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	-	-	S	S	-	-	M	L	-	-	-	-
CO2	S	S	M	M	S	M	S	-	-	-	L	-	-	-	-
CO3	M	L	M		-	-	S	-	M	-	-	-	-	-	-
CO4	S	-	M	-	S	S	M	-	-	-	-	-	-	-	-
CO5	M	L	-		S	-	-	-	L	-	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

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2	Ms.G.Arthi	Assistant Professor	Biotechnology	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 state 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. Recall the Marine ecosystem sources and their properties	Remember
CO2. Describe the biodiversity in marine environment	Understand
CO3. Demonstrate the different culture techniques of marine organisms	Analyse
CO4 Assess the developed drug	Analyse
CO5. Criticize the human impact on marine 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	-	-	-	--	L	M	--	--	-		L	-	-	-
CO2	M	L	-	M	S	L	-	-	L			-	-	-	-
CO3	S	-	L	M	L	-	M	-	L	-	-	M	-	-	-
CO4	S	M	M	L	L	-	L	-	L	-	L	L	-	-	-
CO5	S	S	S	M	L	L	S	-	L	-		S	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO MARINE ENVIRONMENT

Stratification of coastal environment- Bathymetric map, Thermocline; components of marine ecosystem; Biotic and Abiotic and their interrelationships-Role in food chain, food web ;Trophic 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 RachakondaNagabhushanam, 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

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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 <i>in silico</i> 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 modeling.						
PREREQUISITE - NIL						
COURSE OBJECTIVES						
1	Define the basis of Bioinformatics in the biological field					
2	Explains the <i>in silico</i> 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					Remember	
CO2.Demonstrate the importance of biological databases and their significance in Biotechnology					Understand	
CO3. Operate the various tools and software which can be adopted in different fields of Biotechnology					Apply	
CO4. Measure the significance of evolutionary traits using Bioinformatics tools and software					Evaluate	
CO5. Validate the various bioinformatics tools in different fields					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	M				L						
CO2	M			L	L										
CO3	S	M	-	-	S	L	-	-	-			M			
CO4	M	S	L	M	L	-	-	-	-	-	-	M		-	
CO5	-	M	S	L	S	-	-	-	-	-	L	-			

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.

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

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: Dermatophytosis, Candidiosis and Aspergillosis, Pathogenicity and diagnosis of major Protozoan infections: Amoebiasis, 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 Molecular Diagnostics.
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 Lubert Stryer, 2002. Biochemistry. W.H. Freeman and Company. 5th Edn.
5. Parasitology, Chatterjee K.D, Chatterjee Medical Publishers

REFERENCES:

1. Lodish, Berk, Zipursky, Matsudaira, Baltimore Darnell, 2000. Molecular Cell Biology. W.H. Freeman and Company. 4th Edn.
2. Benjamin L., 2008. Genes IX. Jones and Bartlett.
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

S.No.	Name of the Faculty	Designation	Department	Mail ID
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2	Mr.N.Jawahar	Assistant Professor	Biotechnology	jawahar@vmkvec.edu.in
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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 behavior 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 – CELL BIOLOGY

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. Recall the Knowledge about concept of genotype and phenotype characters	Remember
CO2. Compare the structure of gene and their mapping system	Understand
CO3. Predict the Sex determination in plants and animals.	Analyze
CO4. Validate the Structural changes in chromosomes.	Evaluate
CO5. Assess the genetic material, mutation and their frequency of occurrence in population	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	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	M	L	-	-	-	-	-	-	M	-	-	-	-	-	-
CO3	M	-	-	L	-	-	-	-	-	-	-	-	-	-	-
CO4	S	-	L	-	-	-	-	L	-	S	-	-	-	-	-

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

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

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:

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 modelling, 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 recall the basics of stem cell	Remember
CO2. To identify the basic applications of stem cell in regenerative medicine	Understand
CO3. To Illustrate the latest tissue engineering concepts	Apply
CO4. To develop the scaffold tissue using stem cell	Analyse
CO5. To validate the research in tissue engineering.	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	L	M				L		L	M			
CO2	M	L	SM	L	L	L					M	L			
CO3	S		M	L	M	L		L	L		M	L			

CO4	S	M	L		S	M					S	M			
CO5	S					L	M	S	L	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 Thomson E and Donall 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. ^[1]_[SEP]
2. Bredenoord, AL, Clevers, H, Knoblich J (2017) "Human tissues in a dish: The research and ethical implications of organoid technology" *Science* 355. ^[1]_[SEP]
3. Thomson E and Donall 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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1	Dr.B.Prabasheela	Associate Professor	Biotechnology	prabasheela@avit.ac.in

Stem cell syllabus was prepared by Dr. Giri along with the guidance of stem cell expert

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 organism's classifies 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 – GENETIC ENGINEERING

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 classify the legislation, regulations and ethical values relevant to genetic modification
4	To categorise the importance of crop protection and improvement.
5	To design various laws for the selection of genetic changes.

COURSE OUTCOMES

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

CO1. To list out the basic knowledge about genetically modified microbes and organisms	Remember
CO2. To classify the modified gene copy number and chromosomal changes	Understand
CO3. To compare the genetically engineered organisms and methods of bioconfinement	Understand
CO4. To categorise the economic and political aspects of genetic modification	Analyze

CO5. To appraise the advantages of structural changes and numerical changes	Evaluate
CO6. To compose the potential benefits and population genetics, gene frequencies	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	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	M	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	M	-	-	L	-	-	-	-	-	-	-	-	-	-	-
CO4	S	-	S	-	-	-	-	-	-	-	-	-	M	-	-
CO5	S	-	S	L	-	-	-	-	-	-	-	-	-	M	-
CO6	S	-	L	L	-	-	-	-	-	-	-	-	-	-	-

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

S.No.	Name of the Faculty	Designation	Department	Mail ID
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1	Dr.R.Subbaiya	Associate Professor	Biotechnology	rsubbaiya80@gmail.com
2				

17BTSE19	SKILL BASED ETHNO MEDICINE	Category	L	T	P	Credit
		EC-PS	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 – Not Required						
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					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	--	-	M	--	-	-	-	-	-	-	-
CO2	S	M	--	--	--	M	-	-	-	-	-	-	-	-	-
CO3	S	---	M	--	-	-	-	-	-	-	-	S	-	-	-
CO4	S	--	---	S	M	S	M		-	-	-	-	-	-	-
CO5	M	--	--	S	M	S	M	E	-	--	--	S	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION 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*, *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.
4. A Manual of Ethnobotany – S.K.Jain, 1995, 2nd edition.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.A.NIRMALA	Assistant Professor	Biotechnology	nimmi_aruna@yahoo.com
2				

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 – 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 assess the students in making and interpreting phylogenetic trees														
5	To generate the gene duplication and dating of gene duplication														
COURSE OUTCOMES															
After the successful completion of the course, learner will be able to															
CO1. Students will recall the concept and processes of protein and genes in the molecular evolution														Remember	
CO2. Explain how the evolutionary changes act at the molecular level														Understand	
CO3. Utilize 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. Appraise the domains of gene duplication and exon suffling														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	-	-	-	-	-	-	-	-	M	-	-	-
CO2	M	L	L	-	-	-	-	-	-	-	-	-	-	-	-
CO3	L	-	L	L	-	-	-	-	L	-	-	-	-	-	-
CO4	L	-	L	-	-	-	-	-	-	-	-	-	-	-	-
CO5	L	-	L	-	-	-	-	-	-	-	-	-	-	-	-
S- Strong; M-Medium; L-Low															
SYLLABUS															
GENES, GENETIC CODES, AND MUTATION															
Genes and gene structure- Protein-coding genes, RNA-specifying genes, Untranscribed 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

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. S. Vinoth	Assistant Professor	Biotechnology	vinoth@avit.ac.in
2				

17BTEC09	MICROBIAL BIOTECHNOLOGY	Category	L	T	P	Credit
		EC-PS	3	0	0	3
PREAMBLE						
<p>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 is 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.</p>						
PREREQUISITE						
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 pharma 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: To describe the historical background and cultural characteristics of microbes					Remember	
CO2: To describe the differences between culturing techniques, product purification and recovery process					Understand	
CO3: To analyze the production of microbial metabolites					Analyse	
CO4: To compare and contrast the production of primary and secondary metabolites					Analyse	
CO5: Identify the factors that play a role in the production of antibiotics.					Evaluate	

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

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 MICROOBES

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

UNIT - VRECOVERY AND PURIFICATION OF MICROBIAL PRODUCTS

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

TEXT BOOKS:

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

REFERENCES:

- Geo Brooks, Karen C. Carroll, Janet Butel, and Stephen Morse "Medical Microbiology", McGraw-Hill Medical, 26th Edition, 2012 6.
- Lansing M. Prescott, Donald A. Klein, and John P. Harley, "Microbiology", McGraw Hill, 5th Edition, 2002 7.
- G. Reed, Prescott and Dunn's, "Industrial Microbiology", 4th Edition, CBS Publishers, 2009. 8.
- P. E. Stanbury, A. Whitaker, and S. J. Hall, "Principles of Fermentation Technology", Indian Edition, Hall Books, 2007

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. R. Subbaiya			rsubbaiya80@gmail.com

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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 acquire knowledge on basics of cryopreservation and effects caused by it.					
2	To study the different types cryopreservation					
3	To understand how cryopreservation is used in fertilization process.					
4	To apply knowledge of cryopreservation in therapeutics and other fertilization process					
5	To acquire knowledge on basics of cryopreservation and effects caused by it.					
COURSE OUTCOMES						
After the successful completion of the course, learner will be able to						
CO1. Recall the basic principle cryopreservation.					Remember	
CO2. Discuss about different types of cryopreservation.					Understand	
CO3. Practice the cryopreservation techniques in fertilization process					Apply	
CO4. Distinguish the cryopreservation techniques for storage system					Analyze	
CO5. Appraise the importance of cryopreservation process.					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	S	M	L	-	-	M	-	-	-	-	L	L	-	-
CO2	S	M	-	-	L	-	-	-	-	-	M	M	-	-	-
CO3	S	M	L	-	-	-	-	-	-	-	L	M	-	L	-
CO4	S	M	L	-	-	-	-	-	-	-	M	-	-	-	M
CO5	M	S	L	-	-	-	-	-	-	-	S	-	M	L	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 *Homo sapiens*, 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

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	Associate professor	Biotechnology	nirmala@vmkvec.edu.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 the role 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. Recognize the structure and classification of proteins					Remember	

CO2. Describe the amino acid sequence and structure of proteins, and relate this information to the function of proteins strategies.	Understand
CO3. Outline the characteristics of individual amino acids and their effect on the solubility, structure and function of proteins	Understand
CO4. Develop biotechnical methods to construct plasmids for the expression of natural and modified genes	Analyze
CO5. Validate a simple research plan for a protein engineering and design	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

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. Doanald Voet 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.
5. Berg, J. M., Tymoczko, J. L. and Stryer, L., 2002. Biochemis-try. 5th Edn., W.H. Freeman and Company.

COURSE DESIGNERS

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

S- Strong; M-Medium; L-Low

SYLLABUS

NEUROANATOMY

What are 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

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. R. Subbaiya			rsubbaiya80@gmail.com

17BTEC13	FOOD PROCESS ENGINEERING	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

Food Process Engineering deals with the study of post-harvest processing and the role of moisture content. Preservation by salt, sugar and chemicals, High temperature and processing were monitored for the packaging. Food engineers provide the technological knowledge transfer essential to the cost-effective production and commercialization of food products and services. Physics, chemistry, and mathematics are fundamental to understanding and engineering products and operations in the food industry. Food Engineers often use cutting-edge techniques and sophisticated machinery along with other applied fields of research like biotechnology, to study food materials and their complex mechanisms. Knowledge of these principles will enable students to understand importance of food materials.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To acquire knowledge about the preserving techniques of various food stuffs.
2	To study the storage and packaging techniques of foods
3	To know the processing techniques to avoid post-harvest losses.
4	To understand the effects of temperature and freeze drying procedures
5	To apply various methods for packaging and storing the food substances.

COURSE OUTCOMES

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

CO1: Acquire the knowledge about post-harvest technology related to batch and continuous drying	Remember
CO2: To know the Fundamental of preparing juices and pulps.	Understand
CO3: The general methods of pasteurization and sterilization methods will be identified.	Analyse
CO4: Demonstrate the process of storing the food materials.	Analyse
CO5: Analyzing the role of food preservation methods for maintaining the quality of food.	Evaluate

COS	PO	PSO	PSO	PSO3												
CO1	S	M	L	M	L	-	-	-	-	-	-	-	-	L	-	-
CO2	S	L	-	L	L	-	-	-	-	-	-	-	-	-	-	-
CO3	S	M	L	L	1	-	-	-	-	-	-	-	-	L	-	-

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

S- Strong; M-Medium; L-Low

SYLLABUS

POST HARVEST PROCESSING

Post harvest losses, cleaning, grading and sorting types. Moisture content –free moisture, bound and unbound moisture, Role of moisture content - concept of water activity measurement – direct and indirect method, equilibrium moisture content, EMC determination methods, hysteresis effect. Theory and mechanism of drying, constant rate and falling rate drying, Thin layer and deep bed drying, methods of drying agricultural materials - batch and continuous drying. Water activity and its importance

PRESERVATION BY SALT, SUGAR AND CHEMICALS

Preparation of Juices and pulps, concentrates. Theory of gel formation, Preparation of jam, jellies, marmalades. Chemistry of salt preservation - Sauerkraut, and vinegar production, minimal processing, hurdle technology Osmotic dehydration

HIGH TEMPERATURE PROCESSING/PRESERVATION

Methods of applying heat to food. Balancing, Pasteurization and sterilization. Thermal death time relationships (D, Z and F values). Process calculations: general methods, Ball's formula method. sterilization – methods and equipments, UHT sterilization, Aseptic processing and packaging

LOW TEMPERATURE PROCESSING/PRESERVATION

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:

- P. J. Fellows, Food Processing Technology: Principles and practice, Third Edition Woodhead Publishing limited, 2009.
- Paul Singh, R and Dennis R. Heldman, Introduction to Food Engineering, Fourth Edition. Academic Press, 2009.

REFERENCES:

- K. M. Sahay, and K.K. Singh, Unit Operations of Agricultural Processing, Vikas Publishing House Pvt. Ltd., 2010.
- R. L. Earle, Unit Operations in Food Processing, Pergamon Press, 1989.
- Warren L. McCabe, Julian C. Smith, Peter Harriott, Unit Operations of Chemical Engineering, Seventh Edition, McGraw - Hill, 2005

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. R. Subbaiya	Associate Professor	Biotechnology	rsubbaiya80@gmail.com

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 development, 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: Define the historical background and development of endocrine system										Remember					
CO2: Describe the importance of sexual differentiation and the role of biochemical and hormonal aspects										Understand					
CO3: Examine the sources of ovarian hormones and regulation of ovarian functions										Analyse					
CO4 Compare and contrast the internal and external fertilization and genetic recombination.										Analyse					
CO5: Evaluate the role of hormones in developmental stages and the basis of evolutionary change.										Evaluate					
MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES															
CO S	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3

CO	M	L	L	L	L	-	-	-	-	-	-	-	L	-	-
CO	S	L	L	L	L	L	-	-	-	-	-	-	-	-	-
CO	L	L	L	L	M	-	L	M	L	-	-	L	-	L	-
CO	M	M	-	S	S	-	-	-	-	L	M	L	-	L	-
CO	S	M	L	L	M	-	-	-	-	-	-	L	M	L	L

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:

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

COURSE DESIGNERS

S. No	Name of the Faculty	Designation	Department	Mail ID
1	Dr.R.Subbaiya	Associate Professor	Biotechnology	rsubbaiya80@gmail.com
2	Dr.M.Sridevi	Professor & Head	Biotechnology	sridevi@vmkvec.edu.in

CO5	S	M	L	L	-	-	-	-	-	-	L	S	M	L	-
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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, biostimulation, bioaugmentation, biosparging, biofilters, bioscrubbers and phytoremediation – bioleaching, bioprecipitation, 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 biocompost 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”, 2nd 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

S. No	Name of the Faculty	Designation	Department	Mail ID
1	Dr. Chozhavendhan. S	Associate professor	Biotechnology	chozhavendhan@avit.ac.in
2	Dr. B. Prabasheela	Associate professor	Biotechnology	prabasheela@avit.ac.in
3	Dr,M,Sridevi	Professor & Head	Biotechnology	sridevi@vmkvec.edu.in

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

PREREQUISITE

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 <i>cancer treatment</i>

COURSE OUTCOMES

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

CO1. Relate the hallmarks of cancer.	Remember
CO2. Differentiate the types of gene mutations and cancer formation.	Understand
CO3. Demonstrate the molecular mechanisms underlying the development of cancer	Apply
CO4. Correlate the genomic knowledge .	Analyse
CO5. Infer the 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	PSO1	PSO2	PSO3
CO1	L	L	-	L	L	L	-	L	S	-	-	-	-	-	-
CO2	M	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	S	S	-	M	-	-	S	-	-	-	-	-	-	-	-
CO4	M	M	L	-	-	-	-	-	M	-	-	-	-	-	-
CO5	M	M	M	L	-	-	-	-	-	-	-	L	-	-	L

S- Strong; M-Medium; L-Low

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

TEXTBOOK

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. Momna Hejmadi, 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

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.B.Prabasheela	prabasheela@avit.ac.in	Dr.B.Prabasheela	prabasheela@avit.ac.in

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 – PLANT AND ANIMAL BIOTECHNOLOGY

COURSE OBJECTIVES

1	To list the basic techniques of plant tissue culture for crop improvement.
2	To Describe the 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 the use of genetically engineered organisms in environment

COURSE OUTCOMES

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

CO1. Recall the basic information about plant tissue culture techniques	Remember
CO2. Demonstrate the various novel techniques used in medical field	Understand
CO3. Validate the different methods for the production of therapeutics agents in pharmaceutical industry	Evaluate
CO4. Examine the uses of genetically engineered microbes in Industrial application	Analyze
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	S	-	S	-	S	-	M	S	-	-	-	M			
CO2	S	M	M	-	S	-	M	-	-	-	-	L			
CO3	S	M	-	S	M	S	-	S	-	-	-	M			
CO4	M	L	M	-	S	M	M	S	-	-	-	L			
CO5	M	-	-	-	M	L	S	S	-	-	-	L			

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.

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 - 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 ¹³ C-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. Recall about energetics of cellular metabolism	Remember
CO2. Describe the structure and regulation of metabolic networks	Understand
CO3. Explain the optimal strategy for introducing directed genetic changes in the microorganisms with the aim of obtaining better production strains	Understand
CO4. Demonstrate the modern biology with engineering principles.	Apply
CO5. Design Case studies on metabolically engineered products and processes in various expression systems	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

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. Néstor V.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

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	G. Karthiga Devi	Assistant Professor	Biotechnology	karthigadevi@avit.ac.in
2	Mrs.C.Nirmala	Associate professor	Biotechnology	nirmala@vmkvec.edu.in

17BTEC19	CLINICAL TRIALS	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 Relate the research work.	Remember
CO2 Identify the research component	Understand
CO3 Illustrate the procedures for clinical trial	Apply
CO4 Demonstrate the role of toxicology in drug development	Apply
CO5 Assess a Clinical trial	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

PURPOSE OF 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 a problem 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).

TEXTBOOK

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 Verlag*.
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 Therapeutics.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.B.Prabasheela	Associate Professor	Biotechnology	prabasheela@avit.ac.in
2	Dr.S.Anusuya	Associate Professor	Biotechnology	

17BTEC20	AGRICULTURE 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

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

CO1. Recall the basic information about cell structure and functions	Remember
CO2. Interpret about plant and microbes interactions	Understand
CO3. Demonstrate the novel techniques used in genetic engineering and genetic manipulation in crop improvement	Apply
CO4. Examine the uses of different vectors and their application in biotechnology field	Analyze
CO5. Prepare the different organic compounds like vitamins, amino acids and proteins etc, using plant as a major source.	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	-	L
CO2	-	M	-	S	-	M	S	L	-	-	L	L	L	L	-
CO3	M	-	M	-	L	S	M	M	M	M	-	L	L	-	-
CO4	L	-	L	-	S	L	S	M	-	-	-	-	M	-	-
CO5	S	-	L	-	L	L	L	M	-	-	-	M	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 plant and crop stress, 2nd edition. Marcel Dekkar Inc. New York.
4. Melvin J oliver. Agricultural Biotechnology. Wiley Blackwell. 2009

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department	Mail ID	
1	A. Nirmala	Assistant professor	Biotechnology	nimmi_aruna@yahoo.com	
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 – GENETIC ENGINEERING

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.	Apply
CO3. To relate the flow of genetic information from DNA to RNA to protein	Apply
CO4. To compare the advantages and the drawbacks of various proteomics technologies with the emerging technologies	Analyse
CO5. To evaluate the role of proteomics in drug discovery	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

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, Subtractive 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

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

TEXT BOOKS:

2. Rastogi, S.C., Mendiratta, N. and Rastogi, P, 2008. Bioinformatics Methods and Applications. Prentice-Hall of India (Private), Limited.
3. Andreas D. Baxevanis and Francis Ouellette, 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

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.S.Vinoth	Assistant Professor	Biotechnology	vinoth@avit.ac.in
2	Ms.C.Nirmala	Assistant Professor	Biotechnology	nirmala@vmkvec.edu.in

17BTEC22	MOLECULAR MODELLING AND DRUG DESIGNING	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

This course enables the students to broaden their interests to use structure-based and non-linear classification methods in drug design.

PREREQUISITE - PRINCIPLES OF BIOINFORMATICS

COURSE OBJECTIVES

1	To list concepts involved in molecular modeling
2	To summarize molecular mechanisms involved in energy minimization
3	To execute the molecular dynamics using different models
4	To develop basic steps involved in modeling of proteins
5	To justify the molecular dynamics in drug designing and discovery

COURSE OUTCOMES

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

CO1. Recognize about molecular modeling concepts	Remember
CO2. Classify molecular mechanisms behind energy minimization problems	Understand
CO3. Illustrate the models to study the molecular dynamics	Understand
CO4. Compare molecular dynamics with drug designing concepts	Apply
CO5. Design new techniques for the discovery of drugs	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

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”. Angewandte Chemie, International Edition, Vol.42 “Advanced Drug Design and Development” Kourounakis Taylor and Francis

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	G. Karthiga Devi	Assistant Professor	Biotechnology	karthigadevi@avit.ac.in
2				

17BTEC24	BIOFERTILIZER TECHNOLOGY							Category	L	T	P	Credit			
								EC-PS	3	0	0	3			
PREAMBLE															
This course will provide knowledge of comprehensive understanding of the biofertilizer technology and its current trends. It develops the entrepreneurship to catch with the current trends as well as creating the industry ready professionals.															
PREREQUISITE															
NIL															
COURSE OBJECTIVES															
1	To state the basic knowledge on biofertilizer in agriculture.														
2	To discuss about the role of biofertilizer in crop production														
3	To implement the production and application of biofertilizer technology														
4	To outline the marketing strategies of biofertilizer.														
COURSE OUTCOMES															
After the successful completion of the course, learner will be able to															
CO1. Recall the types and importance of biofertilizer.												Remember			
CO2. Describe in detail about the different chemical fertilizer, green manuring and its role in crop production												Understand			
CO3. Illustrate the functions of microorganism from various sources and their mass production												Apply			
CO4. Appraise in detail about the application and limitation of biofertilizer in crop field												Apply			
CO5. Estimate 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	-	L	-
CO2	M	M	M	-	-	-	L	-	-	-	L	L	L	L	-
CO3	S	-	M	M	-	-	M	-	-	-	L	-	-	-	-
CO4	M	-	-	M	-	-	S	-	-	-	-	-	-	-	-
CO5	L	L	L	L	-	-	-	-	-	-	L	L	-	M	-
S- Strong; M-Medium; L-Low															
SYLLABUS															
Biofertilizer															
Definition and types, importance of biofertilizers in agriculture, Characteristics of biofertilizers- <i>Rhizobium</i> , <i>Azotobactor</i> , <i>Azospirillum</i> , Phosphate solubilizing microorganisms, cyanobacteria, <i>Azolla</i> , 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 and nitrogen 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-OE	3	0	0	3

PREAMBLE

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

PREREQUISITE

NIL

COURSE OBJECTIVES

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

COURSE OUTCOMES

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

CO1: Recall the structure and cell theory of living organism.	Remember
CO2: Discuss about the biological diversity of life.	Understand
CO3: Classify the application of enzymes in industrial level.	Apply
CO4: Detect the uses of Bioremediation and Biosensors using molecular machines.	Analyse
CO5: Appraise in detail about the principles of cell signaling 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	S	-	-	-	M	-	-	-	-	-	-	L	M	M	-
CO2	S	M	M	M	S	L	L	-	L	L	-	L	S	S	-
CO3	-	M	M	M	L	M	L	-	L	S	L	S	L	M	L
CO4	S	S	S	M	M	S	S	L	S	M	-	S	S	S	L
CO5	S	M	M	M	-	-	-	-	-	-	L	L	L	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO BIOLOGY – CELL AND CELL STRUCTURE AND FUNCTION:

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

INTRODUCTION 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.Tymoczko 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

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Dr. R. Deepapriya	Assistant Professor	Biotechnology	deepapriya21@gmail.com

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

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

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

REFERENCE 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.
3. Sandra Mendler, William Odell, The Guide Book Of Sustainable Design, John Wiley & Sons, 2000.
4. 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	
2	Dr. S. Chozhavendhan	Associate Professor	Biotechnology	scvibt@gmail.com	

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

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

CO1. To state the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the environment.	Remember
CO2. Discuss remedies/potential solutions to the supply and environmental issues associated with fossil fuels and other energy resources.	Understand
CO3. Illustrate and describe the primary renewable energy resources and technologies.	Apply
CO4. Illustrate the basic electrical concepts and system components.	Apply
CO5. Estimate the 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	S	M	L	L	S	M	S	-	-	-	-	-	-	-	-
CO2	S	M	L	M	-	L	S	-	L	-	-	S	M	-	-
CO3	S	M	M	M	-	L	S	-	-	-	-	M	M	-	-
CO4	S	M	M	M	-	M	S	-	-	-	-	L	S	-	-
CO5	S	M	L	L	-	M	S	-	-	-	-	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
3. D.O.hall and R.P. Overeed - Biomass Renegerable Energy – John Wiley and Sons, New york, 1987.

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Dr.S.Vinoth	Assistant Professor	Biotechnology	vinogenes@gmail.com

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 the students, who can work in a multi-disciplinary environment to anticipate and address evolving challenges of the 21st century.
2	To summarize the synthesized 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

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

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

S- Strong; M-Medium; L-Low

SYLLABUS

CIVIL ENGINEERING IN TWENTY FIRST CENTURY

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 BOOK

- 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

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Dr. R. Subbaiya	Associate Professor	Biotechnology	rsubbaiya80@gmail.com

17BTEC29	GREEN BUILDING AND SUSTAINABLE ENVIRONMENT	Category	L	T	P	Credit
		EC-OE	3	0	0	3

PREAMBLE

Before starting with this course one must get a clear knowledge on the basics of green building, learning the plan details of HVAC for a building, energy efficient 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. Define the basics of green building	Remember
CO2. Discuss the advantages and benefits of green building practices	Understand
CO3. Illustrate low energy architecture features in residential and commercial buildings	Apply
CO4. Develop proper water conservation systems to make up a healthy building	Apply
CO5. Validate 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	S	S	S	M	M	M	S	-	M	M	S	M	S	-	M
CO2	S	-	S	S	-	S	-	-	M	-	M	-	-	S	-
CO3	S	M	-	M	S	M	S	-	-	L	M	L	S	-	L
CO4	S	-	M	-	M	-	-	-	L	-	L	-	-	M	-
CO5	S	M	M	L	-	M	M	-	L	L	-	L	S	-	L

S- Strong; M-Medium; L-Low

SYLLABUS

GREEN BUILDING BASICS AND PRACTICES:

Site Design / Development & Plan Implementation, Resource Efficiency, Energy Efficiency, Water Efficiency, Indoor Environmental Quality and Homeowner Education, Operation, Maintenance & Practices. Assessment of building design and construction, emission of CO₂, SO₂, and NO₂ of building materials, elements, and construction process.

ENERGY MANAGEMENT SYSTEM OF BUILDINGS

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

LOW ENERGY ARCHITECTURE, PASSIVE BUILDING DESIGN

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

WATER MANAGEMENT, BUILDING METHODS & MATERIALS

Water conservation, water management systems, water efficient landscaping, green roofing, rainwater harvesting, sanitary fixtures and plumbing systems, wastewater treatment and reuse, and process water strategies. AAC (Aerated 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: 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

S.No	Name of the Faculty	Designation	Name of the College	Mail ID
1	Dr.S.P.Sangeetha	Professor & Head	AVIT	sangeetha@avit.ac.in

17BTEC30	NATURAL RESOURCE MANAGEMENT	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

Bioresource management shows 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 economical importance of value-added products.

COURSE OUTCOMES

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

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

BASICS OF BIORESOURCE MANAGEMENT

Basics of Bioresources - Concept, kinds, importance. Human Resource: Management, scope and importance

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

AQUACULTURE

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

VERMICULTURE 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 house Pvt.Ltd., New Delhi
2. Trivedi, T, R. (2011) "Forest Management"Discovery Publishing Pvt.Ltd. New Delhi
3. Milton Fingerman, Rachakonda Nagabhushanam 2000. "Recent Advances in Marine Biotechnology" 1st 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

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.Chozhavendhan. S	Associate professor	Biotechnology	chozhavendhan@avit.ac.in

17BTSE01	INDUSTRIAL BIOTECHNOLOGY	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

Industrial Biotechnology deals with the chronological development of fermentation process. This subjects aims to deliver a detailed method of production product recovery process of all primary, secondary metabolites and biological products. Industrial Biotechnology syllabus students are able to understand the use of more advances and sophisticated instruments for the production and purification of biological products. Knowledge of these production process will enable students to carry out their project effectively and individually.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To list the overall industrial fermentation process and the process flow sheet.
2	To summarize the knowledge on production of commercially important primary metabolites.
3	To perform the knowledge on production of commercially important secondary metabolites.
4	To develop production process for different biological products.
5	To formulate the production of therapeutic products.

COURSE OUTCOMES

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

CO1. Recall the overall view of industrial fermentation and the process flow sheet	Remember
CO2. Discuss the methods for the production of primary metabolites	Understand
CO3. Practice the knowledge on commercial production of primary metabolites	Understand
CO4. Compare the production of enzyme from bacterial and fungal species	Analyze
CO5. Select the methods for the commercial production of modern biological 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	S	M	S	M	S	L	L	-	M	L	M	M	S	S	M
CO2	S	M	M	M	M	-	-	-	L	-	L	L	S	S	-
CO3	S	M	M	M	M	-	-	-	L	-	L	L	S	S	-
CO4	S	M	M	M	M	-	-	-	L	-	L	L	S	S	-
CO5	S	M	M	M	M	-	-	-	L	-	L	L	S	S	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO INDUSTRIAL BIOPROCESS

Fermentation - Bacterial, Fungal and Yeast, Biochemistry of fermentation. Traditional and Modern Biotechnology – A brief survey of organisms, processes, products. Basic concepts of Upstream and Downstream processing in Bioprocess, Process flow sheeting – block diagrams, pictorial representation.

PRODUCTION OF PRIMARY METABOLITES

Primary Metabolites- Production of commercially important primary metabolites like organic acids (citric acid, acetic acid, lactic acid) amino acids (L- cysteine, L- Tryptophan and L-phenylalanine), alcohols (ethanol, butanol, propanol) and vitamins Vitamin B12 and Vitamin C).

PRODUCTION OF SECONDARY METABOLITES

Secondary Metabolites- Production processes for various classes of secondary metabolites: Antibiotics natural and semisynthetic penicillin, chloramphenicol Erythromycin, macrolides and Steroids – transformation process and its biological significance

PRODUCTION OF ENZYMES AND OTHER BIOPRODUCTS

Production of Industrial Enzymes (protease and lipase), Biopesticides, Biofertilizers, Bio preservatives (Nisin), Biopolymers (PHA and PHB Xantha Gum) Biodiesel – production process, characteristics, merits and demerits, Production process of Cheese, Beer, SCP & Mushroom culture.

PRODUCTION OF MODERN BIOTECHNOLOGY PRODUCTS

Production of recombinant proteins having therapeutic and diagnostic applications (Insulin, Interferon, Interleukins and Growth stimulating Hormone), Vaccines – Subunit vaccine, recombinant vaccine advantages and disadvantages. Bioprocess strategies in Plant Cell and Animal Cell culture.

TEXT BOOKS:

1. Satyanarayana, U. (2013) “Biotechnology” Books And Allied (p) Limited.
2. Dubey, R.C. (2014) “A Textbook of Biotechnology” 5th revised Edition S. Chand Publishing. Ltd.,
3. Kumar, H.D. (1998) “A Textbook on Biotechnology” 2nd Edition. Affiliated East West Press Pvt.Ltd.,
Ratledge, Colin and Bjorn Kristiansen (2001) “Basic Biotechnology” 2nd Edition Cambridge University Press

REFERENCES:

1. .F.A Bryce and EL.Mansi (2011) Fermentation microbiology & Biotechnology, 3rd Edition CRC Press.
2. Presscott, S.C. and Cecil G. Dunn, (2005). “Industrial Microbiology”, Agrobios (India).
3. Cruger, Wulf and Anneliese Crueger (2000) “Biotechnology: A Textbook of Industrial Microbiology”, 2nd Edition, Panima Publishing,
4. Moo-Young, Murrey, “Comprehensive Biotechnology”, 4 Vols. Pergamon Press, (An Imprint of Elsevier) 2004.
5. K.G.Ramawat & Shaily Goyal, Comprehensive Biotechnology, 2009, S.Chand publications.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. S. Chozhavendhan	Associate professor	Biotechnology	chozhavendhan@avit.ac.in

17BTSE02	CHEMICAL REACTION ENGINEERING	Category	L	T	P	Credit
		EC-PS	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 define 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 develop the knowledge on various chemical reactors

COURSE OUTCOMES

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

CO1. Recall the basics of material balance in chemical reaction	Remember
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. Test the heterogeneous reactions.	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	-	-	-	-	-	-	L	M	L	-
CO2	S	M	L	M	L	-	-	-	-	-	-	-	S	M	-
CO3	S	L	M	L	M	L	-	-	-	-	-	-	S	M	-
CO4	S	L	M	L	L	M	-	-	-	-	L	M	-	-	-
CO5	S	M	-	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:

4. Missen R.W., Mims C.A., Saville B.A. 1999. Introduction to Chemical Reaction Engineering and Kinetics. John Wiley.
5. Froment, G.F.; Bischoff, K.B.; De Wilde, J. 2011. Chemical reactor analysis and design. 3rd Edition. John Wiley & Sons

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. S. Chozhavendhan	Associate professor	Biotechnology	chozhavendhan@avit.ac.in

17BTSE03	FERMENTER DESIGN AND ANALYSIS	Category	L	T	P	Credit
		SE-PS	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 assess 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. Validate the parameters involved in the instrumentation and control	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	S	M	S	-	-	-	-	-	L	M	S	S	L
CO2	S	M	S	M	S	-	-	-	-	-	L	M	S	S	-
CO3	S	S	S	M	M	-	-	-	-	-	L	L	S	S	L
CO4	S	S	M	S	M	-	-	-	-	L	L	M	S	S	-
CO5	S	M	S	M	S	-	-	-	-	-	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 $k_L a$ 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 Interpretation and Control of Biotechnological Processes", Kluwer Academic Publishers, 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:

4. Mansi, E.M.T.EL., Bryce, C.F.A., Demain, A.L. and Allman, A.R., "Fermentation Microbiology and Biotechnology", 3rd edition Taylor and Francis, 2012.
5. Towler, G. and Sinnott, R., "Chemical Engineering Design: Principles, Practice, Economics of Plant and Process Design", 2nd edition, Butterworth – Heinemann Ltd., Elsevier, 2012.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. S. Chozhavendhan	Associate professor	Biotechnology	chozhavendhan@avit.ac.in

17BTSE04	BIOSEPARATION TECHNOLOGY	Category	L	T	P	Credit
		SE-PS	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 list 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 develop the concepts for separation and purification.

COURSE OUTCOMES

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

CO1. Define the need of downstream processing in biotechnology industry	Remember
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. Assess the various finishing operations involved in the DSP	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	-	-	-	-	-	-	L	M	S	S
CO2	S	M	M	L	M	-	-	-	-	-	-	L	M	M	S
CO3	S	M	M	L	M	-	-	-	-	-	-	L	M	S	M
CO4	S	M	M	L	M	-	-	-	-	-	-	L	M	M	S
CO5	S	M	L	L	M	-	-	-	-	-	-	L	M	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

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. S. Chozhavendhan	Associate professor	Biotechnology	chozhavendhan@avit.ac.in

17BTSE05	INDUSTRIAL WASTE MANAGEMENT	Category	L	T	P	Credit
		SE-PS	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 state 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 check the maintenance of hazardous waste

COURSE OUTCOMES

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

CO1: Recall an insight into the pollution from major industries including the sources and characteristics of pollutants	Remember
CO2: Identify the plan minimization of industrial wastes	Understand
CO3: Illustrate the facilities for the processing and reclamation of industrial waste	Apply
CO4: Correlate the various treatments for disposals of industrial waste.	Analyse
CO5: Asses the physio chemical treatment for hazardous waste.	Evaluate

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

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. S. Chozhavendhan	Associate professor	Biotechnology	chozhavendhan@avit.ac.in

17BTSE06	FUNDAMENTALS OF FLUID MECHANICS	Category	L	T	P	Credit
		SE-PS	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	Evaluate

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

COURSE DESIGNERS

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1	Dr. S. Chozhavendhan	Associate professor	Biotechnology	chozhavendhan@avit.ac.in

17BTSE09	INDUSTRIAL BIOTECHNOLOGY LAB	Category	L	T	P	Credit
		EC	3	0	0	3

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 – Biochemistry

COURSE OBJECTIVES

1	To acquires 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	Remember
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 <i>Streptomyces</i> 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	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	-		-	-
CO4	-	M	L	L	S	-	L	-	-	-	-	-		-	-
CO5	L	-	M	L	S	-	M	-	-	-	-	-		-	-

S- Strong; M-MediumS; 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

17BTSE10	FERMENTATION LAB	Category	L	T	P	Credit
		EC	3	0	0	3

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 – Biochemistry

COURSE OBJECTIVES

1	To acquires 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	Remember
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. Understand process for production of antibiotics using <i>Streptomyces</i> 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	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	-	-	-	-
CO4	-	M	L	L	S	-	L	-	-	-	-	-	-	-	-
CO5	L	-	M	L	S	-	M	-	-	-	-	-	-	-	-

S- Strong; M-MediumS; L-Low

SYLLABUS

- 1.Growth of Bacterial yeast-Estimation of Biomass, Calculation of μ and Y_p/s
2. Production of ethanol from yeast
3. Production of wine from blackgrapes
4. Growth Kinetics inFermentation

5. Solid State Fermentation (Production of Metabolite Primary & Secondary)
6. Production of Antibiotics using Streptomycinspecies
7. Residence Time Distribution
8. Production of Protease
9. Production of Biofertilizers(N – Fixers & P -Solubilizers)
10. Production of MicrobialBiomass
11. Production of Single cell Protein(Spirulina)
12. Production ofVermicompost

REFERENCE BOOKS

2. Irwin H.Segel, “Biochemical Calculations”, John Wiley & Sons, 2nd Edition, Wiley Publishers, New Delhi. 2011.
3. Pierre-Yves Bouthyette, “Fermentation Technologies”, 2nd edition, Rai University, Ahmedabad, 2005.

17BTSE07	BIOPROCESS ECONOMICS AND REACTOR DESIGN	Category	L	T	P	Credit
		SE-PS	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	PO66	PO7	PO8	PO9	PO	PO1	PO1	PSO1	P	PSO3
CO1	S	L	L	-	-	-	-	-	-	-	-	-	-	-	L
CO2	S	M	M	L	M	-	-	-	-	-	-	-	L	-	-
CO3	M	L	-	L	L	M	L	M	-	L	-	-	-	L	L
CO4	L	L	L	-	-	-	-	-	-	-	M	-	-	-	-
CO5	M	MAA	M	L	-	-	-	-	L	-	-	-	-	-	-

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, payout 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 septic 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 2^k-p design, Plackett-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, 4th 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, 4th Edition (2003)
3. Biochemical Engineering-Atkinson

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	G. Karthiga Devi	Assistant Professor	Biotechnology	karthigadevi@avit.ac.in
2	Ms.C.Nirmala	Assistant Professor	Biotechnology	nirmala@vmkvec.edu.in

17BTSE08	BIOREACTOR THEORY	Category	L	T	P	Credit
		EC-PS	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

Not required

COURSE OBJECTIVES

1	To acquire knowledge on the basic principle and components of bioreactors
2	To study the different types of bioreactors and its working principle
3	To illustrate the design for fermentation process for biomass growth and product formation.
4	To understand the stoichiometric elemental balance.
5	To apply 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.	Remembrance
CO2. Discuss about different types of bioreactors with its working principle.	Understand
CO3. Design for fermentation process for biomass growth and product formation.	Analyze
CO4. Evaluate the microbial growth and product formation.	Apply
CO5. Interpret the stoichiometric elemental balance with microbial growth.	Evaluate
CO6. Create a kinetic model for microbial growth.	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	S	S	L	-	-	M	-	-	-	-	L	L	-	-
CO2	S	M	S	-	L	-	-	-	-	-	M	M	-	-	-
CO3	S	M	L	L	-	-	-	-	-	-	L	M	-	L	-
CO4	S	M	L	-	-	-	-	-	-	-	M	-	-	-	-
CO5	M	S	L	-	-	-	-	-	-	-	-	-	M	L	-
CO6	S	-	L	M	L	-	-	-	-	-	S	M			

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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3				

17BTSE11	FLUID MECHANICS LAB FOR BIOTECHNOLOGIST	Category	L	T	P	Credit
		SE-PS	0	0	4	2

PREAMBLE

This lab course is designed to impart good knowledge in fluid mechanics concepts

PREREQUISITE

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 |

MAPPING 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	-	-	-	-	-	-	-	-	L	L	-	L
CO2	S	L	M	-	-	-	-	-	-	-	-	L	M	-	L
CO3	S	L	M	-	-	-	-	-	-	-	-	L	M	-	L
CO4	S	L	S	-	-	-	-	-	-	-	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 (Second edition), 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

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Dr. G. KarthigaDevi	Associate professor	Biotechnology	karthigadevi@avit.ac.in
2	Mrs.C.Nirmala	Associate professor	Biotechnology	nirmala@vmkvec.edu.in

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 state 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 assess the regulatory affairs which involved in pharmaceutical industry														
COURSE OUTCOMES															
After the successful completion of the course, learner will be able to															
CO1: Underline the industry layout and Design									Remem						
CO2: Discuss the industry production and observe the quality control and Personnel management									Underst and						
CO3: Classify different methods in marketing and distribution									Apply						
CO4: Infer industry accountancy, costing, profit and loss									Analys						
CO5: Assess the regulatory affairs which involved in pharmaceutical industry									Evaluat						
MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES															
CO S	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PS O1	PSO2	PSO3
CO1	M	L	L	L	-	-	-	-	-	-	-	-	-	-	-
CO2	S	L	L	L	L	-	L	-	-	-	-	L	L	L	L
CO3	M	L	-	L	L	L	-	-	-	-	-	-	-	L	-
CO4	S	L	L	-	L	-	L	-	L	-	-	-	L	-	-
CO5	S	M	L	L	-	-	-	-	L	-	-	-	S	M	L
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

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	A. Nirmala	Assistant professor	Biotechnology	nimmi_aruna@yahoo.com
2	Mr.N.Jawahar	Assistant professor	Biotechnology	jawahar@vmkvec.edu.in

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 generate the monographs of herbal drugs

COURSE OUTCOMES

Recall the basic information of different medicinal plants, estimation of phyto constituents, isolation procedure and characterization of phytoconstituents	Remember
Demonstrate the concepts involved in drug discovery	Understand
Practice the prodrug design and analog design	Apply
Estimate the different phytoconstituents derived from the medicinal plants	Analyse
Design the monographs of herbal drugs	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

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

S. No	Name of the Faculty	Designation	Department	Mail ID
1	A. Nirmala	Assistant professor	Biotechnology	nimmi_aruna@yahoo.com
2	S.Anusuya	Associate Professor	Biotechnology	dr.s.anusuya@vmkvec.edu.in

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 recognize 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

CO.1 Underline the molecular and cellular mechanism of action of hormones and their regulation.	Remember
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	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	-	-	-
CO3	M	L	-	S	S	L	-	-	-	-	M	L	-	-	-
CO4	S	M	L	S	S	-	-	-	-	-	M	-	-	-	-
CO5	S	M	-	M	S	-	M	-	-	L	-	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 β -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

S.No.	Name of the Faculty	Designation	Department	Mail ID		
1	Dr.S.Vinoth	Assistant Professor	Biotechnology	vinoth@avit.ac.in		
2	Dr.S.Anusuya	Associate Professor	Biotechnology	dr.s.anusuya@vmkvec.edu.in		
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														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	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 9 Hrs															
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 9 Hrs															
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 9 Hrs															
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 9 Hrs															
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 9 Hrs															
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:

4. Bentley's Textbook of Pharmaceutics, Editor E. A. Rawlins, 8th Ed. (2002), Publisher: Bailliere Tindall, London
5. 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
1	Dr.S.Vinoth	Assistant Professor	Biotechnology	vinoth@avit.ac.in
2	Dr.S.Anusuya	Associate Professor	Biotechnology	dr.s.anusuya@vmkvec.edu.in

17BTSE16	PHARMACEUTICAL PROCESS CHEMISTRY						Category	L	T	P	Credit				
							SE	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 predict the Impurities in Active Pharmaceutical Ingredient														
5	To understand the basics of Industrial Safety measures and Occupational Health														
COURSE OUTCOMES															
CO1: After the successful completion of the course, learner will be able to															
CO2: Know the basic knowledge on Process chemistry											Understand				
CO3: Operate the techniques of Extraction, Filtration, Distillation and Evaporation process in industry											Understand				
CO4: Compare and differentiate the Aerobic and anaerobic fermentation process											Analyze				
CO5: Validate the Impurities in Active Pharmaceutical Ingredient											Evaluate				
CO6: Perform the Industrial Safety measures and Occupational Health in work place											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	S	-	-	-
CO2	S	-	-	L	M	L	-	-	-	-	L	M	-	-	-
CO3	M	L	-	S	S	L	-	-	-	-	M	L	-	-	-
CO4	S	M	L	S	S	-	-	-	-	-	M	-	-	-	-
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 Hyderabad.

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				

17BTSE17	PHARMACOGENOMICS						Category	L	T	P	Credit				
							SE	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											Analyze				
CO4: Analyse the techniques in medicine											Evaluate				
CO5: Exemplify the genomics of disease											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	S	S	-	-
CO2	S	-	-	L	M	L	-	-	-	-	L	M	-	-	-
CO3	M	L	-	S	S	L	-	-	-	-	M	L	-	-	-
CO4	S	M	L	S	S	-	-	-	-	-	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
		CC	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 acquire knowledge about the medicinal plants and classification.
2	To study the basic concepts of allergens involved in allergic reaction
3	To analyze, 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	Remember
CO2. To Gain information about allergens involved in allergic reactions	Understand
CO3. To Evaluate the mechanism action of drugs in living system	Analyse
CO4. To Analyse the various medicinal plants used for treatment of common disease	Analyse
CO5. To Forecast the disease manifestation and treatment with medicinal plants	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

CO5	-	M	-	S	S	L	L	L	-	-	-	M	L	L	-
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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 paradisiaca* (pseudostem) – 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

S.N o.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.A.NIRMALA	Assistant Professor	Biotechnology	nimmi_aruna@yahoo.com

17BTSE19	SKILL BASED ETHNO MEDICINE	Category	L	T	P	Credit
		EC-PS	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 – Not Required

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	create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	CO	PO1	PO2	PO3	PO4	PO5	PO6	COS	PO1
CO1	-	--	---	S	--	-	CO	-	--	---	S	--	-	CO1	-
CO2	S	M	--	--	--	M	CO	S	M	--	--	--	M	CO2	S
CO3	S	---	M	--	-	-	CO	S	---	M	--	-	-	CO3	S
CO4	S	--	---	S	M	S	CO	S	--	---	S	M	S	CO4	S

CO5	M	--	--	S	M	S	CO	M	--	--	S	M	S	CO5	M
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 – <i>Aegle marmelos</i> , <i>Ficus benghalensis</i> , <i>Curcuma domestica</i> , <i>Cyanodon dactylon</i> and <i>Sesamum indicum</i> - methods of disease diagnosis and treatment.															
MEDICINAL PLANTS IN DAY TO DAY LIFE:															
Traditional knowledge and utility of some medicinal plants in Tamilnadu – <i>Solanum trilobatum</i> , <i>Cardiospermum halicacabum</i> , <i>Vitex negundo</i> , <i>Adathoda vasica</i> , <i>Azadirachta indica</i> , <i>Gloriosa superba</i> , <i>Eclipta alba</i> , <i>Aristolochia indica</i> , <i>Phyllanthus fraternus</i> and <i>Boerhaavia diffusa</i> . <i>Ocimum sanctum</i> , <i>Centella asiatica</i> , <i>Solanum trilobatum</i> , <i>Cassia auriculata</i> , <i>Aloe vera</i> .															
HERBAL PLANTS USED IN COSMETICS															
Plants used as a cosmetics -Almond (<i>Prunus dulcis</i>), Aloe (<i>Aloe vera</i>), Argan Tree (<i>Argania spinosa</i>), Buriti Palm (<i>Mauritia flexuosa</i>), Cinnamon (<i>Cinnamomum verum</i>), Grape (<i>Vitis vinifera</i>), Lemonbalm (<i>Melissa officinalis</i>), Malabar Tamarind (<i>Garcinia cambogia</i>)															
TEXT BOOKS:															
3. Ethnobiology – R.K.Sinha & Shweta Sinha – 2001. Surabhe Publications – Jaipur.															
4. 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. 4. A Manual of Ethnobotany – S.K.Jain, 1995, 2nd edition.															
COURSE DESIGNERS															
S.No.	Name of the Faculty	Designation	Department	Mail ID											
1	Dr.A.NIRMALA	Assistant Professor	Biotechnology	nimmi_aruna@yahoo.com											

17BTSE20	PHARMACEUTICAL CHEMISTRY LAB	Category	L	T	P	Credit
		CC	0	0		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

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	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	-	-	-	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.

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

S- Strong; M-MediumS; 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 glycosides 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 (Hydrodistillation method) TLC of Volatile oils and their pure constituents.

V) Identification of monosaccharides 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.

17BTSE22	PHARMACEUTICAL MICROBIOLOGY LAB	Category	L	T	P	Credit
		EC	3	0	0	3

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 – Biochemistry

COURSE OBJECTIVES

- | | |
|---|--|
| 1 | To acquire and recognize the morphology of different microbes. |
| 2 | To Interpret and analyse the different types of media |
| 3 | To distinguish, 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	Remember
CO2. Describe the motility of bacteria and biochemical methods	Understand
CO3. Estimate the pour plate and microscopic count methods	Analyse
CO4. To compare, Extract, isolates and identifies the microbes.	Evaluate
CO5. Estimate the disinfectant and oligodynamic action	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	S	L	-	-	M	M	-	L	-	M	-		-	-
CO2	L	-	M	-	S	M	-	-	L	-	-	M		-	-
CO3	M	L	S	-	S	L	-	-	M	-	S	-		-	-
CO4	-	M	L	L	S	-	L	-	-	-	-	-		-	-
CO5	L	-	M	L	S	-	M	-	-	-	-	-		-	-

S- Strong; M-Medium; L-Low

SYLLABUS

2. Introduction to equipment and glassware used in microbiology laboratory.
3. Study of morphology of different microbes
4. Preparation of various culture media, cultivation of microbes and observation of colony characteristics.
5. Sterilization techniques (moist and dry heat) and their validations.
6. Aseptic transfer of culture into different types of media.
7. Characterisation of microbes by staining techniques (simple, gram's, acid fast and negative staining).
8. Study of motility of bacteria by hanging drop method.
9. 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.
10. Isolation of pure cultures by streak plate, spread plate & pour plate techniques.
11. Enumeration of bacteria by pour plate/spread plate technique
12. Enumeration of bacteria by direct microscopic count.
13. Evaluation of any disinfectant by phenol coefficient test
14. Study of Oligodynamic action (of metals on bacteria)
15. Preservation of microorganisms (slant and stab cultures)
16. 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:

Name of the faculty	Designation	Department	Mail ID	
Dr. S. Vinoth	Assistant Professor	Biotechnology	vinogenes@gmail.com	

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

S- Strong; M-Medium; L-Low

SYLLABUS

1. Standardization of analytical weights and calibration of volumetric apparatus.
2. 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.
3. 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.
4. Precipitation Titrations ; Preparation and standardization of titrants like silver nitrate and ammonium thiocyanate, titrations according to Mohrs Volhards and Fajans methods.
5. 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.
6. Non-aqueous Titrations ; Preparation and standardization of perchloric acid and sodium/potassium/lithium methoxides solutions, Estimations of some pharmacopoeial products.
7. Complexometric titrations ; Preparations and standardization of EDTA solution, some exercises related to pharmacopoeial assays by complexometric titrations.
8. Separation & identification of amino acids by paper chromatography
9. Separation & identification of alkaloids by TLC
10. UV spectrometric determination of Ibuprofen

TEXT BOOKS

1. Atherden, L.M. "Bentley and Driver's Textbook of Pharmaceutical Chemistry". 8th Edition, Oxford University Press, 1977.
2. Siddiqui, Anees A. "Pharmaceutical Analysis". Vol.I & II, CBS, 2006.
3. Parimoo, P. "Pharmaceutical Analysis". CBS, 1998.
4. Higuchi, Tekeru and Brochmann, Einar "Pharmaceutical Analysis". CBS Publishers, 1997.

REFERENCE BOOKS

1. Gennaro, Alfonso R. "Remington : The Science and Practice of Pharmacy" Vol. I & II, 20th Edition, Lippincott Williams & Wilkins / B.I. Publication, 2000.
2. Connors, Kenneth A. "A Textbook of Pharmaceutical Analysis". 3rd Edition, Johnwiley & Sons, 1982.
3. Ohannesian, Lena and Streeter, A.J. "Handbook of Pharmaceutical Analysis". Marcek Dekker, 2002.
4. Stahl, Egon "Thin – Layer Chromatography : A Laboratory Handbook". 2nd Edition, Springer, 2005

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Dr. G. Karthigadevi	Assistant Professor	Biotechnology	devigk19@gmail.com
2	Mrs. C. Nirmala	Assistant Professor	Biotechnology	nirmala@vmkvec.edu.in

17BTP105	INDUSTRIAL BIOSAFETY	Category	L	T	P	Credit
		EC-OE	3	0	0	3

PREAMBLE

Industrial biosafety deals with the microbial hazards caused to an individual and to the society. In the subject the learners could grasp the knowledge on biosafety levels and the roles of various regulatory committees in avoiding the risk. Biosafety often use pioneering techniques along with other applied fields of research like biotechnology, genetic engineering, biochemistry to study microbes and their complex mechanisms. Knowledge of these principles will enable practice well in handling pathogenic microorganisms carefully in the laboratory.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To recognize the basic knowledge on biosafety levels.
2	To discuss various hazards caused by the GMOs.
3	To classify the role of regulatory committees in controlling the risk
4	To outline the risk involved in using GMOs and LMOs.
5	To design the biosafety procedure in lab and research institutions on handling pathogenic microorganisms.

COURSE OUTCOMES

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

CO1: Recall the various biosafety levels.	Remember
CO2: Explain the various biosafety guidelines	Understand
CO3: Identify the role of regulatory committees in controlling the risk	Understand
CO4: Analyze the risk involved in using GMOs and LMOs products	Analyse
CO5: Differentiate the various safety procedures followed in various industries.	Analyse
CO6: Practice the safety procedure in lab and others research institutions.	Apply

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

S- Strong; M-Medium; L-Low

SYLLABUS

PRINCIPLES OF BIOSAFETY

Introduction, Historical Background, Introduction to Biological Safety Cabinets, Primary Containment for Biohazards, Biosafety Levels, Biosafety Levels of Specific Microorganisms, Biosafety guidelines - Overview of National Regulations and relevant International Agreements including Cartagena Protocol.

BIOSAFETY IN BIOTECHNOLOGY INDUSTRIES

Hazard assessment, Use of genetically modified organisms & their release in environment; special procedures for rDNA based product production (Vaccine and Insulin); Biosafety in laboratory, Laboratory associated infections and other hazards; Prudent biosafety practices in laboratory

BIOSAFETY – REGULATORY FRAMEWORKS

Biotechnology and bio-safety concerns at the level of individuals, institutions, society, region, country and world. Regulatory framework in India governing GMOs-Recombinant DNA Advisory Committee (RDAC), Institutional Biosafety Committee (IBC), Review Committee on Genetic Manipulation, Genetic Engineering Approval Committee (GEAC), State Biosafety Coordination Committee (SBCC), District Level Committee (DLC). Rules for the manufacture, use/import/export and storage of hazardous microorganisms/genetically engineered organisms or cells.

RISK ASSESSMENT

Definition of GMOs & LMOs, GMO applications in food and agriculture, Risk Analysis, Risk Assessment, Risk management and communication Risk assessment in various industries- pharmaceuticals, food and beverages etc., steps towards minimizing the risk operations in industries.

SAFETY AND BIOSAFETY - CASE STUDIES

Recommended Biosafety Levels for Infectious Agents and Infected Animals, Rules and regulation for handling of microbes in laboratory purposes, lab construction procedure, decontamination and discarding procedure of laboratory used microorganisms. Case studies -swine flu spreading, Bhopal tragedy etc.,

TEXT BOOKS:

1. R.C. Dubey., 2014. A Text Book of Biotechnology Fifth Revised *Edition*, S. Chand Publications
2. Anupam Singh, Ashwani Singh, 2012. Intellectual property rights and Bio-Technology (Biosafety and Bioethics), Published by Bio-Green Books, New Delhi.
3. Mueller, M.J., "Patent Law", 3rd Edition, Wolters Kluwer Law & Business, 2009.

REFERENCES:

1. V Sreekrishna, 2017. Bioethics and Biosafety in Biotechnology by New age International publishers.
2. Sateesh, M.K., 2008. Bioethics and Biosafety, IK International Publishers.

COURSE DESIGNERS

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