Adhiyamaan College of Engineering (Autonomous), Hosur

Department of Biotechnology

Academic year: 2018-19

1.1.3 Average percentage of courses having focus on employability/ entrepreneurship/ skill development offered by the institution

Program name	Course name	Course code	Activities/Content with direct bearing on Employability/ Entrepreneurship/ Skill development	Year of Introduction
B.Tech Biotechnology	Pollution Control In Bioprocess Industries	515CHO05	Employability - The course offers skills like design and analysis of idelal and non -ideal reactors, also provides insight into the skills like Bioreactor assembly and manufacturing	2017-2018
B.Tech Biotechnology	Health & Pharmaceutical Biotechnology	615BTT04	Employability - The Course provides skills like design, manufacturing of drugs. The course also provides insight into the standard protocols to be followed in a drug manufacturing facility	2017-2018
B.Tech Biotechnology	Process Dynamics And Control	615EIO01	Employability - The course provides the students with the skill of basics of biological safety measures, industrial process dymanics and its control	2017-2018
B.Tech Biotechnology	Mini Project	715BTP08	Employability - The Project work provides the student with the skill set of managing project, planing and execution.	2018-2019
B.Tech Biotechnology	Employability Skills Lab	715BTP09	Employability - The course provides entrepreunership-based skills like managing a firm, small business and to startups	2018-2019

B.Tech Biotechnology	Clinical Research And Database Management	715BTE01	Employability - The Course provides skills like design, manufacturing of drugs. The course also provides insight into the standard protocols to be followed in a drug manufacturing facility	2018-2019
B.Tech Biotechnology	Molecular Pathogenesis	815BTE03	Employability - Offers the student with therapeutics of diseases	2018-2019
B.Tech Biotechnology	Medical Coding	815BTE09	Employability - The course provides the students with the skill of basics of medical codes and transcripts	2018-2019
B.Tech Biotechnology	Project Work	815BTP05	Employability - The Project work provides the student with the skill set of managing project, planing and execution. In addition they provides the skill like report preparation, and presentation	2018-2019
B.Tech Biotechnology	Industrial Training	815BTP06	Employability - The Project work provides the student with the skill set of managing project, planing and execution. In addition they provides the skill like report preparation, and presentation	2018-2019

ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester VI

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
615BTT04	HEALTH AND PHARMACEUTICAL BIOTECHNOLOGY	3	0	0	3	50	50	100

Prerequisite Biochemistry

Course Objectives

At the end of the course ,the students should be able to:

- *To have the basic knowledge of pharmacology*
- *To gain knowledge in various dosage forms and bio pharmaceutics*
- *To be able to understand in pharmacokinetics and drug discovery*
- *To understand the pharmaceutical dosage forms and applications*
- *To gain the knowledge about the various biopharmaceuticals*

UNIT I INTRODUCTION TO PHARMACOLOGY **9**

Historical outlines of drugs, classifications of drugs, physico-chemical properties of drugs, Routes ofadministration of drugs, drugs metabolism, controlled release drug delivery system, drug stability, Sources: plant, marine and microorganisms

UNIT II DRUG DISCOVERY **9**

Drug discovery an introduction, basic clinical evolution of new drugs, bioavailability of drugs, quantitative and qualitative assay of drugs by biological testing, packing techniques like compression of tablets, wet & dry granulation, direct compression, tablet presses and coating

UNIT III PHARMACOKINETICS AND BIOTRANSFORMATION **9**

Pharmacokinetics: introduction, absorption, distribution, elimination and metabolism of drugs, site of action, Phase I and Phase II reactions, prodrugs, adverse drug effects, Role of Enzymes in drug metabolism

UNIT IV PHARMACEUTICAL DOSAGE FORMS AND APPLICATIONS **9**

Oral solid dosage forms, compressed tablets, types, pills, solutions, syrups, juices, nasal solutions, emulsions, lotions and extracts. Applications of various drugs in human body and site of action

UNIT V BIO PHARMACEUTICALS **9**

Various categories of therapeutics like vitamins, laxatives, analgesics, contraceptives, common drugs which are abused, Antibiotics, human insulin, interferon, somatostalim, somatotropin - itspreservation and analytical methods

Total Hours **45**

Upon Completion of this course, students will be able to get :

Course Outcomes

CO1:Drugs, drugs action, drug metabolism
CO2:Various dosage forms of Biopharmaceuticals
CO3:The recent evolution in pharmaceutical biotechnology
CO4:evaluate different pharmaceutical parameters for the current and future biotechnology related products on the market.
CO5: gained the knowledge about the various biopharmaceuticals

Text Books

1 Remington, "The science and practice of pharmacy", Lippincott Williams and Wilkins, 20th edition,2001
2 Gareth Thomas, Medicinal Chemistry an Introduction", John Wiley, New Delhi, 2000
3 RamI.Mahato,AjitS.Narang,"PharmaceuticalDosageFormsandDrugDelivery",2nd Edition CRC Press,2011
4 Mohsen A. Hedaya"Basic Pharmacokinetics", 2nd Edition,Routledge, 2012

Reference Books

1 Katzung, B.G. "Basic and Clinical Pharmacology", Prentice Hall of India, New Delhi., 1995
2 Tripathi, K.D. "Essentials of Medical Pharmacology", Jaypee Brothers Medical Publishers (P) Ltd, 6th edition, John Wiley, New Delhi, 2000

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department	BIOTECHNOLOGY	Programme	B. TECH. - BT	Regulation	2015

Semester VII

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
715BTP09	EMPLOYABILITY SKILLS LAB	0	0	2	1	50	50	100

Prerequisite TECHNICAL ENGLISH I & II

Course Objectives:

Course Objectives

- *To equip students of engineering and technology with effective speaking and listening skills in English.*
- *To help them enrich their soft skills and interpersonal skills, which will make the transition from college to workplace smoother and help them excel in their career.*
- *To enhance the performance of the students in the recruitment processes, self enhancement and launching start ups.*

Unit 1 Listening **9**

Listening Audios and Answering MCQs - Watching Video Clips on Famous Speeches, Motivational Videos, Documentaries and Answering MCQs - Listening Comprehension and TED talks.

UNIT II Speaking **9**

Prepared Talk – Extempore - Story Knitting - Picture Talk – Brainstorming – Debates - Group Discussions - Elevator Speech - Mock HR Interviews - Story Narration – Miming - Short Skits.

UNIT III Reading **9**

Reading Comprehension - Verbal Analogy - Classification - Alphabet Test - Logical Sequence of Words - Statement & Conclusions - Statement & Courses of Action - Situation Reaction Test - Theme Detection - Deriving Conclusions from Passages.

UNIT IV Writing **9**

Business Letters - Email Writing (hints development) - Essay Writing - Paragraph Writing - Paraphrasing.

UNIT V Career Skills **9**

Vocabulary Test (GRE, TOEFL, TOEIC & CAT Exam words) - Confused Pair of words - Contronyms - One Word Substitution - Sequencing of Sentences – Sentence Correction.

Total Hours **45**

Course Outcomes

On completion of the course, the students shall have the ability to:

CO1: Comprehend the various strategies of listening and its significance.

CO2: Articulate their views clearly and concisely with self-confidence and persuasiveness.

CO3: Understand the prevailing practices of testing in the recruitment process by the corporate and the institutional selection processes.

CO4: Communicate the corporate and social requirements in an impressive written mode.

CO5: Enhance their verbal skills in the screening tests competently both for recruitment and pursuing higher studies as well..

Text Books

1 Agarwal R. S., A Modern Approach to Verbal and Non-verbal Reasoning, Chand & Co., New Delhi, 2012.

Reference Books

1 Lingua: Essays for TOEFL/IELTS, Dreamtech Press, New Delhi, 2016.

2 Lily Mangalam, Global English Comprehension, Allied Publishers Pvt. Ltd., New Delhi, 2014

3 Sharon Weiner Green and Ira K. Wolf, Barron's GRE, Glagotia Publications Pvt. Ltd., 18th Edition, New Delhi, 2011.

4 Mohamed Elias, R. Gupta's IELTS/TOEFL Essays, Ramesh Publishing House, 6th Edition, New Delhi, 2016.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester VII

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
715BTE01	CLINICAL RESEARCHAND DATABASEMANAGEMENT	3	0	0	3	50	50	100

Prerequisite Probability and statistics, Health and pharmaceutical technology

Course Objectives

- *Understand the drug development and study process throughregulations*
- *To understand the roles and responsibilities of the clinical researchteam*
- *To know on review the CDM Start-upactivities/documentation*
- *To know the view about the probability*
- *To gain knowledge related to research outcome*

UNIT I ETHICAL GUIDELINES 9

Ethical Guidelines for Biomedical Research on Human guidelines – student of specific principles for clinical evaluation – Human Genome project - DNA banking – prenatal diagnosis – principles in transplantation. *regulatory affairs - GCP/ICH guidelines*

UNIT II APPLICATIONS OF STATISTICS AND PROBABILITY 9

Applications of Biostatics in clinical Trial Management: Correlation - simple linear regression – multiple regressions – T-test - F-test – Chi square test - ANOVA – One way ANOVA. *Biostatistics and database management system.*

UNIT III CONTRACT RESEARCHES 9

Contract research – delivery model – CR Business environment – CR Information research – Contractresearch – Regulatory affairs of contract research – Clinical trial environment

UNIT IV CILNICAL TRIALS OUT SOURCING 9

Clinical trial – protocol approval – Informed consent – responsibility of sponsor – investigator – ethics committee
– types of clinical trials – structure & contents of clinical report. Data blinding & Randomization – datamanagement – trial subjects recruiting.

UNIT V OUTSOURCING TRENDS-CASE STUDY OF MEDICAL CODING 9

Introductionofmedicalcodingandbilling–
RoleofInternationalclassificationofdiseasesbookinmedical coding- CPT (Current Procedure Terminology codes)-HIPAA (Health information portability andaccounting act) - HCPCS (Healthcare Common Procedure Coding System)- CPC(Certified ProfessionalCoder) –Medical billing andmedical transcription-Medical coding
job market in Business Process Outsourcing (BPO`s) companies-starting own business sectors of medical
coding and billing.

Total Hours 45

Course Outcomes

CO 1: Ability to describe about clinical research documentation and protocol

CO 2: knowledge on handling human and animal trials subjected to regulations

CO 3: Knowledge on biostatistics subjected to validation on drug development

CO4:knowledge related to clinical activites

CO5: ability to describe about the database management

Text Books

1 ICMR,"Ethicalguidelinesforbiologicalresearchonhumansubjects", Indiancouncilof Medical Research Press,New Delhi,2000.

2 International Classification of Diseases (ICD)- 10-CM, code Book diagnoses code set to assist in ICD- 10training and code clarification, Tata Mc Graw Hill, New York, USA, 2012.

3 Knut Schoeder, "The 10 minutes Clinical Assessment", Wiley Black well, Singapore, 2010

Reference Books

1 The drug and cosmetic rule. Schedule Y., "Requirements and guidelines for permission to import and/ or manufacture of new drugs for sale or to undertake clinical trials". Government of India, New Delhi, 1945.

2 Machin,D.andFayers,P.,"Randomizedclinicaltrails–Design,PracticeandReporting",WileyBlackwell, Singapore,2010.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. – BT **Regulation** 2015

Semester VIII

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
815BTE03	MOLECULAR PATHOGENESIS	3	0	0	3	50	50	100

Prerequisite Basic Knowledge of Animal Biotechnology required

Course Objectives

At the end of the course ,the students should be able:

- *To understand about the microbial toxins and modern molecularpathogenesis.*
- *To know about the host pathogen interaction and identifying virulencefactors.*
- *To control pathogens by modernapproaches.*
- *To know about the pathogenic strategies*
- *To understand the concept of the host defense mechanism*

UNIT I OVERVIEW **9**

Historical perspective - discovery of microscope, Louis Pasteur's contributions, Robert Koch's postulates, early discoveries of microbial toxins, toxic assays, vaccines, antibiotics and birth of molecular genetics and modern molecular pathogenesis studies, *Introduction to pathogenesis, components of microbial pathogenicity.*

UNIT II HOST-DEFENSE AGAINST PATHOGENS AND PATHOGENIC STRATEGIES **9**

Hostdefenseagainstpathogens,clinicalimportanceofunderstandinghostdefense,componentsofthehostsurface defences systems like skin, mucosa, eye, mouth, respiratory tract, physical movements, limitation of free iron,antimicrobial compounds, mechanism of killing by humoral and cellular defense mechanisms, complements,inflammation process, general disease symptoms, Pathogenic adaptationsto overcome the above defenses.

UNIT III MOLECULAR PATHOGENESIS (WITH SPECIFIC EXAMPLES) **9**

Virulence, virulence factors, virulence-associated factors and virulence lifestyle factors, molecular genetics and gene regulation in virulence of pathogens, molecular pathogenesis of Vibrio Cholerae: E.coli,Shigella, influenza virus,plasmodium.

UNIT IV EXPERIMENTAL STUDIES ON HOST-PATHOGEN INTERACTIONS **9**

Virulence assays: adherence, invasion, cytopathic, cytotoxic effects. Criteria & tests in identifying virulence factors, attenuated mutants, molecular characterization of virulence factors, signal transduction & host responses,*virulence factors damaging the host tissues, virulence genes and regulation of the virulence genes.*

UNIT V MODERN APPROACHES TO CONTROL PATHOGENS **9**

Classical approaches based on serotyping. Modern diagnosis based on highly conserved virulencefactors, immuno& DNA-based techniques. New therapeutic strategies based on recent findings on

molecular pathogenesis of a variety of pathogens, Vaccines - *modulation of immune response byvaccines, properties of vaccines, other immuno modulators.*

Total Hours 45

Course Outcomes

Upon Completion of this course, students will be able to get :
CO1: Knowledge Of Different Disease- Host Interactions Mechanisms InOrganismsCO 2: Concept About Modern Approaches To ControlPathogens
CO 3: Knowledge About Different Molecular-Molecular PathogenInteractionCO 4: Concept of different drug and pathogeninteraction
CO 5: Idea of different vaccines to differentpathogen

Text Books

1 Clark V L and Bavoil P M, "Bacterial Pathogenesis", Academic Press, 1997.
2 Williams and Peter et al., "Bacterial Pathogenesis", (Methods in Microbiology Vol. 27), 1998.
3 Groisman and Eduardo A, "Principles of Bacterial Pathogenesis", Academic Press, 2001.
4 Nester, Anderson, Roberts, Pearsall, Nester, "Microbiology: A Human Perspective",3rd Edition,McGraw-Hill, 2001.

References

1 Salyers, Abigail A and Dixie D.Whitt, "Bacterial Pathogenesis: A Molecular Approach", 2nd Edition,ASM, 2002.
2 McClane, Bruce A and Timothy A. Mietzner, "Microbial Pathogenesis: A Principles-OrientedApproach", Fence Creek Publishing, 1999.
3 Subramanian MA, "Toxicology: Principles and Methods", MJP Publishers, 2017.
4 "Bergey's Manual of Systematic Bacteriology", Vol. 1-3, 2nd Edition, Springer, 2005.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester VIII

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
815BTE09	MEDICAL CODING	3	0	0	3	50	50	100

Prerequisite NIL

Course Objectives

At the end of the course ,the students should be able to:

- *Develop comprehensive knowledge in the area of Human Anatomy & Physiology,Medical Coding, and CPTCoding.*
- *Understand the knowledge of HCPCS Coding RCM, Coding Compliance, andHIPAALaws.*
- *Gain knowledge in anatonomy*
- *To improve skills in coding*
- *Enhance the work activity related to physiology*

UNIT I HUMAN ANATOMY & PHYSIOLOGY PART I **9**

Cardiovascular System, Blood & its Components, Integumentary System, Endocrine System, Urology, MaleReproductive System. Location, Shape, Size, Structure, Physiology, Pathology, Diagnostic Test, Terminologies

UNIT II HUMAN ANATOMY & PHYSIOLOGY PART II **9**

Female Reproductive Systems, Nervous System, Gastro Intestinal System, Pulmonology, Special Sciences, Orthopedics, Lymphatic System - Location, Shape, Size, Structure, Physiology, Pathology, Diagnostic Test, Terminologies

UNIT III CURRENT PROCEDURE TERMINOLOGY CODING (CPT) **9**

CPT Codes, CPT Description, Medical Record Format, Speciality Listings and its Format, *Usage of CPT Manuals, Software usage*, Examples of CPT Speciality Code Practice, *HCPCS Coding, Basic steps of HCPCScoding, Differentiation of CPT and HCPCS Coding.*

UNIT IV INTERNATIONAL CLASSIFICATION OF DISEASE CODING (ICD) **9**

ICD Codes, ICD 9 CM – ICD 10 Transition, Diagnosis Interpretation, Usage of ICD Manuals, Index Listings, Tabular Listings, Software usage, Examples of Dx Code Practice.

UNIT V MODIFIERS, E&M CODING, MEDICAL BILLING CYCLE & OVERVIEW **9**

Modifiers Listing, Usage and Indexing, E & M codes, classification, Application of E&M, Tabulation, Listings, Software usage, Examples of E&M Code Practice

Total Hours **45**

Course Outcomes

Upon Completion of this course, students will be able to get

Co1: Familiarize in the medical coding procedures for various treatmentprocess.Co2: Acquire knowledge about ICD coding and medical billingprocess.

Co3: Acquire knowledge about human anatomy &physiology.Co4: Familiarize in the softwareusage.

Co5: Acquire knowledge about E&M CodePractice.

Text Books

1 CurrentProcedural Terminology(*CPT*®)2013 American Medical Association: I & II,Professional Edition *(*American Medical Association*),* CPT AMA Professional Edition, London, UK, 2013.

2 ICD-9 CM Physicians Volume I and Volume II Contexo, A division of Access Intelligence,London, UK, Medicine & Health Science Books, CPT 2009 Professional Edition,2013.

References

1 David N. Shier, Jackie Butler and Ricki Lewis, "Hole's Human Anatomy and Physiology Paperback – Import", McGraw Hill Higher Education, 12th edition, 2009.

2 Mader, "Understand Human Anatomy and Physiology Paperback", McGraw-Hill Education, 9thedition, 2006.

3 Carol J. Buck, "Step-by-Step Medical Coding 2014 Text + Workbook Paperback – Import", W BSaunders Co, CSM edition December, 2013.

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Adhiyamaan College of Engineering (Autonomous), Hosur

Department of Biotechnology

Academic year: 2018-19

1.1.3 Average percentage of courses having focus on employability/ entrepreneurship/ skill development offered by the institution

Program name	Course name	Course code	Activities/Content with direct bearing on Employability/ Entrepreneurship/ Skill development	Year of Introduction
B.Tech Biotechnology	Analytical Techniques In Biotechnology Lab	715BTP10	Entrepreneurship - The course will help the students to enhance their language skills to the next level and will hone their presentation skills, active participation in GD, critical thinking and leadership skills.	2018-2019
B.Tech Biotechnology	Bioethics, IPR And Entrepreneurship	815BTT01	Entrepreneurship - The course provides entrepreunership-based skills like managing a firm, small business and to startups. The course provides the student in promoting the Entrepreneurship with the basics of IPR generation and filing, biobusiness management and group presentation among the peers	2018-2019

ADHIYAMAANCOLLEGEOFENGINEERING(AUTONOMOUS),HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

SemesterVI

CourseCode	CourseName	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
715BTP10	ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY LAB	0	0	1	0	50	50	100

Prerequisite InstrumentalMethodsofAnalysis Lab

Course Objectives

Attheend ofthecourse,the studentsshould be ableto:

- *Develop skills and techniques used in modern biotechnology.*
- *Learn the techniques of chromatography*
- *Gain knowledge related to the hybridization techniques*
- *Ability to develop the techniques of fermentor types*
- *Develop skills about the types of centrifugation*

LISTOFEXPERIMENTS

1. VarioustypesofCentrifugation
2. Runningof apilot fermentor
3. 2DgelElectrophoresis
4. ELISA
5. DNAHybridization
6. IsoelectricFocusing
7. Electroporation
8. HighPerformanceLiquidChromatography
9. ThinLayer Chromatography
10. Vermicomposting
11. CODAnalyser

Totalhours 45

Course Outcomes

Upon Completion of thiscourse, students will be abletoget :
CO1:Knowledge on practical skills in analytical techniques and instrumentation of biotechnology
CO2:Analytical skills to do project
CO3:Learn various separation techniques involved inbiotechnology industries
CO4: Student develop the techniques knowledge of fermentor types
CO5: Developed skills about the types of centrifugation

TextBooks

1 KeithWilsonandJohnWalker,PracticalBiochemistry–Principlesandtechniques,Cambridge UniversityPress, U.K;5th Edition, 2003

2 Frank C. Hay, Olwyn M.R. Westwood, quot; Practical Immunology;BlackwellScience; 4thedition(January28,2002)

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department **BIOTECHNOLOGY** Programme **B. TECH. - BT** **Regulation** **2015**

Semester VIII

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
815BTT01	BIOETHICS, IPR AND ENTREPRENEURSHIP	3	0	0	3	50	50	100

Prerequisite

Course Objectives

At the end of the course ,the students should be able to:

- *To create awareness about IPR and Engineeringethics*
- *To follow professional ethics and practices intheircareers*
- *To create awareness and responsibilities about the environment andsociety*
- *To learn the presnt work relted to trade marketing*
- *To create the view with respect to ethics in biotechnology*

UNIT I HISTORY OF BIOETHICS **9**

Bioethics as a discipline – philosophical reflections on experimenting with human subjects - active andpassive euthanasia; culture assumption in the history of Bioethics– medical ethics in India and America.

UNIT II METHODS OF ETHICAL ANALYSIS **9**

Ethical reasoning- philosophical, clinical and cultural dimensions; challenge of ethical relativism; methods of philosophical theories and principles- Equality and its implications; methods of casuistry and methodsof narrative approaches

UNIT III ETHICS IN *BIOTECHNOLOGY* **9**

Ethics committee (hospital) – Inner working of an ethics committee; ethics consultation – skills, roles andtraining;Biosafetyregulation-nationalandInternationalguidelines;rDNAguidelines-guidelinesforrDNA researchactivities, mechanism of implementation of biosafetyguidelines

UNIT IV PATENTING, IPR AND APPLICATIONS **9**

Introduction to Intellectual property rights, types: patents, copy right, trade mark, trade secret, geographical indications, importance of IPR, Patenting and non patenting life, TRIPS

UNIT V ENTREPRENEURSHIP IN BIOTECHNOLOGY **9**

The Significance of the Biotechnology Entrepreneur; The Integration of Two Distinctly Different Disciplines Biotechnology Entrepreneurship Versus General Entrepreneurship ; Entrepreneurship and Intrapreneurship Essential Biotechnology Entrepreneurial Characteristics; Four Backgrounds of Biotechnology Entrepreneurs

Total Hours 45

Course Outcomes

Upon Completion of this course, students will be able to :

CO: 1 Touches on fundamental values, such as human dignity and the genetic integrity ofhumanity.

CO:2 Serve basic human needs such as human health, food and a safe environment, CO:3 Raise human rights issues such as access to health and benefits from scientificprogress

CO: 4 Concerns over equitable access to the fruits of new technologies, the consent of thoseinvolved in research, and protection of the environment.

CO:5 Obtaining a clear information on the entreneurship and understand their economic values

Text Books

1 Bioethics , second edition , Nancy S.Jecker , Albert R.Jonsen,RobertA,Pearlman.Jones and Bartlett Publishers,2003.

2 Singh K, " Intellectual Property Rights on Biotechnology", BCIL, New Delhi,2001.

3 M.K. Sateesh, "Bioethics and Biosafety", I.K. International Publishing House pvt. Ltd, 2008.

References

1 Entrepreneurship Development – Poornima.M.Charantimath – Small Business Enterprises – PearsonEducation – 2006

2 Sasson A, " Biotechnologies and Development", UNESCO Publications, 1998

3 Sasson A, " Biotechnologies in Developing countries present and future", UNESCOPublishers, 1993

E-Books

1 Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech by Craig Shimasaki

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Adhiyamaan College of Engineering (Autonomous), Hosur

Department of Biotechnology

Academic year: 2018-19

1.1.3 Average percentage of courses having focus on employability/ entrepreneurship/ skill development offered by the institution

Program name	Course name	Course code	Activities/Content with direct bearing on Employability/ Entrepreneurship/ Skill development	Year of Introduction
B.Tech Biotechnology	Technical English	118ENT01	Skill Development - This course enhances increase students' efficiency in their academic and general reading, pronunciation in real-lifesituations, pronunciation in real-lifesituations and augmenting the technical writing skills like writing letters in formal and business situations	2018-2019
B.Tech Biotechnology	Engineering Mathematics-I	118MAT02	Skill Development - This course enable basic skills on the eigen value problems and differential equations of certain types, including systems ofdifferential equations	2018-2019
B.Tech Biotechnology	Engineeirng Physics	118PHT03	Skill Development - This course provides skills on the concept of properties of matter, the properties of sound and principles of quantization of energy and coherent light and its importance	2018-2019
B.Tech Biotechnology	Engineering Chemistry	118CYT04	Skill Development - The students can understand and apply the concepts in electrochemistry and Energy storage devices, the chemistry of Corrosion, concepts of thermodynamics and phase equilibrium	2018-2019

B.Tech Biotechnology	Engineering Graphics	118EGT05	Skill Development - The students will learn graphics skill for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technicaldrawings.	2018-2019
B.Tech Biotechnology	Engineeirng Chemistry Laboratory	118CYP07	Skill Development - The students can understand and apply the concepts in electrochemistry and Energy storage devices, the chemistry of Corrosion, concepts of thermodynamics and phase equilibrium	2018-2019
B.Tech Biotechnology	Engineeirng Practice Laboratory	118EPP08	Skill Development - This course enable the student to learn about the basics of computer and problem solving methods.	2018-2019
B.Tech Biotechnology	Basic Civil and Mechanical Engineering	118ESE01	Skill Development - This course enble students to gain the knowledge on civil works like masonry, roofing, flooring and plastering	2018-2019
B.Tech Biotechnology	Communicative English	218ENT01	Skill Development - This course facilitate students amplify suitable language skills for academic and professional purposes, vocabulary power, different functions of technical and scientific English	2018-2019
B.Tech Biotechnology	Engineering Mathematics-II	218MAT02	Skill Development - This course facilitates double and triple integration concepts and apply to study vector calculus comprising of surface and volume integrals along with the classical theorems involvingthem.	2018-2019
B.Tech Biotechnology	Environmental Science and Engineering	218GET03	Skill Development - This course enable students study the nature and facts about environment	2018-2019
B.Tech Biotechnology	Engineering Mechanics	218EMT04	Skill Development - This course make the students understand the vectorial and scalar representation of forces and moments, static equilibrium of particles and rigid bodies both	2018-2019

			in twodimensions	
B.Tech Biotechnology	Problem Solving and Python Programming	218PPT05	Skill Development - This course enable the student to learn about the basics of computer and problem solving methods.	2018-2019
B.Tech Biotechnology	Cell Biology	315BTT03	Skill Development - This course enables students skill in cellular signalling mechanisms, cellular regulations and cell culture techniques	2016-2017
B.Tech Biotechnology	Microbiology	315BTT04	Skill Development- This course provides skills in microbial classification, identification and control	2016-2017
B.Tech Biotechnology	Instrumental Methods of Analysis	315BTT05	Skill Develoment - This course provides basic skills on biolgical instumentation	2016-2017
B.Tech Biotechnology	Cell Biology Lab	315BTP07	Skill Development - This course provides basic skills on identification of cellular mechanisms	2016-2017
B.Tech Biotechnology	Microbiology Lab	315BTP08	Skill Development - This course enables skills on microbial culture techniques and idnetification of microorganisms	2016-2017
B.Tech Biotechnology	Instrumental Methods of Analysis Lab	315BTP09	Skill Development - This course provides basic skills on biolgical instumentation	2016-2017
B.Tech Biotechnology	Basic Industrial Biotechnology	315BTE01	Skill Develoment - This course provides skills on production of biologically important products such as antibiotics, vitamins, alcohol, etc.,	2016-2017
B.Tech Biotechnology	Probability And Statistics	415PST01	Skill Development - This course enables skills on design of experiments and research methodologies	2016-2017

B.Tech Biotechnology	Molecular Biology	415BTT02	Skill Development - This course provide skills on genomic and plasmid DNA and RNA isolation, PCR based techniques and cloning and expression of vectors	2016-2017
B.Tech Biotechnology	Stoichiometry And Process Calculations	418BTT03	Skill Development - This course provide skills on stoichiometric calcultions for various industrial operations	2016-2017
B.Tech Biotechnology	Fundementals of Unit Operations	415BTT04	Skill Develoment - This course provide skills on bioreactor and heat transfer operations	2016-2017
B.Tech Biotechnology	Enzyme Technology	415BTT05	Skill Develoment - This course provide skills on industriallly important enzyme production and activity determination	2016-2017
B.Tech Biotechnology	Molecular Biology Lab	415BTP07	Skill Development - This course provide skills on genomic and plasmid DNA and RNA isolation, PCR based techniques and cloning and expression of vectors	2016-2017
B.Tech Biotechnology	Enzyme Technology Lab	415BTP08	Skill Development - This course provide skills on industriallly important enzyme production and activity determination	2016-2017
B.Tech Biotechnology	Chemical Engineering Lab	415BTP09	Skill Develoment - The course offers the students with the skill set of handling equipment related to heat transfer. The course offers a insight into the basic skill sets like understanding the thermodynamics of the reaction, thermodynamics related to the microbial growth and the product formation	2016-2017
B.Tech Biotechnology	Environmental Biotechnology	415BTE01	Skill Develoment - This course provide skills on environmental studies, bioremediation and waste management	2016-2017
B.Tech Biotechnology	Immunology	515BTT01	Skill Development - The course provides the students with the skillset of raising antigen and antibodies aganist the various disease, and the detection procedure.	2016-2017

B.Tech Biotechnology	Genetic Engineering	515BTT02	Skill Development - This course provide skills on genomic and plasmid DNA and RNA isolation, PCR based techniques and cloning and expression of vectors	2017-2018
B.Tech Biotechnology	Bioprocess Engineering I	515BTT03	Skill Development - The course offers the students with the skill set of handling equipment related to heat transfer. In addition, the course provides the students with an deeper insight into the diffusion, distillation, adsorption, extraction and leaching which is most important skills as a chemical process engineer	2017-2018
B.Tech Biotechnology	Fundamentals of Mass Transfer	515BTT04	Skill Develoment - The course offers the students with the skill set of handling equipment related to heat transfer. In addition, the course provides the students with an deeper insight into the diffusion, distillation, adsorption, extraction and leaching which is most important skills as a chemical process engineer	2017-2018
B.Tech Biotechnology	Chemical Thermodynamics & Biothermodynamics	515BTT05	Skill Develoment - The course offers the students with the skill set of handling equipment related to heat transfer. The course offers a insight into the basic skill sets like understanding the thermodynamics of the reaction, thermodynamics related to the microbial growth and the product formation	2017-2018
B.Tech Biotechnology	Immunology Lab	515BTP07	Skill Develoment - The course provides the students with the skillset of raising antigen and antibodies aganist the various disease, and the detection procedure.	2017-2018

B.Tech Biotechnology	Genetic Engineering Lab	515BTP08	Skill Develoment - The course provides the students with the skill set of generating a recombinant DNA, cloning and expression of vectors, genome mapping and sequencing and PCR based skills	2017-2018
B.Tech Biotechnology	Bioprocess Engineering Lab I	515BTP09	Skill Develoment - The course offers a clear insight into the basic skills required for a Bioprocess Engineers. The course offers the students with the skill set of handling equipment related to chemical process engineer	2017-2018
B.Tech Biotechnology	Bioinformatics	615BTT01	Skill Development - The course provides the students with the skill of basics of database in biological system, sequence alignment, phylgogeny and CADD	2017-2018
B.Tech Biotechnology	Chemical Reaction Engineering	615BTT02	Skill Develoment - The course offers skills like design and analysis of idelal and non - ideal reactors, also provides insight into the skills like Bioreactor assembly and manufacturing	2017-2018
B.Tech Biotechnology	Bioprocess Engineering-II	615BTT03	Skill Develoment - The course focusses on the preparation, sterilization of media, design and optimization of media. Understand the basic of the different kinds of the fermenter and the kinetics of product formation	2017-2018
B.Tech Biotechnology	Health & Pharmaceutical Biotechnology	615BTT04	Employability - The Course provides skills like design, manufacturing of drugs. The course also provides insight into the standard protocols to be followed in a drug manufacturing facility	2017-2018
B.Tech Biotechnology	Plant Biotechnology	615BTT05	Skill Develoment - The course is focussed in the manner to provide indepth application oreinted skills like gene transfer in plants,	2017-2018

			transgenic and commercialization	
B.Tech Biotechnology	Bioprocess Engineering Laboratory -II	615BTP07	Skill Development - The course focusses on the preparation, sterilization of media, design and optimization of media. Understand the basic of the different kinds of the fermenter and the kinetics of product formation	2017-2018
B.Tech Biotechnology	Plant Biotechnology Laboratory	615BTP08	Skill Develoment - The course is focussed in the manner to provide indepth application oreinted skills like gene transfer in plants, transgenic and commercialization	2017-2018
B.Tech Biotechnology	Technical Seminar	615BTP09	Skill Develoment - The course will help the students to enhance their language skills to the next level and will hone their presentation skills, active participation in GD, critical thinking and leadership skills.	2017-2018
B.Tech Biotechnology	Animal Biotechnology	715BTT01	Skill Develoment - The course provides the students with the skill of animal diseaes, treatment, micromanipulation and transgenics anilmal technology	2018-2019
B.Tech Biotechnology	Downstream Processing	715BTT02	Skill Develoment - The course provides the students with the skill of choice of different downstream processing like filteration, chromatography, and othe size-based methods	2018-2019
B.Tech Biotechnology	Cancer Biology	715BTT03	Skill development - This course enables students skill in cellular signalling mechanisms, cancer cell proliferation and regulations and control mechanisms	2018-2019
B.Tech Biotechnology	Disaster Management	715BTT04	Skill Development - Aseismic desgin is mandatory as per IS recommendations. This course develops the skill set required for aseismic desgin of structures	2018-2019

B.Tech Biotechnology	Downstream Processing Lab	715BTP07	Skill Develoment - The course provides the students with the skill of choice of different downstream processing like filteration, chromatography, and othe size-based methods	2018-2019
B.Tech Biotechnology	Genomics And Proteomics	715BTE10	Skill Develoment - The course provides the students with the skill of genome and proteome analysis	2018-2019

118ENT01	TECHNICAL ENGLISH	L	T	P	C
		2	0	0	2

OBJECTIVES

At the end of the course, the students should be able to:

- To develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- To foster the ability to write convincing job applications and effective reports.
- To develop their speaking skills to make technical presentations, participate in groupdiscussions.
- To strengthen their listening skills which will help them comprehend lectures and talk intheir area of specialization.

UNIT I 9

Listening - Ink talks and gap exercises - **Speaking** – Asking for and giving directions - **Reading** – short technical texts from journals and newspapers - **Writing** - definitions – instructions – checklists – recommendations - **Vocabulary Development** - technical vocabulary - **Language Development** – parts of speech – articles – word formation.

UNIT II 9

Listening - longer technical talks - **Speaking** – process description - **Reading** – longer technical texts – **Writing** – graphical representation - **Vocabulary Development** - vocabulary used in formal letters/emails and reports – **Language Development** – tenses - voices - numerical adjectives – question tags.

UNIT III 9

Listening - listening to classroom lectures - **Speaking** – introduction to technical presentations - **Reading** – longer texts both general and technical and practice in speed reading – **Writing** – process description using sequence words and sentences - **Vocabulary Development** - Misspelled words – one-word substitution - **Language Development** - embedded sentences – singular and plural nouns - compound nouns - editing

UNIT IV 9

Listening - Listening to documentaries and making notes - **Speaking** – mechanics of presentations - **Reading**– reading comprehension – **Writing** - email etiquettes - job application – cover letter –Résumé preparation - essay writing - **Vocabulary Development** – synonyms and antonyms –paraphrasing - **Language Development** – modals– conditionals.

UNIT V 9

Listening - TED talks - **Speaking** – brainstorming and debate – **Reading** – reading and understanding technical articles – **Writing** – reports - minutes of a meeting - **Vocabulary Development**- verbal analogies - phrasal verbs - **Language Development** - concord - reported speech.

Total Hours 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Read technical texts and write area- specific texts effortlessly.
CO2: Listen and comprehend lectures and talks in their area of specialization successfully.
CO3: Speak appropriately and effectively in varied formal and informal contexts.
CO4: Understand the basic grammatical structures and its applications.

TEXT BOOKS

1. Board of editors. Fluency in English A Course book for Engineering and Technology. OrientBlackswan, Hyderabad: 2016.
2. Sudharshana. N. P and Saveetha. C. English for Technical Communication.
3. Uttham Kumar. N. Technical English I (with work book). Sahana Publications, Coimbatore, 2016.

REFERENCE BOOKS

1. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication PrinciplesandPractice. Oxford University Press: New Delhi,2014.
2. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015.
3. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
4. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
5. Means, L. Thomas and Elaine Langlois, English & Communication for Colleges. CengageLearning, USA: 2007.

Note: The book given under Extensive Reading is meant for inculcating the reading habit of the students.
They need not be used for testing purposes.

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118MAT02	ENGINEERING MATHEMATICS - I	L	T	P	C
		3	0	0	3

OBJECTIVES

At the end of the course, the students should be able to:

- To understand the eigen value problems.
- To solve differential equations of certain types, including systems of differential equations that they might encounter in the same or higher semesters.
- To understand the concepts of curvatures, evolutes and envelopes and to study the maxima and minima of any function.
- To learn the partial derivations and apply the same to find maxima and minima.
- To solve certain linear differential equations using the Laplace transform technique which has applications in control theory and circuit theory.

UNIT I **9**

Eigen values and eigen vectors of a real symmetric matrix –Properties – Cayley - Hamilton theorem (Statement only) – Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic form–Reduction of quadratic form to canonical form by orthogonal transformation.

UNIT II **9**

Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes –Envelopes – Evolutes as envelope of normals.

UNIT III **9**

Partialderivatives–Euler'stheoremforhomogenousfunctions–Totalderivatives–Jacobians– Taylor's expansion– Maxima and Minima – Method of Lagrangian multipliers.

UNIT IV **9**

Higher order linear differential equations with constant coefficients – Method of variation of parameters

– Cauchy's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients-Applications to Engineering Problems-Electric Circuits, Simple Harmonic Motions and bending of beams.

UNIT V **9**

Laplace transforms – Conditions for existence –Basic properties (without proof) – Laplace Transform of elementary functions, derivatives and integrals, unit step function and impulse functions, periodic functions. Definition of Inverse Laplace transform – Convolution theorem (Statement and applications only) – Initial and final value theorems (Statement and applications only) – Solution of linear ordinary differential equations of second order with constant coefficients using Laplace transform techniques.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Develop the knowledge of basic linear algebraic concepts.

CO2: Determine the solutions of ordinary differential equations by various methods which

have an application in their core subjects.

CO3: Acquire the basic knowledge of ordinary differential calculus. CO4: Compute maxima and minima of a function.

CO5: Apply Laplace transform techniques to solve ordinary differential equations which have an application in many engineering fields

TEXT BOOKS

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, 10th edition New Delhi 2016.
2. Grewal. B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, Delhi, 2014.

REFERENCE BOOKS

1. T.Veerarajan, "Engineering Mathematics " Tata McGraw-Hill Publishing company, New Delhi, 2014.
2. Kandasamy.P, Thilagavathy,K., & Gunavathi.K., "Engineering Mathematics for first year "., S.Chand &Company Ltd., New Delhi,2014.
3. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.

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118PHT03	ENGINEERING PHYSICS	L	T	P	C
		2	0	0	2

OBJECTIVES

At the end of the course, the students should be able to:

- To understand the concept of properties of matter.
- To understand the properties of sound and principles of quantization of energy.
- To understand the properties of coherent light and its importance.

UNIT I PROPERTIES OF MATTER 9

Elasticity – Stress – Strain diagram – Factors affecting elasticity – Twisting couple on a wire – Torsion pendulum – Young's modulus - cantilever - Heavy cantilever – Uniform and Non uniform bending (theory and experiment)–Viscosity- Poiseuille's method for Coefficient of Viscosity.

UNIT II ACOUSTICS AND ULTRASONICS 9

Classification of sound, loudness, intensity – Decibel – Weber Fechner Law – Reverberation and Reverberation time –derivation of Sabine's formula for Reverberation time (Growth and Decay)–Absorption coefficient and itsdetermination. Introduction of Ultrasonics – Production – magnetostriction effect – magnetostriction generator – piezoelectric effect–piezo electric generator–Detection of ultrasonic waves, properties–Cavitation–Applications–Depth of sea – Non Destructive Testing.

UNIT III QUANTUM PHYSICS 9

Black body radiation–Planck's theory (derivation)–Deduction of Wien's displacement law and Rayleigh–jeans' Law from Planck's theory – Compton Effect – derivation – Matter waves – Schrödinger's wave equation – Time independent and time dependent equations– Physical significance of wave function – Particle in a one dimensional box – Degeneracy and Non Degeneracy.

UNIT IV LASER 9

Introduction – Principle of Spontaneous emission and stimulated emission – Population inversion – pumping– Einstein's A and B coefficients – derivation – Types of lasers – He-Ne, CO2, Nd-YAG, Semiconductorlasers – homojunction – Applications of Laser.

UNIT V WAVE OPTICS & FIBRE OPTICS 9

Interference – Air wedge (theory & experiment) – Polarization– Methods of polarizing light- Theory of planecircularly and elliptically polarized light. Principle and propagation of light in optical fibers – Numerical aperture and Acceptance angle – Types of optical fibers (material, refractive index, and mode) – Fiber optical communication system (Block diagram) – Fiber optic sensors – Temperature & Displacement sensors (Qualitative).

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: To understand properties of solids with different types of moduli and to gain knowledge about absorption coefficients of solids and different surfaces.

CO2: To understand basic concepts of high frequency sound waves and its applications.

CO3: To understand basic concepts of quantum mechanical behavior of wave and particle along with applications.

CO4: To understand the concepts of production of laser and its behavior with diffraction principle of interference.

CO5: To apply the concept of polarization phenomenon and thereby its applications in fiber optic communication.

TEXT BOOKS

1. R.K. Gaur and S.C. Gupta, 'Engineering Physics' Dhanpat Rai Publications, New Delhi (2003)
2. Jayaprakash R.N, 'Engineering Physics - I', Dhanam Publications, Chennai, (2007).

REFERENCE BOOKS

1. R. Murugeshan ,Kiruthiga Sivaprasath , Modern Physics S. Chand publications 2016,New Delhi.
2. GhatakOptics the McGraw-Hill Companies, Inc., 1221 Avenue of the Americas, New York, NY 10020.
3. Dr.M.N.Avadhanulu ,Introduction to Lasers: theory and applications S.Chand publications 2012,New Delhi.

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118CYT04	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES

At the end of the course, the students should be able to:

- To make the students conversant with boiler feed water requirements, related problemsand water treatment techniques.
- To recall the terminologies of electrochemistry and explain the function of batteries andfuel cells with its electrochemical reactions.
- To understand the fundamentals of corrosion, its types and polymers with its applications.
- Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels

UNIT I **WATER AND ITS TREATMENT** **9**

Hardness of water - types - expression of hardness - units - estimation of hardness of water by EDTA - numerical problems -Alkalinity-types of alkalinity-determination of alkaninity-boiler troubles (scale and sludge) - treatment of boiler feed water - Internal treatment (carbonate, colloidal, phosphate and calgon conditioning) external treatment Ion exchange process, zeolite process - desalination of brackish water - Reverse Osmosis.

UNIT II **ELECTROCHEMISTRY AND ENERGY STORAGE DEVICES** **9**

Electrochemical cell-single electrode potential-standard electrode potential-electrochemical series and its significance-EMF of a cell- Nernst equation -Electrodes-Reference electrodes-hydrogen, calomel, quinhydrone and glass electrodes. Determination of pH of a solution using a glass electrode. Batteries - primary and secondary cells, dry cell, alkaline, lead acid storage cell, Ni-Cd battery and lithium nano battery. Clean energy fuel cells - H_2-O_2 fuelcell.

UNIT III **CORROSION SCIENCE** **9**

Corrosion: definition - types of corrosion: chemical and electrochemical corrosion – Pilling Bedworth ratio - types of oxide layer (stable, unstable, volatile, porous) - hydrogen evolution and oxygen absorption mechanism for electrochemical corrosion - mechanism for rusting of iron. Types of electrochemical corrosion: Galvanic corrosion- differential aeration corrosion (pitting, waterline and pipeline). Galvanic series - applications. Factors influencing corrosion: nature of metal and environment. Corrosion control methods: sacrificial anode method - impressed current Cathodic protection method - electroplating - electroless plating.

UNIT IV **POLYMERS AND ITS PROCESSING** **9**

Monomers - polymers - polymerization - functionality – degree of polymerization - classification of polymersbased on source and applications - Molecular weight determination. Types of polymerizations: addition, condensation and copolymerization - mechanism of free radical polymerization. Preparation, properties and applications of PE, PVC, Teflon, terylene, Nylon and Bakelite. Rubber-drawbacks of natural rubber-Vulcanization- Compounding of plastics - injection and blow moulding methods.

UNIT V **FUELS AND COMBUSTION** **9**

Fuels: Introduction - classification of fuels - coal - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum -

manufacture of synthetic petrol (Bergius process) - knocking - octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) - power alcohol and biodiesel. **Combustion of fuels:** Introduction - calorific value - higher and lower calorific values- theoretical calculation of calorific value - ignition temperature - spontaneous ignition temperature - explosive range - flue gas analysis (ORSAT Method).

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Attribute the internal and external treatment methods for the removal of hardness in water for domestic and industrial applications.

CO2: Construct an electrochemical cell and identify the components and processes in batteries and infer the selection criteria for commercial battery systems with respect to different applications.

CO3: Utilize electrochemical data to formulate an electrochemical half-cell and cell reactions for corrosion control processes.

CO4: Analyse the three types of fuels based on calorific value for selected application.

CO5: Analyse the three types of fuels based on calorific value for selected application.

TEXT BOOKS

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi,2015
2. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P) LTD, New Delhi,2015

REFERENCE BOOKS

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
2. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
3. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.

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118EGT05	ENGINEERING GRAPHICS	L	T	P	C
		2	0	4	4

OBJECTIVES

At the end of the course, the students should be able to:

- To understand the graphical skills for drawing the object and the principle of free-handsketching techniques.
- To understand the principle of orthographic projection of points, lines and plane surfaces.
- To study the principle of simple solids.
- To understand the principle of section and development of solids.
- To understand the principle of Isometric and Perspective projections.

Concepts and conventions (Not for Examination) 3

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANE CURVES AND FREE HAND SKETCHING 9+6

Curves used in engineering practices:

Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of squad and circle – Drawing of tangents and normal to the above curves.

Free hand sketching:

Representation of Three-Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement – First angle projection – layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 9+6

Projectionofpointsandstraightlineslocatedinthefirstquadrant–Determinationoftruelengthsand true inclinations – Projection of polygonal surface and circular lamina inclined to both reference planes.

UNIT III PROJECTION OF SOLIDS 9+6

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

UNIT IV SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 9+6

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

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 9+3

Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms,pyramids, cylinders and cones.

Perspective projection of prisms, pyramids and cylinders by visual ray method.

Total Hours 45+30 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Recognize the conventions and apply dimensioning concepts while drafting simple objects. CO2: Draw the orthographic projection of points, line, and plane surfaces.

CO3: Draw the orthographic projection of simple solids.

CO4: Draw the section of solid drawings and development of surfaces of the given objects.

CO5: Apply the concepts of isometric and perspective projection in engineering practice.

TEXT BOOKS

1. Ranganath G, Channankaiah and Halesh Koti, "Engineering Graphics", Second Edition, Sahana Publishers,2015.
2. Bhatt. N.D., "Engineering Drawing" Charotar Publishing House, 53th Edition, 2014.

REFERENCE BOOKS

1. Dhananjay A. Jolhe, "Engineering Drawing with an introduction to AutoCAD" Tata McGraw Hill Publishing Company Limited, 2017.
2. Gopalakrishnana. K. R, "Engineering Drawing" (Vol. I & II), Subhas Publications, 2014.
3. Basant Agarwal and C.M.Agarwal, "Engineering Drawing", Tata McGraw Hill, 2013.

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118ESE01 BASIC CIVIL ANDMECHANICAL ENGINEERING L T P C

3 0 0 3

OBJECTIVES

At the end of the course, the students should be able to:

- To gain the knowledge on civil works like masonry, roofing, flooring and plastering.
- To gain the knowledge on stress, strain of various building and foundations.
- The students should familiar with foundry, welding and forging processes.
- The students should familiarly work principle of IC engines and its types.
- To gain the knowledge about various energy recourses and refrigeration air conditionsystems.

UNIT I SURVEYING AND CIVIL ENGINEERING MATERIALS 9

Surveying: Objects, types, classification, principles, measurements of distances, angles, leveling, determination ofareas, illustrative examples. **Civil Engineering Materials:** Bricks, stones, sand, cement, concrete, steel sections.

UNIT II BUILDING COMPONENTS AND STRUCTURES 10

Foundations: Types, Bearing capacity, Requirement of good foundations. **Superstructure:** Brick masonry, stone masonry, beams, columns, lintels, roofing, flooring, plastering, Mechanics, Internal and external forces, Stress, Strain, Elasticity, Types of Bridges and Dams, Basics of Interior Design and Landscaping.

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UNIT III FOUNDRY WELDING AND FORGING 10

Foundry: Introduction - Patterns –materials. Types of pattern and pattern allowances. Molding sand, types and properties, Molding procedure. **Welding:** Definition and Classification, Gas welding, Oxy Acetylene welding, Types of flames, advantages and disadvantages of gas welding. Resistance welding - Classification, Spot welding and Seam welding. Soldering, Definition and Classification. Brazing – Definition and Classification. **Forging:** Types of Forging, Differences between Hot working and Cold working processes.

UNIT IV I C ENGINES& BOILERS 8

Internal combustion engines, working principle of Petrol and Diesel Engines, Four stroke and Two stroke cycles, Comparison of four stroke and two stroke engines, Boilers: Introduction of boilers, classification, Lancashire boiler, Babcock and Wilcox boiler, list of boiler mountings and accessories and applications (no sketches).

UNIT V SOURCE OF ENERGY&REFRIGERATION 8

Sources of energy: Introduction, conventional and non-conventional sources of energy, examples, solar energy, hydro power plant. Introduction to refrigeration and air-conditioning, COP, properties of refrigerants and types of refrigerants, working principle of vapour compression & vapour absorption refrigeration system, Layout of typical domestic refrigerator, Window and Split type room Air conditioner.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: The usage of surveying and properties of construction materials.

CO2: The stress strain of various building and material such as substructure, road transport and bridge.

CO3: The concept of manufacturing methods encountered in engineering practice such as foundry, welding and forging processes.

CO4: The working of internal combustion engines and its types.

CO5: The concept of energy conservation in practical, power plant refrigeration air condition and its types.

TEXT BOOKS

1. Ranganath G and Channankaiah, "Basic Engineering Civil & Mechanical", S.S.Publishers, 2014.
2. Shanmugam G and Palanichamy M S, "Basic Civil and Mechanical Engineering", Tata McGraw Hill Publishing Co., New Delhi, 3rd Edition, 2012.

REFERENCE BOOKS

1. Venugopal.K and PrabhuRaja.V, "Basic Mechanical Engineering", Anuradha Publishers, Kumbakonam, 2015.
2. Ramamrutham. S, "Basic Civil Engineering", Dhanpat Rai Publishing Co. (P) Ltd, 3rd Edition reprint, 2013.
3. Shanmugasundaram. S and Mylsamy. K, "Basics of Civil and Mechanical Engineering", Cenage Learning
4. India Pvt.Ltd, NewDelhi, 2012.
5. Khanna O.P, Foundry Technology, Dhanpat Rai Publishing Co. (P) Ltd, 2011.
6. Shanmugam G., "Basic Mechanical Engineering", Tata McGraw Hill Publishing Co., New Delhi, 2010.

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118CYP07	ENGINEERING CHEMISTRY LAB	L	T	P	C
		0	0	2	1

OBJECTIVES

At the end of the course, the students should be able to:

- Students will be conversant with the estimation of various compound Bussing volumetric and instrumental analysis

LIST OF EXPERIMENTS (A minimum of TEN experiments shall be offered)

1. Estimation of Total hardness by EDTA
2. Determination of percentage of calcium in Lime Stone by EDTA
3. Estimation of chloride in water sample
4. Estimation of alkalinity of Water sample
5. Determination of DO in Water (Winkler's Method)
6. Determination of Rate of Corrosion of the given steel specimen by weight loss method (Without inhibitor)
7. Determination of Rate of Corrosion of the given steel specimen by weight loss method (With inhibitor)
8. Conduct metric titration (Simple acid base)
9. Conduct metric titration (Mixture of weak and strong acids)
10. Conduct metric titration using BaCl2vs Na2SO4
11. Potentiometric Titration (Fe2+ / KMnO4 orK2Cr2O7)
12. PH titration (acid &base)
13. Determination of water of crystallization of a crystalline salt -Copper sulphate
14. Preparation of Bio Diesel by Trans etherification method

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Carry out the volumetric experiments and improve the analytical skills.

CO2: Understand the maintenance and usage of analytical instruments and thereby develop their CO3: skills in the field of engineering.

CO4: Understand the principle and handling of electrochemical instruments and Spectrophotometer.

CO5: Apply their knowledge for protection of different metals from corrosion by using different inhibitors

TEXT BOOKS

1. Arthur I. Vogel's, "Quantitative Inorganic Analysis including Elementary Instrumental Analysis", ELBS, Group, 7th Edition, 2000.
2. Dr. K .Sivakumar, "Engineering Chemistry lab manual", S.S publishers, 2016.

118EPP08	ENGINEERING PRACTICES LAB	L	T	P	C
		0	0	2	1

OBJECTIVES

At the end of the course, the students should be able to:

- To get the knowledge on welding techniques and its types.
- To do the fitting operation on a given material. (Specimen)
- To carry out sheet metal operation.
- To know the principle involved in plumbing work.
- To do the carpentry work on a given work piece

LIST OF EXPERIMENTS

WELDING:

Study of electric Arc welding and Gas welding tools and equipments.

Preparation of Arc welding and Gas welding models: i) Butt joint ii) Lap joint iii) T - joint.

FITTING:

Study of fitting tools and operations.

Preparation offitting models: i) V-fitting ii) Square fitting

SHEET METAL WORK:

Study of sheet metal tools and operations

Preparation of sheet metal models: i) Tray ii) Funnel

PLUMBING WORKS:

Study of pipeline joints and house hold fittings.

Preparation of plumbing models: Basic pipe connections with PVC and GI pipefittings.

CARPENTRY:

Study of wooden joints and tools used in roofs, doors, windows, furniture.

Preparation of carpentry models: i) Lap joint ii) Dovetail joint iii) T-Joint

DEMONSTRATION ON:

ELECTRICAL ENGINNEERING PRACTICE

Study of Electrical components and equipment's

Residential house wiring using switches, fuse, indicator, lamp and energy meter.

ELECTRONICS ENGINNEERING PRACTICE

Study of Electronic components –Resistor, color coding, capacitors etc

Soldering practice – components soldering in simple electric circuit & testing continuity

COMPUTER HARDWARE AND SOFTWARE PRACTICE

Study of PC Hardware, Internet & World Wide Web and Productivity tools including Word, Excel, PowerPoint and Publisher.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Prepare simple Lap, Butt and T- joints using arc welding equipments.
CO2: Prepare the rectangular trays and funnels by conducting sheet metal operation.
CO3: Prepare the pipe connections and identify the various components used in plumbing.
CO4: Prepare simple wooden joints using wood working tools.
CO5: Demonstrate basic electrical, electronic and computer components based on their physical parameters and dimensions

TEXT BOOKS

1. Ranganath. G, & Channankaiah, "Engineering Practices Laboratory Manual" S.S. publishers, 2014.
2. Jeyapoovan.T &, S Gowri "Engineering Practice Lab Manual" Vikas publishing house pvt.ltd, 2014.

REFERENCE BOOKS

1. Kannaiah.P & Narayana.K.L, "Manual on Workshop Practice", Scitech Publications, 2015.
2. Ramesh BabuV, "Engineering Practices Laboratory Manual", VRB Publishers Private Limited, Chennai,
3. Revised Edition, 2014.
4. Peter Norton, "Introduction to Computers", 7th Edition, Mc Graw Hill, 2010.
5. Bawa. H.S, "Workshop Practice", Tata McGraw – Hill Publishing Company Limited, 2009.
6. David Anfinson and Ken Quamme, "IT Essentials PC Hardware and Software Companion Guide", CISCO Press, Pearson Education, Third Edition, 2008.

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218ENT01	Communicative English	L	T	P	C
		3	0	2	3

OBJECTIVES

At the end of the course, the students should be able to:

- To help learners develop their listening skills which will enable them listen to lecturesand comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To develop the basic reading and writing skills of first year engineering and technologystudents.
- To help learners develop grammar and vocabulary of a general kind by developing theirreading skills

UNIT I **9**

Listening - conversation - Speaking – introducing oneself - exchanging personal information - Reading – comprehension - Writing - paragraph - Vocabulary Development - synonyms and antonyms - Language Development – consonants & vowels - phonetic transcription.

UNIT II **9**

Listening - telephonic conversation - Speaking – sharing information of a personal kind – greeting - taking leave - Reading – short stories – The Gift of the Magi, A Service of Love and The Last Leaf by O. Henry – Writing – developing hints - Vocabulary Development – everyday vocabulary - Language Development – British and American English - infinitive and gerund.

UNIT III **9**

Listening – class memory quiz - Speaking – impromptu - Reading – magazines – Writing – agenda - proposals - Vocabulary Development - important words used in speaking and writing - Language Development – types of sentences - information and emphasis.

Agenda – Minutes of Meeting – Advertisement – Fliers – Brochures – Faxes – Internet Websites –Intranet Websites – Extranet Websites – Blog writing.

UNIT IV **9**

Listening – interviews of famous persons - Speaking – story narration - Reading – case study – Writing – invitation letter - quotation letter - Vocabulary Development – listening and reading vocabulary - Language Development – cause and effect – purpose and function.

UNIT V **9**

Listening - a scene from a film - Speaking - role play - Reading – jigsaw – Writing – essay writing - Vocabulary Development- business vocabulary - Language Development - degrees of comparison – real English phrases.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Comprehend conversations and talks delivered in English.

CO2: Participate effectively in formal and informal conversations; introduce themselves and their friends and express opinions in English.

CO3: Read short stories, magazines, novels and other printed texts of a general kind.

CO4: Write short paragraphs, essays, letters and develop hints in English.

TEXT BOOKS

1. Board of Editors. Using English, A Coursebook for Undergarduate Engineers and Technologists. Orient BlackSwan Limited, Hyderabad: 2015.
2. Richards, C. Jack. Interchange Students' Book-2, New Delhi: CUP, 2015.
3. Uttham Kumar, N. Communicative English (with work book). Sahana Publications, Coimbatore, 2019.

REFERENCE BOOKS

1. Bailey, Stephen. Academic Writing: A Practical Guide for Students. NewYork: Rutledge, 2011.
2. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011.
3. Dutt P.Kiranmai and Rajeevan Geeta. Basic Communication Skills, Foundation Books:2013.
4. Means, L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning, USA: 2007.
5. Redston, Chris & Gillies Cunningham. Face2Face (Pre-intermediate Student's Book & Workbook). Cambridge University Press, New Delhi: 2005.
6. Bailey, Stephen. Academic Writing: A Practical Guide for Students. New York: Rutledge, 2011.

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218MAT02	ENGINEERING MATHEMATICS-II	L	T	P	C
		3	1	0	4

Prerequisite ENGINEERING MATHEMATICS-I

OBJECTIVES

At the end of the course, the students should be able to:

- To understand double and triple integration concepts and apply to study vector calculus comprising of surface and volume integrals along with the classical theorems involving them.
- To learn analytic functions and their properties and also conformal mappings withfew standard examples that have direct applications.
- To grasp the basics of complex integration and application to contour integration which is important for evaluation of certain integrals encountered in engineering problems.
- To introduce the concept of improper integrals through Beta and Gamma functions.

UNIT I INTEGRAL CALCULUS **9+3**

Definite and indefinite integrals - Substitution rule – Techniques of integration –Integration by parts – Trigonometric integrals - Trigonometric substitutions - Integration of rational functions by partial fractions – Integration irrational functions.

UNIT II MULTIPLE INTEGRALS **9+3**

Double integration – Cartesian and polar co-ordinates – Change of order of integration – Change of variables between Cartesian and polar coordinates –Triple integration in Cartesian co-ordinates – Area as double integral – Volume as triple integral.

UNIT III VECTOR CALCULUS **9+3**

Gradient Divergence and Curl – Directional derivative – Irrotational and solenoidal, vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (Statement and applications only) – Simple applications involving cubes and rectangular parallelopipeds.

UNIT IV ANALYTIC FUNCTIONS **9+3**

Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy–Riemann equation and Sufficient conditions (Statement and applications only) – Harmonic and orthogonal properties of analytic function (Statement and applications only) – Harmonic conjugate – Construction of analytic functions – Conformal mapping: w= z+c, cz, 1/z, and bilinear transformation.

UNIT V COMPLEX INTEGRATION **9+3**

Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Taylor and Laurent expansions – Singular points –Residues – Residue theorem – Application of residue theorem to evaluate real integrals – Unit circle and semi-circular contour (excluding poles on boundaries).

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Determine the area and volume in 2-dimension and 3-dimension respectively using multiple integrals and also extending the concept to vector fields.

CO2: Learn the basic concepts of analytic functions and transformations of complex functions.

CO3: Master the integration in complex domain.

CO4: Understand the use of improper integrals' applications in the core subject.

TEXT BOOKS

1. Grewal. B.S., "Higher Engineering Mathematics", 43th Edition, Khanna Publications, Delhi, 2015.

REFERENCE BOOKS

1. James Stewart, "Stewart Calculus", 8th edition,2015, ISBN: 9781285741550/1285741552.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", tenth edition, Wiley India, 2011.
3. P.Kandasamy, K.Thilagavathy, K.Gunavathy, "Engineering Mathematics for first year", S.Chand & Company Ltd., 9th Edition, New Delhi, 2014.

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218GET03 ENVIRONMENTAL SCIENCE ANDENGINEERING L T P C

2 0 0 2

OBJECTIVES

At the end of the course, the students should be able to:

- To study the nature and facts about environment.
- To finding and implementing scientific, technological, economic and political solutions toenvironmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the humanworld;
  envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.

UNIT I NATURAL RESOURCES 14

Definition, scope and importance of environment – need for public awareness - Forest resources: Use and over- exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT II ECOSYSTEMSANDBIODIVERSITY 8

Concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India –conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes.

UNIT III ENVIRONMENTAL POLLUTION 10

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation –consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central andstate pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme –environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.

CO2: Public awareness of environmental is at infant stage.

CO3: Ignorance and incomplete knowledge has led to misconceptions

CO4: Development and improvement in std. of living has led to serious environmental disasters

TEXT BOOKS

1. Benny Joseph, Environmental Science and Engineering ', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M. Masters, Introduction to Environmental Engineering and Science ', 2nd edition, Pearson Education, 2004.
3. Dr. G. Ranganath, Environmental Science and Engineering, Sahana Publishers, 2018 edition.

REFERENCE BOOKS

218EMT04	ENGINEERING MECHANICS	L	T	P	C
		3	0	0	4

OBJECTIVES

At the end of the course, the students should be able to:

- To understand the vectorial and scalar representation of forces and moments.
- To understand the static equilibrium of particles and rigid bodies both in two dimensions.
- To understand the concepts of centroids and moment of inertia of composite sections.
- To understand the principle of work and energy.
- To enable the students to comprehend the effect of friction on equilibrium

UNIT I **BASICS & STATICS OF PARTICLES** **9+3**

Introduction-Units and Dimensions-Laws of mechanics - Lame's theorem, Parallelogram and Triangular law of forces, Polygon force, Resolution and Composition of forces, Equilibrium of a particle-Forces in space - Equilibrium of a particle in space-Equivalent systems of forces-Principle of transmissibility-Single equivalent force.

UNIT II **EQUILIBRIUM OF RIGID BODIES** **9+3**

Free body diagram-Types of supports and their reactions-Requirements of stable equilibrium-Moments and Couples, Moment of a force about a point and about an axis-Vectorial representation of couples- Varignon's Theorem-Equilibrium of Rigid bodies in two dimensions-Equilibrium of Rigid bodies in three dimensions – Examples.

UNIT III **PROPERTIES OF SURFACES AND SOLIDS** **9+3**

Determination of Areas and Volumes-First moment of area and the centroid of sections - rectangle, circle, triangle from integration - T section, I section, Angle section, Hollow section by using standard formula, Second and product moments of plane area - Rectangle, triangle, circle from integration-T section, I section, Angle section, Hollow section by using standard formula, Parallel axis theorem and perpendicular axis theorem.

UNIT IV **DYNAMICS OF PARTICLES** **9+3**

Displacement, Velocity and Acceleration, their relationship, Relative motion- Rectilinear motion-Curvilinear motion, Newton's law-Work Energy Equation of particles-Impulse and Momentum-Impact of elastic bodies.

UNIT V **FRICTION** **9+3**

Frictional force - Laws of Coloumb friction - Simple contact friction - Rolling resistance - Belt friction - Ladderfriction - wedge friction.

TOTAL HOURS 45+15 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Explain the differential principle applies to solve engineering problems dealing with force, displacement, velocity and acceleration.

CO2: Find solution for problems related to equilibrium of particles.

CO3: Solve the Moment of inertia for different 2-D plane figures.

CO4: Analyze the forces in any structures.

CO5: Solve rigid body subjected to frictional forces.

TEXT BOOKS

1. Ramamrutham S, "Engineering Mechanics (S.I Units)", Dhanpat Rai Publications, 10th Edition, Reprint 2015.
2. Dr. Gujral I S, "Engineering Mechanics", Lakmi Publications, Second Edition, 2011.

REFERENCE BOOKS

1. Bhavikatti S, "Engineering Mechanics", New Age International Publisher, 4th Edition, 2014.
2. Khurmi R S, "Engineering Mechanics", S Chand Publisher, 20th Edition, 2012.
3. Dr. Bansal R K and Sanjay Bansal, "Engineering Mechanics", Lakshmi Publication, 7th Edition, 2011.
4. Rajput R K, "Engineering Mechanics", Dhanpat Rai Publications, 3rd Edition, 2005.

218PPT05	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES

At the end of the course, the students should be able to:

- To know the basics of algorithmic problem solving
- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures — lists, tuples, dictionaries.
- To do input/output with files in Python

UNIT I ALGORITHMIC PROBLEM SOLVING **9**

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA, EXPRESSIONS, STATEMENTS **9**

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS **9**

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES **9**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.

UNIT V FILES, MODULES, PACKAGES **9**

Files and exception: text files, reading and writing files, format operator; command line arguments, date and time, errors and exceptions, handling exceptions, debugging, modules, packages; Illustrative programs: word count, copyfile.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Develop algorithmic solutions to simple computational problems
CO2: Read, write, execute by hand simple Python programs.
CO3: Structure simple Python programs for solving problems.
CO4: Decompose a Python program into functions.
CO5: Represent compound data using Python lists, tuples, dictionaries. CO6: Read and write data from/to files in Python Programs.

TEXT BOOKS

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updatedfor Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr, —An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCE BOOKS

1. John V Guttag, —Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press, 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-Disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, —Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd., 2015.
4. Kenneth A. Lambert, —Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.

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218PHP07	ENGINEERING PHYSICS LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES

At the end of the course, the students should be able to:

- To understand the practical concepts of Interference and diffraction.
- To understand the concept of velocities of sound in different liquids.
- To get better knowledge of modulus of elasticity.
- To understand the concepts of thermal conductivity.
- To understand the concepts of viscosities of liquid.

LIST OF EXPERIMENTS

1. (a) Determination of laser parameters – Wavelength.
   (b) Particle size determination using Diode Laser.
2. Determination of thickness of a thin wire-Air wedge method.
3. Determination of velocity of sound and compressibility of liquid- Ultra sonic interferometer.
4. Determination of wavelength of mercury spectrum-Spectrometer grating.
5. Determination of thermal conductivity of a bad conductor-Lee's disc method.
6. Determination of Young's modulus of the material –Non uniform bending.
7. Determination of viscosity of liquid – Poiseuille's method.
8. Spectrometer- Dispersive power of prism.
9. Determination of Young's modulus of the material – Uniform bending.

Torsional pendulum- Determination of Rigidity modulus.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Understanding the moduli of elasticity by determining Young's modulus and Rigidity modulus of a beam and cylinder respectively.

CO2: Understanding the phenomenon of diffraction, dispersion and interference of light using optical component

CO3: Acquiring knowledge of viscosity by determining coefficient of viscosity of a liquid and measuring the parameters of ultrasound propagating through a liquid

CO4: Understanding the phenomenon of heat transfer through conductors and bad conductors by determining thermal conductivity.

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218BSE01	MATERIAL SCIENCE	L	T	P	C
		2	0	0	2

OBJECTIVES

At the end of the course, the students should be able to:

- To study the basic theory of structure of crystalline materials.
- To understand the essential principles of electrical properties of materials.
- To get the better knowledge of Physics of semiconductor materials.
- Become proficient in dielectric and nano materials.
- To understand the essential concepts of modern engineering materials.

UNIT I **CRYSTAL PHYSICS** **9**

Introduction and structure of atoms – Crystal structure: The space lattice and Unit Cell - Crystal Systems and Bravais lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC, HCP and Diamond cubic structure – NaCl, ZnS structures (qualitative).

UNIT II **CONDUCTING MATERIALS** **9**

Conductors - Classical free electron theory of metals - Expression for electrical conductivity - Expression for Thermal conductivity - Wiedemann-Franz law - Lorentz number - Draw backs of classical theory - Quantum theory - Fermi distribution function - Effect of temperature on Fermi distribution function - Density of energy states - carrier concentration in metals.

UNIT III **SEMICONDUCTING MATERIALS** **9**

Intrinsic Semiconductors - direct and indirect band gap semiconductors - Carrier concentration in intrinsic semiconductors - Fermi level - Variation of Fermi level with temperature – Electrical conductivity of intrinsic semiconductors – band gap determination - Extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors (qualitative) - Variation of carrier concentration with temperature – variation of Fermi level with temperature and impurity concentration - Electrical conductivity of extrinsic semiconductors.

UNIT IV **DIELECTRIC MATERIALS AND NANOMATERIALS** **9**

Dielectric materials: Dielectric constant – Dielectric loss - Electrical susceptibility-Electronic, ionic – orientational and space charge polarization – Frequency and temperature dependence of polarization – internal field – Claussius – Mosotti relation (derivation) Nano materials: Synthesis-Plasma arcing- – Chemical vapour deposition – Electro deposition – Ball Milling – Properties of nanoparticles and their applications.

UNIT V **NUCLEAR PHYSICS AND HEAT TRANSMISSION** **9**

Nuclear fission-Nuclear fusion-nuclear reactors-classification-general features-efficiency-coolants moderators thermal reactors. Heat conduction-Expression for thermal conductivity-Amount of heat flow through a plane wall in one direction-Determine the thermal conductivity –Lee's disc method for bad conductors.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Have the necessary understanding on the functioning of crystalline in solids of materials

CO2: Gain knowledge on classical and quantum electron theories, and energy band structures.

CO3: Acquire knowledge on basics of semiconductor physics and its applications in various devices.

CO4: Get knowledge on dielectric and nano materials and their applications.

CO5: Understand the basics of modern engineering materials

TEXT BOOKS

1. Jasprit Singh, - Semiconductor Devices: Basic Principles, Wiley 2012.
2. Kasap, S.O. - Principles of Electronic Materials and Devices, McGraw-Hill Education, 2007.
3. Jayaprakash R.N,-Physics for engineers, Dhanam publications, 2018.
4. Kittel, C. - Introduction to Solid State Physics. Wiley, 2005.
5. Theraja B.L - Basic Electronics Solid State, S. Chand & Company Ltd, 2004.

REFERENCE BOOKS

1. Garcia, N. & Damask, A. —Physics for Computer Science Students. Springer-Verlag, 2012.

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218PPP08	PROBLEM SOLVING AND PYTHON PROGRAMMINGLABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES

At the end of the course, the students should be able to:

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python.

LIST OF EXPERIMENTS

1. To Implement python scripts using Variables and operators
2. To Demonstrate Operator precedence to evaluate an expression
3. Display grade of a student using elif statement
4. Implement Floyd triangle using for loop
5. Checks the given number is prime or not using while loop
6. Compute the GCD of Numbers using functions
7. Finding factorial of a given number using recursive function.
8. Takes a list of words and returns the length of longest one using strings
9. To perform linear and binary search using strings
10. To implement list as arrays (multiply 2 matrices)
11. To demonstrate use of list & related functions
12. To demonstrate use of tuple, set& related functions
13. To demonstrate use of Dictionary& related functions
14. Finding most frequent words in a text read from a file
15. Programs that take command line arguments (word count)

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Write, test, and debug simple Python programs.
CO2: Implement Python programs with conditionals and loops.
CO3: Develop Python programs step-wise by defining functions and calling them.
CO4: Use Python lists, tuples, dictionaries for representing compound data.
CO5: Read and write data from/to files in Python.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester III

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
315GET02	ENVIRONMENTAL SCIENCE AND SUSTAINABILITY	3	0	0	3	50	50	100

Prerequisite NIL

Course Objectives

At the end of the course, the students should be able to:

- *The student should be conversant with the evolution of environmentalism and theimportance of environmental studies.*
- *Various natural resources and the current threats to their sustainability*
- *Significance and protection of biodiversity and various forms of environmental*
- *Degradation international conventions*
- *Protocols for the protection of environment and concept of sustainability.*

UNIT I INTRODUCTION TO ENVIRONMENT AND ECOSYSTEM **9**

Definition, scope and importance of environment – need for public awareness. Atmosphere – composition of atmosphere (troposphere, stratosphere, mesosphere and thermosphere) Biosphere – Hydrosphere – Lithosphere. Concept of ecosystem – structure and functions of ecosystem- producers, consumers and decomposers - Energy flow –Ecological succession-Food chains-Food webs- Ecological pyramids-Introduction, types, characteristic features -structures and function of forest, grassland and aquatic ecosystems (ponds and rivers) - Case Studies in current scenario.

UNIT II UNITII NATURAL RESOURCES ANDBIODIVERSITY **9**

Forest resources-Water resources-Mineral resources-Food resources-Energy resources-Land resources. Introduction to biodiversity definition: genetic, species and ecosystem diversity–biogeographically classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threatstobiodiversity:habitatloss,poachingofwildlife,man-wildlifeconflicts–endangeredandendemicspecies of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity

UNIT III ENVIRONMENTAL POLLUTION **9**

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marinepollution (e)Noisepollution (f)Thermalpollution (g)Nuclearhazards–solid waste management:

causes

,effects and control measures of municipal solid wastes–role of an individual in prevention of pollution–pollution casestudies – disaster management: floods, earthquake, cyclone and Landslides

UNIT IV SOCIAL ISSUES, HUMAN POPULATON AND THE ENVIRONMENT **9**

Fromunsustainabletosustainabledevelopment–urbanproblemsrelatedtoenergy–water conservation, rainwater harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, casestudies role of non-governmental organization environmental ethics: Issues and possible solutions – climatechange, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. –Wasteland reclamation – consumerism and waste products – environment protection act –-environmentallegislation- central and state pollution control boards.

UNIT V CONCEPT OF SUSTAINABLE DEVELOPMENT **9**

Definition of sustainability -Components of sustainability History and emergence of the concept of sustainabledevelopment–Our Common Future-Objectives of Sustainable Development- Millennium Development Goals- Environment and Development linkages – Globalization and environment-Sustainability indicators-Hurdles to Sustainability.

Total Hours 45

Course Outcomes

Upon Completion of this course, students will be able to :

CO1: To understand & appropriate the structure of ecosystem and its impact on environment.CO2: To understand the various natural resources and boidiversity.

CO3: To recognize the environmental problems caused due to pollution.

CO4: To understand the concept of sustainable development.

CO5: To understand the types of pollution.

Text Books

1 Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.

2 Benny Joseph, 'Environmental Science and Engineering', Tata McGraw- Hill,NewDelhi, 2006.

Reference Books

1 R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.

2 Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.

3 Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.

4 Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press 2005.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester III

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
315BTT03	CELL BIOLOGY	2	1	0	3	50	50	100

Prerequisite NIL

Course Objectives

At the end of the course, the students should be able to:

- *To provide knowledge on the fundamentals of cell biology*
- *To help students understand the signalling mechanisms*
- *To understand how organisms function and the structure and functions of the plasma membrane and the major organelles that occurring prokaryotic and eukaryotic cells.*
- *To understand how cellular organelles work together to carry out life functions.*
- *To protect cells to prevent infection and other harmful effects.*

UNIT I CELL STRUCTURE AND FUNCTION OF THE ORGANELLES 9

Eukaryotic and prokaryotic cells, principles of membrane organization, membrane proteins, cytoskeletalproteins, types of cell division, mitosis & meiosis, extra cellular matrix, cell cycle and molecules that control cell cycle

UNIT II TRANSPORT ACROSS CELL MEMBRANES 9

Passive & active transport, permeases, sodium potassium pump, Ca2+ ATPase pumps, lysosomal and vacuolarmembrane ATPdependentprotonpumps,cotransportsymport,antiport,transportintoprokaryotic cells, endocytosis and exocytosis, Entry of viruses and toxins intocells

UNIT III RECEPTORS AND MODELS OF EXTRA CELLULAR SIGNALLING 9

Cytosolic, nuclear and membrane bound receptors, examples of receptors, autocrine, paracrine and endocrine models of action, Intracellular surface receptors, quantitation and characterisation of receptors

UNIT IV SIGNAL TRANSDUCTION 9

Signal amplification, different models of signal amplifications, cyclic amp, role of inositol phosphates as messengers,biosynthesisofinositoltriphosphates,cyclicGMPandgproteins,roleinsignal transductio n, calcium ion flux and its role in cell signaling, current models of signal amplification, phosphorylation of protein kinases, regulation of protein kinases, serine –threonine kinases, tumor necrosis factor receptor families

UNIT V CELL CULTURE 9

Techniques for the propagation of eukaryotic and prokaryotic cells. Cell lines, generation of cell lines,maintenance of stock cells, characterization of cells, morphological analysis techniques in cell culture,
ex-plant cultures primary cultures, contamination, differentiation, three dimensional cultures, role of matrix in cell growth.

Total Hours 45

Course Outcomes

Upon Completion of this course, students will be able to :

CO1: To develop integral knowledge on cell structure, molecular organization and function of cell organelles.

CO2: To learn the cell is the basic unit of life in the entireliving world..

CO3: To Understand the basic knowledge on cell structure and function as well as on the molecular basis of chromatin organization

CO4: Understandcellatstructuralandfunctionallevel.

CO5:Understandthemolecularinteractionbetweencellsabdsignaltransduction,secondarym essengers.

Text Books

1 *"Molecular Cell Biology", Darnell J, Lodish H, Baltimore D W.H.Freeman 6TH Edition 2005.*

2 *"Cell Biology" Kimball T.W., Wesley Publishers, 3rd Edition, 2007.*

3 *"The Cell" Georeffy Cooper, ASM Press, 2nd Edition 2007.*

4 *"Molecular Biology of the Cell", James D.Watson, Wilkins, a Wolters Kluwer Business Publishers 8th Edition,2013.*

Reference Books

1 *"Cell Biology" De Robertis & De Robertis, ASM Press and Sinauer Associates 4th Edition, 2006*

2 "Cell and Molecular Biology" Ajoy paul ,Books and Allied (P) Ltd 2007.

3 "Cell and Molecular Biology " Gerald Karp ,Wiley Publishers, 7th Edition, 2013.

4 *E Books:* https://www.scribd.com/.../Karp-Cell-and-Molecular-Biology-Concepts.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester III

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
315BTT04	MICROBIOLOGY	3	0	0	3	50	50	100

Prerequisite NIL

Course Objectives

At the end of the course ,the students should be able to:

- *To introduce structure and functional of Microbiology to emphasize structure and biochemical aspects of various microbes.*
- *To understand the basic principles of microbiology and various aspects*
- *To solve the problems in microbial infection and their control.*
- *To enable students to learn the production process and preservation techniques*
- *To develop skills of the students in the area of industrial and environmental microbiology*

UNIT I INTRODUCTION **9**

Basic of microbial existence; history of microbiology, classification and nomenclature of microorganisms, microscopic examination of microorganisms, light and electron microscopy - phase contrast and fluorescence microscopy, principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining

UNIT II MICROBES-STRUCTURE AND MULTIPLICATION **9**

Structural organization and multiplication of bacteria, viruses, algae and fungi with a special emphasis of life history of actinomycetes, yeast, mycoplasma and bacteriophage. Reproduction of microorganisms- sexual and asexual

UNIT III MICROBIAL NUTRITION, GROWTH AND METABOLISM **9**

Nutritional requirements of bacteria and different types of media used for bacterial culture; growth curve and different methods to quantitate bacterial growth, aerobic and anaerobic bioenergetics and utilization of energy for biosynthesis of important molecules, nutritional types and requirements

UNIT IV CONTROL OF MICROORGANISMS **9**

Physical, chemical and radiation control of microorganisms; Indicators of sterilization & host-microbe interactions; anti-bacterial, anti-fungal and anti-viral agents, mode of action and resistance to antibiotics; clinically important microorganisms, sanitization, disinfection

UNIT V INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY **9**

Primary metabolites; secondary metabolites and their applications; preservation of food; production of penicillin, alcohol, vit.b-12; biogas; bioremediation; leaching of ores by microorganisms; bio-fertilizers and bio-pesticides.

Total Hours 45

Course Outcomes	*Upon Completion of this course, students will be able to* *CO1:Students attains knowledge on the principles of Microbiology and biochemical aspects of various microbes* *CO2:Knowledgeonthemicroorganismstructureanditsdifferenttypes,growthandmetabolism CO3:The interactions between contaminants, soil, water and microorganisms and its control CO4:Knowledge on the production process and preservation techniques* *CO5:An ability to conduct experiments, as well as to analyze and interpret data*

Text Books

1 Talaron K, Talaron A, Casita, Pelczar And Reid. Foundations In Microbiology, W.C. Brown Publishers, 1993.
2 Pelzer MJ, Chan ECS and Krein NR, Microbiology, Tata McGraw-Hill Edition, New Delhi, India.1999
3 Prescott LM, Harley JP, Klein DA, Microbiology, 3rd Edition, Wm. C. Brown Publishers, 1996.

Reference Books

1 General Microbiology by Powar and Daginawala, Himalaya Publishing House.
2 Micro Biology : Laboratory Theory and applications, M.J. Heboffee aw BE Pierce Morten Publishing House, 2006.
3 Alcamo's Fundamentals of Microbiology9th Edition. *Jeffrey C. Pommerville.* Jones & Bartlett *Publishers*; 2012.

E books

1 *www.bestebooksworld.com/cat/microbiology*
2 http://www.microbiologyinfo.com/top-and-best-microbiology-books/

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Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester III

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
315BTT05	INSTRUMENTAL METHODS OF ANALYSIS	3	0	0	3	50	50	100

Prerequisite Biochemistry

Course Objectives

At the end of the course ,the students should be able to:

- *To have a fundamental knowledge about the Light spectrum, Absoprtion, FluorescenceNMR, Massspectroscopy*
- *To acquire knowledge on the different chromotographic methods for separationof biological products*
- *To gain knowledge on basics of measurement*
- *To acquire knowledge on the different chromatographic methods for separation of biological products and surface microscopy*
- *To gain knowledge about separation of biological products.*

UNIT I BASICS OF MEASUREMENT **9**

Classification of methods – types of noise- calibration of instrumental methods – electrical components and circuits – signal to noise ratio – signal – noise enhancement.

UNIT II OPTICAL METHODS **9**

Generaldesign–sourcesofradiation–wavelengthselectors–samplecontainers–radiationtransducers –typesofopticalinstruments-Calorimeter,Flourimeter,Nephlometry–Fouriertransformmeasurements.

UNIT III MOLECULAR SPECTROSCOPY **9**

Measurement of transmittance and absorbance – beer's law – spectrophotometer analysis – qualitative andquantitative absorption measurements - types of spectrometers – UV – visible – IR – Raman spectroscopy, NMR,ESR – instrumentation – theory.

UNIT IV THERMAL METHODS **9**

Thermo-gravimetric methods – differential thermal analysis – differential scanning calorimetry.

UNIT V SEPARATION METHODS

Introduction to chromatography – van deemter equation –Thin Layer Chromatography) Paper Chromatography - gas chromatography – stationary phases – detectors – HPLC – pumps – columns – detectors – ion exchange chromatography – size exclusion chromatography – Agarose Electrophroresis, capillary electrophoresis-Adsorption Chromatography.

Total Hours **45**

Course Outcomes

Upon Completion of this course, students will be able to :

CO1: Knowledge on separation techniques used for biological products
CO2: Knowledge on different chromatographic methods for separation of biologicalproducts
CO3: Understand principle of surface microscopy and its application
CO4: Acquire knowledge on separation techniques used for biological products
CO5: Acquire knowledge on different chromatographic methods for separationof biological products

Text Books

1 Instrumental Methods of Analysis; Willard & H.Merrit, Phi, 1999 7th Edition CBS Publishers.
2 Instrumental Methods of Analysis, D. Skoog, 2000 5th Edition College Publishers.
3 Instrumental Methods of Chemical Analysis Galen N .Ewing 5th Edition Mc Graw Hill International 2006.

Reference Books

1 Introduction to Instrumental Analysis by Robert D Braun, Pharma Book Syndicate 2005.
2 Instrumental Methods of Chemical Analysis by H Kaur PPM Publishers 1999.
3 Biophysical Chemistry by Upadhyay 4th Edition by Himalaya Publishing House 2007.
4 Electrochemical Methods by Bard Faulkner 2nd Edition Wiley Publishers 2006.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester III

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
315BTE01	BASIC INDUSTRIAL BIOTECHNOLOGY	3	0	0	3	50	50	100

Prerequisite Nil

Course Objectives

At the end of the course ,the students should be able to:

- *To make the students aware of the overall lindustrial bioprocess so as to help them to Manipulate the process to the requirement of the industrial needs.*
- *The course prepares the students for the bulk production of commercially important ModernBio products, Industrial Enzymes, Products of plant and animal cell cultures.*
- *To understand the production and purification of industrial enzymes.*
- *To gain knowledge about products of plant, animal and fungal cell cultures.*
- *To understand the production and purification of therapeutic proteins*

UNIT I INTRODUCTION TO INDUSTRIAL BIOPROCESS **9**

A historical overview of industrial fermentation process, Definition and scope of Industrial Biotechnology, Stockculture, A brief survey of organisms, processes. Growth curve of microorganisms (Bacteria), Process flow sheeting – block diagrams, pictorial representation.

UNIT II PRODUCTION OF PRIMARY METABOLITES

A brief outline of processes for the production of some commercially important organic acids(e.g.citric acid,lacticacid,aceticacid);amino acids(glutamicacid,asparticacid)and alcohols(ethanol, butanol)

UNIT III PRODUCTION OF SECONDARY METABOLITES **9**

Study of production processes for various classes of secondary metabolites: antibiotics: betalactams (penicillin, cephalosporin), aminoglycosides (streptomycin etc) macrolides (erythromycin), vitamins and steroids.

UNIT IV PRODUCTION OF ENZYMES AND OTHER BIOPRODUCTS **9**

Production of industrial enzymes such as proteases, amylases, lipases, cellulases. Production of biopesticides, biofertilisers, biopreservatives (Nisin), cheese, biopolymers (PHB), single cell protein.

UNIT V PRODUCTION MODERN BIOTECHNOLOGY PRODUCTS **9**

Production of recombinant proteins and diagnostic applications, production of vaccines. Production of monoclonal antibodies.

Total Hours **45**

Course Outcomes

Upon Completion of this course, students will be able to :

Co1: Understanding of the steps involved in the production ofbioproducts

Co2: Understand the basic biotechnological engineering principles and models to do tasksCo3: Understand the Design and deliver useful modern biotechnology products tothe society

CO4: Understand the bulk production of commercially important modern bioproducts.

CO5:Understand the production and purification of Industrial Enzymes and products of plant

and animal cell cultures.

Text Books

1 Satyanarayana, U. "Biotechnology" Books & Allied (P) Ltd., 2005

2 Kumar, H.D. "A Textbook on Biotechnology" 2nd Edition. Affiliated East West Press Pvt.Ltd.,1998.
3 Balasubramanian, D. *et.al*., "Concepts in Biotechnology" Universities Press Pvt.Ltd.,2004.
4 Ratledge, Colin and Bjorn Kristiansen "Basic Biotechnology" 2nd Edition Cambridge
5 University Press, 2001.
6 Dubey, R.C. "A Textbook of Biotechnology" S.Chand & Co. Ltd., 2006.

Reference Books

1 Casida, L.E. "Industrial Microbiology", New Age International (P) Ltd, 1968.
2 Presscott, S.C. and Cecil G. Dunn, "Industrial Microbiology", Agrobios (India), 2005.
3 Cruger,Wulf and Anneliese Crueger, "Biotechnology: A Textbook of Industrial Microbiology", 2ndEdition, Panima Publishing, 2000.
4 Moo-Young, Murrey, "Comprehensive Biotechnology", 4 Vols. Pergamon Press, (An Imprint of Elsevier)2004.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department	BIOTECHNOLOGY	Programme	B. TECH. - BT	Regulation	2015
		Semester	III		

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
315BTP07	CELL BIOLOGY LABORATORY	0	0	4	2	50	50	100

Prerequisite Nil

Course Objectives

At the end of the course ,the students should be able to:

- *To learn the morphology, identification and propagation of cells*
- *To understand the basic techniques to work with cells*
- *To understanding and perform cell staining techniques*
- *To learn working principles of Microscopy*
- *To understand isolation of plasmids, nucleus or other organelles and cell division*

LIST OF EXPERIMENTS

1. Introduction to principles of sterile techniques and cell propagation.
2. Identification of plant, animal and bacterial cells and their components by microscopy.
3. Grams Staining.
4. Leishman Staining.
5. Determination of cell mobility- Hanging Drop method
6. Giemsa Staining.
7. Lactophenol Cotton Blue Staining
8. Osmosis and Tonicity.
9. Simple Staining.
10. Negative Staining
11. Staining for different stages of mitosis in *Allium Cepa*(Onion).

Total Hours 45

Course Outcomes

Upon Completion of this course, students will be able to get :

CO 1 To learn the basic skills in light microscopy, cell fractionation, and spectroscopy.
CO 2 To be able to perform light microscopy techniques, to isolate plastids, nucleus orotherorganelles and celldivision.
CO 3 To be able to identify the various stages of mitosis. CO 4 To understand the basic techniques to work with cellsCO5To understandandperform cellstainingtechniques

Text Books

1. "Laboratory Investigations in Cell and Molecular Biology", Allen Bregman Wiley publishers, 4th Edition, 2001.

2. "General Microbiology" Powar and Daginawala, Himalaya Publishing House, *8th edition* 2012.

3. *"Cell Biology: A Laboratory Handbook Volume", Julio E. Celis,Tony HunterElsevier Academic Press, 3rd Edition, 2006.*

Reference Books

1 "Cell Biology: A Laboratory Handbook: 004", Julio E. Celis , Academic Pr; 2 edition, 3rdEdition, 2005.

2 "Laboratory Exercises and Techniques in Cellular Biology", Anthony Contento, Wiley Publishers, 1st Edition 2012

3 "Laboratory Methods in Cell Biology" S.Jha Academic Press, 1st Edition, 2012.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester III

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
315BTP08	MICROBIOLOGY LABORATORY	0	0	4	2	50	50	100

Prerequisite Nil

Course Objectives

At the end of the course ,the students should be able to:

- *The course aims to develop the skills of students in different arreas of microbiology*
- *To demonstrate various techniques to learn the morphology, identificationand propagation of microbes*
- *To solve the problems in microbial infection and their control*
- *To enable students learn the basic structure, growth and metabolism of microorganisms*
- *To demonstrate various techniques on effect of physical factors*

LIST OF EXPERIMENTS

1. Laboratory safety and sterilization techniques-Dry heat sterilization (Autoclave, hot air oven)
2. Microscopic methods in the identification of microorganisms
3. Preparation of culture media – nutrient broth and nutrient agar
4. culturing of microorganisms – in broth and in plates (pour plates, streak plates, spread plates isolation and preservation of bacterial cultures)
5. Staining techniques – Grams' and differential, lactophenol cotton blue
6. Quantification of microorganisms-serial dilution and plating
7. Effect of disinfectants on microbial flora
8. Isolation of microorganisms from different sources – soil, water and milk
9. Antibiotic sensitivity assay
10. Growth curve – observation and growth characteristics of bacteria.
11. Effect of different parameters on bacterial growth (pH, temperature, and substrate concentration)

Total Hours 45

Upon Completion of this course, students will be able to get :

Course Outcomes

CO1:Understand the advanced technical information pertaining to laboratory bio-safety and preventive measures from pathogenic microorganism.
CO2:Know the various aseptic techniques and sterilization methods
CO3: Understand the interactions between contaminants, soil, waterand microorganisms and its control
CO4:Gain knowledge on the microorganism structure and its different types, growth and metabolism
CO5:Developtheskillstoworkonseveralimportanttechniquesforthestudyofmicroorganismsin the laboratory

Reference Books

1 Microbiology: Laboratory Theory and applications, M.J. Heboffee aw BE Pierce Morten Publishing House, 2006.
2 Laboratory Investigations in Cell and Molecular Biology, Allen Bregman Wiley.
3 General Microbiology. Powar and Daginawala, Himalaya Publishing House. 2nd Ed. 2011.
4 *Microbiology: Laboratory Theory and Application 4th Edition. by Michael J. Leboffeand Burton E. Pierce; Ring-bound;* Publisher *2015*

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester III

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
315BTP09	INSTRUMENTAL METHODS OF ANALYSIS LABORATORY	0	0	4	2	50	50	100

Prerequisite Nil

Course Objectives

At the end of the course ,the students should be able to:

- *To gain knowledge on the basis of measurements and instruments.*
- *To have a practical hands on experience on absorption spectroscopic methods.*
- *To gain knowledge about separation of biological products.*
- *To acquire experience in the purification by performing chromatography.*
- *To validate and analyze using spectrometric and microscopic techniques.*

LIST OF EXPERIMENTS

1. Ultraviolet and visible spectrometry Instrumentation
2. Determination of maximum wave length of KMnO4
3. Finding the maximum wave length of Fe (1,10 phenanthroline)3 using UV spectrometry.
4. Absorption spectrum of plant pigments.
5. UV spectra of nucleic acids.
6. Estimation of SO4 - by Nephelometer.
7. Estimation of Al3+ by flourimetry.
8. Separation and Identification of amino acids using paper chromatography.
9. Separation and Identification of amino acids using TLC.
10. Chromatography analysis using gel chromatography.
11. Determination of maximum wave length for copper sulphate

Total Hours 45

Course Outcomes

Upon Completion of this course, students will be able to get :

CO1: Understand calibration of instruments;

CO2:Acquireknowledgeonseparationtechniques used for biological products;

CO3: Understand and apply optical methods;

CO4:Acquireknowledgeondifferentchromatographicmethodsforseparationofbiologicalproduct

CO5: Acquire knowledge of purification by chromatography.

Reference Books

1 Textbook of Quantitative Inorganic Analysis, AI Vogal, ELBS edition 1987.

2 A Biologist guide to principles and techniques of practical biochemistry keith Wilson,Kenneth HGouicing 3rd ed.ELBS Series.
3 Hobert H WillardD.L.Merrit$J.R.J.A Dean instrumental methods Analysis, CBS Publisers$Distributors1992.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester
IV

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
415PST01	PROBABILITY AND STATISTICS	3	1	0	4	50	50	100

Prerequisite Engineering mathematics-I,II &III

Course Objectives

At the end of the course ,the students should be able to:

- *To impart the knowledge of basic probabilistic theory.*
- *To learn one dimensional discrete and continuous probability distributions occurring innatural phenomena*
- *To extend the probability theory to two dimensional random variable and to study thestatistical measures.*
- *To introduce the notion of sampling distributions and have acquired knowledge ofstatistical techniques useful in making rational decision in management problems.*
- *To expose to statistical methods designed to contribute to the process of makingscientific judgments in the face of uncertainty and variation.*

UNIT I PROBABILITY AND RANDOM VARIABLE **9+3**

Axioms of probability - Conditional probability - Total probability – Baye's theorem- Random variable - Probability mass function - Probability density function - Properties - Moments - Moment generating functionsand their properties

UNIT II PROBABILITY DISTRIBUTIONS **9+3**

Binomial, Poisson, Geometric, Uniform, Exponential, and Normal distributions and their properties - Functions of a random variable-simple applications

UNIT III TWO-DIMENSIONAL RANDOM VARIABLES **9+3**

Joint distributions – Marginal and Conditional distributions – Covariance – Correlation and Linear regression –
Central limit theorem (Statement and applications only for independent and identicallydistributed random variables)0

UNIT IV TESTING OF HYPOTHESIS **9+3**

Sampling distributions - Tests for single mean, Proportion, Difference of means (large and small samples)
– Tests for single variance and equality of variances – Chi-square test for goodness of fit –Independence of attributes.

UNIT V DESIGN OF EXPERIMENTS **9+3**

Analysis of variance – One way classification – CRD - Two – way classification – RBD - Latin square - control charts for measurements ($\bar{x}$ and R charts

Total Hours **45+15**

Course Outcomes

Upon Completion of this course, students will be able to :

CO 1: Imbibing the knowledge of basicprobability improves the quality of interpretationand decisionmakingin real time problems of uncertainity.

CO 2: Understanding the real time application of probabilitydistributions.

CO 3: Learning the concept of two dimensional random variables helps to understand andanalyse the statistical measures which describe an outcome of a random experiment.

CO 4: Drawing inference & decision making through hypothesis testing.

CO 5: learning the statistical methods designed to contribute to the process of making scientificjudgments in the face of uncertainty and variation

Text Books

1 Ibe, O.C.,"Fundamentals of Applied Probability and Random Processes", Elsevier, U.P., 1st Indian Reprint, 2007.

2 Gupta.S.C.,& Kapoor,V.K., "Fundamentals of mathematical statistics", 11th edition, SultanChand & Sons publishers, New Delhi, 2013.

Reference Books

1 Miller and Freund., "Probability and Statistics for Engineers", Pearson Education, Asia, 7th edition, 2012.

2 Spiegel, M.R, Schiller, J and Alu Srinivasan, R, "Schaum's Outlines Probability and Statistics", Tata McGraw-Hill Publishing Company Ltd. New Delhi , 2010.

3 Veerarajan.T., "Probability, Statistics and Random Processes", Tata McGraw-Hill publishing companyLimited, New Delhi, 2014.

4 Kandasamy.P,Thilagavathy,K.,&Gunavathi.K., "Probability, Statistics and Queueing Theory"., S.Chand& Company Ltd., New Delhi, 2014.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester IV

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
415BTT02	MOLECULAR BIOLOGY	3	0	0	3	50	50	100

Prerequisite Cell biology, microbiology

Course Objectives

At the end of the course ,the students should be able to:

- *Study the structural and functional organization of nucleic acids.*
- *Learn molecular tools for studying activity of genes.*
- *Learn the structure and properties of biomolecules and their functions.*
- *Understand the genetics of prokaryotes and eukaryotes.*
- *Acquire basic fundamental knowledge and explore skills in molecular biology and become aware of the complexity and harmony of cells.*

UNIT I CHEMISTRY OF NUCLEIC ACIDS **9**

Introductiontonucleicacids:Nucleicacidsasgeneticmaterial,Structureandphysicochemicalproperties of elements in DNA and RNA, Biological significance of differences in DNA and RNA. Primary structure of DNA: Chemical and structural qualities of 3',5'-Phosphodiester bond. Secondary Structure of DNA: Watson & Crick model, Chargaff's rule, Tertiary structure of DNA:DNA supercoiling. Reversible denaturation and hyperchromiceffect.

UNIT II DNA REPLICATION & REPAIR **9**

OverviewofCentraldogma.Organizationofprokaryoticand eukaryoticchromosomes.DNAreplication: Meselson & Stahl experiment, bi–directional DNA replication, Okazaki fragments, Proteomics of DNA replication, Fidelity of DNA replication, Inhibitors of DNA replication, Overview of differences in prokaryotic andeukaryoticDNAreplication,Telomerereplicationineukaryotes.D-loopandrollingcirclemodeofreplication.

Mutagens, DNA mutations and their mechanism, varioustypes of repair mechanisms.

UNIT III TRANSCRIPTION **9**

Structure and function of mRNA, rRNA and tRNA. Characteristics of promoter and enhancer sequences. RNA synthesis: Initiation, elongation and termination of RNA synthesis, Proteins of RNA synthesis, Fidelity of RNA synthesis, Inhibitors of transcription, Differences in prokaryotic and eukaryotic transcription. Basic concepts in RNA world: Ribozymes, RNA processing: 5'-Capping,Splicing-

Alternative splicing, Poly 'A' tail addition and basemodification.

UNIT IV TRANSLATION **9**

Introduction to Genetic code: Elucidation of genetic code, Codon degeneracy, Wobble hypothesis and its importance, Prokaryotic and eukaryotic ribosomes. Steps in translation: Initiation, Elongation and termination of protein synthesis. Inhibitors of protein synthesis. Posttranslational modifications and its Importance

UNIT V REGULATION OF GENE EXPRESSION **9**

Organization of genes in prokaryotic and eukaryotic chromosomes, Hierarchical levels of gene regulation,

Prokaryoticgeneregulation–

*lac*and*trp*operon,Regulationofgeneexpressionwithreference to λphage lifecycle

Total Hours 45

Course Outcomes

Upon Completion of this course, students will be able to :

CO 1: The background and scope of molecular biology, Genetics and gene therapy. CO 2: Theinformationgainedwillhelpthestudentstounderstandthebeneficialroleofcell molecularlevel.

CO 3: After successful completion of this subject the students will get an overall view aboutgenetic makeup of organisms and can take up a career inresearch.

CO4:Understandmetabolicregulation andintermediatecompounds;

CO 5:Understand gene organization and mechanisms of control of the gene andexpressionin various organisms

Text Books

1 Phundan Singh, "Principles of Genetics", Kalyani Publishers, 2012.

2 David Freifelder, "Molecular Biology", 4th revised Jones & Bartlett Publisher. 2005.

3 Dr. P.K. Gupta, "Molecular Biology and Genetic Engineering"; 2nd Reprint. RastogiPublications, 2011.

Reference Books

1 Dr. P. K. Gupta, "A Text Book of Cell & Molecular Biology" 4th Revised Edition, RastogiPublications, 2015.

2 Robert Brooker, "Genetics: Analysis and Principles" 5th Edition, Publishing Pennsylvania Plazapublisher, 2014,

3 Dr. P.S. Vermaand V K Agarwal, "Genetics", S. Chand publishing, 2010.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester
IV

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
415BTT03	STOICHIOMETRIC AND PROCESS CALCULATIONS	3	1	0	4	50	50	100

Prerequisite Engineering mathematics III, Microbiology, Cell Biology

Course Objectives

At the end of the course ,the students should be able to:

- *To learn the basic principles of process calculations;*
- *To understand the calculations of mass flow rate in different processes employed in bio-chemical industries;*
- *Topredicttheenergyconsumptionandenergyefficiencyinchemicalprocessingindustries;*
- *To develop skills in the area of chemical engineering wit the mphasis on fluid mechanics*
- *To study the techniques and skills underlying fluid flow measurement.*

UNIT I BASIC PRINCIPLES OF MATERIALBALANCES AND ENERGY BALANCES **9+3**

Importance of material balance and energy balance in process industry-Dimensions, Units,Conversion factors and their uses; applied mathematics for experimental curve fitting; numerical differentiation; *Numerical Integration*

UNIT II MATERIAL BALANCES **9+3**

Overall and component balances; material balances without chemical reaction; material balances withchemical reactions-stoichiometric coefficient;degrees of freedom; recycle ratio calculations, purge ratio calculations; humidity calculations

UNIT III ENERGY BALANCES **9+3**

Overall and component balances; Calculation of heat capacity, specific heat capacity; partial pressure-calculations; Latent heats- calculations, energy balances- calculations. Sensible heat calculations; vapour pressure-calculations

UNIT IV FLUID MECHANICS **9+3**

Fluid – properties – compressible, incompressible fluids, Newtonian and Non Newtonian Fluids, Fluid statics for compressible & incompressible fluids- applications in chemical engineering, Fluid pressure dropcalculations. Pressure measuring devices.

UNIT V FLOW THROUGH PACKINGS AND FLUIDZATION **9+3**

FlowMeasurement-OrificeMeter,Venturimeter,Pitottube;Flowinpackedcolumns,flowinfluidizationcolumns, settlingphenomena-sedimentation,centrifugalpumps,*centripetalpumps*andpistonpumps-characteristics, working and its applications

Total Hours **45+15**

Upon Completion of this course, students will be able to :

Course Outcomes

CO 1: Knowledge of mathematics, science, and engineering
CO 2: Design and conduct experiments, as well as to analyze and interpret data
CO 3: Designasystem,component,orprocesstomeetdesiredneedswithinrealisticconstraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
CO4: Applytheirknowledgeindescribingthephysicalpropertiesoffluidandcalculatingthe pressure distribution for incompressible fluids and
CO5: Designasystem,component,or process to meet desired needs with in realistic constraints such aseconomic, manufacturability, and sustainability.

Text Books

1 McCabe, W.L., J.C. Smith and P.Harriot "Unit Operations of Chemical Engineering", 6th Edition,Mc Graw Hill, *2014.*

2 Bhatt, B.I. and S.M. Vora "Stoichiometry (SI Units)", 3rd Edition, Tata McGraw-Hill, *2014.*

3 K.A.Gavhane , "Introduction to process calculations" ,22 nd edition, Nirali Prakashan 2012

Reference Books

1 Himmelblau, D.M. "Basic principles and calculations in Chemical Engineering", 8thEdition,PHI,2013.

2 Geankoplis, C.J. "Transport Processes and Separation process Principles", 7th Edition, PHI,2012.

3 Foust, A.S. etal., " Principles of Unit Operations", 2nd Edition, John Wiley & Sons, *2014.*

4 Narayanan, K.V. and Lakshmi Kutty "Stoichiometry and Process Calculations",PHI, 2006.

5 Coulson, J.M. and etal. "Coulson & Richardson's Chemical Engineering", 7th Edition, Vol. I & II,Butterworth – Heinman (an imprint of Elsevier), 2011.

ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester IV

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
415BTT04	FUNDAMENTALS OF UNIT OPERATIONS	3	0	0	3	50	50	100

Prerequisite Basic Industrial Biotechnology, Microbiology

Course Objectives

At the end of the course ,the students should be able to:

- *To understand about dimensional analysis and empirical methods governing the transport ofmomentum (fluid flow) in chemical and biotechnology engineering systems;*
- *To analyze the scale-up of equipments for the production of biochemical products;*
- *To assimilate the basic concepts of solid-liquids preparation gained in earlier courses;*
- *To predict various modes of heat transfer and exchange operations in transportation of fluids*
- *To understand the techniques of unit operations involved in designing a heat transfer in bioprocess equipment applications.*

UNIT I MIXING AND AGITATION **9**

Dimensional analysis- Rayleigh and Buckingham's method; principles of agitation, impellers, flow patterns: power consumption and power correlationin Newtonian liquids. Blending and mixing, agitator selectionand scale up

UNIT II BASICS OF FILTRATION **9**

Theory of filtration and equations; constant pressure, constant volume, constant rate filtration, discontinuous filter, continuous vacuum filter: rotary drum filters, centrifugal filter: batch centrifuges

UNIT III MECHANISM OF HEAT TRANSFER **9**

Introduction to modes of heat transfer, Fourier's law of heat conduction, thermal conductivity, steady state conduction; compound resistances in series, extended surfaces; combined conductionandConvection

UNIT IV CONVECTION HEAT TRANSFER **9**

Convection-Forced and natural convection, heat flux, individual heat transfer coefficients, overall heat transfercoefficients and fouling factors, application of dimensional analysis for convection,heat transfer through boiling and condensation in pipes

UNIT V HEAT EXCHANGERS **9**

Heat exchange equipment; counter current and parallel-current flows, LMTD correction factor, heat exchangers: single-pass 1-1 exchanger, 1-2 parallel-counter flow exchanger, 2-4 exchanger, multipass exchanger,enthalpy balances, and condensers- shell-tube condensers

Total Hours **45**

Course Outcomes

Upon Completion of this course, students will be able to :

CO 1: To be familiar about dimensional analysis and empirical methods governing thetransportof momentum (fluid flow) in chemical engineering systems.

CO 2: Ability to improve the knowledge in techniques of agitation, mixing of liquids,filtration operations and sedimentation separation.
CO 3: To understand modes of heat transferring techniques during extraction, distillation, evaporation
CO4Evaluate effects of process variables while scaling up the bioprocess equipment
CO5Comprehend the important mechanical aspects while designing bioprocess equipment.

Text Books

1 McCabe W.L., Smith J.C. Unit Operations in Chemical Engineering.7th Edition. Mcgrawhill2014.

2 Dutta B.K, "Heat: Principles & applications", PHI publication 2000.

3 Gavahne.K.A., Unit Operations-I Fluid flow & mechanical separations, Nirali prakasan,2011.

4 Gavahne.K.A., Unit Operations-II Heat & Mass Transfer,Nirali prakasan,25th edition,2012.

Reference Books

1 Geankoplis C.J. Transport Processes and Unit Operations.4thedition,Prentice Hall India.2003.

2 Coulson J.M., Richardson J.F., Backhurst J.R. and Harker J.M., "Coulson & Richardson's Chemical Engineering", 6th Edition,Vol. I& II, Butterworth – Heinman (an imprint of Elsevier), 2004.

3 Donald Q. Kern, "*Process Heat Transfer*", Tata McGraw Hill Book Co., New Delhi, 1997.

4 Foust, A.S. "Principles of Unit Operations", 2nd Edition, John Wiley & Sons, 1999.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester IV

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
415BTT05	ENZYME TECHNOLOGY	3	0	0	3	50	50	100

Prerequisite Biochemistry, Cell Biology

Course Objectives

At the end of the course ,the students should be able to:

- *To provide knowledge and application of working principles and their mechanism of action onenzymes;*
- *To learn theoretical and practical aspects of kinetics;*
- *To improve knowledge in the area of immobilization techniques;*
- *To learn enzyme reactions and their characteristics along with the production and purification process*
- *To understand about the principles of Biosensors.*

UNIT I INTRODUCTION TO ENZYMES **9**

Classification of enzymes. Mechanisms of enzyme action- Lock and key and Induced fit model,; concept of active site, specificity of enzyme action; Enzyme units; principles of catalysis – collision theory, transition statetheory; role of entropy in catalysis

UNIT II KINETICS OF ENZYME ACTION **9**

Kinetics of single substrate reactions; Michelis – Menten equations, signification of Michelis – Menten equations,The lineweaver-burk plot, Eadie-hofstee and hanes plots: turnover number; types of inhibition – Competitive, uncompetitive and uncompetitive inhibition; Allosteric regulation of enzymes; Monod , wyman
model; pH and temperature effect on enzymes ; Deactivation kinetics.

UNIT III ENZYME IMMOBILIZATION **9**

Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages of enzyme immobilization, overview of applications of immobilized enzyme systems

UNIT IV PURIFICATION AND CHARACTERIZATION OF ENZYMES FROM NATURAL SOURCES **9**

Production and purification of crude enzyme extracts from plant, animal and microbial sources; methods of characterization of enzymes; development of enzymatic assays

UNIT V ENZYME BIOSENSORS **9**

Enzyme biosensors; Definition and Main component of biosensor, Advantages and disadvantages of enzyme biosensors, Example of an Enzyme biosensor- Electrochemical Biosensor, Blood Glucose Biosensor,Applications of biosensors in industry, healthcare and environment

Total Hours 45

Upon Completion of this course, students will be able to :

Course Outcomes

CO 1: Knowledge on enzyme and enzyme reactions will be key step towards variousconcepts in biotechnology

CO 2: Ideas on processing, production and purification of enzymes at an industrialscale

CO 3: Theoretical and practical aspects of kinetics will provide the importance towards theresults
CO4: Implement ideas on processing, production and purification ofenzymes on a nindustrial scale and
CO5: Design and novel biosensor products with better quality and wide commercialapplication.

Text Books

1 Harvey W. Blanch, Douglas S. Clark, "Biochemical Engineering", Marcel Dekker, .2006

2 James M. Lee, "Biochemical Engineering", PHI, USA.2001

3 Nicholas C.Price and Lewis Stevens, "Fundamentals of Enzymology",Oxforduniversity pres s1999

4 Trevor Palmer "Enzymes: Biochemistry, Biotechnology and Clinical Chemistry" Horwood,2001

Reference Books

1 James. E. Bailey & David F. Ollis, "Biochemical Engineering Fundamentals", McGraw- Hill.2001

2 Wiseman, "Enzyme Biotechnology", Ellis Horwood Pub.2003

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester IV

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
415BTE01	ENVIRONMENTAL BIOTECHNOLOGY	3	0	0	3	50	50	100

Prerequisite Environmental Science and Sustainability, Microbiology

Course Objectives

At the end of the course ,the students should be able to:

- *To understand the fundamentals of biotechnological concepts;*
- *To develop the skills in the are of environmental biotechnology and its pre-requisite(s)for PGstudies in Biotechnology;*
- *To know the conversion of waste into energy using microorganisms;*
- *To understand about the eco-friendly bioproducts from renewable sources and*
- *To improve the skills in the area of wastewater treatment technology.*

UNIT I BIOGEOCHEMICAL ROLE OF SOIL MIC ROORGANISMS **9**

Microbial flora of soil – Interactions among soil microorganisms – Nitrogen cycle – Carboncycle – Sulfur
cycle – Phosphorous cycle

UNIT II BIODEGRADATION **9**

Aerobic degradation of recalcitrant organic compounds by microorganisms – Growth associated degradation of aliphatic – Diversity of aromatic compounds – Co-metabolic degradation of organopollutants – Degradative capacities of fungi.Anaerobic degradation of organic compounds – Degradation of hydrocarbons – Alkyl compounds – ketones – Aromatic compounds – Halogenated organics – Sulfonates –Nitroorganics.

UNIT III BIOREMEDIATION TECHNOLOGIES **9**

Remediation technologies – Bioventing – Biosparging and bioslurping – Phytoremediation, Biodesulphurization of coal and oil – Microbial transformation of heavy metals –Bioleaching, bioaccumulation –Biosorption and bioprecipitation of heavy metals

UNIT IV ECO-FRIENDLY BIOPRODUCTS FROM RENEWABLE SOURCES **9**

Fundamentals of composting process – Composting technologies – Composting systems –Compost quality – Biofertilizers – Biopesticides – Scientific aspects and prospects of biofuelproduction – Bioethanol –Biohydrogen and biodiesel

UNIT V BIOLOGICAL TREATMENT OF WASTEWATER **9**

Biological processes for wastewater treatment – Physico-chemical characteristics of wastewater– Activatedsludge process – Trickling filter – Rotating biological contactors – Fluidized bed reactor –

Upflow anaerobic sludge blanket reactor (UASB) – High-rate anaerobic wastewatertreatment – Comparisonbetween aerobic and anaerobic processes

Total Hours **45**

Course Outcomes *Upon Completion of this course, students will be able to :*

CO 1: Development and improvement in standard ofliving
CO 2: Understand the dynamic process integrated themes related to biodiversityandwaste management
CO 3: Envisionthesurroundingenvironmentitsfunctionwithtechnology
CO4:Understandthestructureandbiochemicalaspectsofvariousmicrobesand
CO5:Acquirekknowledgeabouttherenewableformsofenergyanditsfeaturesofbiomassand its utilization

Text Books

1 Jordening, H.J. and Winter, J., "Environmental Biotechnology: Concepts andApplication", Wiley-VCH Verlag, 2005.

2 Evans, G.M. and Furlong, J.C., "Environmental Biotechnology: Theory andApplication", JohnWiley and Sons, 2003.

3 Bhattacharya, B.C. and Banerjee, R., "Environmental Biotechnology", OxfordUniversity Press,2007.

Reference Books

1 Pelczar, M.J., Chan, E.C.S. and Krieg, N.R., "Microbiology", Tata McGraw-Hill, 2005.

2 . Rittmann, B.E. and McCarty, P.L., "Environmental Biotechnology: Principles and Applications",McGraw-Hill, 2001.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester IV

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
415BTP07	MOLECULAR BIOLOGY LABORATORY	0	0	4	2	50	50	100

Prerequisite Cell biology and microbiology Lab

Course Objectives

At the end of the course ,the students should be able to:

- *Gain knowledge on the basis of measurements and instruments used in MolecularBiology;*
- *Provide hands-on experience in performing basic molecular biology techniques;*
- *Understand the theory behind each technique and to describe common applications of each methodology in biological research;*
- *Gain knowledge about separation of biological products;*
- *Take up specialized projects in Molecular biology which is a pre-requisite for research work*

List of experiments

1. Preparationofreagents,handlingequipmentsandlabsafetyinmolecularbiologylab
2. Agarose gelelectrophoresis
3. Isolation of genomic DNA-Plant Cells
4. Isolation of genomic DNA-Yeast Cells
5. Quantification of DNA using UVspectrophotometer
6. Transformation forrecombinants
7. Isolation of bacterial plasmid DNA
8. Competent cellspreparation
9. Southernblotting
10. Westernblotting

List of equipments needed

- Electrophoresis Kit
- Polymerase chain Research(PCR)
- Incubators
- MicroCentrifuge
- LightMicroscopes
- IncubatorShaker
- Spectrophotometer
- Laminar FlowChamber

Others: Glassware, Chemicals, Media

Course Outcomes

Upon Completion of this course, students will be able to get :

CO 1: Demonstrate knowledge and understanding techniques in molecularbiology

CO 2: Use genetic and biotechnological techniques to manipulate geneticmaterials and develops new and improved living organisms

CO 3: Present advanced knowledge in the specialized fields of molecular and Genetics

CO 4: Demonstrate the ability to carry out laboratory experiments and interpret the results;

CO5: Understandand be aware of hazardous chemicals and safety precautions incase of an emergency.

Reference Books

1 Michael P. Weiner "Genetic Variation: A Laboratory Manual" RainDance Technologies, 2007.

2 Robert Schleif "Genetics and Molecular Biology" 2nd Edition. The Johns Hopkins University Press.1993.

3 Carson, Susan, "Molecular Biology Techniques" 3rd Edition, Elsevier. 2012.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester IV

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
415BTP08	ENZYME TECHNOLOGY LABORATORY	0	0	4	2	50	50	100

Prerequisite Biochemistry

Course Objectives

At the end of the course ,the students should be able to:

- *To study about various parameters affecting the natural properties of enzymes.*
- *To provide hands on experience in enzyme production and purification techniques.*
- *Provide hands-on experience in performing enzyme production and purification techniques.*
- *To understand the students on enzyme characterization and immobilization methods.*
- *Introduce students to the theory behind in each technique and to describe common applications of each methodology in biological research. This will facilitate the students to takeup specialized project in enzyme production and purification will be a pre-*

Requisite for research work..

LIST OF EXPERIMENTS

1. Determination of activities of industrial enzymes.
2. Estimation of Vmax andKm.
3. Effect of pH on enzyme activity.
4. Effect of temperature on enzyme activity
5. Effect of substrate concentration on enzyme activity
6. Determination of stability of enzyme activity.
7. Production of microbial enzymes
8. Partial purification of enzymes
9. Characterization of enzymes
10. Immobilization techniques such as adsorption, entrapment and encapsulation.
11. Immobilization of yeast cells as biocatalyst for the production of ethanol from sugar.
12. Assaying of alkaline phosphatase activity

TOTAL PERIODS: 45

Upon Completion of this course, students will be able to get :

Course Outcomes

CO 1: Demonstrate the activity of enzyme with various factorsCO 2: Learnt the various process of enzyme immobilization CO 3: Awareness about various kinetic studies on enzymes
CO4Demonstratetheabilitytocarryoutlaboratoryexperimentsandinterprettheresults.
CO5 Explain about Enzyme kinetics and characterization and how to use them for

Reference Books

1 1. Practical Enzymology, 2nd Edition , By Hans Bisswange , Wiley-VCH Verlag GmbH &Co. KGaA, 2012.

2 2. Practical Biochemistry for Colleges by E. J. Wood, 1st Edition, Elsevier,1989.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department	BIOTECHNOLOGY	Programme	B. TECH. - BT	Regulation	2015

Semester IV

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
415BTP09	CHEMICAL ENGINEERING LABORATORY	0	0	4	2	50	50	100

Prerequisite Nil

Course Objectives

At the end of the course ,the students should be able to:

- *To provide basic understanding of chemical engineering principles*
- *Course will enable the students to apply the principles in other chemical engineering and biotechnology subjects offered in higher semesters*
- *To provide basic understanding of chemical engineering preparations*
- *To gain knowledge related to distillation*
- *To provide the overview about the heat exchanger*

LIST OF EXPERIMENTS

1. Flow measurement – a) Orifice meter b) Venturimeter
2. Pressure drop in flow through packed column
3. Pressure drop in pipes
4. Filtration – Vacuum leaf filter
5. Filtration – Plate and Frame filter press
6. Heat transfer characteristics in heat exchanger
7. Horizontal Condenser
8. Simple distillation
9. Steam distillation
10. HETP in packed column
11. Liquid-liquid equilibria in extraction
12. Adsorption equilibrium
13. Drying Characteristics in Tray Dryer

TOTAL PERIODS: 45

Course Outcomes

Upon Completion of this course, students will be able to get :

CO 1: Ability to apply the skill of unit process of chemical engineering andbiotechnology.
CO 2: Ability to analyse the principles of chemical engineering and its application on biological perspectives.
CO 3: Design and working principles of fluid moving machinery and transport phenomenon.CO 4: gained knowledge related to distillation
CO 5: Learned the overview about the heat exchanger

Reference Books

1 Geankoplis C.J. Transport Processes and Unit Operations. 4rd Edition, Prentice Hall India,2003.

1. McCabe

2 W.L.,SmithJ.C.UnitOperationsInChemicalEngineering.7thEditionMcgrawhill, 2014..

3 Dutta.B.K , Principles of Mass Transfer Separation processes, Prentice Hall India, 2000

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester V

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
515BTT01	IMMUNOLOGY	3	0	0	3	50	50	100

Prerequisite Microbiology

Course Objectives

At the end of the course ,the students should be able to:

- *To discuss the structure, functions and integration of immune system.*
- *To mechanisms involved in immune system development and responsiveness*
- *To explain various techniques of monoclonal and engineered antibodies*
- *To understand of activation of system of a complement. Receptors. Negative immuneregulation.*
- *To explain the antigen-antibody interactions and how the immune system isprotecting the body from foreign pathogens.*

UNIT I Introduction **9**

Cells and tissues of immune system; hematopoiesis; innate and acquired immunity; types of immune responses;antigens: chemical and molecular nature; haptens; adjuvants. Immunization and vaccines, Immunotechniques

UNIT II Humoral Response **12**

Development, maturation, activation and differentiation of B cells: Clonal purification theory; Structure andfunctions of antibodies: Genes and generation of diversity; Hybridoma technology for production of monoclonal antibodies- Antibody engineering, Kinetics of antibody response

UNIT III Cellular Response **10**

Development, maturation, activation and differentiation of T cells; and CMI (Cell mediate immunity), TCR;
Clonal Anergy; Antigen presenting cells: Macrophage, langerhan's cells and B cells- Antigen processing and presentation; Classes of MHC; MHC/HLA genetic loci; HLA alleles and diseases

UNIT IV Immunity to Infection and Hypersensitivity Reactions **7**

Immune response to infections: viruses, bacteria, fungi and parasites; Cytokines; Complement systems; Hypersensitivity and their types.

UNIT V Immunology of Transplantation, Autoimmunity And Tumor **7**

Transplantation: types of graft; mechanism of graft rejection; HVG and GVH rejection; immunologicalstrategies to prevent graft rejection; *Autoimmune diseases and their mechanism*Tumor immunity.

Total Hours **45**

Course Outcomes

Upon Completion of this course, students will be able to get :

CO1: Awareness of immune system structure and function

CO2: Awareness of immunity to various pathogens
CO3: Awareness of cellular and molecular aspects of lymphocyte activation, homeostasisdifferentiation, and memory.
CO4: Awareness of molecular basis of complex, cellular processes involved ininflammation and immunity, in states of health and disease
CO5: Awareness of tumour allergy and hypersensitivity reactions

Text Books

1 Ashim K. Chakravarthy," Immunology", Tata McGraw- Hill, 2010

2 Richard A Goldsby, Thomas J Kindt, Barbara A Osborne and Janis Kuby. "Immunology" 5th Edition, W.H. Freeman & Co., 2005

3 Benjamin E. and Leskowitz S. Immunology A short Course, Wiley Liss NY, 2010

4 William E. Paul "Fundamental Immunology", 7th edition, Library of congress cataloguing inpublications, 2013

5 Danny Altmann "Immunology", 12 th edition, British Society of Immunology, 2017.

Reference Books

1 Roitt I Male, Brostoff. "Immunology", Mosby Publ., 2017

2 Janeway,Travers, Walport and Shlomichik,(2001),"Immunobiology",Garland Publ.,2011

3 Ian R. Tizard." Immunology- An Introduction" 4th Edition. Thomson Publ., 2013

4 Andrew H. Lichtman,Shiv Pilla,Abul K. Abbas, Cellular & Molecular Immunology, 7th edition, south AsiaPublication, 2011

5 Dr.S.K.Gupta, "Essentials of Immunology", 2nd edition, Arya Publications, 2010.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester V

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
515BTT02	GENETIC ENGINEERING	3	0	0	3	50	50	100

Prerequisite Molecular Biology

Course Objectives

At the end of the course ,the students should be able to:

- *To understand the principle of nucleic acid isolation.*
- *To understand the principles of PCR and their uses in genetic engineering.*
- *To gain a thorough knowledge about nucleic acid hybridization.*
- *To learn history of DNA sequencing and current methods and gene synthesis*
- *To understand the genetic hypothesis*

UNIT I BASICS OF RECOMBINANT DNA TECHNOLOGY **9**

Introduction of recombinant DNA into host cells, manipulation of DNA – Restriction and modification enzymes, Design of linkers and adaptors; Characteristics of cloning and vectors; prokaryotic and eukaryotic host systems.

UNIT II POLYMERASE CHAIN REACTION TECHNIQUES **9**

Principle of polymerase chain reaction (PCR) - Components of PCR reaction and optimization of PCR - Gene specific primer and degenerate primer – Inverse PCR, Hot-start PCR, Loop mediated PCR -, Reversetranscription PCR and Real time PCR.

UNIT III PROTEIN TECHNIQUES **9**

Electrophoresis of protein – native and denaturing conditions, capillary and gel electrophoresis, 2D gel electrophoresis, Enzyme-linked immunosorbent assay, yeast hybrid system – one hybrid system – two hybrid system, phage display.

UNIT IV TESTING OF GENETIC HYPOTHESIS **9**

Probability in the prediction of progeny distributions using Binomial distribution, Genetic hypothesis, Chi-squaremethod, Genetic analysis of quantitative traits using Statistics (Mean, Variance, Standard deviation, Correlation, Regression), Heritability is useful in predicting the phenotypes of offspring.

UNIT V TRANSGENIC TECHNOLOGY **9**

Principles of Transgene Technology. Scope of Transgenetic Technology. Gene tagging (T-DNA tagging andTransposon tagging) in gene analysis (identification and isolation of gene), Transgenic and Gene Knockouts Technologies-Targeted gene replacement, Chromosome engineering.

Total Hours 45

Course Outcomes

Upon Completion of this course, students will be able to :

CO:1. Understand the basics of biotechnology

CO:2 Understand the value of and the processes involved with the polymerase chainreaction (PCR).

CO:3 Understand the concept of recombinant DNA technology or genetic engineeringCO:4 Analyze a research problem and step-by-step instructions for conducting experiments or testing hypothesis

CO:5 Explain the general principles of generating transgenic plants, animals and Genetically modified organisms.

Text Books

1 Klug, Cummings and Spencer. "Concepts of Genetics" published Pearson, 2016.

2 Daniel L. Hartl, Maryellen Ruvolo. "Genetics: Analysis of Genes and Genomes" 8th Edition, PublishedLaxmi (Pvt. Ltd). 2011.

Reference Books

1 Gardner,Simmonsand Snustad. "Principles of Genetics" 8th Edition, Published, Wiley.2006

2 Benjamin A. Pierce. "Genetics: A Conceptual Approach" 4th Edition, Published, W H Freeman &Co. 2010.

3 Scott F. Gilbertand Susan R. Singer. "Developmental Biology (Developmental Biology DevelopmentalBiology)"9th Edition, Published, Sinauer Associates, 2010.

4 Robert J. Brooke, "Genetics: Analysis and Principles" 4th Edition, McGraw-Hill Higher Education, 2012.

5 Smita Rastogiand Neelam Pathak. "Genetic Engineering (Oxford Higher Education)" 1st Edition, OxfordUniversity Press, 2009.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester V

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
515BTT03	BIOPROCESS ENGINEERING I	3	0	0	3	50	50	100

Prerequisite Microbiology, Basic Industrial Biotechnology

Course Objectives

At the end of the course ,the students should be able to:

- *To study the historical development of bio process technology, design of fermenter andtypes of fermentation process*
- *To gain knowledge about formulation, optimization of medium and principles of sterilization*
- *To inculcate the stoichiometry and energetics of cell growth and product formation*
- *To evaluate the kinetics and mechanism of microbial growth*
- *To gain knowledge related to the processing of fermentor*

UNIT I OVERVIEW OF FERMENTATION PROCESSES **9**

Introduction to bioprocessing: Historical development of Bioprocess technologies, General requirements of fermentation processes, Basic design and construction of fermenters and ancillaries, Main parameters to be monitored and controlled in fermentation processes. Solid-state fermentation and its applications.

UNIT II RAW MATERIALS AND MEDIA DESIGN FOR FERMENTATION PROCESS **9**

Criteria for good medium, medium requirements for fermentation processes, carbon, nitrogen, minerals, vitaminsand other complex nutrients, oxygen requirements, Medium Formulation: Types of media – media design and usage of various commercial media for industrial fermentations, Medium optimization.

UNIT III STERILIZATION KINETICS **8**

Thermaldeathkineticsofmicroorganisms,Batchandcontinuousheatsterilizationofliquidmedia,Filter sterilization ofliquid media, Air sterilization and design of sterilizationequipment.

UNIT IV METABOLIC STOICHIOMETRY AND ENERGETICS **10**

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.

UNIT V KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION **10**

PhasesofCellgrowthinbatchcultures,Simpleunstructuredkineticmodelsformicrobialgrowth,growthof filamentousorganisms, product formation kinetics – Leudeking - Piret models, substrate andproduct inhibition on cell growth and product formation.

Total Hours **45**

Course Outcomes

Upon Completion of this course, students will be able to :

CO1:Develop skills of the students in the area of bioprocess technology with the emphasis andbioprocess principles

CO 2:Discuss and distinguish the medium requirements and optimization methodsCO 3:Explain the sterilization kinetics of medium and equipments

CO 4:Learn about fermentation processes, metabolic stoichiometry, energetics, kinetics of microbialgrowth etc

CO 5:Understand the kinetics of microbial growth that plays a vital role in the fermentation process

Text Books

1 Pauline. M. Doran, "Bioprocess Engineering Principles", Academic press, 2012.

2 Stanbury. P. F, Whitaker. A and Hall. S. J, "Principles of Fermentation Technology", 2nd Edition,Butterworth– Heinemann, 1995.

Reference Books

1 Najafpour. G. D, "Biochemical Engineering and Biotechnology", Elsevier, 2007.

2 Shuler. M. L and Kargi. F, "Bioprocess Engineering: Basic Concepts" 2nd Edition, Pearson, 2002.

3 Bailey. J. E and Ollis. D. F, "Biochemical Engineering Fundamentals", 2nd Edition, McGraw-Hill,2010.

4 Blanch. H. W and Clark. D. S, "Biochemical Engineering". Marcel & Dekker, Inc., 2007.

5 Rao. D. G, "Introduction to Biochemical engineering" ", 2nd Edition, McGraw-Hill, 2010.

ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR- 635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester V

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
515BTT04	Fundamentals of Mass Transfer	3	1	0	4	50	50	100

Prerequisite Fundamentals of Unit Operations

Course Objectives

At the end of the course ,the students should be able to:

- *Explain the basic principles of mass transfer operations and other separationprocesses with examples.*
- *Impart knowledge on how certain substances undergo the physical change withdiffusion/mass transfer of components from one phase to other phases.*
- *Focus on absorption and distillation operations and the process design aspects ofthe same operations.*
- *Understand extraction and leaching operations and their applications inbioprocessing industry.*
- *Understand adsorption and drying operations and the process design aspects ofthe same operations.*

UNIT I DIFFUSION AND MASS TRANSFER **9+3**

Diffusion: Molecular diffusion, Fick's law of diffusion, steady state molecular diffusion in gases and liquid one component transferring to non diffusing component and equimolar diffusivity estimation, Inter phase Mass Transfer; Mass Transfer coefficients, Concept of overall mass transfer coefficient for liquids and gases, diffusivity measurement and prediction.

UNIT II GAS LIQUID OPERATIONS **9+3**

Principles of gas absorption; Single component absorption in single and multistage operation; selection criteria forsolvents, material balance, minimum gas-liquid ratio, Design principles of packed absorbers-HETP, HTU and NTU concepts, Industrial absorbers.

UNIT III VAPOUR LIQUID OPERATIONS **9+3**

V-L Equilibria, P-x-y and T-x-y diagrams, relative volatility, Raoult's law; Ideal behavior of fluids, types ofDistillation-Simple,SteamandFlashDistillation;Continuousdistillation;Designcalculations-McCabe–Thiele method,Conceptofminimum,totalandoptimumrefluxratio,deviations from ideality - Extractive distillation and Azeotropic distillation.

UNIT IV EXTRACTION OPERATIONS **9+3**

Liquid- liquid extraction: distribution coefficient, ternary systems and triangular diagrams, solvent selection criteria for extraction, single stage and multistage extraction – immiscible system, extraction equipments. Solid- liquid equilibria, Leaching Principles, constant underflow staged processes - Single stage leaching, multistage counter current leaching, Leaching equipments – Batch and continuoustypes.

UNIT V SOLID FLUID OPERATIONS **9+3**

Types of adsorption, Nature of adsorbents, Langmuir and Freundlich isotherm, calculation of staged processes, adsorption equipments – Batch and fixed bed adsorption; Drying - Mechanism, Drying curves-Time of Drying calculation; Batch and continuous drying equipments.

Total Hours 60

Course Outcomes

Upon Completion of this course, students will be able to :

CO1:definethebasicprinciplesofmasstransferoperationsandthemeasurementofdiffusivity, masstransfer coefficient;
CO2:understandtheimportanceofmasstransferphenomenainthedesignofprocessequipmen t in distillation operations;
CO 3: understand the HETP, NTU and HTU concepts of various gas absorption packed towercolumns;
CO 4: understand the design aspects of extraction and various leaching equipments and
CO 5:understand the importance of adsorption and drying processes and their industrial applications.

Text Books

1 Geankoplis C J. "Transport process and separation process principles", 4th edition, Prentice Hall ofIndia. 2003
2 Anantharaman N. and Meera Sheriffa Begum K.M. "Mass Transfer - Theory and Practice", New Delhi: PHI Learning Private Limited. 2011
3 Treybal R.E. Mass Transfer Operations.3rd edition. McGraw-Hill, 1981.

Reference Books

1 Warren L.Mc Cabe, Julian C.Smith, Peter Harriot. "Unit Operations of Chemical Engineering", 7thedition, New Delhi: McGraw Hill. 2012
2 Ghosal, S. K., Sanyal S. K. & Datta S.. "Introduction to Chemical Engineering", New Delhi: Tata McGraw Hill. 2006
3 Benitez J, Principles and modern applications of Mass Transfer Operation, Wiley, 2009.
4 Coulson and Richardson, "*Chemical Engineering*". Vol I & II, New Delhi:Asian Books Pvt Ltd, 1998.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department	**BIOTECHNOLOGY**	**Programme**	**B. TECH. - BT**	**Regulation**	**2015**
		Semester V			

		Hours/Week			**Credit**	**Maximum Marks**		
515BTT05	**CHEMICAL THERMODYNAMICS AND BIOTHERMODYNAMICS**	**L**	**T**	**P**	**C**	**CA**	**EA**	**Total**
		3	**0**	**0**	**3**	**50**	**50**	**100**

Prerequisite Stoichiometry and process calculations

Course Objectives

At the end of the course the students should able to

- *To study about the ideal and non-ideal behavior properties of fluids*
- *To understand about the determination of solution on thermodynamic properties*
- *To deal thermodynamic properties of fluids on its equilibrium in phase change*
- *To deal thermodynamic properties of fluids on its chemical reaction under equilibriumcondition*
- *To analyse the energy in process on behavior with its properties*

UNIT I THERMODYNAMIC PROPERTIES OF FLUIDS **9**

Basics concepts in thermodynamics, Volumetric properties of fluids exhibiting non ideal behaviour; residual properties; estimation of thermodynamic properties using equations of state; calculations involving actualproperty exchanges; Gibbs Helmhotz Equation, Maxwell's relations and applications.

UNIT II SOLUTION THERMODYNAMICS **9**

Partial molar properties; concepts of chemical potential and fugacity; ideal and non-ideal solutions; concepts andapplications of excess properties of mixtures; activity coefficient; composition models; Gibbs Duhem equation.

UNIT III PHASE EQUILIBRIA **9**

Criteria for phase equilibria; v-l-e calculations for binary and multi component systems; Bubble point, Dew point Calculation, liquid-liquid equilibria and solid-solid equilibria.

UNIT IV CHEMICAL REACTION EQUILIBRIA **9**

Equilibrium criteria for homogeneous chemical reactions; evaluation of equilibrium constant; effect of temperature and pressure on equilibrium constant; calculation of equilibrium conversion and yields for single and
multiple reactions.

UNIT V THERMODYNAMIC ANALYSIS OF PROCESSES **9**

Concept of lost work; entropy generation; calculation of real irreversible processes; power cycle; liquefaction, Carnot Cycle, Biothermodynamics.

Total Hours **45**

Course Outcomes

Upon completion of this course, students will be able to

CO:1 Knowledge on ideal and non-ideal behaviour in thermodynamics on properties offluids

CO:2 Knowledge on solutions thermodynamics to determine the properties in the processes.

CO:3 Description of properties criteria in order to maintain the phase change coexistin equilibrium

CO:4Description of properties criteria in order to maintain the chemical reactionscoexist in equilibrium

CO: 5 Knowledge on energy utilization and to interpret thermodynamic properties data in thebio processing operations.

Text Books

1 Narayanan K.V. A Text Book Of Chemical Engineering Thermodynamics. Prentice Hall India,Eighth Edition 2013.

2 Smith J.M., Van Ness H.C., Abbot M.M. Chemical Engineering Thermodynamics. 6th Edition.McGraw-Hill, 2005

Reference Books

1 Sandler S.I. Chemical and Engineering Thermodynamics. John Wiley, 3 edition 1998.

2 B.G.Kyle,"Chemical process thermodynamics",2nd Edn., Prectice Hall of India Pvt.Ltd.,New Delhi 2000.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department	BIOTECHNOLOGY	Programme	B. TECH. - BT	Regulation	2015
		Semester V			

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
515BTP07	IMMUNOLOGY LABORATORY	0	0	4	2	50	50	100

Prerequisite Microbiology, cell biology lab

Course Objectives

At the end of the course ,the students should be able to:

- *To state the principle of the routine immunologic procedures performed in theclinical laboratory.*
- *To describe the immunologic responses involved in preventing andcombating infections.*
- *To understand the role of antibodies in the immune response*
- *To understand the molecular specificity of antibodies for specificantigens*
- *To simulate the spread of an infectious disease and determine it'ssource with an ELISA assay*

LIST OF EXPERIMENTS

1. Handling of animals, immunization and raising antisera
2. Identification of Blood cells
3. Differential count of white blood cells
4. Blood grouping (ABO & Rh factor)
5. Widal Test (Slide & Tube Test)
6. Ouchterlony doubles immune diffusion technique (ODD)
7. Radial immune diffusion (RID)*(mancini method)*
8. Immunoelectrophoresis
9. Isolation of monocytes from blood
10. Isolation of peripheral blood mononuclear cells Identification of T cells by T cell resetting using sheep RBC.
11. Enzyme Linked Immuno Sorbent Assay
12. Western Blotting

Total Hours 45

Upon Completion of this course, students will be able to get :

Course Outcomes

CO 1: Awareness of basic and state-of-the-art experimental methods and technologies CO2: Awareness to develop an ability to summarize, integrate and organize informationand relate it to disease outcomes

CO3: Awareness to evaluate the potential for current research and new discoveries toimprove our understanding of immunology and its relevance to human health and to our society.
CO4: Awareness to use medical case reports, identify "disease defects" and definemolecular or cellular targets for therapeutic intervention:
CO5: Awareness to understand basic mechanisms and preventive therapeutic implications

Text Books

1. Ashim K. Chakravarthy," Immunology", Tata McGraw- Hill, 2010
2. Richard A Goldsby, Thomas J Kindt, Barbara A Osborne and Janis Kuby. "Immunology" 5th Edition, W.H. Freeman & Co., 2005
3. Benjamin E. and Leskowitz S. "Immunology A short Course", Wiley Liss NY, 2010
4. Mark Peakman and Leonie Taams, "Clinical & Experimental Immunology", 12th edition, British Societyfor Immunology, 2017.
5. Frank C. Hay,Olwyn M. R. Westwood"Practical Immunology", 4th Edition Wiley BlackwellPublications, 2010

Reference Books

1 Talwar, G.P and Gupta, S.K. 2004" A Handbook of practical and immunology", CBS Publishers & Distributors.
2 Janeway,Travers, Walport and Shlomichik,(2001),"Immunobiology",Garland Publ.,2011
3 Ian R. Tizard." Immunology- An Introduction. 4th Edition". Thomson Publ., 2013
4 J Ochei and A.Kolhatlkar "Medical Laboratory Science Theory and Practice" by PPM Publishers. 1999.
5 Barbara Detrick, Robert G. Hamilton, John L. Schmitz "Manual of Molecular and Clinical LaboratoryImmunology", 8th edition ASM Press, 2016

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester V

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
515BTP08	GENETIC ENGINEERING LABORATORY	0	0	4	2	50	50	100

Prerequisite Molecular biology lab

Course Objectives

At the end of the course ,the students should be able to:

- *To illustrate creative use of modern tools and techniques for manipulation andanalysis of genomic sequences.*
- *To expose students to application of recombinant DNA technology inbiotechnological research.*
- *To understand research methodologies employing genetic engineeringtechniques.*
- *To understand the principles of PCR and their uses in genetic engineering.*
- *To understand the principles of blotting*

LIST OF EXPERIMENTS

1. Isolation of plasmid DNA
2. Restriction enzyme digestion
3. Purification of digested DNA- Gel Elution
4. Preparation of competent cells
5. Transformation and screening in *E. coli*
6. β-galactosidase assay
7. DNA cloning
8. PCR
9. DNA finger printing
10. SDS-PAGE
11. Western blotting
12. Southern blotting

Total Hours **45**

Course Outcomes

Upon Completion of this course, students will be able to :

CO1: Technical know-how on versatile techniques in recombinant DNA technology.*CO2: An ability to design and conduct experiments, as well as to analyze and interpretdata*

CO3: Apply of genetic engineering techniques in basic and applied experimentalbiology.

CO4: Develop proficiency in designing and conducting experiments involving geneticmanipulation.

CO5:An ability to use the techniques, skills, and modern engineering tools necessary forengineering practice.

Text Books

Isil Aksan Kurnaz, "Techniques in Genetic Engineering" Published, CRC Press, 2015

David Micklos "Genome science a practical and conceptual introduction to molecular genetic analysis in eukaryotes" 1st Edition, Published, Cold Spring. 2013
Rolf H. J. Schlegel, "Rye: Genetics, Breeding, and Cultivation" Published, CRC Press. 2013
T A Brown "Introduction to Genetics: A Molecular Approach" Published, Garland Science. 2011.
Setlow, Jane K. "Genetic Engineering- Principles and Methods" Published, Plenum. 2003

Reference Books

1 Isil Aksan Kurnaz, "Techniques in Genetic Engineering" Published, CRC Press. 2015.
2 DR. P.S. VERMA and V K Agarwal. "Genetic Engineering" Publishded, S. Chand Publishing. 2009.
3 Utpal Roy and Vishal Saxena. "A Handbook of Genetic Engineering" 47th, Edition, Published,Kalyani. 2007.
4 Vennisonand S John. "Laboratory Manual for Genetic Engineering" published, Prentice Hall India Learning Private Limited. 2009.
5 C.C. GiriandArchana Giri. "Plant Biotechnology: Practical Manual" Published, I K International Publishing House Pvt. Ltd. 2007

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department	**BIOTECHNOLOGY**	**Programme**	**B. TECH. - BT**	**Regulation**	**2015**

Semester V

		Hours/Week			**Credit**	**Maximum Marks**		
515BTP09	**BIOPROCESS ENGINEERING LABORATORY - I**	**L**	**T**	**P**	**C**	**CA**	**EA**	**Total**
		0	**0**	**4**	**2**	**50**	**50**	**100**

Prerequisite **Bioprocess principles theory**

Course Objectives

At the end of the course the students should able

- *To develop basic experimental skills for preparing medium and sterilization.*
- *To provide practical understanding of effect on parameters on cell growth*
- *To provide training on upstream processes technology*
- *To provide knowledge on preparation and utilization offer mentor*
- *To provide knowledge on production primary and secondary metabolite.*

LIST OF EXPERIMENTS

1. Preparation of bioreactor, utilizes for bioreactor
2. Medium preparation and sterilization
3. Effect of temperature on cell growth
4. Effect of pH on cell growth
5. Monod kinetics
6. Growth of bacteria-Estimation of biomass, calculations of specific growth rate, yield coefficient
7. Growth of Yeast-Estimation of biomass, calculations of specific growth rate, yield coefficient
8. Effect of substrate inhibition on cell growth
9. Production of primary metabolites
10. Production of secondary metabolites
11. Medium optimization-Plackett burmandesign
12. Medium optimization-Response surface methodology
13. Single cell protein (SCP) production by continuous culture

TOTAL HOURS 45

Course Outcomes

Upon completion of this course, students will be able to have

CO:1 Knowledge on preparation of medium and sterilization in upstream processesCO:2 Knowledge on optimization of cell growth

CO:3 Exposure to upstream processes and preparation before the fermentation

CO:4 Knowledge on preparation and utility of bioreactor

CO:5 Knowledge on production of metabolites in lab scale fermentor

Text Books

1 S. Kulandaivelu and S. Janarthanan,"Practical Manual on Fermentation Technology" IK International publishling house, NewDelhi ,2012

2 Palvannan T, Shanmugam S, Satish Kumar T,"Laboratory Manual On Biochemistry, Bioprocess & Microbiology", Scitech Publications (India) Pvt Lt ,2006

Reference Books

1 Sarfaraz K. Niazi, Justin L. Brown," Fundamentals of Modern Bioprocessing"CRC Press, 2015

2 Pauline Doran, "Bioprocess Engineering Calculation", Blackwell Scientific Publications, 1998.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester VI

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
615BTT01	BIOINFORMATICS	3	0	0	3	50	50	100

Prerequisite Basics of computing and C programming

Course Objectives

At the end of the course ,the students should be able to:

- *To develop interdisciplinary skills in the applications of computers in biotechnology.*
- *To navigate through internet-based biological databases and genomic browsers*
- *To let the students know the recent evolution in biological science.*
- *To develop the knowledge related to phylogenetic tree*
- *To gain knowledge related to tools used in bioinformatics*

UNIT I INTRODUCTION **9**

Introduction to Bioinformatics – applications, Operating systems- types, Elementary UNIX commands, TCP/IP, Telnet, FTP, Protocols, Hardwares, Network topology, Search engines.

UNIT II BIOLOGICAL DATABASES **9**

Introduction to databases – Data life cycle Biological databases; Primary nucleotide databases (EMBL, GeneBankand DDBJ); Primary protein databases (SwissProt) Secondary protein databases (PROSITE); Structural databases – SCOP and CATH. Sequence retrieval from database

UNIT III PATTERN MATCHING AND DYNAMIC PROGRAMMING **9**

Introduction to pairwise sequence alignment – local vs. global; Dynamic programming – Needleman – Wunsch algorithm & Smith – Waterman algorithm; Dot matrix analysis; substitution matrices,BLAST – FASTA-
– Statistical methods – Hidden Markovmodels.

UNIT IV PHYLOGENY **9**

Introduction to multiple sequence alignment, Introduction; mutations; mutations as a measure of time;PhylogeneticanalysisDistance matrix methods, character based methods.Molecular clock theory, Bootstrapping.

UNIT V ADVANCED TOPICS IN BIOINFORMATICS **9**

Introduction to Systems Biology and Synthetic Biology, Microarray analysis - types andapplications, Bioinformatics approaches for drug discovery.

Total Hours **45**

Upon Completion of this course, students will be able to get :

Course Outcomes

CO1: Develop bioinformatics tools with programming skills.
CO2: Apply computational based solutions for biological perspectives
.CO3: Pursue higher education in this field.
CO4: Practice life-long learning of applied biological science.CO5: Developed the knowledge related to phylogenetic tree

Text Books

1 Lesk, A. K., "Introduction to Bioinformatics" 4th Edition, Oxford University Press, 2013

2 Dan Gusfield, "Algorithms on Strings, Trees and Sequences: Computer Science andComputationalBiology" Cambridge University Press, 1997.

3 Durbin, R., Eddy, S., Krogh, A., and Mitchison, G., "Biological Sequence AnalysisProbabilisticModels of proteins and nucleic acids" Cambridge, UK: CambridgeUniversity Press, 1998.

4 Mount, D.W., "Bioinformatics Sequence and Genome Analysis" 2nd Edition, Cold SpringHarborLaboratory Press, 2004

5 Bergeron.B. Bioinformatics Computing, 2ndEdition, Prentice Hall of India Learning Pvt (Ltd), India,(2009).

Reference Books

1 Attwood, T.K and ParrySmith.D.J. Introduction to Bioinformatics, 1stEdition, Pearson EducationAsia, India, (2002).

2 Uri Alon, An Introduction to Systems Biology: Design Principles of Biological Circuits,Chapman&Hall, 2006.

3 Andreas D. Baxevanis, B. F. Francis Ouellette: Bioinformatics: A Practical Guide to the AnalysisofGenes and Proteins, Volume 39, John Wiley, 1998

4 Baldi, P. and Brunak, S., "Bioinformatics: The Machine Learning Approach" 2ndEdition,MITPress, 2001.

5 J. Pevsner, Bioinformatics and Functional Genomics, 2ndEdn.,Wiley-Blackwell, 2009.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester VI

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
615BTT02	CHEMICAL REACTION ENGINEERING	3	1	0	4	50	50	100

Prerequisite Stoichiometric and process calculations

Course Objectives

At the end of the course ,the students should be able to:

- *To impart the basic concepts in reaction kinetics*
- *To provide the information about different reactor systems and deriving the performance equations for different reactor systems.*
- *To develop knowledge for design of ideal reactors and RTD studies*
- *To acquire knowledge in heterogeneous reactions and reactor types.*
- *To gain knowledge related to various types of reactor*

UNIT I SCOPE OF CHEMICAL KINETICS & CHEMICAL REACTIONENGINEERING 9+3

Introduction to Chemical kinetics; rate equation, rate constant, elementary and non- elementary reactions; concentration and temperature dependence; development of rate equations for different homogeneous reactions,

Search for reaction mechanism; Interpretation of batch reactor data-Integral and differentialmethod of analysis (constant volume batch reactor).

UNIT II IDEAL REACTORS 9+3

Isothermal batch, flow, semi-batch reactors; performance equations for single reactors - batch, plug flowand mixed flow reactors; space time and space velocity; multiple reactor systems; multiple reactions.

UNIT III IDEAL FLOW AND NON IDEAL FLOW 9+3

Basics of non ideal flow; RTD function and measurement, RTD in plug flow and mixed flow reactor, relationamong E, F and C curve, conversion in non ideal flow, non-ideal flow models- tank in series and dispersion models; reactor performance with non-ideal flow.

UNIT IV UNIT IV GAS-SOLID, GAS-LIQUID REACTIONS 9+3

Resistances and rate equations; heterogeneous catalysis; reactions steps; selection of a model, unreactedcore models for spherical particles - progressive conversion model and shrinking core model , determination of rate controlling step.

UNIT V **FIXED BED AND FLUID BED REACTORS** **9+3**

G/L reactions on solid catalysis; trickle bed, slurry reactors; three phase-fluidized beds; reactors for fluid-fluid reactions; tank reactors.

Total Hours 60

Course Outcomes

Upon Completion of this course, students will be able to get :CO1: Write the rate equation for any type of chemical reaction.

CO 2: Relate and calculate theconversions,concentrations and rates in a reaction and identify, formulate and solve chemical engineering problems.

CO 3: Design reactors for heterogeneous reactions and optimize operating conditions.

CO 4 understood the concept of RTD

CO 5 gained knowledge about the reaction catalysis

Text Books

1 Levenspiel O. Chemical Reaction Engineering. 3rd Edition. John Wiley.1999.

2 Fogler H.S. Elements of Chemical Reaction Engineering. Prentice Hall India.2002

3 Mark E.Davis and Robert J.Davis, Fundamentals of Chemical Reaction Engineering, McGraw-Hill HigherEducation; 1st edition 2002

Reference Books

1 MissenR.W.,MimsC.A.,SavilleB.A.IntroductiontoChemicalReactionEngineeringandKinetics. JohnWiley.1999

2 Dawande, S.D., "Principles of Reaction Engineering", I st Edition, Central Techno Publications, 2001.

3 Richardson, J.F. and Peacock, D.G., "Coulson Richardson - Chemical Engineering", Vol.III, III rd Edition, Butterworth- Heinemann- Elsevier, 2006.

ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester VI

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
615BTT03	BIOPROCESS ENGINEERING-II	3	1	0	4	50	50	100

Prerequisite Bioprocess Engineering – I and Fundamentals of Mass Transfer

Course Objectives

At the end of the course ,the students should be able to:

- *To impart the basic of different operational modes of bioreactors*
- *Todevelopknowledgefordesignaspectsofbioreactorscaleupforvarioussystems*
- *Toacquireknowledgeinrectorconsiderationforenzymesystemsandmodeli ngand simulation of bioprocess.*
- *To develop knowledge in recombinant cultivation systems.*
- *To gain knowledge about the scale up process*

UNIT I OPERATIONAL MODES OF BIOREACTORS **9+3**

Fed batch cultivation, Cell recycle cultivation, Cell recycle cultivation in waste water treatment, twostage cultivation Packed bed reactor, airlift reactor, fluidized bed reactor bubble column reactors.

UNIT II BIOREACTOR SCALE – UP **9+3**

Regime analysis of bioreactor processes, oxygen mass transfer in bioreactors - microbial oxygen demands; methods for the determination of mass transfer coefficients; mass transfer correlations. Scale upcriteria for bioreactors based on oxygen transfer, power consumption and impeller tip speed.

UNIT III BIOREACTOR CONSIDERATION IN ENZYME SYSTEMS **9+3**

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

UNIT IV MODELLING AND SIMULATION OF BIOPROCESSES **9+3**

Study of structured models for analysis of various bioprocess – compartmental models, models of cellular energetics and metabolism, single cell models, plasmid replication and plasmid stability model. Dynamic simulation of batch, fed batch, steady and transient culture metabolism.

UNIT V RECOMBINANT CELL CULTIVATION **9+3**

Different host vector system for recombinant cell cultivation strategies and advantages. E.coli, yeast *Pichiapastoris/ Saccharomyces cereviseae*, Animal cell cultivation, plant cell cultivation, Insect cell cultivation. High cell density cultivation, process strategies, reactor considerations in the above system

Total Hours 45+15

Course Outcomes

Upon Completion of this course, students will be able to get :CO1: Analyze various operational modes of bioreactor systems

CO 2: Capability to design bioreactor system for various industrial applications.

CO 3: Understand and modeling different bioreactor systems with advanced modeling concepts.

CO 4: Demonstrate recombinant cultivation of various plant, animal and systems for industrial applications.

CO 5 understood the concept of cultivation technologies

Text Books

1 James E. Bailey & David F. Ollis, "Biochemical Engineering Fundamentals", McGraw-Hill 2000

2 Anton Moser, "Bioprocess Technology", Kinetics and Reactors", Springer Verlag.1999

3 Shuler and Kargi, "Bioprocess Engineering ", Prentice Hall, 1992.

Reference Books

1 James M. Lee, "Biochemical Engineering", PHI, USA 2002.

2 Pauline Doran, "Bioprocess Engineering Calculation", Blackwell Scientific Publications 1998.

3 Harvey W. Blanch, Douglas S. Clark, "Biochemical Engineering", Marcel Decker Inc 2001.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester VI

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
615BTT05	PLANT BIOTECHNOLOGY	3	0	0	3	50	50	100

Prerequisite Molecular Biology

Course Objectives

At the end of the course ,the students should be able to:

- *Tointroducestudentstotheprinciples,practicesandapplicationofplanttissueculture*
- *Learn about the transformationinscience,agricultureandindustry.*
- *Toacquaintstudentswithexperimentaldesignandanalysisofplantbiotechnology experiments.*
- *Togivestudentshandsonexperienceandtraininginrepresentativeplanttissueculture and geneticengineering techniques.*
- *To give student wide knowledge related to practical aspects of gene transfer*

UNIT I INTRODUCTION TO PLANT BIOTECHNOLOGY: AN OVERVIEW **9**

History of plant Biotechnology, Scope and significance of Plant Biotechnology, Plant Tissue Culture as atechnique to produce novel plants and hybrids, Different types of tissue culture medium and their constituents. Plant growth hormones.

UNIT II PLANT CELL AND TISSUE CULTURE **9**

Types of cell culture: culture of single cells, cell and organ differentiation. Stages of micropropagation. Choice of plant species for micropropagation, production of virus free plants:protoplast isolation, micropropagation work inIndia

UNIT III GENE TRANSFER TO NUCLEAR GENOME **9**

Time line for utilization of gene transfer technology (event). Target cells for transformation: vector for genetransfer technology. Ti and Ri plasmids of *Agrobacterium*. Gene transfer methods: Agro-infection and gene transfer, physical delivery method.

UNIT IV PLANT BIOTECHNOLOGY FOR AGRICULTURAL PRACTICES **9**

Biopesticides and Bioinsecticides, Integrated pest management. A total system or ecological approach of IPM. Present status and future needs for making biopesticides and IPR popular. Biofertilizers and integratednutrients management.

UNIT V PLANT BIOTECHNOLOGY FOR ENVIRONMENT **9**

Environment, bioenergy and biofuels, bioremediation, types of biodiversity and their applications, plantbiotechnology: reasons of concern for loss of biodiversity, plant biotechnology and climate change

Total Hours 45

Course Outcomes

Upon Completion of this course, students will be able to get :

CO1: acquaint with principles, technical requirement, scientific and commercial applications inPlantBiotechnology,

CO 2: support methodologies in plant tissue/cell culture toplantimprovement,aswellas DNA handling with PCR-based detection diagnostic tools,

CO 3: becomemotivatedtosetgoalstowardspursuinggraduateschoolandhigherlevel positions,such as la manager and keyscientistinplantbiotechnological research institutes and industries.

CO 4 acuquired knowledge relted to tissue culture

CO5 gained knowledge about the gene transfer

Text Books

1 Slater A, NW Scott, MR Fowler. Plant Biotechnology, 2nd ed. Oxford University Press, 2008.

2 Hopkins, W. Gand Huner, N.P.A. Introduction to Plant Physiology. 3rded.John Wiley&Sons Inc.New York, 2004.

3 Balasubramanian,Bryce,Dharmalingam,Green,Kunthalajayaraman.ConceptsinBiotechnology,revisededition. Universities Press,2007.

4 Karvita B Ahluwalia. Genetics. New age international Pvt. Ltd. Publishers. New Delhi. 2002.

Reference Books

1 Bhojwani and Bhatnagar. Embryology of Angiosperms, vikar Publishing House Pvt. Ltd, New Delhi. 1981.

2 Sharpiro. Mobil Genetic Elements, Academic press, New York. 1983.

ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department	BIOTECHNOLOGY	Programme	B. TECH. - BT	Regulation	2015
		Semester VI			

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
615BTP07	BIOPROCESS ENGINEERING LABORATORY -II	0	0	4	2	50	50	100

Prerequisite Bioprocess Engineering lab–I

Course Objectives

At the end of the course ,the students should be able to:

- *To impart practical knowledge in sterilization and preparation for bioreactor*
- *To develop practical knowledge of bioreactor operations in lab scale*
- *To develop knowledge in mass transfer rate in bioreactor*
- *To develop practical knowledge of reactor*
- *To learn about the RTD process*

1. Batch sterilization kinetics
2. Batch cultivation with exhaust gasanalysis
3. Estimation of KLa- Dynamic gassing out method
4. Estimation of KLa- Sulphite oxidation method
5. Estimation of KLa-Power correlation method
6. Fed batch cultivation kinetics
7. Algal cultivation
8. Residence time distribution-CSTR
9. Residence time distribution-PFR
10. Estimation of overall Heat transfer coefficient
11. Estimation of mixing time in reactor

Course Outcomes

Upon Completion of this course, students will be able to get CO1: Analyzevariousoperationalmodesofbioreactorsystems

CO 2: Capabilitytohandlebioreactorsystemforvariousindustrialapplications.

CO 3: Abilitytoinvestigate,designandconductexperimentsonbioprocessengineering problems

CO 4: ability to investigate about the RTD process

CO 5 understood the concept of various reactor

Text Books

1 James E. Bailey & David F. Ollis, "Biochemical Engineering Fundamentals", McGraw-Hill 2000

2 Anton Moser, "Bioprocess Technology", Kinetics and Reactors", Springer Verlag.1999

Reference Books

1 James M. Lee, "Biochemical Engineering", PHI, USA 2002.

2 Pauline Doran, "Bioprocess Engineering Calculation", Blackwell Scientific Publications 1998.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester VI

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
615BTP08	PLANT BIOTECHNOLOGY LABORATORY	0	0	3	2	50	50	100

Prerequisite Molecular Biology

Course Objectives

At the end of the course ,the students should be able to:

- *To introduce students to the principles, practices and application of plant tissue culture andtransformation in science, agriculture and industry.*
- *To acquaint students with experimental design and analysis of plant biotechnologyexperiments.*
- *Togivestudentshands-onexperienceandtraininginrepresentativeplanttissue culture and genetic engineering techniques.*
- *To introduce the concept of culture techniques*
- *To gives handson experience related to embryogenesis*

1. Introduction to plant tissue culture
2. Preparation of Tissue culture medium (Murashige andskoog)
3. Effect of Plant growth regulator of various explants for callus induction and cell suspensionculture
4. *In vitro* seeds germination
5. Micropropagation of *Moringaolifera* or*concanensis* plant by leaf disc culture
6. Organogenesis and somatic embryogenesis
7. Artificial seed preparation
8. Shoot tip and nodal sector culture
9. Callus culture
10. Meristem Culture for Virus-FreePlants
11. *Agrobacterium tumefaciens*-mediated plant transformation

Course Outcomes

Upon Completion of this course, students will be able to get :

CO1: Understandingofthetheoreticalbackgroundknowledgeinplantsciencesneededforan understandingofplantbiotechnology.

CO2: Workingknowledgeoflaboratorytechniquesusedinplantbiotechnology

CO 3: Acapacitytoundertakeresearchinplantbiotechnology.

CO 4 introduced the concept of culture techniques

CO 5 gaine the knowledge and experience related to embryogenesis

Text Books

1 J. Reinert and M.M. Yeoman, "Plant Cell and Tissue Culture" Springer-Verlag Berlin Heidelberg. 1982
2 Keith Lindsey, "Plant Tissue Culture Manual", Springer Netherlands.1997.

Reference Books

1 K. Lindsey, "Plant Tissue Culture Manual", Springer US 1992.
2 L.G. Nickell,, "Plant Growth Regulators", pringer-Verlag Berlin Heidelberg 1982.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester VI

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
615BTP09	TECHNICAL SEMINAR	0	0	2	1	50	50	100

Prerequisite Microbiology, Biochemistry, Molecular biology, Genetic Engineering

Course Objectives

At the end of the course ,the students should be able to:

- Tobgainbtheknowledgeofvariousrecentlydevelopedbiotechnologytopics.Thiswill helpstudents in their PGstudies

1. Biochips
2. Nanotechnology inmedicine
3. Forensicscience
4. Genetically modified organisms (Bt cotton and Btbrinjaletc.)
5. Bioinstrumentation
6. Biosensors
7. Upstream processTechnology
8. Bioprocess Control &automation
9. Biomaterials
10. Protein engineering &inslico drugdesigns
11. Artificialorgans

Course Outcomes

Upon Completion of this course, students will be able to get :C01: Analyze various techniques in Biotechnology

Co2: Capability to handle various Instruments in the field of Biotechnology.

Reference Books

1 James M. Lee, "Biochemical Engineering", PHI, USA 2002.

2 Pauline Doran, "Bioprocess Engineering Calculation", Blackwell Scientific Publications 1998.

3 IsilAksanKurnaz, "Techniques in Genetic Engineering" Published, CRC Press, 2015

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Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester VII

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
715BTT01	ANIMAL BIOTECHNOLOGY	3	0	0	3	50	50	100

Prerequisite Genetic Engineering

Course Objectives

At the end of the course ,the students should be able to:

- *To provide the fundamentals of animal cell culture, details of the diseases and therapy*
- *To offer the knowledge about the micromanipulation and transgenic animals*
- *Know about transgenic animals*
- *Learn about large scale production of animal cell cultures*
- *Learn about the therapy activities*

UNIT I ANIMAL CELL CULTURE 9

Introduction to basic tissue culture techniques; Natural media, Nutritional requirement of media; chemically defined and serum free media; commonly used cell lines & their origin, various types of cultures-suspension cultures, immobilized cultures; somatic cell fusion; cell cultures as a source of valuable products; animal cell cultures and their applications, their maintenance and preservation; organ cultures. Measurement of cell viability,contact inhibition.

UNIT II ANIMAL DISEASES, DIAGNOSIS AND THEIR THERAPY 9

Bacterial and viral diseases in animals; diagnosis of animal diseases using monoclonal antibodies, molecular diagnostic techniques - like PCR, in-situ hybridization; northern and southern blotting, RFLP. Animal diseases; Treatment of animal diseases through recombinant cytokines, monoclonal antibodies, vaccines and gene therapy.

UNIT III MICROMANIPULATION OF EMBRYO'S 9

Introduction to micromanipulation technology; equipments used in micromanipulation; artificial insemination

in vitro fertilization and embryo transfer; micromanipulation technology and intracytoplasmic sperminjection.

UNIT IV TRANSGENIC ANIMALS 9

Conceptsoftransgenicanimaltechnology;stemcellculturesinthe productionoftransgenicanimals.DNAmicro injection, lipofection, production of dolly, embryonic stem cells, retro viral method of gene insertion, calcium phosphate DNA uptakemethod.

UNIT V SCALING UP OF ANIMAL CELL CULTURES 9

Tissue culture as a screening system, cytotoxicity and diagnostic tests, mass production of important biological molecules, Harvesting of products, applications of cell culture technology in production of human andanimal viral vaccines, cell culture fermenters.

Total Hours 45

Upon Completion of this course, students will be able to get :

Course Outcomes

Co1: Understand the animal cell culture, animal diseases and its diagnosisCo2: Gain the knowledge of therapy of animal infections
Co3: Know the concepts of micro manipulation technology and transgenic animaltechnology
C04 Know the concepts of micro manipulation technology and transgenic animal technologyCo5 The concepts of transgenic animals
Bulk production of animal cell cultures

Text Books

1 Ranga M.M. Animal Biotechnology. Agrobios India Limited, 2002

2 Ramadass P, Meera Rani S. Text Book of Animal Biotechnology. Akshara Printers,1997

Reference Books

1 Masters J.R.W. Animal Cell Culture: Practical Approach. Oxford University Press, 2000

2 Johnson A and Holland.A, Animal Biotechnology and ethics, Chapmara & Hall Madras 1998

3 CultureofAnimalCells:AManualofBasicTechniqueandSpecializedApplications,6thEditio n,R.Ian Freshney,September2010,Wiley-Blackwellpublications

ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester VII

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
715BTT02	DOWNSTREAM PROCESSING	3	0	0	3	50	50	100

Prerequisite **Fundamentals of Unit Operation, Instrumental Methods of Analysis**

Course Objectives

At the end of the course ,the students should be able to:

- *Understand the methods to obtain pure proteins, enzymes and in general aboutproduct development R &D*
- *Have depth knowledge and hands on experience with onDownstreamprocessesUnderstandtheconceptsinpurificationofbiomolecules*
- *Have depth knowledge in drying and crystallization*
- *Gain knowledge about the finishing operation*
- *Understand the method related to purification*

UNIT I DOWNSTREAM PROCESSING **9 Hrs**

Introductiontodownstreamprocessing,principlescharacteristicsofbiomoleculesandbioprocesses.Cell disruption for product release- mechanical, enzymatic and chemical methods. Pretreatment ofproducts..

UNIT II PHYSICAL METHODS OF SEPERATION **9 Hrs**

Unit operations for solid-liquid separation: filtration- Batch and continuous filtration, Microfiltration:centrifugation- Types of centrifuge and sedimentation

UNIT III ISOLATION OF PRODUCTS **9 Hrs**

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

UNIT IV PRODUCT PURIFICATION **9 Hrs**

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

UNIT V FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS **9 Hrs**

Crystallization – Basic Concept, Crystal size distributions, Batch Crystallization, Recrystallization. Drying – Basic concept, Drying Equipments, Conduction drying, Adiabate Drying, lyophilization ofFinal product **45 Hrs**

Upon Completion of this course, students will be able to :

Course Outcomes

CO1: Abilityto define the fundamentals of downstream processing for product recoveryCO 2: Understand the requirements of successful operations of downstream processingCO 3: Describe the process of downstream equipments and explain the techniques in multifactorial manufacturing
CO 4: Ability to understood the knowledge in finishing operation inDSPCO 5: Understood the concept related to purification

Text Books

1 P.A. Belter, E.L. Cussler And Wei-Houhu – Bioseparations – Downstream Processing For Biotechnology, Wiley Interscience Pub. (2002).

2 R.O. Jenkins, (Ed.) – Product Recovery In Bioprocess Technology – Biotechnology By Open LearningSeries, Butterworth-Heinemann (1998).

Reference Books

1 E L V Harris and S. Angal, Protein Purification Methods, Ed. IRL Press at Oxford University Press, 2004.

2 J. E. Bailey and D. F. Ollis, Biochemical Engineering Fundamentals, 2nd Edition, Mc-Graw Hill, Inc., 2001.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR-635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester VII

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
715BTT03	CANCER BIOLOGY	3	0	0	3	50	50	100

Prerequisite Genetic Engineering, Molecular biology

Course Objectives

At the end of the course ,the students should be able to:

- *To learn about pathogenesis of cancer*
- *To understand fundamentals of cancer*
- *To identify cancer through tools developed by biotechnology research molecules synthesized for cancer therapy*
- *To understand and preventive measure from cancer*
- *To understand the activities related to metastasis*

UNIT I FUNDAMENTALS OF CANCER BIOLOGY **9 Hrs**

Introduction of cancer biology and cancer genetics, intra and extra cellular control of cell division, programmed cell death (apoptosis), intrinsic and extrinsic pathways of cell death, necrosis, malignancies, metastasis, apoptosisin relation with cancer , Regulation of cell cycle, tumour suppressor genes, different forms of cancers, diet and cancer.

UNIT II PRINCIPLES OF CARCINOGENESIS **9 Hrs**

Theory of carcinogenesis, Chemical carcinogenesis, metabolism of carcinogenesis, Detection using biochemical assays, tumor markers, principles of physical carcinogenesis, x-rayradiation-mechanisms of radiation carcinogenesis

UNIT III PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER **9 Hrs**

Signal targets and cancer, activation of kinases; Oncogenes, identification of oncogenes, retroviruses and oncogenes, detection of oncogenes. Oncogenes/proto oncogene activity.

UNIT IV PRINCIPLES OF CANCER METASTASIS **9 Hrs**

Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three step theory of invasion, proteinases and Tumour cell invasion.

UNIT V NEW MOLECULES FOR CANCER THERAPY **9 Hrs**

Different forms of therapy, chemotherapy, radiation therapy, detection of cancers, Anticancer Drugs- Classes of Anticancer Drugs, Drug Metabolism and Toxicity, Targeted Therapy in Cancer, Gene therapy.

TotalHours **45**

Course Outcomes

Upon Completion of this course, students will be able to :

CO1: Thestudentsaftercompletingthiscoursewouldbeawareofcancerandcausesofcancer.

CO 2: Thestudentswouldbeawareofcancerdetectiontechniques.

CO 3: Thestudentswouldbeawareofidentificationanddetectionofoncogene

CO 4: Thestudentswillcometoknowthenewmoleculesusedtotreatcancer

CO5: The student will come to gain knowledge relted to metastatis

Text Books

1 Primrose, S.B., and R.M. Twyman, "Principles of gene manipulation and Genomics", Blackwell Publishing, MA. USA, 2006.

2 Twayman.R.M, "Principles of Proteomics" (Advanced text series), Taylor and Francis, 1st edition, 2004.

Reference Books

1 Brown T. A. 2007, Genomes 3. Garland Science Publishing, New York
2 Campbell, A.M. and Heyer, L.J., "Discovering Genomics, Proteomics and Bioinformatics", 2 nd Edition, Benjamin Cummings, 2007.
3 Dunham, I., "Genome Mapping and sequencing", Horizon Scientific, 2003
4 Read, T.D., Nelson, K.E., Fraser, C.M., "Microbial Genomes", Humana Press, Inc., USA, 2004.
5 Daniel C. Liebler "Introduction to Proteomics" Humana Press, 2002.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR - 635 109

Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester VII

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
715BTT04	DISASTER MANAGEMENT	3	0	0	3	50	50	100

Prerequisite Environmental Science and Sustainability

Course Objectives

At the end of the course ,the students should be able to:

- *To ensure that students begin to understand the relationship between Vulnerability, disasters, disaster prevention and riskreduction*
- *To gain a preliminary understanding of approaches of Disaster Risk Reduction(DRR)*
- *To enhance awareness of institutional processes in the country*
- *Todeveloprudimentaryabilitytorespondtotheirsurroundingswithpotentialdisaster response in areas where they live,with due sensitivity*
- *To gain concept of the disaster management*

UNIT I INTRODUCTION TO DISASTERS **9**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) **9**

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR,Structural-nonstructuralmeasures,Rolesandresponsibilitiesof-community,PanchayatiRajInstitutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processes and Framework atStateandCentralLevel-StateDisasterManagementAuthority(SDMA)
– Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT **9**

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the contextof India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA **9**

HazardandVulnerabilityprofileofIndia,ComponentsofDisasterRelief:Water,Food,Sanitation,Shelter,Health
,
WasteManagement,Institutionalarrangements(Mitigation,ResponseandPreparedness,DisasterManagement Act andPolicy - Other related policies, plans, programmes and legislation – Role of GIS and Information TechnologyComponentsinPreparedness,RiskAssessment,Responseand
Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS **9**

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure:
CaseStudies,DroughtAssessment:CaseStudies,CoastalFlooding:StormSurgeAssessment,Floods:FluvialandPluvialFlooding:CaseStudies;ForestFire:Case Studies,ManMade disasters:CaseStudies,Space BasedInputs forDisaster Mitigation and Management and fieldworks
related to disaster management.

Total Hours 45

Upon Completion of this course, students will be able to :

Course Outcomes

CO 1: Differentiate the types of disasters, causes and their impact on environment andsociety.
CO 2: Assess vulnerability and various methods of risk reduction measures as well asmitigation.
CO 3:Draw the hazard and vulnerability profile of India, Scenarios in the Indiancontext, Disaster damage assessment and management.
CO 4: learned about the disaster management
CO5: variation occur with respect to atmospheric change.

Text Books

1 Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012.
2 Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi,2011
3 Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.
4 Singhal J.P. "Disaster Management", Laxmi Publications, 2010.

Reference Books

1 Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2 Government of India, National Disaster Management Policy, 2009.

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ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR - 635 109

Department **BIOTECHNOLOGY** **Programme** **B. TECH. - BT** **Regulation** **2015**

Semester VII

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
715BTP07	DOWNSTREAM PROCESSING LABORATORY	0	0	4	2	50	50	100

Prerequisite Bioprocess Engineering lab–I and Bioprocess Engineering lab -II

Course Objectives

At the end of the course ,the students should be able to:

- *To understand the nature of the end product, its concentration, stability and degree of purification required*
- *To design processes for the recovery and subsequent purification of target biological products*
- *To gain knowledge on sonication*
- *To learn about the chromatography techniques*
- *To learn about the drying equipment*

1. Solid liquid separation – Centrifugation
2. Precipitation – Ammonium sulphite precipitation
3. Aqueous two phase extraction of biologicals
4. Cell disruption techniques – Ultrasonication
5. Cell disruption techniques –Batch and continuous
6. Ultra filtration separation
7. High resolution purification – Affinity chromatography
8. High resolution purification – Size exclusion chromatography
9. High resolution purification – Ion exchange chromatography
10. Product polishing – Spray drying

Course Outcomes

Upon Completion of this course, students will be able to get :

CO1: Acquired knowledge for the separation of whole cells and other insoluble ingredients from the culture broth.

CO2: Learned various techniques like extraction, precipitation, membrane separation for concentrating biological products

CO3: Learned the basic principles and techniques of chromatography to purify the biological products and formulate the products for different end uses

Co4: learned about the drying equipment

Co5: Gained knowledge on sonication

Text Books

1 R.O. Jenkins, (Ed.) – Product Recovery In Bioprocess Technology – Biotechnology By Open Learning Series, Butterworth-Heinemann (1992).

2 P.A. Belter, E.L. Cussler And Wei-Houhu – Bioseparations – Downstream Processing For Biotechnology, Wiley Interscience Pun. (1988).

Reference Books

1 J.C. Janson And L. Ryden, (Ed.) – Protein Purification – Principles, High Resolution Methods And Applications, VCH Pub. 1989.

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Department BIOTECHNOLOGY **Programme** B. TECH. - BT **Regulation** 2015

Semester VII

Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
715BTE10	GENOMICS AND PROTEOMICS	3	0	0	3	50	50	100

Prerequisite Genetic Engineering

Course Objectives

At the end of the course ,the students should be able to:

- *To understandthegenecloningmethods, toolsandtechniquesinvolvedingenomeanalysis andgenomics.*
- *Toexplaintheheterologousexpressionofclonedgenesindifferenthosts,production ofrecombinant proteinsandPCRtechniques.*
- *Toidentifytheimportanceofproteinbiomoleculesandthestructure-function relationships inproteins.*
- *Toexplaincomparativegenomicsandproteomics.*
- *Toknowaboutthefunctionalorganizationofthegenomeandproteome*

UNIT I ORGANIZATION OF GENOMES **8 Hrs**

Introduction:Genome,Genomics,Omicsandimportance,Generalfeatures,C-valueparadox.Geneidentification; geneprediction rulesandsoftware's;Genomedatabases;Annotationofgenome.Genomediversity:taxonomyand significance of genomes – bacteria, yeast, Caenorhabditis, Homosapiens, Arabidopsis, etc

UNIT II MAPPING GENOMES **10 Hrs**

Genetic mapping – i) Cross breeding and pedigree analysis, ii)DNA markers - RFLPs, SSLPs, SNPs Physical mapping - Restriction mapping, Fluorescent in situ hybridization, Radiation hybrid mapping and Sequence tagged site mapping.

UNIT III GENOMICS **10 Hrs**

Structural genomics: Assembly of a contiguous DNA sequence- shotgun method, clone contig method, and whole –genome shotgun sequencing Understanding a genome sequence: locating the genes in a genome sequence, determining the functions of individual genes and by studying the activity of a protein coded of an unknown gene

UNIT IV PROTEOME INFORMATICS **9 Hrs**

2D Electrophoresis - Spot visualization and picking - Database for 2D gel - Tryptic digestion of protein - Peptide fingerprinting - Data analysis: Mass spectrometry; ion source (MALDI, spray sources); analyzer (ToF, quadrupole, quadrupole ion trap) and detectors - Ramachandran plot - Post-translational modificationsof proteins - Limitation ofproteomics

UNIT V APPLICATIONS OF GENOMICS ANDPROTEOMICS **8 Hrs**

Genomicmedicine - Synthetic biology and bioengineering - Conservation genomics - Interactionproteomics - Protein networks - Expression proteomics – Biomarkers – Proteogenomics.

45

Total Hours

Course Outcomes

Upon Completion of this course, students will be able to :

CO 1: Thestudentsaftercompletingthiscoursewouldbeawareofhowtoclonecommercially importantgenes andrecombinantproteins.

CO 2: Thestudentswouldbeawareofgeneandgenomesequencingtechniques.

CO 3: Thestudentswouldbeawareofmicroarrays,AnalysisofGeneexpressionandproteomics.

CO 4: Toanalyzethevariousinteractionsinproteinmakeupanddifferentlevelsofproteinstructure.

CO 5: Topracticethelatestapplicationofproteinscienceintheirresearch.

Text Books

1 Primrose, S.B., and R.M. Twyman, "Principles of gene manipulation and Genomics", Blackwell Publishing, MA. USA, 2006.

2 Twayman.R.M, "Principles of Proteomics" (Advanced text series), Taylor and Francis, 1st edition, 2004.

Reference Books

1 Brown T. A. 2007, Genomes 3. Garland Science Publishing, New York

2 Campbell, A.M. and Heyer, L.J., "Discovering Genomics, Proteomics and Bioinformatics", 2 nd Edition, Benjamin Cummings, 2007.

3 Dunham, I., "Genome Mapping and sequencing", Horizon Scientific, 2003

4 Read, T.D., Nelson, K.E., Fraser, C.M., "Microbial Genomes", Humana Press, Inc., USA, 2004.

5 Daniel C. Liebler "Introduction to Proteomics" Humana Press, 2002.