St. PETER'S UNIVERSITY

St. Peter's Institute of Higher Education and Research
(Declared under section 3 of UGC Act 1956)
Avadi, Chennai – 600 054.

B.Tech. (BIO TECHNOLOGY) PROGRAMME

(I to VIII SEMESTERS)

REGULATIONS AND SYLLABI

(REGULATIONS – 2013)

(Effective from the Academic Year 2013-'14)

B.Tech. (BIO TECHNOLOGY) PROGRAMME

Regulations and Syllabi

(Effective from the Academic Year 2013-'14)

1. Eligibility:

(1) Candidates who passed Higher Secondary Examination with Mathematics, Biology, Physics and Chemistry conducted by the Government of Tamil Nadu or any other equivalent examination thereto and who appeared for the entrance test conducted by the Government of Tamil Nadu or approved institutions wherever prescribed are eligible for admission to Four Year B.Tech.(Bio Technology) Programme.

Higher Secondary Examination with Mathematics, Physics and Chemistry conducted by the Government of Tamil Nadu or its equivalent in the relevant subjects.

(2) Candidates who passed Three Year Diploma in Technical Education in the concerned subject conducted by the Government of Tamil Nadu are eligible for admission to Second Year of Four Year B.Tech. (Bio-Technology Engineering) Programme.

2. Duration: Four Years comprising 8 Semesters. Each semester has a minimum 90 working days with a minimum of 5 hours a day.

3. Medium: English is the medium of instruction and examination.

4. Weightage for Continuous and End Assessment: The weightage for Continuous Assessment (CA) and End Assessment (EA) be 25:75 unless the ratio is specifically mentioned in the scheme of Examinations.

5. Credit System: Credit system be followed with 18 credits for each semester and each credit is equivalent to 25 hours of effective study provided in the Time Table.

6. Scheme of Examinations

I Semester

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
113EHT01	Technical English – I	1	25	75	100
113MAT02	Mathematics – I	3	25	75	100
113PHT03	Engineering Physics – I	3	25	75	100
113CYT04	Engineering Chemistry – I	3	25	75	100
113CPT05	Computer Programming	2	25	75	100
113EGT06	Engineering Graphics	3	25	75	100
Practical					
113CLP01	Computer Practices Laboratory	1	25	75	100
113ELP02	Engineering Practices Laboratory	1	25	75	100
113PCP03	Physics and Chemistry Laboratory - I	1	25	75	100
	Total	**18**	**225**	**675**	**900**

II Semester

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
213EHT01	Technical English - II	1	25	75	100
213MAT02	Mathematics - II	3	25	75	100
213PMT03	Physics of Materials	3	25	75	100
213CFT04	Chemistry for Technologists	3	25	75	100
213BYT05	Biochemistry	3	25	75	100
213MYT06	Microbiology	3	25	75	100
Practical					
213BYP01	Biochemistry Laboratory	1	25	75	100
213MYP02	Microbiology Laboratory	1	25	75	100
	Total	**18**	**200**	**600**	**800**

III Semester

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
313MAT01	Transforms and Partial Differential Equations	3	25	75	100
313BTT02	Stoichiometry and Fluid Mechanics	3	25	75	100
313BTT03	Bioorganic Chemistry	3	25	75	100
313BTT04	Cell Biology	3	25	75	100
313BTT05	Basic Industrial Biotechnology	2	25	75	100
313BTT06	Bioprocess Principles	2	25	75	100
Practical					
313BTP01	Cell Biology Laboratory	1	25	75	100
313BTP02	Bioorganic Chemistry Laboratory	1	25	75	100
	Total	**18**	**200**	**600**	**800**

IV Semester

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
413BTT01	Probability and Statistics	3	25	75	100
413BTT02	Analytical Methods and Instrumentation	3	25	75	100
413BTT03	Applied Thermodynamics for Biotechnologists	3	25	75	100
413BTT04	Heat Transfer Operations	2	25	75	100
413BTT05	Enzyme Technology and Biotransformation	3	25	75	100
413BTT06	Environmental Science and Engineering	2	25	75	100
Practical					
413BTP01	Chemical Engineering Laboratory	1	25	75	100
413BTP02	Instrumental Methods of Analysis Laboratory	1	25	75	100
	Total	**18**	**200**	**600**	**800**

V Semester

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
513BTT01	Protein Structure Function and Proteomics	3	25	75	100
513BTT02	Bioprocess Engineering	3	25	75	100
513BTT03	Mass Transfer Operation	3	25	75	100
513BTT04	Molecular Biology	3	25	75	100
	Elective – I:	2	25	75	100
	Elective – II:	2	25	75	100
Practical					
513BTP01	Bioprocess Lab – I	1	25	75	100
513BTP02	Molecular Biology Lab	1	25	75	100
	Total	**18**	**200**	**600**	**800**

VI Semester

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
613BTT01	Total Quality Management for Biotechnologists	2	25	75	100
613BTT02	Immunology	3	25	75	100
613BTT03	Genetic Engineering and Genomics	3	25	75	100
613BTT04	Chemical Reaction Engineering	3	25	75	100
	Elective III:	2	25	75	100
	Elective IV:	2	25	75	100
Practical					
613BTP01	Genetic Engineering Laboratory	1	25	75	100
613BTP02	Bioprocess Lab – II	1	25	75	100
613BTP03	Communication and Soft skills Lab	1	25	75	100
	Total	**18**	**200**	**600**	**800**

VII Semester

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
713BTT01	Bioinformatics and Computational Biology	3	25	75	100
713BTT02	Downstream processing	3	25	75	100
713BTT03	Creativity, Innovation and New Product Development	3	25	75	100
	Elective V:	3	25	75	100
	Elective VI:	3	25	75	100
Practical					
713BTP01	Downstream processing Lab	1	25	75	100
713BTP02	Immunology Lab	1	25	75	100
713BTP03	Bioinformatics Lab	1	25	75	100
	Total	**18**	**200**	**600**	**800**

VIII Semester

Code No.	Course Title	Credit	Marks		
Project			**CA**	**EA**	**Total**
813BTP01	Project Work	18	25	65	100
	Viva Voce			10	
	Total	**18**	**25**	**75**	**100**

Electives

Course Code	Electives	Credit
ELECTIVE I		
513BTT05	Introduction to Symbolic Mathematics	2
513BTT06	Biophysics	2
513BTT07	Principles of Food Processing	2
Elective II		
513BTT08	Advanced Biochemistry	2
513BTT09	Biological Spectroscopy	2
513BTT10	Biopharmaceutical Technology	2
Elective III		
613BTT05	Fundamentals of Nanoscience	2
613BTT06	Animal Biotechnology	2
613BTT07	Molecular Pathogenesis of Infections Disease	2
613BTT08	Cancer Biology and Therapeutics	2
ELECTIVE - IV		
613BTT09	Plant Biotechnology	2
613BTT10	Metabolic Engineering	2
613BTT11	IPR and Ethical Issues in Biotechnology	2
ELECTIVE – V		
713BTT04	Bioconjugate Technology and Applications	3
713BTT05	Bio Industrial Entrepreneurship	3
713BTT06	Process Equipment and Plant Design	3
ELECTIVE – VI		
713BTT07	Process Instrumentation Dynamics and Control	3
713BTT08	Tissue Engineering	3
713BTT09	Neurobiology and Cognitive Sciences	3

7. **Passing Requirements:** The minimum pass mark (raw score) be 50% in End Assessment (EA) and 50% in Continuous Assessment (CA) and End Assessment (EA) put together. No minimum mark (raw score) in Continuous Assessment (CA) be prescribed unless it is specifically mentioned in the scheme of Examination.

8. **Grading System:** Grading System on a 10 Point Scale be followed with 1 mark = 0.1 Grade point to successful candidates as given below.

CONVERSION TABLE

(1 mark = 0.1 Grade Point on a 10 Point Scale)

Range of Marks	Grade Point	Letter Grade	Classification
90 to 100	9.0 to 10.0	O	First Class
80 to 89	8.0 to 8.9	A	First Class
70 to 79	7.0 to 7.9	B	First Class
60 to 69	6.0 to 6.9	C	First Class
50 to 59	5.0 to 5.9	D	Second Class
0 to 49	0 to 4.9	**F**	**Reappearance**

Procedure for Calculation

Cumulative Grade Point Average (CGPA) = $\frac{\text{Sum of Weighted Grade Points}}{\text{Total Credits}}$

= $\frac{\sum (CA+EA)\ C}{\sum C}$

Where Weighted Grade Points in each Course = Grade Points (CA+EA) multiplied by Credits

= (CA+EA)C

Weighted Cumulative Percentage of Marks(WCPM) = CGPAx10

C- Credit, CA-Continuous Assessment, EA- End Assessment

9. Pattern of the Question Paper: The question paper for End Assessment will be set for three hours and for the maximum of 100 marks with following divisions and details.

Part A: 10 questions (with equal distribution to all units in the syllabus). Each question carries 2 marks.

Part B: 5 question with either or type (with equal distribution to all units in the syllabus). Each question carries 16 marks.

The total marks scored by the candidates will be reduced to the maximum prescribed in the Regulations.

10. Effective Period of Operation for the Arrear Candidates: Two Year grace period is provided for the candidates to complete the arrear examination, if any.

Registrar

11.Syllabus

I Semester

113EHT01 - TECHNICAL ENGLISH – I

AIM:
To encourage students to actively involve in participative learning of English and to help them acquire Communication Skills.

OBJECTIVES:
1. To help students develop listening skills for academic and professional purposes.
2. To help students acquire the ability to speak effectively in English in real-life situations.
3. To inculcate reading habit and to develop effective reading skills.
4. To help students improve their active and passive vocabulary.
5. To familiarize students with different rhetorical functions of scientific English.
6. To enable students write letters and reports effectively in formal and business situations.

UNIT I
General Vocabulary - changing words from one form to another - Adjectives, comparative adjectives – Adverbs - Active and passive voice – Tenses - simple present, present continuous - Adverb forms – Nouns – compound nouns - Skimming and scanning - Listening and transfer of information – bar chart, flowchart - Paragraph writing, description – Discussing as a group and making an oral report on the points discussed, conversation techniques - convincing others.

Suggested activities:
1. Matching words & meanings - Using words in context – Making sentences.
2. Changing sentences from active to passive voice & vice versa.
3. Skimming, cloze exercises, exercises transferring information from text to graphic form – bar charts, flow charts.
4. Writing descriptions using descriptive words & phrases, and technical vocabulary.
5. Role play, conversation exercises, discussions, oral reporting exercises
   Any other related relevant classroom activity

UNIT II
Vocabulary – prefixes & suffixes – simple past tense - Spelling and punctuation – 'wh' Question forms - Scanning, inference - Listening & note-taking - Paragraph writing - comparison and contrast - Creative thinking and speaking.

Suggested Activities:
1. (a) Vocabulary activities using prefixes and suffixes.
   (b) Exercises using questions – asking & answering questions.
2. Scanning the text for specific information
3. Listening guided note-taking - Writing paragraphs using notes, giving suitable headings and subheadings for paragraphs. Using expressions of comparison and contrast.
4. Discussion activities and exploring creative ideas. Any other related relevant classroom activity

UNIT III
Tenses - simple past, simple future and past perfect - Reading in Context -Listening & note-taking – single line – Definitions – sequencing of sentences – instruction - Persuasive speaking.

Suggested activities:
1. Providing appropriate context for the use of tenses
2. Listening and note-taking
3. (a) Writing sentence definitions, instructions
   (b) Identifying the discourse links and sequencing jumbled sentences / writing instructions.
4. Speaking exercises, discussions, role play exercises using explaining, convincing and

persuasive strategies Any other related relevant classroom activity

UNIT IV

Modal verbs and Probability – Concord subject verb agreement – Correction of errors - Cause and effect expressions – Extended Definition - Speaking about the future plans.

Suggested activities:

1. (a) Making sentences using modal verbs to express probability
   (b) Gap filling using relevant grammatical form of words.
2. Writing extended definitions Speaking - role play activities, discussions, extempore speaking exercises speculating about the future.
3. Any other related relevant classroom activity.

UNIT V

'If' conditionals – Gerunds - Intensive reading - Speaking – Presentation of problems & solutions - Itinerary – planning for an industrial visit - Formal Letter writing – Letter to the editor, invititation letter, accepting, declining letter and permission letter.

Suggested activities:

1. (a) Sentence completion exercises using 'If' conditionals.
   (b) Gap filling exercises using gerunds and present participle forms
2. Reading comprehension exercises.
3. Role play, discussion, debating and speaking activities for stating, discussing problems and suggesting solutions.
4. Planning a tour, Writing a travel itinerary. Writing letters to officials and to the editor in formal/official contexts.
5. Any other related relevant classroom activity

TEXT BOOK:

1. Department of Humanities & Social Sciences, Anna University, 'English for Engineers and Technologists' Combined Edition (Volumes 1 & 2), Chennai: Orient Longman Pvt. Ltd., 2006. Themes 1 – 4 (Resources, Energy, Computer, Transport)

REFERENCES:

1. Meenakshi Raman and Sangeeta Sharma, 'Technical Communication English skills for Engineers', Oxford University Press, 2008.
2. Andrea, J. Rutherford, 'Basic Communication Skills for Technology', Second Edition, Pearson Education, 2007.
3.

Extensive Reading:

A.P.J.Abdul Kalam with Arun Tiwari, 'Wings of Fire' An Autobiography, University Press (India) Pvt. Ltd.,1999, 30th Impression 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.

113MAT02 - MATHEMATICS – I

OBJECTIVES:

- To develop the use of matrix algebra techniques this is needed by engineers for practical applications.
- To make the student knowledgeable in the area of infinite series and their convergence so that he/ she will be familiar with limitations of using infinite series approximations for solutions arising in mathematical modeling.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To introduce the concepts of improper integrals, Gamma, Beta and Error functions which are needed in engineering applications.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

UNIT I MATRICES

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Statement and applications of Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II SEQUENCES AND SERIES

Sequences: Definition and examples – Series: Types and Convergence – Series of positive terms – Tests of convergence: Comparison test, Integral test and D'Alembert's ratio test – Alternating series – Leibnitz's test – Series of positive and negative terms – Absolute and conditional convergence.

UNIT III APPLICATIONS OF DIFFERENTIAL CALCULUS

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

UNIT IV DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES

Limits and Continuity – Partial derivatives – Total derivative – Differentiation of implicit functions – Jacobian and properties – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT V MULTIPLE INTEGRALS

Double integrals in cartesian and polar coordinates – Change of order of integration – Area enclosed by plane curves – Change of variables in double integrals – Area of a curved surface - Triple integrals – Volume of Solids.

TEXT BOOKS:

1. Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt Ltd., (2011).
2. Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, (2011).

REFERENCES:

1. Dass, H.K., and Er. Rajnish Verma," Higher Engineering Mathematics", S. Chand Private Ltd., (2011).
2. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, (2012).
3. Peter V. O'Neil," Advanced Engineering Mathematics", 7th Edition, Cengage learning, (2012).

4. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, (2008).

113PHT03 – ENGINEERING PHYSICS I

OBJECTIVE:

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

UNIT I CRYSTAL PHYSICS

Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Diamond and graphite structures (qualitative treatment)- Crystal growth techniques –solution, melt (Bridgman and Czochralski) and vapour growth techniques (qualitative)

UNIT II PROPERTIES OF MATTER AND THERMAL PHYSICS 9

Elasticity- Hooke's law - Relationship between three modulii of elasticity (qualitative) – stress - strain diagram – Poisson's ratio –Factors affecting elasticity –Bending moment – Depression of a cantilever –Young's modulus by uniform bending- I-shaped girders

Modes of heat transfer- thermal conductivity- Newton's law of cooling - Linear heat flow – Lee's disc method – Radial heat flow – Rubber tube method – conduction through compound media (series and parallel)

UNIT III QUANTUM PHYSICS

Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh – Jeans' Law from Planck's theory – Compton effect. Theory and experimental verification – Properties of Matter waves – G.P Thomson experiment -Schrödinger's wave equation – Time independent and time dependent equations – Physical significance of wave function – Particle in a one dimensional box - Electron microscope - Scanning electron microscope - Transmission electron microscope.

UNIT IV ACOUSTICS AND ULTRASONICS

Classification of Sound- decibel- Weber–Fechner law – Sabine's formula- derivation using growth and decay method – Absorption Coefficient and its determination –factors affecting acoustics of buildings and their remedies. Production of ultrasonic by magnetostriction and piezoelectric methods - acoustic grating -Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, Medical applications - Sonogram

UNIT V PHOTONICS AND FIBRE OPTICS

Spontaneous and stimulated emission- Population inversion -Einstein's A and B coefficients - derivation. Types of lasers – Nd:YAG, CO2 , Semiconductor lasers (homojunction & heterojunction)- Industrial and Medical Applications. Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle - Types of optical fibres (material, refractive index, mode) – attenuation, dispersion, bending - Fibre Optical Communication system (Block diagram) - Active and passive fibre sensors- Endoscope.

TEXT BOOKS:

1. Arumugam M. Engineering Physics. Anuradha publishers, 2010
2. Gaur R.K. and Gupta S.L. Engineering Physics. Dhanpat Rai publishers, 2009

REFERENCES:

1. Searls and Zemansky. University Physics, 2009
2. Mani P. Engineering Physics I. Dhanam Publications, 2011
3. Marikani A. Engineering Physics. PHI Learning Pvt., India, 2009
4. Palanisamy P.K. Engineering Physics. SCITECH Publications, 2011
5. Rajagopal K. Engineering Physics. PHI, New Delhi, 2011

6. Senthilkumar G. Engineering Physics I. VRB Publishers, 2011

113CYT04 - ENGINEERING CHEMISTRY –I

UNIT I POLYMER CHEMISTRY

Introduction: Classification of polymers – Natural and synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerization. Types and mechanism of polymerization: Addition (Free Radical, cationic and anionic); condensation and copolymerization. Properties of polymers: Tg, Tacticity, Molecular weight – weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension. Preparation, properties and uses of Nylon 6,6, and Epoxy resin.

UNIT II CHEMICAL THERMODYNAMICS

Terminology of thermodynamics - Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Clausius inequality. Free energy and work function: Helmholtz and Gibbs free energy functions (problems); Criteria of spontaneity; Gibbs- Helmholtz equation (problems); Clausius-Clapeyron equation; Maxwell relations – Van't Hoff isotherm and isochore(problems).

UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY

Photochemistry: Laws of photochemistry - Grotthuss–Draper law, Stark–Einstein law and Lambert- Beer Law. Quantum efficiency – determination- Photo processes - Internal Conversion, Inter-system crossing, Fluorescence, Phosphorescence, Chemiluminescence and Photo-sensitization. Spectroscopy: Electromagnetic spectrum - Absorption of radiation – Electronic, Vibrational and rotational transitions. UV-visible and IR spectroscopy – principles, instrumentation (Block diagram only).

UNIT IV PHASE RULE AND ALLOYS

Phase rule: Introduction, definition of terms with examples, One Component System- water system - Reduced phase rule - Two Component Systems- classification – lead-silver system, zinc-magnesium system. Alloys: Introduction- Definition- Properties of alloys- Significance of alloying, Functions and effect of alloying elements- Ferrous alloys- Nichrome and Stainless steel – heat treatment of steel; Non-ferrous alloys – brass and bronze.

UNIT V NANOCHEMISTRY

Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties. nanoparticles: nano cluster, nano rod, nanotube(CNT) and nanowire. Synthesis: precipitation, thermolysis, hydrothermal, solvothermal, electrodeposition, chemical vapour deposition, laserablation; Properties and applications.

TEXT BOOKS

1. Jain P.C. and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2010
2. Kannan P., Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2009

REFERENCES

1. Dara S.S, Umare S.S, "Engineering Chemistry", S. Chand & Company Ltd., New Delhi 2010
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company, Ltd., New Delhi, 2008.
3. Gowariker V.R. , Viswanathan N.V. and JayadevSreedhar, "Polymer Science", New Age International P (Ltd.,), Chennai, 2006.
4. Ozin G. A. and Arsenault A. C., "Nanochemistry: A Chemical Approach to Nanomaterials", RSC Publishing, 2005.

113CPT05 - COMPUTER PROGRAMMING

UNIT I INTRODUCTION

Generation and Classification of Computers- Basic Organization of a Computer –Number System – Binary – Decimal – Conversion – Problems. Need for logical analysis and thinking – Algorithm – Pseudo code – Flow Chart.

UNIT II C PROGRAMMING BASICS

Problem formulation – Problem Solving - Introduction to ' C' programming –fundamentals – structure of a 'C' program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in 'C' – Managing Input and Output operations – Decision Making and Branching – Looping statements – solving simple scientific and statistical problems.

UNIT III ARRAYS AND STRINGS

Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays. String- String operations – String Arrays. Simple programs- sorting- searching – matrix operations.

UNIT IV FUNCTIONS AND POINTERS

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays- Example Problems.

UNIT V STRUCTURES AND UNIONS

Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure - Union - Programs using structures and Unions – Storage classes, Pre-processor directives.

TEXTBOOKS:

1. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
2. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009
3. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.

REFERENCES:

1. Byron S Gottfried, "Programming with C", Schaum's Outlines, Second Edition, Tata McGraw-Hill, 2006.
2. Dromey R.G., "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007.
3. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006.

113EGT06 - ENGINEERING GRAPHICS

OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination)

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

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves, Scales: Construction of Diagonal and Vernier scales.

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method and auxiliary plane method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .

COMPUTER AIDED DRAFTING (Demonstration Only)

Introduction to drafting packages and demonstration of their use.

TEXT BOOK:

- Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.

REFERENCES:

1. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
2. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
3. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.
4. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.
5. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
6. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

113CLP01 - COMPUTER PRACTICE LABORATORY – I

LIST OF EXERCISES

LIST OF EXPERIMENTS:

1. Search, generate, manipulate data using MS office/ Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts
4. C Programming using Simple statements and expressions
5. Scientific problem solving using decision making and looping.
6. Simple programming for one dimensional and two dimensional arrays.
7. Solving problems using String functions
8. Programs with user defined functions – Includes Parameter Passing
9. Program using Recursive Function and conversion from given program to flow chart.
10. Program using structures and unions.

113ELP02 ENGINEERING PRACTICES LABORATORY

OBJECTIVES:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

GROUP A (CIVIL & MECHANICAL) I CIVIL ENGINEERING PRACTICE

Buildings: (a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:
(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
(b) Study of pipe connections requirements for pumps and turbines.
(c) Preparation of plumbing line sketches for water supply and sewage works.
(d) Hands-on-exercise:
Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:
(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise: Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE

Welding:
(a) Preparation of arc welding of butt joints, lap joints and tee joints.
(b) Gas welding practice

Basic Machining:
(a) Simple Turning and Taper turning
(b) Drilling Practice

Sheet Metal Work:
(a) Forming & Bending:
(b) Model making – Trays, funnels, etc.
(c) Different type of joints.

Machine assembly practice:
(a) Study of centrifugal pump
(b) Study of air conditioner

Demonstration on:
(a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
(b) Foundry operations like mould preparation for gear and step cone pulley.
(c) Fitting – Exercises – Preparation of square fitting and vee – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS) III ELECTRICAL ENGINEERING PRACTICE

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring

4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EOR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

REFERENCES:

1. Jeyachandran K., Natarajan S. & Balasubramanian S., "A Primer on Engineering
2. Practices Laboratory", Anuradha Publications, (2007).
3. Jeyapoovan T., Saravanapandian M. & Pranitha S., "Engineering Practices Lab Manual", Vikas Puplishing House Pvt.Ltd, (2006)
4. Bawa H.S., "Workshop Practice", Tata McGraw – Hill Publishing Company Limited, (2007).
5. Rajendra Prasad A. & Sarma P.M.M.S., "Workshop Practice", Sree Sai Publication, (2002).
6. Kannaiah P. & Narayana K.L., "Manual on Workshop Practice", Scitech Publications, (1999).

113PCP03- PHYSICS AND CHEMISTRY LABORATORY – I

PHYSICS LABORATORY – I

LIST OF EXPERIMENTS

(Any FIVE Experiments)

1. (a) Determination of Wavelength, and particle size using Laser
   (b) Determination of acceptance angle in an optical fiber.
2. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
3. Determination of wavelength of mercury spectrum – spectrometer grating
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of Young's modulus by Non uniform bending method
6. Determination of specific resistance of a given coil of wire – Carey Foster's Bridge

CHEMISTRY LABORATORY-I

LIST OF EXPERIMENTS

(Any FIVE Experiments)

1. Determination of DO content of water sample by Winkler's method.
2. Determination of chloride content of water sample by argentometric method
3. Determination of strength of given hydrochloric acid using pH meter
4. Determination of strength of acids in a mixture using conductivity meter
5. Estimation of iron content of the water sample using spectrophotometer (1,10- phenanthroline / thiocyanate method)
6. Determination of molecular weight of polyvinylalcohol using Ostwald viscometer
7. Conductometric titration of strong acid vs strong base

REFERENCES:

1. Daniel R. Palleros, "Experimental organic chemistry" John Wiley & Sons, Inc., New Yor (2001).
2. Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., "Vogel's Textbook of practical organic chemistry", LBS Singapore (1994).
3. Jeffery G.H., Bassett J., Mendham J.and Denny vogel's R.C, "Text book of quantitative analysis chemical analysis", ELBS 5th Edn. Longman, Singapore publishers, Singapore, 1996.
4. Kolthoff I.M., Sandell E.B. et al. "Quantitative chemical analysis", Mcmillan, Madras 1980.

II Semester

213EHT01 TECHNICAL ENGLISH II

OBJECTIVES:

- To make learners acquire listening and speaking skills in both formal and informal contexts.
- To help them develop their reading skills by familiarizing them with different types of reading strategies.
- To equip them with writing skills needed for academic as well as workplace contexts.
- To make them acquire language skills at their own pace by using e-materials and language lab components.

OUTCOMES:

Learners should be able to speak convincingly, express their opinions clearly, initiate a discussion, negotiate, argue using appropriate communicative strategies.
write effectively and persuasively and produce different types of writing such as narration, description, exposition and argument as well as creative, critical, analytical and evaluative writing. read different genres of texts, infer implied meanings and critically analyse and evaluate them for ideas as well as for method of presentation. listen/view and comprehend different spoken excerpts critically and infer unspoken and implied meanings.

UNIT I

Listening - Listening to informal conversations and participating; Speaking - Opening a conversation (greetings, comments on topics like weather) - Turn taking - Closing a conversation (excuses, general wish, positive comment, thanks); Reading - Developing analytical skills, Deductive and inductive reasoning - Extensive reading; Writing - Effective use of SMS for sending short notes and messages - Using 'emoticons' as symbols in email messages; Grammar - Regular and irregular verbs - Active and passive voice; Vocabulary - Homonyms (e.g. 'can') - Homophones (e.g. 'some', 'sum'); E-materials - Interactive exercise on Grammar and vocabulary – blogging; Language Lab - Listening to different types of conversation and answering questions.

UNIT II

Listening - Listening to situation based dialogues; Speaking - Conversation practice in real life situations, asking for directions (using polite expressions), giving directions (using imperative sentences), Purchasing goods from a shop, Discussing various aspects of a film (they have already seen) or a book (they have already read); Reading - Reading a short story or an article from newspaper, Critical reading, Comprehension skills; Writing - Writing a review / summary of a story / article, Personal letter (Inviting your friend to a function, congratulating someone for his / her success, thanking one's friends / relatives); Grammar - modal verbs, Purpose expressions; Vocabulary - Phrasal verbs and their meanings, Using phrasal verbs in sentences; E-materials - Interactiveexercises on Grammar and vocabulary, Extensive reading activity (reading stories / novels), Posting reviews in blogs - Language Lab - Dialogues (Fill up exercises), Recording students' dialogues.

UNIT III

Listening - Listening to the conversation - Understanding the structure of conversations; Speaking -Conversation skills with a sense of stress, intonation, pronunciation and meaning - Seeking information – expressing feelings (affection, anger, regret, etc.); Reading - Speed reading – reading passages with time limit - Skimming; Writing - Minutes of meeting – format and practice in the preparation of minutes - Writing summary after reading articles from journals - Format for journal articles – elements of technical articles (abstract, introduction, methodology, results, discussion, conclusion, appendices, references) - Writing strategies; Grammar - Conditional

clauses - Cause and effect expressions; Vocabulary - Words used as nouns and verbs without any change in the spelling (e.g. 'rock', 'train', 'ring'); E-materials - Interactive exercise on Grammar and vocabulary Speed Reading practice exercises; Language Lab - Intonation practice using EFLU and RIE materials – Attending a meeting and writing minutes.

UNIT IV

Listening - Listening to a telephone conversation, Viewing model interviews (face-to-face, telephonic and video conferencing); Speaking - Role play practice in telephone skills - listening and responding, -asking questions, -note taking – passing on messages, Role play and mock interview for grasping interview skills; Reading - Reading the job advertisements and the profile of the company concerned – scanning; Writing - Applying for a job – cover letter - résumé preparation – vision, mission and goals of the candidate; Grammar - Numerical expressions - Connectives (discourse markers); Vocabulary - Idioms and their meanings – using idioms in sentences; E-materials - Interactive exercises on Grammar and Vocabulary - Different forms of résumés- Filling up a résumé / cover letter; Language Lab - Telephonic interview – recording the responses - e-résumé writing.

UNIT V

Listening - Viewing a model group discussion and reviewing the performance of each participant - Identifying the characteristics of a good listener; Speaking - Group discussion skills – initiating the discussion – exchanging suggestions and proposals – expressing dissent/agreement – assertiveness in expressing opinions – mind mapping technique; Reading - Note making skills – making notes from books, or any form of written materials - Intensive reading; Writing – Checklist - Types of reports – Feasibility / Project report – report format – recommendations / suggestions – interpretation of data (using charts for effective presentation); Grammar - Use of clauses; Vocabulary – Collocation; Ematerials - Interactive grammar and vocabulary exercises - Sample GD - Pictures for discussion,
Interactive grammar and vocabulary exercises; Language Lab - Different models of group discussion.

TEXTBOOKS

1. Department of English, Anna University. Mindscapes: English for Technologists and Engineers. Orient Blackswan, Chennai. 2012
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Blackswan, Chennai. 2011

REFERENCES

1. Anderson, Paul V. Technical Communication: A Reader-Centered Approach. Cengage. New Delhi. 2008
2. Muralikrishna, & Sunita Mishra. Communication Skills for Engineers. Pearson, New Delhi. 2011
3. Riordan, Daniel. G. Technical Communication. Cengage Learning, New Delhi. 2005
4. Sharma, Sangeetha & Binod Mishra. Communication Skills for Engineers and Scientists. PHI Learning, New Delhi. 2009
5. Smith-Worthington, Darlene & Sue Jefferson. Technical Writing for Success. Cengage, MasonUSA. 2007

EXTENSIVE Reading (Not for Examination)

1. Khera, Shiv. You can Win. Macmillan, Delhi. 1998.

Websites

1. http://www.englishclub.com
2. http://owl.english.purdue.edu

TEACHING METHODS:

- Lectures
- Activities conducted individually, in pairs and in groups like individual writing and presentations, group discussions, interviews, reporting, etc

- Long presentations using visual aids
- Listening and viewing activities with follow up activities like discussions, filling up worksheets,
- writing exercises (using language lab wherever necessary/possible) etc
- Projects like group reports, mock interviews etc using a combination of two or more of the language skills

EVALUATION PATTERN:

Internal assessment: 20%

3 tests of which two are pen and paper tests and the other is a combination of different modes of assessment like

- Project
- Assignment
- Report
- Creative writing, etc.

All the four skills are to be tested with equal weightage given to each.

- Speaking assessment: Individual presentations, Group discussions
- Reading assessment: Reading passages with comprehension questions graded following
- Bloom's taxonomy
- Writing assessment: Writing essays, CVs, reports etc. Writing should include grammar and
- vocabulary.
- Listening/Viewing assessment: Lectures, dialogues, film clippings with questions on verbal as well as audio/visual content graded following Bloom's taxonomy.

End Semester Examination: 80%

213MAT02 MATHEMATICS – II

OBJECTIVES:

- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To acquaint the student with the concepts of vector calculus, needed for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow the of electric current.
- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I VECTOR CALCULUS

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 (excluding proofs) – Simple applications involving cubes and rectangular parallelopipeds.

UNIT II ORDINARY DIFFERENTIAL EQUATIONS

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.

UNIT III LAPLACE TRANSFORM

Laplace transform – Sufficient condition for existence – Transform of elementary functions – Basic properties – Transforms of derivatives and integrals of functions - Derivatives and integrals of transforms - Transforms of unit step function and impulse functions – Transform of periodic functions. Inverse Laplace transform -Statement of Convolution theorem – Initial and final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

UNIT IV ANALYTIC FUNCTIONS

Functions of a complex variable – Analytic functions: Necessary conditions – Cauchy-Riemann equations and sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping: w = z+k, kz, 1/z, z2, ez and bilinear transformation.

UNIT V COMPLEX INTEGRATION

Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Taylor's and Laurent's series expansions – Singular points – Residues – Cauchy's residue theorem – Evaluation of real definite integrals as contour integrals around unit circle and semi-circle (excluding poles on the real axis).

TEXT BOOKS:

1. Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, LaxmiPublications Pvt Ltd.,(2011).
2. Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi,(2011).

REFERENCES:

1. Dass, H.K., and Er. Rajnish Verma," Higher Engineering Mathematics", S. Chand Private Ltd., (2011)
2. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, (2012).

3. Peter V. O'Neil," Advanced Engineering Mathematics", 7th Edition, Cengage learning, (2012).
4. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, (2008).

213PMT03 - PHYSICS OF MATERIALS

UNIT I PREPARATION AND PROCESSING OF MATERIALS

Phases - Phase rule – binary systems – tie line rule – lever rule – phase diagram – invariant reactions – diffusion Fick's law - Nucleation – homogeneous and heterogeneous nucleation – Free energy of formation of a critical nucleus – crystal growth – Czochralski, Bridgman, Solution methods - Thin films – preparation: PVD method - Sol-gel method – heat treatment and hardening processes.

UNIT II PROPERTIES OF CONDUCTING AND SUPER CONDUCTING MATERIALS

Classical free electron theory of metals –Fermi function - Schrödinger wave equation - Time independent and time dependent equations. Physical significance of wave function, particle in a box (in one dimension) – electrons in a metal - Density of energy states – effect of temperature on Fermi energy – carrier concentration in metals - Superconducting Phenomena, Properties of superconductors – Meissner effect and Isotope effect. Type I and Type II superconductors, High Tc superconductors – Magnetic levitation and SQUIDS.

UNIT III ELECTRONIC MATERIALS

Elemental and compound semiconductors - Origin of band gap in solids (qualitative) - Concept of effective mass of electron and hole – carrier concentration in an intrinsic semiconductor (derivation) – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination – carrier concentration in n-type and p-type semiconductors (derivation) – variation of Fermi level with temperature and impurity concentration – Compound semiconductors – Hall effect – Determination of Hall coefficient – LED and Solar cells.

UNIT IV INSULATING AND MAGNETIC MATERIALS

Dielectric, paraelectric and ferroelectric materials - Electronic, Ionic, Orientational and space charge polarization – Internal field and deduction of Clausius Mosotti equation – dielectric loss – different types of dielectric breakdown – classification of insulating materials and their applications - Introduction to magnetic materials - Domain theory of ferromagnetism, Hysteresis, Soft and Hard magnetic materials – Anti-ferromagnetic materials – Ferrites, Giant Magneto Resistance materials. Magnetic bubbles.

UNIT V CERAMIC AND NEW MATERIALS

Introduction to Ceramics and its applications - Ceramic Fibres - Fibre reinforced Plastics – Fibre reinforced Metal – Metallic glasses – Shape memory alloys – Copper base alloys – Nickel – Titanium alloys – Relaxor- Ferroelectric materials – Electro and magneto rheological fluids - Sensors and Actuators – polymer semiconductos – photoconducting polymers – liquid crystals - Bio-sensors - Scintillation detectors (Position sensitive) –Bio materials – hydroxyapatite – PMMA – Silicone.

REFERENCES

1. Raghavan. V. Materials Science and Engineering, Prentice Hall of India, 2002.
2. Kumar.J, Moorthy Babu. S and Vasudevan. S., Engineering Physics, Vijay Nicole Imprints, 2006
3. Palanisamy.. P.K., Materials Science, Scitech., 2003.
4. Calister, W.D., Materials Science and Engineering an Introduction, John Wiley, 2003.
5. Raghavan, V., Physical Metallurgy, Prentice Hall of India, 2002.

213CFT04 - CHEMISTRY FOR TECHNOLOGISTS

UNIT I WATER

Water quality parameters- determination of hardness (EDTA method), TDS, BOD, COD and iron and their significance. Softening – Zeolite and demineralization processes. Boiler troubles and remedies – removal of oils and silica, internal conditioning. Desalination by electro-dialysis and reverse osmosis. Water quality parameters and standards for textile wet processing.

UNIT II CHEMISTRY OF INTERFACES

Interface region-curved interfaces-thermodynamics of surfaces - Surface film on liquids-Adsorption of gases on Solids-adsorption isotherms. Applications of adsorption studiesdetergency, wetting, foaming , defoaming, spreading, water repellency.

UNIT III OILS, FATS, SOAPS & LUBRICANTS

Chemical constitution, Chemical analysis of oils and fats – acid, saponification and iodine values, Definitions, determinations and significance.Definition, mechanism of lubrication, preparation of petrolubes, desirable characteristics – viscosity, viscosity index, carbon residue, oxidation stability, flash and fire points, cloud and pour points, aniline point. Semisolid lubricant – greases, preparation of sodium, lithium, calcium and axle greases and uses, consistency test and drop point test. Solid lubricants – graphite and molybdenum disulphide

UNIT IV CHEMICALS AND AUXILIARIES

Surfactant Chemistry, bleaching powder, sodium hypochlorite, hydrogen peroxide, chlorine dioxide, preparation, estimation of available chlorine in hypochlorite bleach liquor. determination of strength of hydrogen peroxide.

UNIT V COLORANTS

Theory of color and constitution: chromophore and auxochrome,classification of dyes based on application. Chemistry and synthesis of , azo dye.

REFERENCES:

1. Dhara S. S., "A Text Book of Engineering Chemistry", S. Chand & Co. Ltd., New Delhi, 2002
2. Jain. P.C. and Monica Jain, "Engineering Chemistry", Dhanpet Rai & Sons, New Delhi, 2001
3. Puri B. R., Sharma L. R. and Madhan S. Pathania, "Principles of Physical Chemistry", Shoban Lal Nagin Chand & Co., Jalandar, 2000
4. Shore J., "Colourants and Auxiliaries: Volume I Colorants", Wood head Publishing Ltd., 2002, ISBN 0 901956 77 5
5. Shore J., "Colourants and Auxiliaries: Volume II Auxiliaries", Wood head Publishing Ltd., 2002, ISBN 0 901956 78 3
6. Trotman E. R., "Dyeing and Chemical Technology of Textile Fibres", B.I Publishing Pvt. Ltd., New Delhi, 1994
7. Shenai V. A., "Chemistry of Dyes and Principles of Dyeing", Sevak Publications, Mumbai, 1995

213BYT05 - BIOCHEMISTRY

OBJECTIVES

- To develop understanding and provide scientific basics of the life processes at the molecular level and explain the structure, function and inter-relationships of biomolecules and their deviation from normal and their consequences for interpreting and solving clinical problems.

UNIT I BIOCHEMICAL ORGANIZATION AND BIOENERGETICS

Scope of clinical biochemistry, component of the cell, structure and biochemical functions, membrane structure and functions, transport through biological cell membrane, the concept of free energy, determination of change in free energy from equilibrium constant and reduction potential, bioenergetics and biological oxidation – general concept of oxidation and reduction, electron transport chain, oxidative phosphorylation, uncouplers and theories of biological oxidation and oxidative phosphorylation

UNIT II BIOMOLECULES

Carbohydrates – classification, prope
rties.starch, glycogen, dextrin, inulin, cellulose,
metabolism of carbohydrates – gluconeogenesis, glycogenolysis, glycolysis. citric acid cycle and its biological significance, role of sugar in nucleotide biosynthesis and pentose phosphate pathway. **Lipids** – Classification, properties. sterols, essential fatty acids, eicosanoids, phospholipids, sphingolipids, metabolism of lipids, oxidation of fatty acids, α,β - oxidation and biosynthesis of ketone bodies, cholesterol, porphyrin biosynthesis, metabolism of bile pigments. **Proteins and amino acids** – Classification, properties, biosynthesis of amino acids and proteins, essential amino acids, metabolism of amino acids and proteins, Nitrogen balance. **Nucleic acids** –genetic code, nucleic acids, and structure of DNA and RNA, purine biosynthesis and pyrimidine biosynthesis.

UNIT III BIOENERGETICS

High energy compounds , electronegative potential of compounds , respiratory chain , ATP cycle , Calculation of ATP during oxidation of glucose and fatty acids.

UNIT IV MACROMOLECULES, VITAMINS, HORMONES, ENZYMES

Physical and chemical properties, structure of haemoglobin, immunoglobulins and nucleoprotein, classification and their properties, occurrence, functions, requirements, deficiency manifestations and role of vitamins as coenzyme, chemical nature and properties, hormones, Nomenclature, enzyme kinetics, classification and their properties, mechanism of action, enzyme induction and inhibition, coenzyme significance and enzymes of clinical importance

UNIT V BIOCHEMISTRY OF CLINICAL DISEASES

Diabetes mellitus, atherosclerosis, fatty liver, and obesity, hormonal disorders, aging, inborn errors of metabolism organ function tests

TEXTBOOKS:

1. Lehninger A.L., Nelson D.L. and Cox M.M. Principles of Biochemistry. CBS publishers and distributers
2. Murray R.K., Granner D.K., Mayes P.A. and Rodwell V.W. Harpers Biochemistry. Appleton and Lange ,Stanford ,Conneticut.
3. Thomas M. Devlin.Textbook of Biochemistry with clinical correlations. Wiley Liss Publishers

REFERENCES:

1. Burtis & Ashwood W.B. Tietz Textbook of Clinical chemistry. Saunders Company
2. Lubert Stryer W.H. Biochemistry. Freeman and company, New york.
3. Donald Voet & Judith G. Voet. Biochemistry. John Wiley and Sons ,Inc.
4. Rama Rao Textbook of Biochemistry.
5. Deb. Textbook of Biochemistry.

213MYT06 - MICROBIOLOGY

OBJECTIVES

- To introduce students to the principles of Microbiology to emphasize structure and biochemical aspects of various microbes.
- To solve the problems in microbial infection and their control.

UNIT I INTRODUCTION

Basics of microbial existence; history of microbiology, classification and nomenclature of microorganisms, microscopic examination of microorganisms, light and electron microscopy; principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining.

UNIT II MICROBES- STRUCTURE AND MULTIPLICATION

Structural organization and multiplication of bacteria, viruses, algae and fungi, with special mention of life history of actinomycetes, yeast, mycoplasma and bacteriophages.

UNIT III MICROBIAL NUTRITION, GROWTH AND METABOLISM

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

UNIT IV CONTROL OF MICROORGANISMS

Physical and chemical control of microorganisms; host-microbe interactions; anti-bacterial, anti-fungal and anti-viral agents; mode of action and resistance to antibiotics; clinically important microorganisms.

UNIT V INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY

Primary metabolites; secondary metabolites and their applications; preservation of food; production of penicillin, alcohol, vitamin B-12; biogas; bioremediation; leaching of ores by microorganisms; biofertilizers and biopesticides; microorganisms and pollution control; biosensors

TEXT BOOKS

1. Talaron K, Talaron A, Casita, Pelczar and Reid. Foundations in Microbiology, W.C. Brown Publishers, 1993.
2. Pelczar MJ, Chan ECS and Krein NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India.
3. Prescott L.M., Harley J.P., Klein DA, Microbiology, 3rd Edition, Wm. C. Brown Publishers, 1996.

PRACTICAL

213BYP01 - BIOCHEMISTRY LABORATORY

OBJECTIVES

- To learn and understand the principles behind the qualitative and quantitative estimation of biomolecules (proteins, carbohydrates, lipids, metabolites etc.,) and laboratory analysis of the same in the body fluids.

LIST OF EXPERIMENTS

1. Preparation and measurement of pH of standard buffers (phosphate, carbonate, borate, TRIS etc.,).
2. Qualitative analysis of carbohydrates (monosaccharides, disaccharides, polysaccharides etc.,)
3. Enzymatic hydrolysis of glycogen by α and β amylase
4. Qualitative analysis of proteins
5. Qualitative analysis of lipids (triglycerides, cholesterol, phospholipids etc.,)
6. Quantitative analysis of proteins (Lowrys method, Bradford, UV)
7. Quantitative analysis of carbohydrates (Benedict's method etc.,) lipids
8. Quantitative analysis of lipids (Benedict's method etc.,)
9. Quantitative estimation of blood glucose
10. Acid hydrolysis and action of salivary amylase on starch
11. Estimation of chloride, glucose, ammonia and creatinine in urine.
12. Quantitative analysis of urea in serum
13. Quantitative analysis of serum bilirubin
14. Quantitative estimation of serum cholesterol by Libermann Burchard's method
15. Isolation and assay of glycogen from the liver and skeletal muscle of mice
16.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1. UV-Visible Spectrophotometers
2. pH meter
3. Centrifuge

TEXT BOOKS:

1. Gupta R.C. and Bhargavan S. Practical Biochemistry.
2. David T. Phummer. Introduction of Practical Biochemistry (II Edition).

REFERENCES:

1. Murray R.K., Granner D.K., Mayes P.A. and Rodwell V.W. Harpers Biochemistry, Appleton and Lange ,Stanford ,Conneticut.
2. Thomas M. Devlin. Textbook of Biochemistry with clinical correlations. Wiley Liss Publishers

213MYP02 -MICROBIOLOGY LABORATORY

LIST OF EXPERIMENTS

1. Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques;
2. Culture Media-Types and Use; Preparation of Nutrient broth and agar
3. Culture Techniques, Isolation and Preservation of Cultures- Broth: flask, test tubes; Solid: Pour plates, streak plates, slants, stabs
4. Microscopy – Working and care of Microscope
5. Microscopic Methods in the Study of Microorganisms; Staining Techniques- Simple, Differential- Gram's Staining
6. Quantification of Microbes: Sampling and Serial Dilution; Bacterial count in Soil – TVC
7. Effect of Disinfectants- Phenol Coefficient
8. Antibiotic Sensitivity Assay
9. Growth Curve in Bacteria and Yeast
10. Effect of pH, Temperature, UV radiation on Growth Bacteria

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Autocalve 1
Hot Air Oven 1
Incubators 2
Light Microscopes 4
Incubator Shaker 1
Colorimeter 2
Lamina Flow Chamber 2
Glassware, Chemicals, Media as required

REFERENCES:

1. Cappuccino, J.G. and N. Sherman "Microbiology : A Laboratory Manual", 4th Edition, Addison-Wesley, 1999.
2. Collee, J.G. etal., "Mackie & McCartney Practical Medical Microbiology" 4th Edition, Churchill Livingstone, 1996.

III SEMESTER

313MAT01 - TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

OBJECTIVE:
To facilitate the understanding of the mathematical principles on transforms and partial differtial equations and to cultivate the art of formulating physical problems in the language of mathematics.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS
Formation of partial differential equations – Singular integrals -- Solutions of standard types of first order partial differential equations - Lagrange's linear equation -- Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II FOURIER SERIES
Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS
Classification of PDE – Method of separation of variables - Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (excluding insulated edges).

UNIT IV FOURIER TRANSFORMS
Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS
Z- transforms - Elementary properties – Inverse Z - transform (using partial fraction and residues) – Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

OUTCOMES:
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Ztransform techniques for discrete time systems.

TEXT BOOKS:

1. Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
2. Grewal. B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi, 2012.
3. Narayanan.S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students" Vol. II & III, S.Viswanathan Publishers Pvt Ltd. 1998.

REFERENCES:

1. Bali.N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 7th Edition, Laxmi Publications Pvt Ltd , 2007.
2. Ramana.B.V., "Higher Engineering Mathematics", Tata Mc-GrawHill Publishing Company Limited, NewDelhi, 2008.
3. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson

Education, 2007.
4. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India, 2007.
5. Ray Wylie. C and Barrett.L.C, "Advanced Engineering Mathematics" Tata Mc Graw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2012.
6. Datta.K.B., "Mathematical Methods of Science and Engineering", Cengage Learning India Pvt Ltd, Delhi, 2013.

313BTT02 - STOICHIOMETRY AND FLUID MECHANICS

OBJECTIVES:

The course aims to develop skills of the students in the area of Chemical Engineering with emphasis in process calculations and fluid mechanics. The objectives are to enable the students

- To perform calculations pertaining to processes and operations.
- To apply fluid mechanics principles to applied problems

UNIT I INTRODUCTION

Units, conversion factors –gas laws- humidity and other physical properties

UNIT II CONCEPTS IN MATERIAL BALANCES

Application problems in unit operations - Material balance in reactions – Application in bioprocesses

UNIT III CONCEPTS IN ENERGY BALANCES

Sensible, Latent heats- Thermo chemical calculations-use of steam tables-examples of simultaneous material and energy balance- Application of energy balance in Bioprocesses

UNIT IV FLUID PROPERTIES

Newtonian and Non Newtonian Fluids, Fluid statics, Fluid Flow in pipelines and other flow channels- pressure drop calculations. Flow measurements.

UNIT V AGITATION, FLOW THROUGH PACKINGS, FLUIDIZATION, FLUID TRANSPORT

Flow in packed columns, fluidization –valves,pumps gas moving devices, gases – equipments. Agitation – power requirement

OUTCOMES:

Upon success completion of this course, the students will be able to:

- Solve problems related to units and conversions and fit the given data using the methodologies
- Solve problems related to material and energy balance concepts and design reactors for biochemical processes
- Apply their knowledge in the field of biochemical engineering from the principles of thermodynamics.
- Acquire knowledge related to fluid statics and dynamics, agitators and applications of various pumps.

TEXT BOOKS:

1. Bhatt, B.I. and S.M. Vora "Stoichiometry (SI Units)", 3rd Edition, Tata McGraw-Hill, 1996.
2. Geankoplis, C.J. "Transport Processes and Separation process Principles", 4th Edition, PHI, 2006.

REFERENCES:

1. McCabe, W.L., J.C. Smith and P.Harriot "Unit Operations of Chemical Engineering", 6th Edition, Mc Graw Hill, 2001.
2. Himmelblau, D.M. "Basic principles and calculations in Chemical Engineering", 6th Edition, PHI, 2006.

3. Foust, A.S. etal., " Principles of Unit Operations", 2nd Edition, John Wiley & Sons, 1999.
4. Narayanan, K.V. and Lakshmi Kutty "Stoichiometry and Process Calculations",PHI, 2006.
5. Coulson, J.M. and etal. "Coulson & Richardson's Chemical Engineering", 6th Edition, Vol. I & II, Butterworth – Heinman (an imprint of Elsevier), 2004.
6. Perrys Chemical Engineers Hand Book.

313BTT03 - BIOORGANIC CHEMISTRY

OBJECTIVES:

- To enable the students
- To know in detail about the elements of atom, charges and their bonding rule.
- To understand the various kinetic properties and types of reaction mechanisms
- To understand the possible bio-organic reactions involved in biosynthesis

UNIT I BONDING AND STEREOCHEMISTRY

Atoms Electrons and orbitals - Covalent Bonds - Octet rule - Polar covalant Bonds - Electronegativity- formal charge - Resonance Acids and Bases - Arrhenius and Bronsted Lowry Theories - Acid Base equilbria - SP3 hybridization - Conformations analysis ethane, butane and cyclohexane - Cis- trans isomerism. Stereochem activity around the tetrahedral carbon – optical activity - Conformation of the peptide bond.

UNIT II MECHANISMS OF SUBSTITUTION AND ADDITION REACTIONS

SN1 and SN2 reactions on tetrahedral carbon- nucleophiles- mechanism steric effects – nucleophilic addition on Acetals and ketals -Aldehyde and ketone groups – reactions of carbonyl group with amines- acid catalyzed ester hydrolysis – Saponification of an esterhydrolysis of amides. Ester enolates - claisen .condensation – Michael condensation.

UNIT III KINETICS AND MECHANISM

Kinetic method – Rate law and mechanism – Transition states- Intermediates – Trapping of intermediates – Microscopic reversibility – Kinetic and thermodynamic reversibility – Isotopes for detecting intermediates. Primary and secondary isotopes – the Arrhenius equation Eyring equation - ΔG, ΔS, ΔH, Thermodynamics of coupled reactions.

UNIT IV CATALYSIS

Reactivity – Coenzymes – Proton transfer – metal ions – Intra molecular reactions – Covalent catalysis – Catalysis by organized aggregates and phases. Inclusion complexation

UNIT V BIOORGANIC REACTIONS

Timing of Bond formation and fission – Acyl group transfer – C-C bond formation and fission – Catalysis of proton transfer reactions – Transfer of hydride ion – Alkyl group. Transfer – Terpene biosynthesis – Murrlfield state peptide synthesis – Sanger method for peptide and DNA sequencing.

OUTCOME:

On completion of this course, the students will learn the basics principles of chemical Bonding, Stereochemistry of Bio-organic molecules and their kinetics, mechanisms of reactions and catalysis.

TEXT BOOKS:

1. Carey, Francis A." Organic Chemistry". 7th Edition, Tata MCGraw Hill, 2009.
2. Page, M.I. and Andrew Williams "Organic and Bio-organic Mechanisms". Pearson, 2010.

REFERENCE:

1. Dugas, Hermann " Bioorganic Chemistry : A Chemical Approach to Enzyme Action" 3rd Edition, Springer, 2003.

313BTT04 - CELL BIOLOGY

OBJECTIVES:

- To provide knowledge on the fundamentals of cell biology
- To help students understand the signalling mechanisms

UNIT I CELL STRUCTURE AND FUNCTION OF THE ORGANELLES

Eukaryotic, Prokaryotic cells, Subcellular Organelles and Functions Principles of membrane organization membrane proteins, cytoskeletal proteins eg. RBC cytoskeletal contractile proteins Actin, myosin, Actin Polymerization Act- myosin complex, mechanism of myosin-ATpase activity, contraction; microtubules, microfilaments activity in Organelle movement.

UNIT II CELL DIVISION AND CONNECTION

Cell cycle – Mitosis, Meiosis, Molecules controlling cell cycle, Extra cellular matrix, role of matrix in cell enthore : Gap junctions, Tight junctions, Desmosomes, Hemidesmosomes.

UNIT III TRANSPORT ACROSS CELL MEMBRANE

Passive and Active Transport, Permeases, Ion channels, ATP pumps. Na+ / K+ / Ca+2T pumps uniport, symport antiporter system. Ligand gated / voltage gated channels, Agonists and Antagonists.

UNIT IV SIGNAL TRANSDUCTION

Receptors – extracellular signaling, Cell surface / cytosolic receptors and examples,Different classes of receptors antocrine / paracrine / endocrine models, Secondary messengers molecules.

UNIT V TECHNIQUES USED TO STUDY CELLS

Cell fractionation and flow cytometry, Morphology and identification of cells using microscopic studies like SEM, TEM and Confocal Microscopy. Localization of proteins in cells – Immunostaining.

OUTCOMES:

Upon completion of this course, the students

- Would have deeper understanding of cell at structural and functional level.
- Would have broad knowledge on the molecular interaction between cells.
- Would demonstrate a clear understanding of the signal transduction, secondary messengers.
- Would develop skill on working principles of microscopy and identification of cell types.

TEXT BOOKS:

1. Lodish, Harvey etal., " Molecular Cell Biology," 6th Edition. W.H.Freeman, 2008
2. Alberts, Bruce etal., "Essentail Cell Biology", 2nd Edition, Garland Science, 2004

REFERENCES:

1. Alberts, Bruce, "Molecular Biology of Cell", 5th Edition, Garland Science, 2008.
2. Cooper,G.M. "The Cell: A Molecular Approach, 4th Edition, ASM Press, 2007.

313BTT05 - BASIC INDUSTRIAL BIOTECHNOLOGY

OBJECTIVES:

- To make the students aware of the overall industrial 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 modern Bioproducts, Industrial Enzymes, Products of plant and animal cell cultures.

UNIT I INTRODUCTION TO INDUSTRIAL BIOPROCESS

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

UNIT II PRODUCTION OF PRIMARY METABOLITES

Primary Metabolites- Production of commercially important primary metabolites like organic acids, amino acids, alcohols and vitamins.

UNIT III PRODUCTION OF SECONDARY METABOLITES

Secondary Metabolites- Production processes for various classes of secondary metabolites: Antibiotics and Steroids.

UNIT IV PRODUCTION OF ENZYMES AND OTHER BIOPRODUCTS

Production of Industrial Enzymes, Biopesticides, Biofertilizers, Biopreservatives, Biopolymers Biodiesel, Cheese, Beer, SCP & Mushroom culture. Bioremediation.

UNIT V PRODUCTION OF MODERN BIOTECHNOLOGY PRODUCTS

Production of recombinant proteins having therapeutic and diagnostic applications, vaccines. Bioprocess strategies in Plant Cell and Animal Cell culture.

OUTCOMES:

At the end of the course, the students will be able

- To explain the steps involved in the production of bioproducts and methods to improve modern biotechnology.
- To apply basic biotechnological principles, methods and models to solve biotechnological tasks.
- To identify and debate the ethical, legal, professional, and social issues in the field of biotechnology.
- To design and deliver useful modern biotechnology products to the Society.

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. etal., "Concepts in Biotechnology" Universities Press Pvt.Ltd., 2004.
4. Ratledge, Colin and Bjorn Kristiansen "Basic Biotechnology" 2nd Edition Cambridge University Press, 2001.
5. Dubey, R.C. "A Textbook of Biotechnology" S.Chand & Co. Ltd., 2006.

REFERENCES:

1. A.H. Patel " Industrial Microbiology" Macmillan Presscott, S.C. and Cecil G. Dunn, "Industrial Microbiology", Agrobios (India), 2005.

2. Cruger,Wulf and Anneliese Crueger, "Biotechnology: A Textbook of Industrial Microbiology", 2nd Edition, Panima Publishing, 2000.
3. Moo-Young, Murrey, "Comprehensive Biotechnology", 4 Vols. Pergamon Press, (An Imprint of Elsevier) 2004.
4. C.F.A Bryce and EL.Mansi, Fermentation microbiology & Biotechnology, 1999.
5. K.G.Ramawat & Shaily Goyal, Comprehensive Biotechnology, 2009, S.Chand publications.

313BTT06 - BIOPROCESS PRINCIPLES

OBJECTIVES:

- To impart knowledge on design and operation of fermentation processes with all its prerequisites.
- To endow the students with the basics of microbial kinetics, metabolic stoichiometry and energetics.

UNIT I OVERVIEW OF FERMENTATION PROCESSES

Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermenter and ancillaries, main parameters to be monitored and controlled in fermentation processes.

UNIT II RAW MATERIALS AND MEDIA DESIGN FOR FERMENTATION PROCESS

Criteria for good medium, medium requirements for fermentation processes- carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements. Medium formulation for optimal growth and product formation, examples of simple and complex media, design of various commercial media for industrial fermentations- medium optimization methods.

UNIT III STERILIZATION KINETICS

Thermal death kinetics of microorganisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media, air sterilization and design of sterilization equipment - batch and continuous.

UNIT IV METABOLIC STOICHIOMETRY AND ENERGETICS

Stoichiometry of cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients, energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth.

UNIT V KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION

Batch cultivation and continuous cultivation. Simple unstructured models for microbial growth, Monod model, growth of filamentous organisms, product formation kinetics – Leudeking-Piret models, substrate and product inhibition on cell growth and product formation. Biomass estimation - Direct and Indirect methods.

OUTCOMES:

Upon completion of the course in Bioprocess Principles graduates will be able to

- Apply engineering principles to systems containing biological catalysts to meet the needs of the society.
- Convert the promises of molecular biology and genetic engineering into new processes to make bio-products in economically feasible way.
- Interpret the kinetics of living cells and to develop a strategy to solve the issues emerging during fermentation processes.
- Enhance and modify the biological materials to improve its usefulness by finding the optimal formulation materials to facilitate product production.

TEXT BOOKS:

1. Shuler, Michael L. and Fikret Kargi, "Bioprocess Engineering ", Prentice Hall, 1992.
2. Doran M Pauline "Bioprocess Engineering Principles" . 2nd Edition, Elsevier, 2012.
3. Ghasem D.Najafpour, "Biochemical Engineering and Biotechnology", Elsevier, 2007.

REFERENCES:

1. Bailey, James E. and David F. Ollis, " Biochemical Engineering Fundamentals", 2nd Edition. McGraw Hill , 1986.

2. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Science & Technology Books, 1995.
3. Jens Nielson, John Villadsen and Gunnar Liden, "Bioreaction engineering principles", 2nd Edition, Kulwer Academic, 2002
4. Tapobrate Panda, "Bioreactors: Analysis and Design", Tata McGraw Hill, 2011
5. Rajiv Dutta, "Fundamentals of Biochemical Engineering", Springer, 2008

PRACTICAL

313BTP01 - CELL BIOLOGY LABORATORY

OBJECTIVES:
To demonstrate various techniques to learn the morphology, identification and propagation of cells

LIST OF EXPERIMENTS
1. Introduction to principles of sterile techniques and cell propagation
2. Principles of microscopy, phase contrast and fluorescent microscopy
3. Identification of given plant, animal and bacterial cells and their components by microscopy
4. Gram's Staining
5. Leishman Staining
6. Giemsa Staining
7. Thin Layer Chromatography
8. Separation of Peripheral Blood Mononuclear Cells from blood
9. Osmosis and Tonicity
10. Trypan Blue Assay
11. Staining for different stages of mitosis in AlliumCepa (Onion)

OUTCOMES:
This practical course will facilitate the students
- To understand the basic techniques to work with cells
- To demonstrate working principles of Microscopy
- To understand and perform cell staining techniques
- To identify the various stages of mitosis

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
Autoclave 1
Hot Air Oven 1
Incubators 2
Light Microscopes 4
Incubator Shaker 1
Colorimeter 2
Laminar Flow Chamber 2
Glassware, Chemicals, Media as required

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

313BTP02 - BIOORGANIC CHEMISTRY LABORATORY

OBJECTIVE:
To train the students in preparation of bioorganic molecules and characterizing them.

LIST OF EXPERIMENTS
1. Synthesis of aspirin
2. Hydrolysis of sucrose
3. Preparation of pyruvic acid from tartaric acid
4. Preparation of oleic acid from tartaric acid
5. Preparation of alpha D- glucopyranose pentaacetate
6. Preparation of 1,2,5,6 dicyclohexylnoine alpha d glucofuranose
7. Isolation of lycopene from tomato paste
8. Preparation of L-proline
9. Preparation of L-cysteine from hair
10. Preparation of S-ethyl hydroxybutonate from ethyl acetoacetate using yeast
11. Resolution of S-ethyl hydroxybutonate using 3,5 dinitrobenzoate.
12. Preparation of 5,10,15,20-tetrakisphenyl porphyrin.

OUTCOME:
On completion of the course, the students will have hands on experience on the synthesis of certain useful bioorganic molecules and be able to analyse their physical and chemical properties.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
1. Colorimeter 2 No.
2. Glassware, Chemicals, Media as required

REFERENCES:

1. Organic Chemistry, Francis A.Carey, VII Edition, Tata MCGraw Hill, Fourth reprint 2009.
2. Organic and Bio-organic Mechanisms, M.I. Page and Andrew Williams. Pearson, First Impression, 2010.

IV SEMESTER

413BTT01 - PROBABILITY AND STATISTICS

OBJECTIVES
This course aims at providing the required skill to apply the statistical tools in engineering problems.

UNIT I RANDOM VARIABLES
Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions.

UNIT II TWO - DIMENSIONAL RANDOM VARIABLES
Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III TESTING OF HYPOTHESIS
Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample test based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

UNIT IV DESIGN OF EXPERIMENTS
One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design - 22 factorial design.

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

OUTCOMES:
The students will have a fundamental knowledge of the concepts of probability. Have knowledge of standard distributions which can describe real life phenomenon. Have the notion of sampling distributions and statistical techniques used in management problems.

TEXT BOOKS:

1. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.
2. Johnson. R.A. and Gupta. C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th Edition, 2007.
3. Papoulis. A and Unnikrishnapillai. S., "Probability, Random Variables and Stochastic Processes " Mc Graw Hill Education India , 4th Edition, New Delhi , 2010.

REFERENCES:

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2012.
2. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia , 8th Edition, 2007.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.

4. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.

413BTT02 - ANALYTICAL METHODS AND INSTRUMENTATION

OBJECTIVES:

- To enable the students
- To have a fundamental knowledge about the Light spectrum, Absoprtion, Fluorescence NMR, Mass spectroscopy
- To acquire knowledge on the different chromotographic methods for separation of biological products.

UNIT I INTRODUCTION TO SPECTROMETRY

Properties of electromagnetic radiation- wave properties – components of optical instruments – Sources of radiation – wavelength selectors – sample containers – radiation transducers – Signal process and read outs – signal to noise ratio - sources of noise – Enhancement of signal to noise - types of optical instruments – Principle of Fourier Transform optical Measurements.

UNIT II MOLECULAR SPECTROSCOPY

Molecular absorption spectrometry – Measurement of Transmittance and Absorbance – Beer's law – Instrumentation - Applications -Theory of fluorescence and Phosphorescence – Instrumentation – Applications – Theory of Infrared absorption spectrometry – IR instrumentation – Applications – Theory of Raman spectroscopy – Instrumentation – applications.

UNIT III MAGNETIC RESONANCE SPECTROSCOPY AND MASS SPECTROMETRY

Theory of NMR – environmental effects on NMR spectra – chemical shift- NMRspectrometers – applicatons of 1H and 13C NMR- Molecular mass spectra – ion sources – Mass spectrometer. Applications of molecular mass - Electron paramagnetic resonance- g values – instrumentation.

UNIT IV SEPARATION METHODS

General description of chromatography – Band broadening and optimization of column performance- Liquid chromatography – Partition chromatography – Adsorption chromatography – Ion exchange chromatography -size exclusion chromatography- Affinity chromatography- principles of GC and applications – HPLC- Capillary electrophoresis – Applications**.**

UNIT V ELECTRO ANALYSIS AND SURFACE MICROSCOPY

Electrochemical cells- Electrode potential cell potentials – potentiometry- reference electrode – ion selective and molecular selective electrodes – Instrument for potentiometric studies – Voltametry – Cyclic and pulse voltametry- Applications of voltametry . Study of surfaces – Scanning probe microscopes – AFM and STM.

OUTCOME:

On completion of the course, students will have a better understanding of spectroscopy and the separation techniques used for biological products.

TEXT BOOKS:

1. Skoog, D.A. F. James Holler, and Stanky, R.Crouch "Instrumental Methods of Analysis". Cengage Learning , 2007.
2. Willard, Hobart, etal., "Instrumental Methods of Analysis". 7th Edition, CBS, 1986.
3. Braun, Robert D. " Introduction to Instrumental Analysis". Pharma Book Syndicate, 1987.
4. Ewing,G.W. "Instrumental Methods of Chemical Analysis", 5th Edition, McGraw-Hill, 1985

REFERENCES:

1. Sharma, B.K. "Instrumental Methods of Chemical Analysis : Analytical Chemistry" Goel Publishing House, 1972.
2. Haven, Mary C., etal., "Laboratory Instrumentation ". 4th Edition, John Wiley, 1995.

413BTT03 - APPLIED THERMODYNAMICS FOR BIOTECHNOLOGISTS

OBJECTIVE:

To enable the students to learn about basic concepts of classical and statistical thermodynamics

UNIT I THERMODYNAMIC LAW AND PROPERTIES OF FLUIDS

First Law of thermodynamics, a generalized balance equation and conserved quantities, Volumetric properties of fluids exhibiting non ideal behavior; residual properties; estimation of thermodynamic properties using equations of state; calculations involving actual property exchanges; Maxwell's relations and applications.

UNIT II SOLUTION THERMODYNAMICS

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

UNIT III PHASE EQUILIBRIA

Criteria for phase equilibria; VLE calculations for binary and multi component systems; liquid- liquid equilibria and solid-solid equilibria.

UNIT IV CHEMICAL REACTION EQUILIBRIA

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

UNIT V THERMODYNAMIC DESCRIPTION OF MICROBIAL GROWTH AND PRODUCT FORMATION

Thermodynamics of microbial growth stoichiometry thermodynamics of maintenance, Calculation of the Operational Stoichiometry of a growth process at Different growth rates, Including Heat using the Herbert –Pirt Relation for Electron Donor, thermodynamics and stoichiometry of Product Formation.

OUTCOMES:

At the end of this course, the student would have the ability

- To explain the theoretical concepts of thermodynamics and how it applies to energy conversion in technological applications and biological systems.
- To demonstrate the capability to analyze the energy conversion performance in a variety of modern applications in biological systems.
- To design and carry out bioprocess engineering experiments, and analyze and interpret fundamental data to do the design and operation of bioprocesses.
- To describe the criteria when two phases coexist in equilibrium and the vapour liquid equilibrium calculations microbial growth and product formation.

TEXT BOOKS:

1. Smith J.M., Van Ness H.C., and Abbot M.M. "Introduction to Chemical Engineering Thermodynamics", 6th Edition. Tata McGraw-Hill, 2003.
2. Narayanan K.V. "A Text Book of Chemical Engineering Thermodynamics", PHI,2003.
3. Christiana D. Smolke, " The Metabolic Pathway Engineering Handbook Fundamentals", CRC Press Taylor & Francis Group, 2010.

REFERENCE:

1. Sandler S.I. "Chemical and Engineering Thermodynamics", John Wiley,1989.

413BTT04 - HEAT TRANSFER OPERATIONS

OBJECTIVE:
To enable the students to understand the fundamental principles and concepts of heat transfer. This course will be a prerequisite for certain engineering subjects offered in the subsequent semesters

UNIT I MIXING AND AGITATION
Dimensional analysis; power for agitation; agitation of liquids; gas-liquid systems; gassolid suspensions; agitator scale up.

UNIT II CONDUCTION HEAT TRANSFER
Steady state conduction; combined resistances; unsteady state conduction; lumped heat capacity; extended surfaces; combined conduction and convection.

UNIT III CONVECTION HEAT TRANSFER
Dimensional analysis; forced and natural convection; convection in flow over surfaces through pipes boiling and condensation.

UNIT IV RADIATION HEAT TRANSFER
The problem of radiative exchange-Kirchoff's law, radiant heat exchange between two finite black holes-heat transfer among gray bodies

UNIT V HEAT TRANSFER EQUIPMENTS
Equipments; overall heat transfer coefficients; heat transfer in fermentors, design of heat exchangers; NTU concept; evaporators; single and multiple effects; mass and enthalpy balances.

OUTCOMES:
Upon success completion of this course, the students will be able to understand

- Purpose of mixing and agitation, types of agitators, scale up of agitators and dimensional analysis.
- About different modes of heat transfer, different laws and terms used for design purpose and industrial applications, steady state and transient conduction
- Concept of forced and natural convection, boiling and condensation and radiation heat transfer
- On heat exchangers and its design, NTU concepts, evaporators and its types

TEXT BOOKS:

1. McCabe, W.L., J.C. Smith and P. Harriott "Unit Operations of Chemical Engineering", 6th Edition, McGraw-Hill, 2001.
2. Geankoplis, C.J. "Transport Process and Separation Process Principles", 4th Edition, Prentice Hall of India, 2005.

REFERENCE:

1. Incropera F.P. "Fundamentals Of Heat And Mass Transfer", John Wiley,1998.

413BTT05 - ENZYME TECHNOLOGY AND BIOTRANSFORMATION

OBJECTIVES:

To enable the students

- To learn enzyme reactions and its characteristics along with the production and purification process
- To give the student a basic knowledge concerning biotransformation reactions with the usage of enzymes

UNIT I INTRODUCTION TO ENZYMES

Classification of enzymes – Mechanisms of enzyme action – Concept of active site and energetics of enzyme substrate complex formation – Specificity of enzyme action – Principles of catalysis – Collision theory and transition state theory – Role of entropy in catalysis.

UNIT II KINETICS OF ENZYME ACTION

Kinetics of single substrate reactions; estimation of Michelis-Menten parameters – Multisubstrate reactions – Mechanisms and kinetics – Turnover number – Types of inhibition and models for substrate and product – Allosteric regulation of enzyme – Monod Changeux Wyman model – pH and temperature effect on enzymes & deactivation kinetics.

UNIT III ENZYME IMMOBILIZATION AND BIOSENSORS

Physical and chemical techniques for enzyme immobilization – Adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding and suitable examples – Advantages and disadvantages – Design of enzyme electrodes and their application as biosensors in industry, healthcare and environment.

UNIT IV PURIFICATION AND CHARACTERIZATION OF ENZYMES FROM NATURAL SOURCES

Production and purification of crude enzyme extracts from plant, animal and microbial sources – Methods of characterization of enzymes – Development of enzymatic assays

UNIT V BIOTRANSFORMATION APPLICATIONS OF ENZYMES

Hydrolytic- Ester bond, Amide, Epoxides, Nitriles, Reduction reactions – Aldehydes, Ketones, C=C, Oxidation reactions – Alkanes, Aromatic, Baeyer-Villiger – Enzymes in organic synthesis – esters, amide, peptide – Modified and Artificial Enzymes – Catalytic antibodies

OUTCOMES:

- The knowledge on enzyme and enzyme reactions will be the key step in to proceed towards various concepts in biotechnology.
- The theoretical and practical aspects of kinetics will provide the importance and utility of enzyme kinetics towards research.
- The process of immobilization has been increased steadily in food, pharmaceutical and chemical industries and thus this study will provide simple and easy method of implementation.
- Ideas on Processing, Production and Purification of enzymes at an industrial scale will be helpful to work technologically.

TEXT BOOKS:

1. Pandey A., Webb C., Soccol C. R. and Larroche C., Eds " Enzyme Technology", Springer, 2006.
2. Buchholz, K., Kasche, V. and Bornscheuer, U., "Biocatalysts and Enzyme Technology", WILEY–VCH, 2005.

REFERENCES:

1. Drauz K., Gröger, H. and May O., "Enzyme Catalysis in Organic Synthesis: A Comprehensive Handbook", Volume 1, Wiley-VCH Verlag & Co, 2012.

2. Blanch, H.W., Clark, D.S. Biochemical Engineering, Marcel Dekker, 1997
3. Bailey J.E. & Ollis, D.F. Biochemical Engineering Fundamentals, 2nd Ed., McGraw Hill, 1986
4. Wiseman, Alan. Hand book of Enzyme Biotechnology, 3rd ed., Ellis Harwood 1995.

413BTT06 - ENVIRONMENTAL SCIENCE AND ENGINEERING

OBJECTIVES:
To enable the students

- To the study of nature and the facts about environment
- To find and implement scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; 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.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY
Definition, scope and importance of Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers-Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – 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, etc.

UNIT II ENVIRONMENTAL POLLUTION
Definition – causes, effects and control measures of: (a) Air pollution (Atmospheric chemistry- Chemical composition of the atmosphere; Chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, oxygen and ozone chemistry;- Mitigation procedures- Control of particulate and gaseous emission, Control of SO2, NOX, CO and HC) (b) Water pollution : Physical and chemical properties of terrestrial and marine water and their environmental significance; Water quality parameters – physical, chemical and biological; absorption of heavy metals - Water treatment processes. (c) Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards–role of an individual in prevention of pollution – pollution case studies Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES
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 overutilization of surface and ground 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. Energy Conversion processes – Biogas – production and uses, anaerobic

digestion; 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. Introduction to Environmental Biochemistry: Proteins – Biochemical degradation of pollutants, Bioconversion of pollutants. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT

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 – 12 Principles of green chemistry- nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air act – Water act – Wildlife protection act – Forest conservation act –The Biomedical Waste (Management and Handling) Rules; 1998 and amendments- scheme of labeling of environmentally friendly products (Ecomark). enforcement machinery involved in environmental legislation- central and state pollution control boards- disaster management: floods, earthquake, cyclone and landslides. Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare –Environmental impact analysis (EIA)- -GIS-remote sensing-role of information technology in environment and human health – Case studies.

OUTCOMES:

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.

- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

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, New Delhi, (2006).

REFERENCES:

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)

PRACTICAL

413BTP01 - CHEMICAL ENGINEERING LABORATORY

OBJECTIVES:

- To provide basic understanding of chemical engineering principles and operations
- Course will enable the students to apply the principles in other chemical engineering and biotechnology subjects offered in higher semesters

LIST OF EXPERIMENTS

1. Flow measurement a) Orifice meter b) Venturimeter, c) Rotameter
2. Pressure drop flow in pipes
3. Pressure drop in flow through packed column
4. Pressure drop in flow through fluidized beds
5. Chacteristics of centrifuge pump
6. Flate and frame filter press
7. Filteration in leaf filter
8. Heat transfer characteristics in heat exchanger
9. Simple and steam distillation
10. HETP in packed distillation
11. Ternary equilibrium in liquid-liquid extraction
12. Adsorption isotherm
13. Drying characteristics in a pan dryer

OUTCOMES:

Upon completion of this practical course the student will

- Have knowledge on the basic principles of chemical engineering
- Be able to apply the skill of material balance and energy balance in unit operations unit process of chemical engineering and biotechnology
- Be able to analyze the principles of chemical engineering and its applications in chemical, mechanical and biological perspectives
- Understand the design and working principles of fluid moving machinery and transport phenomena

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Colorimeter 2 No.
Filter leaf 1 No.
Orifice meter 1 No.
Venturimeter 1 No.
Rotameter 1 No.
Glassware, Chemicals, Media as required

413BTP02 - INSTRUMENTAL METHODS OF ANALYSIS LABORATORY

OBJECTIVES:

To train the students

- To have a practical hands on experience on Absoprtion Spectroscopic methods
- To acquire experience in the purification by performing chromatography
- To validate and analysis using spectrometric and microscopic techniques

LIST OF EXPERIMENTS

1. Precision and validity in an experiment using absorption spectroscopy .
2. Validating Lambert-Beer's law using KMnO 4
3. Finding the molar absorbtivity and stoichiometry of the Fe (1,10 phenanthroline)3 using absorption spectrometry.
4. Finding the pKa of 4-nitrophenol using absorption spectroscopy.
5. UV spectra of nucleic acids.
6. Chemical actinometry using potassium ferrioxolate.
7. Estimation of SO -- by nephelometry.
8. Estimation of Al3+ by Flourimetry.
9. Limits of detection using aluminium alizarin complex.
10. Chromatography analysis using TLC.
11. Chromatography analysis using column chromatography.

OUTCOME:

The students would visualize and interpret the theory of spectroscopic methods by hands on experiments.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1. Colorimeter 2 No.
2. Glassware, Chemicals, Media as required

REFERENCES:

1. Skoog, D.A. etal. "Principles of Instrumental Analysis", 5th Edition, Thomson / Brooks – Cole,1998.
2. Braun, R.D. "Introduction to Instrumental Analysis", Pharma Book Syndicate, 1987.
3. Willard, H.H. etal. "Instrumental Methods of Analysis", 6th Edition, CBS, 1986.
4. Ewing,G.W. "Instrumental Methods of Chemical Analysis", 5th Edition, McGraw-Hill, 1985.

V SEMESTER

513BTT01 - PROTEIN STRUCTURE FUNCTION AND PROTEOMICS

OBJECTIVES:

To enable the students

- To identify the importance of protein biomolecules.
- To realize the structure-function relationships in proteins.

UNIT I BONDS, ENERGIES, BUILDING BLOCKS OF PROTEINS

Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions in protein structure. Interaction with electromagnetic radiation (radio, micro, infrared, visible, ultraviolet, X-ray) and elucidation of protein structure. Amino acids (the students should be thorough with three and single letter codes) and their molecular properties (size, solubility, charge, pKa), Chemical reactivity in relation to post-translational modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups).

UNIT II PROTEIN ARCHITECTURE

Primary structure: peptide mapping, peptide sequencing - automated Edman method & mass- spec. High-throughput protein sequencing setup Secondary structure: Alpha, beta and loop structures and methods to determine Super-secondary structure: Alpha-turnalpha, beta-turn- beta (hairpin), beta-sheets, alpha-beta-alpha, topology diagrams, up and down & TIM barrel structures nucleotide binding folds.

UNT III TERTIARY STRUCTURE

Prediction of substrate binding sites, Tertiary structure: Domains, folding, denaturation and renaturation, overview of methods to determine 3D structures. Quaternary structure: Modular nature, formation of complexes, protein-protein interactions and methods to study it: Computer exercise on the above aspects

UNIT IV STRUCTURE-FUNCTION RELATIONSHIP

DNA-binding proteins: prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, Trp repressor, Eukaryotic transcription factors, Zn fingers, helix-turn helix motifs in homeodomain, Leucine zippers, Membrane proteins: General characteristics, Trans-membrane segments, prediction, bacteriorhodopsin and Photosynthetic reaction center, Immunoglobulins: IgG Light chain and heavy chain architecture, abzymes and Enzymes: Serine proteases, understanding catalytic design by engineering trypsin, chymotrypsin and elastase, substrate-assisted catalysis other commercial applications Computer exercise on the above aspects

UNIT V PROTEOMICS

Introduction to the concept of proteome, components of proteomics, proteomic analysis, importance of proteomics in biological functions, protein arrays, cross linking methods, affinity methods, yeast hybrid systems and protein arrays. Computer exercise on the above aspects

OUTCOMES:

Upon completion of this course, students will be able:

- To analyze the various interactions in protein makeup.
- To be familiar with different levels of protein structure.
- To know the role of functional proteins in various field of study.
- To practice the latest application of protein science in their research.

TEXT BOOKS:

1. Branden C. and Tooze J., "Introduction to Protein Structured" 2nd Edition, Garlan

Publishing, 1999.
2. Creighton T.E. "Proteins" 2nd Edition. W.H. Freeman, 1993.
3. Pennington, S.R and M.J. Dunn, "Proteomics : Protein Sequence to Function". Viva Books, 2002

REFERENCE:

- Liebler, "Introduction to Proteomics" Humana Press, 2002.

513BTT02 - BIOPROCESS ENGINEERING

OBJECTIVES:

- To provide the students with the basics of bioreactor engineering.
- To develop bioengineering skills for the production of biochemical product using integrated biochemical processes.

UNIT I OPERATIONAL MODES OF BIOREACTORS

Fed batch cultivation, Cell recycle cultivation, Cell recycle cultivation in waste water treatment, two stage cultivation. Packed bed reactor, airlift reactor, fluidized bed reactor and bubble column reactor.

UNIT II BIOREACTOR SCALE – UP

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 up criteria for bioreactors based on oxygen transfer, power consumption and impeller tip speed.

UNIT III BIOREACTOR CONSIDERATION IN ENZYME SYSTEMS

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

UNIT IV MODELLING AND SIMULATION OF BIOPROCESSES

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

Different host vector system for recombinant cell cultivation strategies and advantages. E.coli, yeast Pichia pastoris/ Saccharomyces cereviseae, Animal cell cultivation, plant cell cultivation, Insect cell cultivation. High cell density cultivation, process strategies, reactor considerations in the above system.

OUTCOMES:

Upon completion of Bioprocess Engineering course graduates will be able to

- Select appropriate bioreactor configurations and operation modes based upon the nature of bioproducts and cell lines and other process criteria.
- Apply modeling and simulation of bioprocesses so as to reduce costs and to enhance the quality of products and systems.
- Plan a research career or to work in the biotechnology industry with strong foundation about bioreactor design and scale-up.
- Integrate research lab and Industry; identify problems and seek practical solutions for large scale implementation of Biotechnology.

TEXT BOOKS:

1. Jens Nielson, John Villadsen and Gunnar Liden, "Bioreaction engineering principles", 2nd Edition, Kulwer Academic, 2002
2. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc

REFERENCES:

1. Anton Moser, "Bioprocess Technology: Kinetics and Reactors", , Springer Verlag 2011.
2. Tapobrate Panda, "Bioreactors: Analysis and Design", Tata McGraw Hill, 2011
3. Shijie Liu "Bioprocess Engineering" Elsevier, 2013
4. Atkinson, B, Mavituna, F, "Biochemical Engineering and Biotechnology Handbook"

Macmillan Publishers Ltd, New York, 1992.
5. James E. Bailey & David F. Ollis, "Biochemical Engineering Fundamentals", McGraw Hill. James M. Lee, "Biochemical Engineering", PHI, USA 2002.
6. E. Heinzle, A. Biwer and C.Cooney " Development of Sustainable Bioprocesses" John
7. Wiley & sons, 2006.

513BTT03 - MASS TRANSFER OPERATION

OBJECTIVES:

- To define the principles of adsorption, absorption, leaching and drying extraction, distillation, crystallization operations.
- To begin the concept of membrane separation process and develop skills of the students in the area of mass transfer operations with emphasis on separation and purification of products.

UNIT I DIFFUSION AND MASS TRANSFER

Molecular diffusion in fluids and solids; Interphase Mass Transfer; Mass Transfer coefficients; Analogies in Transport Phenomenon.

UNIT II GAS LIQUID OPERATIONS

Principles of gas absorption; Single and Multi component absorption; Absorption with Chemical Reaction; Design principles of absorbers; Industrial absorbers; HTU, NTU concepts.

UNIT III VAPOUR LIQUID OPERATIONS

V-L Equilibria; Simple, Steam and Flash Distillation; Continuous distillation; McCABE-THIELE & PONCHON-SAVARIT Principles; Industrial distillation equipments, HETP, HTU and NTU concepts.

UNIT IV EXTRACTION OPERATIONS

L-L equilibria, Staged and continuous extraction, Solid-liquid equilibria, Leaching Principles.

UNIT V SOLID FLUID OPERATIONS

Adsorption equilibria – Batch and fixed bed adsorption; Drying-Mechanism-Drying curves-Time of Drying; Batch and continuous dryers.

OUTCOMES:

Upon completion of this course the students will be able

- To demonstrate about gas -liquid, vapour- liquid and solid- liquid and liquid–liquid equilibrium.
- To classify and use the accurate engineering correlations of diffusion and mass transfer coefficients to model a separation process.
- To investigate a multi-stage equilibrium separation processes, simultaneous phase equilibrium and mass balances in continuous separation processes (absorbers, strippers, and distillation columns) and sizing continuous separation units.
- To design and construction with operating principles of process economics of separating equipments

TEXT BOOKS:

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

REFERENCE:

1. Coulson and Richardson's Chemical Engineering. Vol I & II, Asian Books Pvt Ltd, 1998.

513BTT04 - MOLECULAR BIOLOGY

OBJECTIVES:
Familiarize students with the cell and molecular biology of both Prokaryotes and Eukaryotes. This will be needed for any project work in modern biotechnology.

- By doing this course students will acquire basic fundamental knowledge and explore skills in molecular biology and become aware of the complexity and harmony of the cells.
- This course will emphasize the molecular mechanism of DNA replication, repair, transcription, protein synthesis and gene regulation in various organisms.

UNIT I CHEMISTRY OF NUCLEIC ACIDS
Introduction to nucleic acids: Nucleic acids as genetic material, Structure and physicochemical properties 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, X–ray diffraction analysis of DNA, Forces stabilizes DNA structure, Conformational variants of double helical DNA, Hogsteen base pairing, Triple helix, Quadruple helix, Reversible denaturation and hyperchromic effect. Tertiary structure of DNA: DNA supercoiling.

UNIT II DNA REPLICATION & REPAIR
Overview of Central dogma. Organization of prokaryotic and eukaryotic chromosomes. DNA replication: 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 and eukaryotic DNA replication, Telomere replication in eukaryotes. D-loop and rolling circle mode of replication. Mutagens, DNA mutations and their mechanism, various types of repair mechanisms.

UNIT III TRANSCRIPTION
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 base modification.

UNIT IV TRANSLATION
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. Post- translational modifications and its importance.

UNIT V REGULATION OF GENE EXPRESSION
Organization of genes in prokaryotic and eukaryotic chromosomes, Hierarchical levels of gene regulation, Prokaryotic gene regulation –*lac* and *trp* operon, Regulation of gene expression with reference to λ phage life cycle.

OUTCOMES:
By the end of this course, students should be able to:

- Describe the basic structure and biochemistry of nucleic acids and proteins and discriminate between them;
- Identify the principles of DNA replication, transcription and translation and explain how they relate to each other.
- Discuss clearly about gene organization and mechanisms of control the gene expression in various organisms.
- Articulate applications of molecular biology in the modern world.

TEXT BOOKS:

1. Friefelder, David. " Molecular Biology." Narosa Publications, 1999.
2. Weaver, Robert F. " Molecular Biology" 2nd Edition, Tata McGraw-Hill,2003.
3. Karp, Gerald " Cell and Molecular Biology : Concepts and Experiments" 4th Edition, John Wiley, 2005.
4. Friefelder, David and George M. Malacinski "Essentials of Molecular Biology" 2nd Edition, Panima Publishing, 1993.
5. Lewin's GENES XI, Published by Jones & Bartlett Learning; 11 edition (January 15, 2013).

REFERENCES:

1. Tropp, Burton E. " Molecular Biology : Genes to Proteins". 3rd Edition. Jones and Bartlett, 2008.
2. Glick , B.R. and J.J. Pasternak. "Molecular Biotechnology : Principles and Applications of Recombinant DNA" 4th Edition. ASM, 2010.

PRACTICAL

513BTP01 - BIOPROCESS LABORATORY – I

OBJECTIVES:

- To train the students on enzyme characterization, immobilization and medium optimization methods.
- To train on methods to investigate the growth of microorganisms in different systems under different conditions.

LIST OF EXPERIMENTS

1. Enzyme kinetics – Determination of Michaelis Menten parameters
2. Enzyme activity – Effect of Temperature and Deactivation Kinetics
3. Enzyme activity – Effect of pH
4. Enzyme inhibition kinetics
5. Enzyme immobilization – Gel entrapment/ Cross linking
6. Enzymatic conversion in Packed bed Column/Fluidized bed Column
7. Growth of Bacteria – Estimation of Biomass, Calculation of Specific Growth Rate, Yield Coefficient
8. Growth of Yeast – Estimation of Biomass, Calculation of Specific Growth Rate, Yield Coefficient
9. Medium optimization – Plackett Burman Design
10. Medium optimization – Response Surface Methodology

OUTCOMES:

At the end of this course, students will be able to:

- Explain about Enzyme kinetics and characterization and how to use them for practical applications.
- Evaluate the growth kinetics of microorganisms and become adept with medium optimization techniques.
- Determine an experimental objective, understand the theory behind the experiment, and operate the relevant equipment safely.
- Demonstrate good lab citizenry and the ability to work in team.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Autoclave 1
Hot Air Oven 1
Incubators 2
Light Microscopes 4
Incubator Shaker 1
Colorimeter 2
Laminar Flow Chamber 2
Optimization software 2
Glassware, Chemicals, Media as required

REFERENCES:

1. Bailey and Ollis, " Biochemical Engineering Fundamentals", McGraw Hill (2nd Ed.),1986.
2. Shuler and Kargi, " Bioprocess Engineering ", Prentice Hall, 1992.
3. Pauline Doran, Bioprocess Engineering Calculation, Blackwell Scientific Publications.
4. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology,

Science & Technology Books.

513BTP02 - MOLECULAR BIOLOGY LABORATORY

OBJECTIVES:
Provide hands-on experience in performing basic molecular biology techniques.
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 take up specialized project in Molecular biology and will be a pre-requisite for research work.

LIST OF EXPERIMENTS
1. Isolation of bacterial DNA
2. Isolation of plant cell and animal cell genomic DNA
3. Agarose gel electrophoresis
4. Restriction enzyme digestion
5. Competent cells preparation
6. Transformation
7. Blue and white selection for recombinants
8. Plating of λ phage
9. Lamda phage lysis of liquid cultures

OUTCOMES:
By the end of this course, students should be able to:
- Demonstrate knowledge and understanding of the principles underpinning important techniques in molecular biology.
- Demonstrate knowledge and understanding of applications of these techniques.
- Demonstrate the ability to carry out laboratory experiments and interpret the results.
- Students will be aware of the hazardous chemicals and safety precautions in case of emergency.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
Electrphoresis Kit 1
PCR 1
Incubators 2
Light Microscopes 4
Incubator Shaker 1
Spectrophotometer 2
Laminar Flow Chamber 2
Glassware, Chemicals, Media as required

REFERENCE:

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

VI SEMESTER

613BTT01 - TOTAL QUALITY MANAGEMENT FOR BIOTECHNOLOGISTS

OBJECTIVES:

- The course aims to develop skills of the Students in various total quality management Principles, tools and quality systems in the Biotechnology industries.
- To understand the TQM tools for continuous process improvement of ISO and Quality systems

UNIT I INTRODUCTION

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality - Basic concepts of TQM – TQM Framework - Contributions of Quality Gurus – Barriers to TQM – Cost of Quality.

UNIT II TQM PRINCIPLES

Quality statements - Customer focus –Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Continuous process improvement – PDCA cycle, 5s, Kaizen- Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS & TECHNIQUES I

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT IV TQM TOOLS & TECHNIQUES II

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures - BPR.

UNIT V QUALITY SYSTEMS

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – Quality Council – Leadership, Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward.

OUTCOMES:

Upon completion of this course, the student will be able

- To know the basic knowledge of total quality management principles and concepts of Current Biotech Industries.
- To know the customer orientated quality and leadership and continuous improvement process and supplier selection and management
- To know the six sigma concept methodology and application and the TQM tools
- To know the design of quality systems of ISO auditing in the field of Biotechnology

TEXT BOOK:

1. Dale H.Besterfiled, et al., "Total Quality Management", Pearson Education Asia, Third Edition, Indian Reprint , 2006.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", (6th Edition), South-Western (Thomson Learning), 2005.

2. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, Third Edition , 2003.
3. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006 .
4. Janakiraman,B and Gopal, R.K, "Total Quality Management – Text and Cases",Prentice Hall (India) Pvt. Ltd., 2006.

613BTT02 - IMMUNOLOGY

OBJECTIVES:

- To discuss the structure, functions and integration of immune system.
- To explain the antigen-antibody interactions and how the immune system is protecting the body from foreign pathogens/germs.
- To explain various techniques of monoclonal and engineered antibodies (important therapeutic molecules) production, for treating most of the human diseases.

UNIT I INTRODUCTION

Cells of immune system; innate and acquired immunity; primary and secondary lymphoid organs; antigens: chemical and molecular nature; haptens; adjuvants; types of immune responses; antigen processing and presentation. Theory of clonal selection. monoclonal antibodies: principles and applications.

UNIT II CELLULAR RESPONSES

Development, maturation, activation and differentiation of T-cells and B-cells; TCR; antibodies: structure and functions; antibodies: genes and generation of diversity; antigenantibody reactions; antigen presenting cells; major histocompatibility complex; regulation of Tcell and B-cell responses.

UNIT III INFECTION AND IMMUNITY

Injury and inflammation; immune responses to infections: immunity to viruses, bacteria, fungi and parasites; cytokines; complement; immunosuppression, tolerance; AIDS and Immunodeficiencies; resistance and immunization; Vaccines.

UNIT IV TRANSPLANTATION AND TUMOR IMMUNOLOGY

Transplantation: genetics of transplantation; laws of transplantation; tumor immunology: tumor antigens, tumor immune response, tumor diagnosis, tumor immunotherapy.

UNIT V ALLERGY, HYPERSENSITIVITY AND AUTOIMMUNITY

Allergy and hypersensitivity- Types of hypersensitivity, Autoimmunity, Auto immune disorders and diagnosis.

OUTCOMES:

- The students after completing the course would be aware of immune system structure and functions.
- The students would be aware of immunity to various pathogens
- The students would be aware of how to produce the therapeutic/diagnostic molecules.
- The students would be aware of tumour, allergy and hypersensivity reactions.

TEXT BOOKS:

1. Roitt I, Male, Brostoff. Immunology, Mosby Publ., 12th edition 2011.
2. Kuby J, Immunology, WH Freeman & Co., 7th Edition 2012.
3. Ashim K. Chakravarthy, Immunology, Tata McGraw-Hill, 2006.

REFERENCES:

1. Coico, Richard "Immunology: A Short Course" 6th Edition. John Wiley, 2008.
2. Khan, Fahim Halim "Elements of Immunology" Pearson Education, 2009.

613BTT03 - GENETIC ENGINEERING AND GENOMICS

OBJECTIVES:

- To discuss the gene cloning methods and the tools and techniques involved in gene cloning and genome analysis and genomics.
- To explain the heterologous expression of cloned genes in different hosts, production of recombinant proteins and PCR techniques.
- To explain comparative genomics and proteomics.

UNIT I BASICS OF RECOMBINANT DNA TECHNOLOGY

Manipulation of DNA – Restriction and Modification enzymes, Design of linkers and adaptors. Characteristics of cloning and expression vectors based on plasmid and bacteriophage, Vectors for yeast, insect and mammalian systems, Prokaryotic and eukaryotic expression host systems, Introduction of recombinant DNA in to host cells and selection methods.

UNIT II DNA LIBRARIES

Construction of genomic and cDNA libraries, Artificial chromosomes – BACs and YACs, Chromosome walking, Screening of DNA libraries using nucleic acid probes and antisera.

UNIT III SEQUENCING AND AMPLIFICATION OF DNA

Maxam Gilbert's and Sanger Coulson's and automated methods of DNA sequencing, Inverse PCR, Nested PCR, AFLP-PCR, Allele specific PCR, Assembly PCR, Asymmetric PCR, Hot start PCR, Colony PCR, single cell PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Molecular beacons, Site directed mutagenesis.

UNIT IV

Organization and structure of genomes, Genome sequencing methods, Conventional and shotgun genome sequencing methods, Next generation sequencing technologies , Ordering the genome sequence, Genetic maps and Physical maps, STS content based mapping, Restriction Enzyme Finger Printing, Hybridization mapping, Radiation Hybrid Maps, Optical mapping. ORF finding and functional annotation.

UNIT V

Current status of genome sequencing projects, Introduction to Functional genomics, Microarrays, Serial Analysis of Gene expression (SAGE), Subtractive hybridization, DIGE, TOGA, Yeast Two hybrid System, Comparative Genomics, Proteogenomics, Web resources for Genomics, Applications of genome analysis and genomics.

OUTCOMES:

- The students after completing this course would be aware of how to clone commercially important genes.
- The students would be aware of how to produce the commercially important recombinant proteins.
- The students would be aware of gene and genome sequencing techniques.
- The students would be aware of microarrays, Analysis of Gene expression and proteomics.

TEXT BOOKS:

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

REFERENCES:

1. Ansubel FM, Brent R, Kingston RE, Moore DD, "Current Protocols In Molecular Biology "Greene Publishing Associates, NY, 1988.
2. Berger Sl, Kimmer AR, "Methods In Enzymology", Vol 152, Academic Press, 1987.
3. Genomes 3 by T.A.Brown, Third Edition (Garland Science Publishing), 2007.

613BTT04 - CHEMICAL REACTION ENGINEERING

OBJECTIVES:

- To impart the knowledge of reaction rate theories and reaction mechanisms to derive expressions for rate equations mass and energy balances.
- To provide a core foundation for the analysis and design of chemical reactors.

UNIT I SCOPE OF CHEMICAL KINETICS & CHEMICAL REACTION ENGINEERING

Broad outline of chemical reactors; rate equations; concentration and temperature dependence; development of rate equations for different homogeneous reactions. Industrial scale reactors.

UNIT II IDEAL REACTORS

Isothermal batch, flow, semi-batch reactors; performance equations for single reactors; multiple reactor systems; multiple reactions.

UNIT III IDEAL FLOW AND NON IDEAL FLOW

RTD in non-ideal flow; non-ideal flow models; reactor performance with non-ideal flow.

UNIT IV GAS-SOLID, GAS-LIQUID REACTIONS

Resistances and rate equations; heterogeneous catalysis; reactions steps; resistances and rate equations.

UNIT V FIXED BED AND FLUID BED REACTORS

G/L reactions on solid catalysis; trickle bed, slurry reactors; three phase-fluidized beds; reactors for fluid-fluid reactions; tank reactors.

OUTCOMES:

Upon completion of this course, the student would be able

- To design and conduct an experimental investigation in order to determine rate equations.
- To demonstrate an ability to solve material and energy balances in order to analyze the performance of a reactor.
- To demonstrate an experimental data using standard statistical methods to establish quantitative results.
- To design a reactor for bio based products to achieve production and yield specifications.

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

REFERENCE:

1. Missen R.W., Mims C.A., Saville B.A. Introduction To Chemical Reaction Engineering and Kinetics. John Wiley.1999

PRACTICAL

613BTP01 - GENETIC ENGINEERING LABORATORY

OBJECTIVES:

- Provide hands-on experience in performing basic recombinant DNA techniques.
- Introduce students to the theory behind in each techniques and to describe common applications of each methodology in biological research.

LIST OF EXPERIMENTS

1. Preparation of plasmid DNA
2. Elution of DNA from agarose gels
3. Ligation of DNA into expression vectors
4. Transformation
5. Optimisation of inducer concentration for recombinant protein expression
6. Optimisation of time of inducer for recombinant protein expression
7. SDS-PAGE
8. Western blotting
9. Hybridisation with anti-sera
10. PCR.

OUTCOMES:

By the end of this course, students should be able to:

- Describe the main principles, methods for preparation and cloning of DNA in various organisms.
- Express clearly about the gene amplification and methods for analysis of DNA, such as hybridization, restriction analysis and gene expressions.
- Use genetic and biotechnological techniques to manipulate genetic materials and develops new and improved living organisms.
- Students will be aware of the hazardous chemicals and safety precautions in case of emergency.

REFERENCES:

1. Old RW, Primrose SB, "Principles Of Gene Manipulation, An Introduction To Genetic Engineering ", Blackwell Science Publications, 1993.
2. Ansubel FM, Brent R, Kingston RE, Moore DD, "Current Protocols In Molecular Biology ", Greene Publishing Associates, NY, 1988.
3. Berger Sl, Kimmer AR, "Methods In Enzymology", Vol 152, Academic Press,1987

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Electrphoresis Kit 1
PCR 1
Incubators 2

613BTP02 - BIOPROCESS LABORATORY II

OBJECTIVES:

- The course applies earlier learned knowledge about mass transfer in bio reactors and sterilization kinetics.
- Skills and knowledge gained is useful by analogy when solving problems typical for the bio industry or for research.

LIST OF EXPERIMENTS

1. Batch Sterilization kinetics
2. Batch cultivation with exhaust gas analysis.
3. Estimation of KLa – Dynamic Gassing-out method.
4. Estimation of K a – Sulphite Oxidation Method
5. Estimation of K a – Power Correlation Method
6. Fed batch cultivation and Total cell retention cultivation
7. Algal cultivation - Photobioreactor
8. Residence time distribution
9. Estimation of Overall Heat Transfer Coefficient
10. Estimation of Mixing Time in reactor

OUTCOMES:

At the end of this course,

- Graduates gain ability to investigate, design and conduct experiments, analyze and interpret data, and apply the laboratory skills to solve complex bioprocess engineering problems.
- Graduates become creative, innovative and adaptable engineers as leaders or team members in their organizations and society.
- Graduates perform competently in chemical and bioprocess industries and become important contributors to national development.
- Graduates will demonstrate advancement in their careers through increasing professional responsibility and continued life-long learning.

REFERENCES:

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

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Electrphoresis Kit 1
Reactors 6
Incubators 2
Light Microscopes 1
Incubator Shaker 1
Spectrophotometer 2
Glassware, Chemicals, Media as required
Laminar Flow Chamber 1

613BTP03 - COMMUNICATION AND SOFT SKILLS LAB

UNIT 1 : LISTENING/ VIEWING SKILLS :

Listening to lectures, discussions - talk shows - news programmes - interviews – instructions - dialogues – Speeches of different nationalities with focus on American and British accent – Inspiring speeches – telephonic conversations – discussion to answer different kinds of questions – Watching documentaries on personalities, places, socio-cultural events.

UNIT 2: SPEAKING SKILLS :

Conversational skills – Interview skills – Making Presentations - Group Discussion – Introducing oneself and others – Role Play – Debate – Panel Discussion – telephonic communication - attending job interviews.

UNIT 3: READING SKILLS :

Reading different genres of texts from Newspapers, Literature, Media, Technical – Vocabulary building – speed reading (skimming & scanning) – Reading online sources like e-books, e-journals and e-newspapers – critical reading – Facts and Fiction – Sumarizing & intrepretation.

UNIT 4 : WRITING SKILLS :

Writing Job applications – cover letter – resume - emails – letters/ Recomendations and Instructions/ Writing for media on current events/ Report Writing/ English for National & International Examination (TOEFL, IELTS, GRE, IAS Language related)

UNIT 5 : SOFT SKILLS & EMPLOYABILITY SKILLS :

Motivation – Self Image – Goal Setting – Time management – Creative & Critical Thinking – Learning Style & Strategies – Gestures – Eye Contact.

LAB INFRASTRUCTURE

Sl.No.	Description of equipment (Minimum Configuration)	Oty Required
1.	**Server**	1 No.
	PIV SYSTEM	
	• 1 GB RAM / 40 GB HDD	
	• OS : Win 2000 server	
	• Audio card with Headphones	
	• JRE 1.3	
2.	**Client Systems**	60 Nos.
	• PIII System	
	• 256 or 512 MB RAM / 40 GB HDD	
	• OS : Win 2000	
	• Audio Card with headphones	
	• JRE 1.3	
3.	Handicam	1 No.
4.	Television 46”	1 No.
5.	Collar Mike	1 No.
6.	Cordless Mike	1 No.
7.	Audio Mixer	1 No.
8.	DVD recorder / Player	1 No.
9.	LCD projector with MP3/ CD/ DVD provision for Audio/video facility	1 No.

VII SEMESTER

713BTT01 - BIOINFORMATICS AND COMPUTATIONAL BIOLOGY

OBJECTIVES:

- To improve the programming skills of the student
- To let the students know the recent evolution in biological science.

UNIT I

Introduction to Operating systems, Linux commands, File transfer protocols ftp and telnet, Introduction to Bioinformatics and Computational Biology, Biological sequences, Biological databases, Genome specific databases, Data file formats, Data life cycle, Database management system models, Basics of Structured Query Language (SQL).

UNIT II

Sequence Analysis, Pairwise alignment, Dynamic programming algorithms for computing edit distance, string similarity, shotgun DNA sequencing, end space free alignment. Multiple sequence alignment, Algorithms for Multiple sequence alignment, Generating motifs and profiles, Local and Global alignment, Needleman and Wunsch algorithm, Smith Waterman algorithm, BLAST, PSIBLAST and PHIBLAST algorithms.

UNIT III

Introduction to phylogenetics, Distance based trees UPGMA trees, Molecular clock theory, Ultrametric trees, Parsimonious trees, Neighbour joining trees, trees based on morphological traits, Bootstrapping. Protein Secondary structure and tertiary structure prediction methods, Homology modeling, *abinitio* approaches, Threading, Critical Assessment of Structure Prediction, Structural genomics.

UNIT IV

Machine learning techniques: Artificial Neural Networks in protein secondary structure prediction, Hidden Markov Models for gene finding, Decision trees, Support Vector Machines. Introduction to Systems Biology and Synthetic Biology, Microarray analysis, DNA computing, Bioinformatics approaches for drug discovery, Applications of informatics techniques in genomics and proteomics: Assembling the genome, STS content mapping for clone contigs, Functional annotation, Peptide mass fingerprinting.

UNIT V

Basics of PERL programming for Bioinformatics: Datatypes: scalars and collections, operators, Program control flow constructs, Library Functions: String specific functions, User defined functions, File handling.

OUTCOMES:

Upon completion of this course, students will be able to

- Develop bioinformatics tools with programming skills.
- Apply computational based solutions for biological perspectives.
- Pursue higher education in this field.
- Practice life-long learning of applied biological science.

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 and Computational Biology" Cambridge University Press, 1997.
3. Durbin, R., Eddy, S., Krogh, A., and Mitchison, G., "Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids" Cambridge, UK: Cambridge University Press, 1998.
4. Mount, D.W., "Bioinformatics Sequence and Genome Analysis" 2nd Edition, Cold Spring Harbor Laboratory Press, 2004
5. Tindall, J., "Beginning Perl for Bioinformatics: An introduction to Perl for Biologists" 1st

Edition, O'Reilly Media, 2001

REFERENCE:

1. Baldi, P. and Brunak, S., "Bioinformatics: The Machine Learning Approach" 2nd Edition, MIT Press, 2001.

713BTT02 - DOWNSTREAM PROCESSING

OBJECTIVES:

To enable the students to

- Understand the methods to obtain pure proteins, enzymes and in general about product development R & D
- Have depth knowledge and hands on experience with on Downstream processes

UNIT I DOWNSTREAM PROCESSING

Introduction to downstream processing principles characteristics of biomolecules and bioprocesses. Cell disruption for product release – mechanical, enzymatic and chemical methods. Pretreatment and stabilisation of bioproducts.

UNIT II PHYSICAL METHODS OF SEPERATION

Unit operations for solid-liquid separation - filtration and centrifugation.

UNIT III ISOLATION OF PRODUCTS

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

UNIT IV PRODUCT PURIFICATION

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

UNIT V FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS

Crystallization, drying and lyophilization in final product formulation.

OUTCOMES:

Upon success completion of this course, the students will be able to:

- Define the fundamentals of downstream processing for product recovery
- Understand the requirements for successful operations of downstream processing
- Describe the components of downstream equipment and explain the purpose of each
- Apply principles of various unit operations used in downstream processing and enhance problem solving techniques required in multi-factorial manufacturing environment in a structured and logical fashion.

TEXTBOOKS:

1. Belter, P.A. E.L. Cussler And Wei-Houhu – "Bioseparations – Downstream Processing For Biotechnology, Wiley Interscience Pun. (1988).
2. Sivasankar, B. "Bioseparations : Principles and Techniques". PHI, 2005.

REFERENCES:

1. R.O. Jenkins, (Ed.) – Product Recovery In Bioprocess Technology – Biotechnology By Open Learning Series, Butterworth-Heinemann (1992).
2. J.C. Janson And L. Ryden, (Ed.) – Protein Purification – Principles, High Resolution Methods And Applications, VCH Pub. 1989.
3. R.K. Scopes – Protein Purification – Principles And Practice, Narosa Pub. (1994).

713BTT03 - CREATIVITY, INNOVATION AND NEW PRODUCT DEVELOPMENT

OBJECTIVE:
To impart the knowledge of various aspects of Creativity, Innovation and New Product Development

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

UNIT II PROJECT SELECTION AND EVALUATION
Collection of ideas and purpose of project - Selection criteria - screening ideas for new products(evaluation techniques)

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

UNIT IV NEW PRODUCT PLANNING
Design of proto type - testing - quality standards - marketing research introducing new products

UNIT V MODEL PREPARATION & EVALUATION
Creative design - Model Preparation - Testing - Cost evaluation – Patent application

OUTCOME:
On completion of the course, students will have gained knowledge on various issues related to Patents, Quality, Creativity, Innovation, New Product Development, Planning and Evaluation.

TEXT BOOKS:

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

REFERENCES:

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

PRACTICAL

713BTP01 - DOWNSTREAM PROCESSING LABORATORY

OBJECTIVES:

To provide hands on training in Down stream processing through simple experimentations in the laboratory. This will be a pre-requisite for project work.

The objectives of this course is to practice the students

- 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.

LIST OF EXPERIMENTS

1. Solid liquid separation – centrifugation, microfiltration
2. Cell disruption techniques – ultrasonication, French pressure cell
3. Cell disruption techniques – dynomill – batch and continuous
4. Precipitation – ammonium sulphite precipitation
5. Ultra filtration separation
6. Aqueous two phase extraction of biologicals
7. High resolution purification – affinity chromatography
8. High resolution purification – ion exchange chromatography
9. Product polishing – spray drying, freeze drying

OUTCOMES:

Upon success completion of this course, the students would have

- Acquired knowledge for the separation of whole cells and other insoluble ingradients from the culture broth.
- Learned cell disruption techniques to release intracellular products
- Learned various techniques like evaporation, extraction, precipitation, membrane separation for concentrating biological products
- Learned the basic principles and techniques of chromatography to purify the biological products and formulate the products for different end uses.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1. Centrifuge 1
2. Cross flow filtration set up 2
3. FPLC 1
4. Sonicator 1
5. French press 1

REFERENCES:

1. P.A. Belter, E.L. Cussler And Wei-Houhu – Bioseparations – Downstream Processing For Biotechnology, Wiley Interscience Pun. (1988).
2. R.O. Jenkins, (Ed.) – Product Recovery In Bioprocess Technology – Biotechnology By Open Learning Series, Butterworth-Heinemann (1992).
3. J.C. Janson And L. Ryden, (Ed.) – Protein Purification – Principles, High Resolution Methods And Applications, VCH Pub. 1989.

713BTP02 - IMMUNOLOGY LABORATORY

OBJECTIVES:

- To give practical training in the functioning of immune system.
- To give laboratory training in different immunological and immunotechnological techniques.

LIST OF EXPERIMENTS

1) Handling of animals, immunization and raising antisera
2) Identification of cells in a blood smear
3) Identification of blood group
4) Immunodiffusion
5) Immunoelectrophoresis
6) Testing for typhoid antigens by Widal test
7) Enzyme Linked ImmunoSorbent Assay (ELISA)
8) Isolation of peripheral blood mononuclear cells
9) Isolation of monocytes from blood
10) Immunofluorescence
11) Identification of t cells by T-cell rossetting using sheep RBC.

OUTCOMES:

- The students would be aware of immune system cells and tissues.
- The students would have knowledge on immunological /clinical tests.
- The students would be able to isolate lymphocytes and monocytes.
- The students would be able to identify various immune system cells.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Elisa reader 1
Microscopes 8
Microwave owen 1
Hot plate 4
Vortex mixer 4
Table top refrigerated Centrifuge 1
Fluorescent microsope 1

REFERENCES:

1. Roitt I, Male, Brostoff. Immunology, Mosby Publ., 2002.
2. Kuby J, Immunology, WH Freeman & Co., 2000.
3. Ashim K. Chakravarthy, Immunology, TataMcGraw-Hill, 1998.

713BTP03 - BIOINFORMATICS LABORATORY

OBJECTIVES:

- To get qualified with programming knowledge.
- To enable the usage of recent bio-tools.

LIST OF EXPERIMENTS

1. Introduction to UNIX basic commands and UNIX Filters.

2. Perl programming and applications to Bioinformatics.

- Basic scripting.
- Regular expressions.
- File i/o& control statement.
- Subroutines & functions.
- Writing scripts for automation.

3. Types of Biological Databases and Using it.

- Genbank.
- Protein Data Bank .
- Uniprot.

4. Sequence Analysis Tools

- Use of BLAST, FASTA (Nucleic Acids &Protiens).
- Use of Clustal W.
- Use of EMBOSS.

5. Phylogenetic Analysis

- Use of Phyllip.

6. Molecular Modeling

- Homology Modeling – Swissmodeller.
- Any Open Source Software .

OUTCOMES:

Upon completion of this course, students will be able:

- To understand basic commands in UNIX OS.
- To apply Perl programming to develop bioinformatics tools.
- To understand different biological databases.
- To carry out sequence and phylogenetic analysis.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

One computer for every 2 students with the software indicated.

ELECTIVES

513BTT05 - INTRODUCTION TO SYMBOLIC MATHEMATICS

OBJECTIVE:
This course will help the students to learn MATLAB, its operators and loops, data flow, Program Design and Development and their virtual instrumentation.

UNIT I INTRODUCTION TO MATLAB
Introduction - Operations with variables – Arrays - Multidimensional Arrays - Element by Element operations - Polynomial operations using arrays - Cell Arrays - Structure arrays - Writing script files - Logical variables and operators- Flow control- Loop operators- Writing functions- Input/ output arguments- Function visibility, path.- Simple graphics- 2D plots- Figures and subplots

UNIT II DATA AND DATA FLOW IN MATLAB
Data types- Matrix, string -cell and structure- Creating, accessing elements and manipulating of data of different types - File Input-Output- Matlab files- Text files- Binary files - Mixed text- binary files- Communication with external devices- Serial port- Parallel port- Sound card- Video input

UNIT III FUNCTIONS & FILES
Elementary Mathematical Functions - User Defined Functions - Advanced Function Programming - Working with Data Files,Introduction to Numerical Methods -Linear algebranumerical integration and differentiation- solving systems of ODE's and interpolation of data.

UNIT IV PROGRAMMING TECHNIQUES & DATA VISUALIZATION AND STATISTICS
Program Design and Development - Relational Operators and Logical Variables Logical Operators and Functions - Conditional Statements -Loops - Basic statistical tools in Matlab,XY- plotting functions - Subplots and Overlay plots - Special Plot types – Interactive plotting - Designing GUI interfaces using Matlab's GUIDE interface.

UNIT V FUNDAMENTALS OF VIRTUAL INSTRUMENTATION & DATA ACQUISITION
Concept of virtual instrumentation (VI)– LabVIEW software- basics- Creating, Editing and debugging a VI in LabVIEW- Creating a sub VI- Loops and charts- data acquisition with LabVIEW- plug-in DAQ boards- Organization of the DAQ VI System- Performing analog input and analog output- Scanning multiple analog channels- Driving the digital I/Os- Buffered data acquisition

OUTCOME:
Upon completion of this course, students will be able design programs and understand virtual instrumentation and data design.

TEXT BOOKS
1. Essential Matlab for Engineers and Scientists (Fourth Edition). Copyright © 2010 Elsevier Ltd. Author(s): Brian H. Hahn and Daniel T. Valentine ISBN: 978-0-12-374883-6
2. Rahman, and Herbert Pichlik,, 'LabVIEW – Applications and Solutions', National Instruments Release, ISBN 01309642392. National Instruments LabVIEW Manual

ONLINE MATLAB TUTORIALS AND REFERENCES:
1. Tutorials offered by The Mathworks .The creators of Matlab.
2. Introductory Matlab material from Indiana University
3. A practical introduction to Matlab from Michigan Tec
4. Links to Matlab tutorials, references, books, packages, etc. -- from the Math Department at UIC

MATLAB GUIDES PROVIDED WITH THE MATLAB INSTALLATION:
1. Getting Started with Matlab
2. Using Matlab

3. Using Graphs in Matlab
4. Using GUIs in Matlab
For links to these documents visit Dr. Randy Jost's web page (USU ECE Department). For other links related to Matlab,

513BTT06 - BIOPHYSICS

OBJECTIVES:
To enable the students
- To gain structural knowledge of biological systems.
- To understand transport and dynamic properties of biological systems.

UNIT I MOLECULAR STRUCTURE OF BIOLOGICAL SYSTEMS
Intramolecular bonds – covalent – ionic and hydrogen bonds – biological structures - general features – water structure – hydration – interfacial phenomena and membranes – self assembly and molecular structure of membranes.

UNIT II CONFORMATION OF NUCLEIC ACIDS
Primary structure – the bases – sugars and the phosphodiester bonds- double helical structure – the a b and z forms – properties of circular DNA – topology – polymorphism and flexibility of DNA – structure of ribonucleic acids – hydration of nucleic acids.

UNIT III CONFORMATION OF PROTEINS
Conformation of the peptide bond – secondary structures – Ramachandran plots – use of potential functions – tertiary structure – folding – hydration of proteins – hydropathy index.

UNIT IV CELLULAR PERMEABILITY AND ION – TRANSPORT
Ionic conductivity – transport across ion channels – mechanism - ion pumps-proton transfer – nerve conduction – techniques of studying ion transport and models.

UNIT V ENERGETICS & DYNAMICS OF BIOLOGICAL SYSTEMS
Concepts in thermodynamics – force and motion – entropy and stability – analyses of fluxes – diffusion potential – basic properties of fluids and biomaterials – laminar and turbulent flows.

OUTCOMES:
Upon completion of this course, students will be able:
- To analyze the various forces responsible for biological molecular structure.
- To be familiar with different levels of conformation in biomolecules.
- To gain the knowledge of cellular permeability and ion transport.
- To understand the dynamics of biological systems.

TEXTBOOKS:

1. Glaser R., "Biophysics" Springer Verlag , 2000.
2. Duane R., "Biophysics: Molecules In Motion" Academic Press, 1999.

REFERENCE:

1. Charles C.R., and Schimmel P.R., "Biophysical Chemistry" 1-3 Vols, W.H. Freeman & Co., 1980.

513BTT07 - PRINCIPLES OF FOOD PROCESSING

OBJECTIVES:

To enable the students

- To know about the constituents and additives present in the food.
- To gain knowledge about the microorganisms, which spoil food and food borne diseases.
- To know different techniques used for the preservation of foods.

UNIT I FOOD AND ENERGY

Constituents of food – carbohydrates, lipids, proteins, water, vitamins and minerals, dietary sources, role and functional properties in food, contribution to organoleptic and textural characteristics.

UNIT II FOOD ADDITIVES

Classification, intentional and non-intentional additives, functional role in food processing and preservation; food colourants – natural and artificial; food flavours; enzymes as food processing aids.

UNIT III MICROORGANISMS ASSOCIATED WITH FOOD

Bacteria, yeasts and molds – sources, types and species of importance in food processing and preservation; fermented foods and food chemicals, single cell protein.

UNIT IV FOOD BORNE DISEASES

Classification – food infections – bacterial and other types; food intoxications and poisonings – bacterial and non-bacterial; food spoilage – factors responsible for spoilage, spoilage of vegetable, fruit, meat, poultry, beverage and other food products.

UNIT V FOOD PRESERVATION

Principles involved in the use of sterilization, pasteurization and blanching, thermal death curves of microorganisms, canning; frozen storage-freezing characteristics of foods, microbial activity at low temperatures, factors affecting quality of foods in frozen storage; irradiation preservation of foods.

OUTCOMES:

Through this subject the student can understand about

- Different constituents present in food and microorganism involved in processing of food.
- Principles and different preservations techniques of food can also be known.
- Unit operations in modern food processing and impact of the process on food quality

TEXTBOOKS:

1. T.P. Coultate – Food – The Chemistry Of Its Components, 2nd Edn. Royal Society, London, 1992.
2. B. Sivasanker – Food Processing And Preservation, Prentice-Hall Of India Pvt. Ltd. New Delhi 2002.

REFERENCES:

1. W.C. Frazier And D.C. Westhoff – Food Microbiology, 4th Ed., Mcgraw-Hill Book Co., New York 1988.
2. J.M. Jay – Modern Food Microbiology, Cbs Pub. New Delhi, 1987.

513BTT08 - ADVANCED BIOCHEMISTRY

OBJECTIVES:

- To orient towards the application of knowledge acquired in solving clinical problems.
- To provide a base for molecular modelling and drug designing

UNIT I METABOLISM OF AMINO ACIDS

Biosynthesis of Gly, Ser and Cys; Biosynthesis of six essential amino acids (Met, Thr, Lys, Ile, Val, Leu) and regulation of branched chain amino acids (concerted inhibition, allosteric regulation and enzyme multiplicity, sequential feed back) from oxaloacetate and pyruvate;Biosynthesis of aromatic amino acids. Metabolic disorders associated with branched chain and aromatic amino acid degradation. Important molecules derived from amino acids (auxins, DOPA, Serotonin, porphyrins, T3, T4, Adrenaline, Noradrenaline, histamine, GABA, polyamines etc)

UNIT II PROTEIN TRANSPORT AND DEGRADATION

Protein targeting, signal sequence, secretion; Folding, Chaperons and targeting of organelle proteins, Protein degradation, receptor-mediated endocytosis, turnover.

UNIT III METABOLISM OF NUCLEIC ACIDS, POLYSACCHARIDES AND LIPIDS

Biosynthesis of nucleotides, denovo and salvage pathways for purines and pyrimidines, regulatory mechanisms: Degradation of nucleic acid by exo and endo nucleases. Biosynthesis and degradation of starch and glycogen. Triacylglycerol and phospholipid biosynthesis and degradation; Cholesterol biosynthesis and regulation and targets and action of cholesterol lowering drugs.

UNIT IV VITAMINS AND COENZYMES

Fat Soluble Vitamins, provitamins (A, D, E and K). Structure,physiological significance and deficiency symptoms. Water soluble vitamins, structure, coenzyme role and deficiency symptoms. Thiamine,riboflavin, pyridoxine, niacin, folic acid, biotin and Vitamin B12. Recommended dietary intake. Coenzymes: Their role in metabolic pathways.NAD, FAD,TPP, PLP, carboxy biotin

UNIT V HORMONES

Introduction. Effects of Hormones. Chemical classification of hormones.Peptide hormonevasopressin, protein hormone- insulin. Lipid and phospholipid derived hormonesprostaglandin and phospholipids. Steroid hormones-testosterone, estrogen, cortisol. Monoamines: thyroxine, adrenaline. Mechanism of action of the different classes of hormones.

OUTCOMES:

Upon completion of advanced biochemistry, students will be able

- To recognize how fundamental chemical principles and reactions are utilized in biochemical Processes.
- To apply knowledge gained in food and drug industries.
- To define various metabolic concepts for applying them to solve clinical problems.
- To summarize the knowledge of biomolecules to use them in biotechnology industry

TEXT BOOKS:

1. Nelson, D.L et al., "Lehninger's Principles of Biochemistry"
2. Stryer, Lubert. "Biochemistry". 4th Edition, W.H Freeman & Co., 2000.
3. Voet, D.J and J.G. Voet and C.W. Pratt "Principles of Biochemistry" 3rd Edition, John Wiley & Sons Inc., 2008.
4. Murray, R.K., et al., "Harper's Illustrated Biochemistry". 27th Edition. McGraw-Hill, 2006.

REFERENCES:

1. Creighton. T.E., "Proteins: Structure and Molecular Properties" 2nd Edition, W.H.Freeman and Co.,1993.

2. Salway, J.G., "Metabolism at a Glance". 2nd Edition, Blackwell Science Ltd., 2000.

513BTT09 - BIOLOGICAL SPECTROSCOPY

OBJECTIVES:

- To deliver the knowledge of spectroscopic techniques and its functions
- To provide the technical information of spectroscopy for biological applications

UNIT I OPTICAL ROTATORY DISPERSION AND FLUORESCENC POLARIZATION

Polarized light – optical rotation – circular dichroism – circular dichroism of nucleic acids and proteins – Fluorescence polarization – Integration of HIV genome into host genome and alpha- Ketoglutarate.

UNIT II NUCLEAR MAGNETIC RESONANCE

Chemical shifts – Spin-spin coupling – Relaxation mechanisms – Nuclear overhauser effect multidimensional nmr spectroscopy – Determination of macromolecular structure by NMR – Magnetic resonance imaging.

UNIT III MASS SPECTROMETRY

Ion sources sample introduction – Mass analyzers and ion detectors – Biomolecule mass sepctrometry – Analysis of peptide and protein, carbohydrates and small molecules – Applications of mass spectrometry.

UNIT IV X-RAY DIFFRACTION

Scattering by x- rays – Diffraction by a crystal – Measuring diffraction pattern – Bragg reflection – Unit cell – Phase problems – Anomalous diffraction – Determination of crystal structure – Electron and neutron diffraction.

UNIT V SPECIAL TOPICS AND APPLICATIONS

Electron microscopy – Transmission and scanning electron microscopy – Scanning tunneling and atomic force microscopy – Combinatorial chemistry and high throughput screening methods.

OUTCOMES:

Upon completion of this course, the student would be able
understand

- Basics of optical rotary dispersion methods and nuclear magnetic resonance
- Principles and applications of mass spectrometry and X-ray diffraction
- About the microscopic techniques and applications
- And apply the spectroscopic techniques for various biological applications

TEXT BOOKS:

1. Hammes G.G., "Spectroscopy for the Biological Sciences", Wiley-Inter Science, First Edition, 2005.
2. Ramamoorthy A., "NMR Spectroscopy of Biological Solids", CRC Press, 2005.

REFERENCES:

1. Campbell I.D and Dwek R.A., " Biological Spectroscopy ", Benjami Cummins and Company, 1986.
2. Pretsch E., Bühlmann P. and Badertscher M., "Structure Determination of Organic compounds: Tables of Spectral Data", Springer, Fourth Edition, 2009.
3. Gremlich H. and Yan B., "Infrared and Raman Spectroscopy of Biological Materials", CRC Press, 2000.
4. Greve J., Puppels G.J. and Otto C., "Spectroscopy of Biological Molecules: New Directions Springer", First Edition, 1999.

513BTT10 - BIOPHARMACEUTICAL TECHNOLOGY

OBJECTIVES:

The aim of the course is to give strong foundation and advanced information on biopharmaceutical aspects in relation to drug development.

- This course provides core responsibilities for the development and monitoring of the drug and the preparation of medicines according to the norms.
- To gain knowledge in physicochemical properties, pharmacology and the formulation of commonly used biopharmaceuticals.

UNIT I INTRODUCTION

Pharmaceutical industry & development of drugs ; types of therapeutic agents and their uses; economics and regulatory aspects .

UNIT II DRUG ACTION, METABOLISM AND PHARMACOKINETICS

Mechanism of drug action; physico-chemical principles of drug metabolism; radioactivity; pharmacokinetics.

UNIT III MANUFACTURE OF DRUGS, PROCESS AND APPLICATIONS

Types of reaction process and special requirements for bulk drug manufacture.

UNIT IV PRINCIPLES OF DRUG MANUFACTURE

Compressed tablets; dry and wet granulation; slugging or direct compression; tablet presses; coating of tablets; capsule preparation; oval liquids – vegetable drugs – topical applications; preservation of drugs; analytical methods and other tests used in drug manufacture; packing techniques; quality management; GMP.

UNIT V BIOPHARMACEUTICALS

Various categories of therapeutics like vitamins, laxatives, analgesics, contraceptives, antibiotics, hormones and biologicals.

OUTCOMES:

- The knowledge gained in this course would be used to understand and evaluate different pharmaceutical parameters for the current and future biotechnology related products on the market.
- This course paves a ways to the students to acquire knowledge on novel biotechnological and pharmaceutical products, current medicines and their applications in therapeutic and diagnostic fields.

The course would facilitate the students to

- Demonstrate knowledge and understanding of current topical and newly emerging aspects of pharmaceutical biotechnology.
- Understand the legal steps involved in progressing a new drug to market. Grasping the current regulatory acts and safety norms of the modern pharmaceutical industries.

TEXT BOOKS:

1. Finkel, Richard, etal., "Lippincott's Illustrated Reviews Pharmacology" 4th Edition.Wolters Kluwer / Lippincott Williams & Wilkins, 2009.
2. Shayne Cox Gad. Pharmaceutical Manufacturing Handbook, Published by John Wiley & Sons, Inc., 2008.
3. Bernd Meibohm. Pharmacokinetics and Pharmacodynamics of biotech drugs, Published by Wiley-VCH, 2006.

REFERENCES:

1. Gareth Thomas. Medicinal Chemistry. An introduction. John Wiley. 2000.

2. Katzung B.G. Basic and Clinical Pharmacology, Prentice Hall of Intl. 1995.

613BTT05 - FUNDAMENTALS OF NANOSCIENCE

OBJECTIVE:
To learn about basis of nanomaterial science, preparation method, types and application

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

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

UNIT III NANOMATERIALS
Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays-functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications

UNIT IV CHARACTERIZATION TECHNIQUES
X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation

UNIT V APPLICATIONS
NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery

OUTCOMES:
Upon completing this course, the students
- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial

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

REFERENCES:
1. G Timp (Editor), "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia (Editor),"The Hand Book of Nano Technology,Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

613BTT06 - ANIMAL BIOTECHNOLOGY

OBJECTIVES:

- To provide the fundamentals of animal cell culture, details of the diseases and therapy
- To offer the knowledge about the micromanipulation and transgenic animals

UNIT I ANIMAL CELL CULTURE

Introduction to basic tissue culture techniques; chemically defined and serum free media; animal cell cultures, their maintenance and preservation; various types of culturessuspension cultures, continuous flow cultures, immobilized cultures; somatic cell fusion; cell cultures as a source of valuable products; organ cultures.

UNIT II ANIMAL DISEASES AND THEIR DIAGNOSIS

Bacterial and viral diseases in animals; monoclonal antibodies and their use in diagnosis; molecular diagnostic techniques like PCR, *in-situ* hybridization; northern and southern blotting; RFLP.

UNIT III THERAPY OF ANIMAL DISEASES

Recombinant cytokines and their use in the treatment of animal infections; monoclonal antibodies in therapy; vaccines and their applications in animal infections; gene therapy for animal diseases.

UNIT IV MICROMANIPULATION OF EMBRYO'S

What is micromanipulation technology; equipments used in micromanipulation; enrichment of x and y bearing sperms from semen samples of animals; artificial insemination and germ cell manipulations; in vitro fertilization and embryo transfer; micromanipulation technology and breeding of farm animals.

UNIT V TRANSGENIC ANIMALS

Concepts of transgenic animal technology; strategies for the production of transgenic animals and their importance in biotechnology; stem cell cultures in the production of transgenic animals.

OUTCOMES:

Upon completion of this subject the student will be able to

- Understand the animal cell culture, animal diseases and its diagnosis
- Gain the knowledge for therapy of animal infections
- Know the concepts of micromanipulation technology and transgenic animal technology
- Use the knowledge gained in this section to apply in the field of clinical research

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.

REFERENCES:

1. Freshney, R.I., "Culture of Animal Cells: A Manual of Basic Techniques and Specialized Applications", 6th Edition, John Wiley & Sons, 2010.
2. Portner, R., "Animal Cell Biotechnology: Methods and Protocols", 2nd Edition, Humana Press, 2007
3. Masters J.R.W. Animal Cell Culture: Practical Approach. Oxford University Press.2000

613BTT07 - MOLECULAR PATHOGENESIS OF INFECTIOUS DISEASES

OBJECTIVES:

To enable the students

- To understand about the microbial toxins and modern molecular pathogenesis
- To know about the host pathogen interaction and identifying virulence factors
- To control pathogens by modern approaches.

UNIT I OVERVIEW

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, Various pathogen types and modes of entry.

UNIT II HOST-DEFENSE AGAINST PATHOGENS AND PATHOGENIC STRATEGIES

Attributes & components of microbial pathogenesis, Host defense: skin, mucosa, cilia, secretions, physical movements, limitation of free iron, antimicrobial compounds, mechanism of killing by humoral and cellular defense mechanisms, complements, inflammation process, general disease symptoms, Pathogenic adaptations to overcome the above defenses.

UNIT III MOLECULAR PATHOGENESIS (WITH SPECIFIC EXAMPLES)

Virulence, virulence factors, virulence-associated factors and virulence lifestyle factors, molecular genetics and gene regulation in virulence of pathogens, Vibrio Cholerae: Cholera toxin, co-regulated pili, filamentous phage, survival *E.coli* pathogens: Enterotoxigenic *E.coli* (ETEC), labile & stable toxins, Entero- pathogenic *E.coli* (EPEC), type III secretion, cytoskeletal changes, intimate attachment; Enterohaemerrohogic *E.coli* (EHEC), mechanism of bloody diarrhoea and Hemolytic Uremic Syndrome, Enteroaggregative *E.coli* (EAEC). Shigella: Entry, macrophage apoptosis, induction of macropinocytosis, uptake by epithelial cells, intracellular spread, inflammatory response, tissue damage Plasmodium: Life cycle, erythrocyte stages, transport mechanism and processes to support the rapidly growing schizont, parasitiparous vacuoles, and knob protein transport, Antimalarials based on transport processes. Influenza virus: Intracellular stages, Neuraminidase & Haemagglutinin in entry, M1 & M2 proteins in assembly and disassembly, action of amantidine.

UNIT IV EXPERIMENTAL STUDIES ON HOST-PATHOGEN INTERACTIONS

Virulence assays: adherence, invasion, cytopathic, cytotoxic effects. Criteria & tests in identifying virulence factors, attenuated mutants, molecular characterization of virulence factors, signal transduction & host responses

UNIT V MODERN APPROACHES TO CONTROL PATHOGENS

Classical approaches based on serotyping. Modern diagnosis based on highly conserved virulence factors, immuno & DNA-based techniques. New therapeutic strategies based on recent findings on molecular pathogenesis of a variety of pathogens, Vaccines - DNA, subunit and cocktail vaccines.

OUTCOMES:

Upon completion of this course, the student will be able to understand the

- Host pathogen interactions at the level of cellular and molecular networks.
- Diagnosis of diseases through the examination of molecules.
- Modern therapeutic strategies on various pathogens.

TEXTBOOKS:

1. Iglewski B.H and Clark V.L " Molecular basis of Bacterial Pathogenesis ", Academic Press, 1990.
2. Eduardo A. Groisman, Principles of Bacterial Pathogenesis, Academic Press, 2001.

REFERENCES:

1. Peter Williams, Julian Ketley & George Salmond, "Methods in Microbiology : Bacterial Pathogenesis, Vol. 27", Academic Press, 1998.
2. Recent reviews in Infect. Immun., Mol. Microbiol., Biochem. J., EMBO etc
3. Nester, Anderson, Roberts, Pearsall, Nester, "Microbiology: A Human Perspective", Mc Graw Hill, 3rd Edition, 2001.

4. Brenda B. Wilson, Abigail A. Salyers, Dixie D. Witt, Malcolm E. Winkler, "Bacterial Pathogenesis", ASM press, 3rd Edition, 2011.

613BTT08 - CANCER BIOLOGY AND THERAPEUTICS

OBJECTIVES:

To enable the students to understand

- Basic biology of cancer
- Impact of antibodies against cancer in the human body leading to more effective treatments
  - Enhanced immunology based detection methods and imaging techniques
  - Development of cell based and cytokine based immunotherapy against cancer.

UNIT I OVERVIEW AND ELEMENTS OF THE CANCER IMMUNOLOGY

Role of Immune system in cancer – role of individual immune cell types against cancer – role of cytokines in immune cell programming against cancer.

UNIT II CANCER ANTIGENS

Source of cancer antigens – clonal (viral)/mutational origin – detection and processing by immune cell types through MHC - T-cell receptor - B-cell receptor and cytokines involved - cancer cell death strategies induced by immune cells.

UNIT III ANTIBODY DEVELOPMENT AGAINST CANCER ANTIGENS

Role of VDJ recombination – Causes for the failure to recognize cancer antigen – roles and mechanism of immune self-tolerance machinery and Immune surveillance – Correlating pathway specific deregulations in self-tolerance machinery and Immune surveillance as a risk factor/potential target towards autoimmune disorders and cancer.

UNIT IV IMMUNE EVASION BY CANCER

Cytokines involved – Role of T regulatory and Th17 cells – Role of cancer microenvironment in influencing immune response.

UNIT V MEDICAL APPLICATIONS OF CANCER THERAPEUTICS

Use of cancer antigens in cancer detection/classification – Cancer antigen based vaccines – Monoclonal antibodies in cancer diagnosis, imaging and immunotherapy – use of cytokines as biological response modifiers – cell based therapy against cancer.

OUTCOMES:

The course would facilitate the students

- To appreciate the role of immune system in cancer
- To describe self – tolerance machinery and immune surveillance
- To understand the cancer microenvironment and its influence on immune cells
- To have awareness on medical applications of cytokines and immune cells against cancer

TEXT BOOKS:

1. Thomas J. Kindt, Barbara A. Osborne and Richard Goldsby. Kuby Immunology, 6th edition. W.H. Freeman, 2007
2. Stella Pelengaris and Michael Khan. The Molecular Biology of Cancer, 2nd edition. Wiley Blackwell, 2013

REFERENCES:

1. Roitt I., Brostoff J. and Male D. Immunology, 6th ed. Mosby, 2001
2. Tannock I. and Hill. R.P. The basic science of oncology, 3rd ed. McGraw-Hill, 1998

613BTT09 - PLANT BIOTECHNOLOGY

OBJECTIVES:

- To give the details of plant cells and its functions
- To provide the basics of agrobacterium and applications of plant biotechnology

UNIT I ORGANIZATION OF GENETIC MATERIAL

Genetic material of plant cells – nucleosome structure and its biological significance; junk and repeat sequences; outline of transcription and translation.

UNIT II CHLOROPLAST & MITOCHONDRIA

Structure, function and genetic material; rubisco synthesis and assembly, coordination, regulation and transport of proteins. Mitochondria: Genome, cytoplasmic male sterility and import of proteins.

UNIT III NITROGEN FIXATION

Nitrogenase activity, nod genes, nif genes, bacteroids.

UNITIV AGROBACTERIUM & VIRAL VECTORS

Pathogenesis, crown gall disease, genes involved in the pathogenesis, Ti plasmid – t-DNA, importance in genetic engineering. Viral Vectors: Gemini virus, cauliflower mosaic virus, viral vectors and its benefits.

UNIT V APPLICATION OF PLANT BIOTECHNOLOGY

Outline of plant tissue culture, transgenic plants, herbicide and pest resistant plants, molecular pharming , theraputic products.

OUTCOMES:

Upon completion of the course, the student would be able

- To understand the fundamentals of plant cells, structure and functions
- To learn the nitrogen fixation mechanism and significance of viral vectors
- To gain the knowledge about the plant tissue culture and transgenic plants
- To use of the gained knowledge for the development of therapeutic products

TEXT BOOKS:

1. Chawla, H.S., "Introduction to Plant Biotechnology", 3rd Edition, Science Publishers, 2009.
2. Gamburg OL, Philips GC, Plant Tissue & Organ Culture fundamental Methods, Narosa Publications. 1995.

REFERENCES:

1. Stewart Jr., C.N., "Plant Biotechnology and Genetics: Principles, Techniques and Applications" Wiley-Interscience, 2008.
2. Heldt HW. Plant Biochemistry & Molecular Biology, Oxford University Press. 1997.
3. Ignacimuthu .S, Applied Plant Biotechnology , Tata McGraw Hill. 1996.

613BTT10 - METABOLIC ENGINEERING

OBJECTIVES:

- To provide a quantitative basis, based on thermodynamics, enzyme kinetics, for the understanding of metabolic networks in single cells and at the organ level.
- To enable the students to use organisms to produce valuable substances on an industrial scale in cost effective manner.

UNIT I SUCCESSFUL EXAMPLES OF METABOLIC ENGINEERING

Product over production examples: amino acids, polyhydroxyalkanoic acids, By-product minimization of acetate in recombinant *E. coli*, Extension of substrate utilization range for organisms such as *S. cerevisae and Z. mobilis* for ethanol production*,* Improvement of cellular properties, Altering transport of nutrients including carbon and nitrogen and xenobiotic degradation.

UNIT II METABOLIC FLUX ANALYSIS

Comprehensive models of cellular reactions; stoichiometry of cellular reactions, reaction rates, dynamic mass balances, metabolic flux analysis. MFA of exactly determined systems, over determined systems.

UNIT III CONSTRAINT BASED GENOMIC SCALE METABOLIC MODEL

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

UNIT IV METABOLIC FLUX ANALYSIS BY ISOTOPIC LABELLING

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

UNIT V METABOLIC CONTROL ANALYSIS AND NETWORK ANALYSIS

Fundamental of Metabolic Control Analysis, control coefficients and the summation theorems, Determination of flux control coefficients, MCA of linear pathways, branched pathways, theory of large deviations. Control of flux distribution at a single branch point, grouping of reactions, optimization of flux amplification.

OUTCOMES:

After completion of metabolic engineering, students will be able

- To learn stoichiometry and energetics of metabolism.
- To apply practical applications of metabolic engineering in chemical,energy,medical and environmental fields.
- To integrate modern biology with engineering principles.
- To design a system, component, or process to meet desired needs.

TEXT BOOKS:

1. Stephanopoulos, G.N. "Metabolic Engineering : Principles and Methodologies". Academic Press / Elsevier, 1998.
2. Lee, S.Y. and Papoutsakis, E.T. "Metabolic Engineering". Marcel Dekker, 1998.
3. Nielsen, J. and Villadsen, J. "Bioreaction Engineering Principles". Springer, 2007.

REFERENCES:

1. Voit, E.O. "Computational Analysis of Biochemical Systems : A Practical Guide for Biochemists and Molecular Biologists". Cambridge University Press, 2000.
2. Scheper, T. "Metabolic Engineering" Vol 73 (Advances in Biochemical Engineering Biotechnology) Springer, 2001.
3. S. Cortassa, M.A.Aon,A.A.Iglesias and D.Llyod, " An Introduction to Metabolic and Cellular Engineering", World Scientific Publishing Co. Pte. Ltd, 2002.
4. Christiana D. Smolke, " The Metabolic Pathway Engineering Handbook Fundamentals", CRC Press Taylor & Francis Group, 2010.

5. Boris N. Kholodenko and Hans V. Westerhoff "Metabolic Engineering in the Post Genomic Era", Horizon Bioscience, 2004.

613BTT11 - IPR AND ETHICAL ISSUES IN BIOTECHNOLOGY

OBJECTIVES:

- To create awareness about IPR and engineering ethics
- To follow professional ethics and practices in their careers
- To create awareness and responsibilities about the environment and society

UNIT I ENGINEERING ETHICS

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories.

UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study

UNIT III ENGINEER'S RESPONSIBILITY FOR SAFETY

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – Risk communication, management and assessment. The Government Regulator's Approach to Risk - Chernobyl and Bhopal Case Studies. Case studies on basumethi rice, turmeric and neem

UNIT IV RESPONSIBILITIES AND RIGHTS

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) - Discrimination.

UNIT V GLOBAL ISSUES

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct.

OUTCOMES:

Upon completion of this course, the student would be able

- To understand the ethics and responsibility for safety
- To create awareness for the professional responsibilities and rights
- To offer the importance of intellectual property rights for the technologies

TEXT BOOKS:

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York (2005)
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Thompson Learning, (2000).
3. Kankanala C., Genetic Patent law & strategy .First edition .Manupatra ,Information Solution Pvt.Ltd., 2007.

REFERENCES:

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, (1999).
2. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, (2003)
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethic forScientists and Engineers", Oxford University Press, (2001)
4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi, (2004)

5. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, (2003)

713BTT04 - BIOCONJUGATE TECHNOLOGY AND APPLICATIONS

OBJECTIVES:

To enable the students

- To understand the functional targets and chemistry of active groups.
- To gain knowledge about the linkers and cleavable reagent systems.
- To know about enzyme, nucleic acid modification and its application in bioconjugation

UNIT I FUNCTIONAL TARGETS

Modification of Amino Acids, Peptides and Proteins – Modification of sugars, polysaccharides and glycoconjugates – modification of nucleic acids and oligonucleotides.

UNIT II CHEMISTRY OF ACTIVE GROUPS

Amine reactive chemical reactions – Thiol reactive chemical reactions – carboxylate reactive chemical reactions – hydroxyl reactive chemical reactions – aldehyde and ketone reactive chemical reactions – Photoreactive chemical reactions.

UNIT III BIOCONJUGATE REAGENTS

Zero length cross linkers – Homobifunctional cross linkers – Heterobifunctional cross linkers – Trifunctional cross linkers – Cleavable reagent systems – tags and probes.

UNIT IV ENZYME AND NUCLEIC ACID MODIFICATION AND CONJUGATION

Properties of common enzymes – Activated enzymes for conjugation – biotinylated enzymes – chemical modification of nucleic acids – biotin labeling of DNA- enzyme conjugation to DNA – Fluorescent of DNA.

UNIT V BIOCONJUGATE APPLICATIONS

Preparation of Hapten-carrier Immunogen conjugates - antibody modification and conjugation – immunotoxin conjugation techniques – liposome conjugated and derivatives- Colloidal – gold-labeled proteins – modification with synthetic polymers.

OUTCOMES:

Upon completion of this course, the student would know about

- Joining of two molecules to form a hybrid conjugate with the help of linkers.
- Active groups of various chemical reactions and targets of the functional groups.
- Antibody modification and conjugation.

TEXTBOOK:

1. Bioconjugate Techniques, G.T. Hermanson, Academic Press, 1999.

713BTT05 - BIO- INDUSTRIAL ENTREPRENEURSHIP

OBJECTIVES:

- To enable the students to understand the sources of innovation opportunities and development of the skills to indentify and analyze these opportunities for entrepreneurship and innovation.
- To develop personal skills set for creativity, innovation and entrepreneurship and specific concepts and tools for combining and managing creativity in organization.

UNIT I

• Should You Become an Entrepreneur?
• What Skills Do Entrepreneurs Need?
• Identify and Meet a Market Need
• Entrepreneurs in a Market Economy
• Select a Type of Ownership

UNIT II

• Develop a Business Plan

UNIT III

• Choose Your Location and Set Up for Business
• Market Your Business
• Hire and Manage a Staff

UNIT IV

• Finance, Protect and Insure Your Business
• Record Keeping and Accounting
• Financial Management

UNIT V

• Meet Your Legal, Ethical, Social Obligations
• Growth in Today's Marketplace

OUTCOMES:

At the end of this course, the students will be able to

- Determine relevant licensing and regulatory issues for a specific small business plan.
- Develop the marketing plan component for a specific bio – industry and the operation plan component for a bio-industry.
- Develop the customer service plan component and to present and defend business reports in a professional manner.
- Develop strategies for ongoing personal and professional development and advancement.

TEXT BOOK:

1. Entrepreneurship Ideas in Action—South-Western, 2000.

713BTT06 -PROCESS EQUIPMENTS AND PLANT DESIGN

OBJECTIVES:

- To develop key concepts and techniques to design, process equipment in a process plant.
- To train the students to utilize these key concepts to make design and operating decisions.

UNIT I HEAT EXCHANGERS, CONDENSERS, EVAPORATORS

Single and multi process exchangers, double pipe, U tube heat exchangers, combustion details supporting structure. Single and vertical tube evaporation, Single and multi effect evaporators, forced circulation evaporators.

UNIT II STORAGE VESSEL FOR VOLATILE AND NON VOLATILE FLUIDS, PRESSURE VESSEL STRUCTURE

Design of the following equipments as per ASME, ISI codes, drawing according to scale; monoblock and multiplayer vessels, combustion details and supporting structure.

UNIT III EXTRACTOR, DISTILLATION AND ABSORPTION TOWER

Construction details and assembly drawing; Plate and Packed Extraction Towers; Plate and Packed absorption Towers; Plate and Packed Distillation Towers.

UNIT IV PUMPS, MECHANICAL SEALS, VALVES AND SWITCHES

Various types of pumps, Principle of working, construction, usages, advantages and disadvantages; Various types of seals, effectiveness, usages; Pneumatic Seals; Gate, Globe and Butterfly Valves, their material of construction; Pneumatically Controlled Valves.

UNIT V PIPING, PLANT LAY OUT AND DESIGN

Various types of Piping, material of construction, their usage; Pipe lay out; Modern Plant Design and case Studies.

OUTCOMES:

Upon success completion of this course, the students

- Will understand the working principles of heat exchanger, condensers and evaporators and develop a data sheet
- Will acquire basic knowledge to draw and design of storage vessel and pressure vessel as per ASME and ISI codes
- Will understand the construction and assembly drawing of extraction towers, distillation towers and absorption towers
- Would have learned working principles, constructions, usage of various pump, seals , valves and pipes

TEXTBOOKS:

1. Brownbell I.E., Young E.H.. "Chemical Plant Design" 1985.
2. Kern D.Q. "Heat Transfer". McGraw Hill, 1985.

REFERENCE:

1. McCabe, W.L., J.C. Smith and P. Harriott "Unit Operations of Chemical Engineering", 6th Edition, McGraw-Hill, 2001

713BTT07 - PROCESS INSTRUMENTATION DYNAMICS AND CONTROL

OBJECTIVES:

- To enable the students to understand the design principles of control system
- To introduce dynamic response of open and closed loop systems, control loop components and stability of control systems along with instrumentation.

UNIT I INSTRUMENTATION

Principles of measurements and classification of process instruments, measurement of temperature, pressure, fluid flow, liquid weight and weight flow rate, viscosity, pH, concentration, electrical and thermal conductivity, humidity of gases.

UNIT II OPEN LOOP SYSTEMS

Laplace transformation, application to solve ODEs. Open-loop systems, first order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics; transportation lag.

UNIT III CLOSED LOOP SYSTEMS

Closed loop control systems, development of block diagram for feed-back control systems, servo and regulatory problems, transfer function for controllers and final control element, principles of pneumatic and electronic controllers, transient response of closed-loop control systems and their stability

UNIT IV FREQUENCY RESPONSE

Introduction to frequency response of closed-loop systems, control system design by frequency response techniques, Bode diagram, stability criterion, tuning of controller settings

UNIT V ADVANCED CONTROL SYSTEMS

Introduction to advanced control systems, cascade control, feed forward control, Smith predictor controller, control of distillation towers and heat exchangers, introduction to computer control of chemical processes

OUTCOMES:

Upon completion of this course, the students would be able

- To demonstrate the mathematical knowledge in designing a control system
- To Identify the control configuration for a given process
- To apply the control mechanism for process control problems
- To explain and apply their knowledge of process control in instruments, process and various operations.

TEXT BOOKS:

1. Stephanopoulos, G., "Chemical Process Control", Prentice Hall of India, 2003.
2. Coughnowr, D., " Process Systems Analysis and Control ", 2nd Edn., McGraw Hill, New York, 1991.

REFERENCES:

1. Marlin, T. E., " Process Control ", 2nd Edn, McGraw Hill, New York, 2000.
2. Smith, C. A. and Corripio, A. B., "Principles and Practice of Automatic Process Control", 2nd Edn., John Wiley, New York, 1997.
3. Singh S.K., "Industrial Instrumentation and Control" Tata McGraw Hill, 2nd Edition, 2007

713BTT08 - TISSUE ENGINEERING

OBJECTIVES:

To enable the students

- To learn the fundamentals of tissue engineering and tissue repairing
- To acquire knowledge on clinical applications of tissue engineering
- To understand the basic concept behind tissue engineering focusing on the stem cells, biomaterials and its applications

UNIT I INTRODUCTION

Introduction to tissue engineering:Basic definition; current scope of development; use in therapeutics, cells as therapeutic agents, cell numbers and growth rates, measurement of cell characteristics morphology,number viability,motility and functions.Measurement of tissue characteristics ,appearance,cellular component,ECM component,mechanical measurements and physical properties.

UNIT II TISSUE ARCHITECTURE

Tissue types and Tissue components,Tissue repair,Engineering wound healing and sequence of events. Basic wound healing Applications of growth factors: VEGF/angiogenesis,Basicproperties,Cell-Matrix&Cell-Cell Interactions,telomeres and Selfrenewal, , Control of cell migration in tissue engineering.

UNIT III BIOMATERIALS

Biomaterials: Properties of biomaterials ,Surface, bulk, mechanical and biological properties. Scaffolds & tissue engineering, Types of biomaterials, biological and synthetic materials, Biopolymers, Applications of biomaterials,Modifications of Biomaterials, Role of Nanotechnology.

UNIT IV BASIC BIOLOGY OF STEM CELLS

Stem Cells : Introduction, hematopoietic differentiation pathway Potency and plasticity of stem cells,sources,embryonic stem cells,hematopoietic and mesenchymal stem cells,Stem Cell markers, FACS analysis, Differentiation,Stem cell systems- Liver, neuronal stem cells, Types & sources of stem cell withcharacteristics: embryonic, adult, haematopoetic, fetal, cord blood,placenta, bone marrow, primordial germ cells, cancer stem cells induced pleuripotent stem cells.

UNIT V CLINICAL APPLICATIONS

Stem cell therapy,Molecular therapy,In vitro organogenesis, Neurodegenrative diseases, spinal cord injury, heart disease,diabetes, burns and skin ulcers, muscular dystrophy, orthopedicapplications, Stem cells and Gene therapy Physiological models, tissue engineered therapies, productcharacterization, components, safety, efficacy. Preservation –freezing and drying. Patent protection and regulation of of tissueengineered products, sethical issues**.**

OUTCOMES:

Upon completion of this course, the students would get

- Ability to understand the components of the tissue architecture
- Opportunity to get familiarized with the stem cell characteristics and their relevance in medicine
- Awareness about the properties and broad applications of biomaterials
- Overall exposure to the role of tissue engineering and stem cell therapy in organogenesis

TEXT BOOKS:

1. Bernhard O.Palsson,Sangeeta N.Bhatia,"Tissue Engineering" Pearson Publishers 2009.
2. Meyer, U.; Meyer, Th.; Handschel, J.; Wiesmann, H.P. Fundamentals of Tissue Engineering and Regenerative Medicine.2009.

REFERENCES:

1. Bernard N. Kennedy (editor). New York : Nova Science Publishers, 2008.Stem cell transplantation, tissue engineering, and cancer applications
2. Raphael Gorodetsky, Richard Schäfer. Cambridge : RSC Publishing, c2011.Stem cellbased tissue repair.
3. R. Lanza, I. Weissman, J. Thomson, and R. Pedersen, Handbook of Stem Cells, Two-Volume, Volume 1-2: Volume 1-Embryonic Stem Cells; Volume 2-Adult & Fetal Stem Cells, 2004, Academic Press.
4. R. Lanza, J. Gearhart etal (Eds), Essential of Stem Cell Biology, 2006, Elsevier Academic press.
5. J. J. Mao, G. Vunjak-Novakovic *et al* (Eds), Translational Approaches In Tissue Engineering & Regenrative Medicine" 2008, Artech House, INC Publications.
6. Naggy N. Habib, M.Y. Levicar, , L. G. Jiao,.and N. Fisk, Stem Cell Repair and Regeneration, volume-2, 2007, Imperial College Press.

713BTT09 - NEUROBIOLOGY AND COGNITIVE SCIENCES

OBJECTIVES:

To enable the students

- To know the general organization of brain and physiological and cognitive processes.
- To apply the molecular, cellular, and cognitive bases of learning and memory.

UNIT I NEUROANATOMY

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

UNIT II NEUROPHYSIOLOGY

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

UNIT III NEUROPHARMACOLOGY

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

UNIT IV APPLIED NEUROBIOLOGY

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

UNIT V BEHAVIOUR SCIENCE

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

OUTCOMES:

Upon completion of this course, students will be able:

- To know the anatomy and organization of nervous systems.
- To understand the function of nervous systems.
- To analyze how drugs affect cellular function in the nervous system.
- To understand the basic mechanisms associated with behavioral science.

TEXTBOOKS:

1. Mathews G.G. Neurobiology, 2nd edition, Blackwell Science, UK, 2000.
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Registrar