

# St. PETER'S UNIVERSITY

Chennai – 600 054.

## B.TECH. BIOTECHNOLOGY

### 3 & 4 SEMESTERS CURRICULUM AND SYLLABI

Regulations – 2008

#### SEMESTER III

(Applicable to the students admitted from the Academic year 2008–2009 onwards)

Code No.	Course Title	Credit	L	T	P	Marks		
Theory						CA	EA	Total
308BTT01	<a href="#">Transforms and Partial Differential Equation</a>	3	3	1	0	25	75	100
308BTT02	<a href="#">Principles of Chemical Engineering</a>	2	3	0	0	25	75	100
308BTT03	<a href="#">Environmental science and Engineering</a>	2	3	0	0	25	75	100
308BTT04	<a href="#">Cell Biology</a>	3	3	0	0	25	75	100
308BTT05	<a href="#">Bioorganic Chemistry</a>	2	3	0	0	25	75	100
308BTT06	<a href="#">Biochemistry – I</a>	3	3	0	0	25	75	100
Practical								
308BTP01	<a href="#">Bio Chemistry Lab</a>	1	0	0	4	25	75	100
308BTP02	<a href="#">Bioorganic Chemistry Lab</a>	1	0	0	4	25	75	100
308BTP03	<a href="#">Cell Biology Lab</a>	1	0	0	4	25	75	100
<b>Total</b>		<b>18</b>	<b>18</b>	<b>1</b>	<b>12</b>	<b>225</b>	<b>675</b>	<b>900</b>

#### SEMESTER IV

(Applicable to the students admitted from the Academic year 2008 – 2009 onwards)

Code No.	Course Title	Credit	L	T	P	Marks		
Theory						CA	EA	Total
408BTT01	<a href="#">Basic Industrial Biotechnology</a>	2	3	0	0	25	75	100
408BTT02	<a href="#">Probability and Statistics</a>	3	3	1	0	25	75	100
408BTT03	<a href="#">Unit Operations</a>	3	3	0	0	25	75	100
408BTT04	<a href="#">Chemical Thermodynamics and Bio Thermodynamics</a>	3	3	0	0	25	75	100
408BTT05	<a href="#">Instrumental Methods of Analysis</a>	2	3	0	0	25	75	100
408BTT06	<a href="#">Microbiology</a>	2	3	0	0	25	75	100
Practical								
408BTP01	<a href="#">Microbiology Lab</a>	1	0	0	4	25	75	100
408BTP02	<a href="#">Instrumentation Methods of Analysis Lab</a>	1	0	0	4	25	75	100
408BTP03	<a href="#">Chemical Engineering Lab</a>	1	0	0	4	25	75	100
<b>Total</b>		<b>18</b>	<b>18</b>	<b>1</b>	<b>12</b>	<b>225</b>	<b>675</b>	<b>900</b>

**308BTT01 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS 3 1 0 4**  
(Common to all branches of BE / B.Tech Programmes)

**OBJECTIVES**

The course objective is to develop the skills of the students in the areas of Transforms and Partial Differential Equations. This will be necessary for their effective studies in a large number of engineering subjects like heat conduction, communication systems, electro-optics and electromagnetic theory. The course will also serve as a prerequisite for post graduate and specialized studies and research.

**UNIT I FOURIER SERIES 9+3**

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 II FOURIER TRANSFORMS 9+3**

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

**UNIT III PARTIAL DIFFERENTIAL EQUATIONS 9+3**

Formation of partial differential equations – Lagrange's linear equation – Solutions of standard types of first order partial differential equations - Linear partial differential equations of second and higher order with constant coefficients.

**UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9+3**

Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (Insulated edges excluded) – Fourier series solutions in cartesian coordinates.

**UNIT V Z -TRANSFORMS AND DIFFERENCE EQUATIONS 9+3**

Z-transforms - Elementary properties – Inverse Z-transform – Convolution theorem - Formation of difference equations – Solution of difference equations using Z-transform.

**Lectures : 45**

**Tutorials : 15**

**Total : 60**

### **TEXT BOOKS**

1. Grewal, B.S, "*Higher Engineering Mathematic*", 40<sup>th</sup> Edition, Khanna publishers, Delhi, (2007)

### **REFERENCES**

1. Bali.N.P and Manish Goyal, "*A Textbook of Engineering Mathematic*", 7<sup>th</sup> Edition, Laxmi Publications(P) Ltd. (2007)
2. Ramana.B.V., "*Higher Engineering Mathematics*", Tata Mc-GrawHill Publishing Company limited, New Delhi (2007).
3. Glyn James, "*Advanced Modern Engineering Mathematics*", 3<sup>rd</sup> Edition, Pearson Education (2007).
4. Erwin Kreyszig, "*Advanced Engineering Mathematics*", 8<sup>th</sup> edition, Wiley India (2007).



**OBJECTIVES**

- To create an awareness on the various environmental pollution aspects and issues.
- To give a comprehensive insight into natural resources, ecosystem and biodiversity.
- To educate the ways and means to protect the environment from various types of pollution.
- To impart some fundamental knowledge on human welfare measures.

**1. INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES****10**

Definition, scope and importance – need for public awareness – forest resources: use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their ground water, floods, drought, conflicts over water, dams-benefits and problems – mineral resources: use effects on forests and tribal people – water resources: use and over-utilization of surface and exploitation, environmental effects of extracting and using mineral resources, case studies – food resources: world food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – energy resources: growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies – land resources: land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – equitable use of resources for sustainable lifestyles.

Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

**2. ECOSYSTEMS AND BIODIVERSITY****14**

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

Field study of common plants, insects, birds

Field study of simple ecosystems – pond, river, hill slopes, etc.

### **3. ENVIRONMENTAL POLLUTION**

**8**

Definition – causes, effects and control measures of: (a) air pollution (b) water pollution (c) soil pollution (d) marine pollution (e) noise pollution (f) thermal pollution (g) nuclear hazards – solid waste management: causes, effects and control measures of urban and industrial wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides.  
Field study of local polluted site – urban / rural / industrial / agricultural

### **4. SOCIAL ISSUES AND THE ENVIRONMENT**

**7**

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – environmental ethics: issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – air (prevention and control of pollution) act – water (prevention and control of pollution) act – wildlife protection act – forest conservation act – issues involved in enforcement of environmental legislation – public awareness.

### **5. HUMAN POPULATION AND THE ENVIRONMENT**

**6**

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

**TOTAL : 45**

### **TEXT BOOKS**

1. Gilbert M.Masters, "Introduction to Environmental Engineering and Science", Pearson Education Pvt., Ltd., Second Edition, ISBN 81-297-0277-0, 2004.
2. Miller T.G. Jr., "Environmental Science", Wadsworth Publishing Co.

### **REFERENCES**

1. Bharucha Erach, "The Biodiversity of India", Mapin Publishing Pvt. Ltd., Ahmedabad India.
2. Townsend C., Harper J and Michael Begon, "Essentials of Ecology", Blackwell Science.
3. Trivedi R.K. and P.K. Goel, "Introduction to Air Pollution", Techno-Science Publications.
4. Trivedi R.K., "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media.
5. Cunningham, W.P.Cooper, T.H.Gorhani, "Environmental Encyclopedia", Jaico Publ., House, Mumbai, 2001.
6. Wager K.D. "Environmental Management", W.B. Saunders Co., Philadelphia, USA, 1998.

**MAIN AIM(S) OF THE COURSE**

The course aims to develop skills of the Students in the area of Cell Biology and Cell Signalling pathways. This will be necessary for studies in course like Microbiology, Molecular course is also a prerequisite for other Biology, etc., This courses offered in the subsequent semesters.

**UNIT I CELL STRUCTURE AND FUNCTION OF THE ORGANELLES 9**

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

**UNIT II TRANSPORT ACROSS CELL MEMBRANES 9**

Passive & active transport, permeases, sodium potassium pump, Ca<sup>2+</sup> ATPase pumps, lysosomal and vacuolar membrane ATP dependent proton pumps, co transport symport, antiport, transport into prokaryotic cells, endocytosis and exocytosis. Entry of viruses and toxins into cells.

**UNIT III RECEPTORS AND MODELS OF EXTRA CELLULAR SIGNALLING 9**

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

**UNIT IV SIGNAL TRANSDUCTION 9**

Signal amplification, different models of signal amplifications, cyclic amp, role of inositol phosphates as messengers, biosynthesis of inositol tri phosphates, cyclic GMP and g proteins, role in signal transduction, calcium ion flux and its role in cell signaling, current models of signal amplification, phosphorylation of protein kinases, regulation of protein kinases, serine –threonine kinases, tumor necrosis factor receptor families.

**UNIT V CELL CULTURE 9**

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

**TOTAL PERIOD: 45****TEXTS PRESCRIBED:**

1. Darnell J, Lodish H, Baltimore D, "Molecular Cell Biology", W.H.Freeman;
2. Kimball T.W., "Cell Biology", Wesley Publishers;

**REFERENCES:**

1. De Robertis & De Robertis, "Cell Biology".
2. James D.Watson, "Molecular Biology of the Cell".

**PRE-REQUISITE:****MAIN AIM(S) OF THE COURSE**

The course aims to develop skills of Students in the area of Organic Chemistry and its applications in Biology. This will be a prerequisite to courses like Molecular Modelling, Bioseparations etc.

**MAIN TOPICS OF STUDY****UNIT I INTRODUCTION TO ENZYMES 9**

Classification of enzymes. Mechanisms of enzyme action; concept of active site and energetics of enzyme substrate complex formation; specificity of enzyme action; Stereochemistry – R,S notation – re-si faces – e,z isomerism- conformers- ethane – cyclopean - reactivates- mechanisms of sn1 sn2 reactions, e1 e2 reactions – ester formation and hydrolysis, reaction rates - hammond's postulate – h/d effects. Catalysis – general acid – base and covalent catalysis.

**UNIT II KINETICS OF ENZYME ACTION 9**

Allosteric regulation of enzymes, Monod changeux wyman model, ph and temperature effect on enzymes & deactivation kinetics - Stereospecific enzymatic reactions – Stereochemistry of nucleophilic reactions – chiral methyl group – chiral phosphate.

**UNIT III ENZYME IMMOBILIZATION & CASE STUDIES OF ENZYME STRUCTURE AND MECHANISM 9**

Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages. Case studies include dehydrogenases, proteases – - lysozyme-stability of proteins

**UNIT IV KINETICS OF PROTEIN FOLDING 9**

Kinetics of single substrate reactions; estimation of Michelis – Menten parameters, multi substrate reactions- mechanisms and kinetics; turnover number; types of inhibition & models –substrate, product - folding of peptides.

**UNIT V FOLDING PATHWAYS & ENERGY LANDSCAPES 9**

Folding of ci2 – nucleation condensation mechanism – folding of barnase – time resolution – insights from theory – optimization of folding rates – molecular chaperones. Production and purification of crude enzyme extracts from plant, animal and microbial sources; methods of characterization of enzymes; development of enzymatic assays

**TOTAL PERIOD: 45****TEXTS PRESCRIBED:**

1. Harvey W. Blanch, Douglas S. Clark, "Biochemical Engineering", Marcel Dekker, Inc.
2. James M. Lee, "Biochemical Engineering", PHI, USA.

**REFERENCES:**

1. Structure and Mechanism In Protein Science: A Guide To Enzyme Catalysis and Protein Folding; A. R. Fersht, W.H. Freeman, 1999.
2. Bioorganic Chemistry; H. Dugas, Springer Verlag, 1999.
3. James. E. Bailey & David F. Ollis, "Biochemical Engineering Fundamentals", McGraw-Hill.
4. Wiseman, "Enzyme Biotechnology", Ellis Horwood Pub.

**Aim :** To enable students learn the basic fundamental of biochemical Processes.

**Objectives:**

To ensure students have a strong grounding in structures and reactions of biomolecules.

To introduce them to metabolic pathway of the major biomolecular and relevance to clinical conductors.

To correlate biochemical processes with biotechnology applications.

**UNIT I INTRODUCTION TO BIOMOLECULES 5**

Basic principles of organic chemistry, types of functional groups, biomolecules, chemical nature, water, pH and biological buffers.

**UNIT II 15**

Structure and properties of Important Biomolecules.

**Carbohydrates** (mono, di, oligo & polysaccharides) Proteoglycans, glucosaminoglycans. mutarotation, glycosidic bond, reactions of monosaccharides, reducing sugars .

**Lipids:** fatty acids, glycerol, saponification, iodination, hydrogenation, phospholipids, glycolipids, sphingolipids, cholesterol, steroids, prostaglandins.

Amino Acids, Peptides, Proteins, measurement, structures, hierarchy of organization primary, secondary, tertiary and quaternary structures, glycoproteins, lipoproteins. Determine of primary structure.

Nucleic acids: purines, pyrimidines, nucleoside, nucleotide, RNA, DNA ,reactions, properties, measurement, nucleoprotein complexes

**UNIT III METABOLISM CONCEPTS 5**

Functions of Proteins, Enzymes, introduction to biocatalysts, metabolic pathways, primary and secondary metabolites.

**UNIT IV INTERMEDIARY METABOLISM AND REGULATION 15**

Glycolysis, TCA cycle, gluconeogenesis, pentose phosphate shunt, glyoxalate shunt, fatty acid synthesis and oxidation, reactions of amino acids, deamination, transamination and decarboxylation, urea cycle, interconnection of pathways and metabolic regulation. Case study on overproduction of glutamic acid, threonine , lysine, methionine, isoleucine and ethanol.

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

**TEXT BOOK:**

1. Nelson, D.L. and M.M. Cox, "Lehninger's Principles of Biochemistry", 4<sup>th</sup> Edition, W.H. Freeman & Co., 2005.
2. Stryer, L., "Biochemistry", 4<sup>th</sup> Edition, W.H. Freeman & Co., 2000.
3. Voet, D. and Voet, J.G., "Biochemistry", 3<sup>rd</sup> Edition, John Wiley & Sons Inc., 2004.
4. Murray, R.K., et al "Harper's Biochemistry", 23<sup>rd</sup> Edition, Prentice Hall International, 1993.

**MAIN TOPICS OF STUDY**

Demonstration of use of volume and weight measurements devices.  
Titration of weak acid-weak base.  
Quantitative Test for carbohydrates  
Distinguish reducing and nonreducing sugars.  
Using ninhydrin for distinguishing Imino and amino acids  
Protein estimation by Biuret and Lowry's methods.  
Protein estimation by Bradford colorimetric methods.  
Extraction of lipids and analysis by TLC.  
Estimation of nucleic acids by absorbance at 260nm and hyper chromicity.  
Enzymatic assay of phosphates.  
Hydrolysis of starch by an enzyme

**TOTAL: 60 PERIODS****REFERENCES:**

1. Wilson and Walker "Principles and Techniques of Practical Biochemistry" 4 Edn., Cambridge Knew pros 1997.
2. Plummer DT "An Introduction to Practical Biochemistry" III Edn., Tata McGrawhill.

**LIST OF EQUIPMENTS**

Heating Mantles (5) / Water Baths (5) / Bunsen Burners (10)  
TLC Plates – Required Numbers  
Colorimeter – 2 Nos.  
Consumables and Reagents.

**MAIN AIM(S) OF THE COURSE**

The course aims is offering hands on training in the area of Bio Organic Chemistry. This will be a prerequisite for certain lab courses offered in the subsequent semesters and also for the project work.

**LIST OF EXPERIMENTS**

1. Synthesis of aspirin
2. Hydrolysis of sucrose
3. Preparation of pyruvic acid.
4. Preparation of oleic 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.

**TOTAL: 60 PERIODS****REFERENCES:**

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

**EQUIPMENTS / APPARATUS REQUIREMENTS**

Heating Mantles (Nos. 5) / Water baths (Nos. 5) / Bunsen Burners (Nos. 15)  
Round bottom flasks of various volumes (100ml, 500 ml, 250 ml – Nos.5)  
condensers (Nos. 5), Distillation units (Nos. 2).  
Reagents and consumables.

**MAIN AIM(S) OF THE COURSE**

The course aims is offering hands on training in the area of Cell culture and Cell identification. This will serve as a prerequisite for post graduate and specialized studies & research.

**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. Thin Layer Chromatography,
7. Giemsa Staining,
8. Separation of Peripheral Blood Mononuclear Cells from blood,
9. Osmosis and Tonicity,
10. Tryphan Blue Assay,
11. Staining for different stages of mitosis in AlliumCepa (Onion).

**TOTAL : 60 PERIODS**

**REFERENCE :**

1. Laboratory Investigations in Cell and Molecular Biology, Allen Bregman Wiley, 2001.

**EQUIPMENTS / APPARATUS**

Microbiological Hood for sterilization with UV lighting (One).  
Bunsen Burners – 10 Nos.  
Orbital Shaker and Incubator – 2 Nos.  
Refrigerator – 1 No.  
Reagents and consumables – Required amount.

**MAIN AIM(S) OF THE COURSE**

The course aims to develop skills of the Students in area of Basic Industrial Biotechnology. This will be very effect in understanding courses like Bioprocess technology, genetic engineering. Etc.,

**MAIN TOPICS OF STUDY****UNIT I INTRODUCTION TO INDUSTRIAL BIOPROCESS 7**

A historical overview of industrial fermentation process – traditional and modern biotechnology. A brief survey of organisms, processes, products relating to modern biotechnology. Process flow sheeting – block diagrams, pictorial representation.

**UNIT II PRODUCTION OF PRIMARY METABOLITES 10**

A brief outline of processes for the production of some commercially important organic acids (e.g. citric acid, lactic acid, acetic acid etc.); amino acids (glutamic acid, phenylalanine, aspartic acid etc.) and alcohols (ethanol, butanol etc.)

**UNIT III PRODUCTION OF SECONDARY METABOLITES 10**

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

**UNIT IV PRODUCTION OF ENZYMES AND OTHER BIOPRODUCTS 8**

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

**UNIT V PRODUCTION MODERN BIOTECHNOLOGY PRODUCTS 10**

Production of recombinant proteins having therapeutic and diagnostic applications, production of vaccines. Production of monoclonal antibodies. Products of plant and animal cell culture

**TOTAL PERIOD: 45****TEXTS PRESCRIBED:**

1. Casida Jr, L.E., "Industrial Microbiology", New Age International (P) Ltd.
2. Prescott, Dunn, "Industrial Microbiology", Agrobios (India).

**REFERENCES:**

1. Wulf Cruger and Anneliese Crueger, "Biotechnology: A Textbook of Industrial Microbiology", Panima Publishing Corporation.
2. Murrey Moo & Young, "Comprehensive Biotechnology", Pergamon

**OBJECTIVES**

At the end of the course, the students would

1. Acquire skills in handling situations involving more than one random variable and functions of random variables.
2. Be introduced to the notion of sampling distributions and have acquired knowledge of statistical techniques useful in making rational decision in management problems.
3. Be exposed to statistical methods designed to contribute to the process of making scientific judgments in the face of uncertainty and variation.

**1. RANDOM VARIABLES 9+3**

Discrete and continuous random variables - Properties- Moments - Moment generating functions and their properties. Binomial, Poisson, Geometric, Negative binomial, Uniform, Exponential, Gamma, and Weibull distributions.

**2. TWO DIMENSIONAL RANDOM VARIABLES 9+3**

Joint distributions - Marginal and conditional distributions – Covariance - Correlation and Regression – function of a random variable-Transformation of random variables - Central limit theorem.

**3. TESTING OF HYPOTHESIS 9+3**

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

**4. DESIGN OF EXPERIMENTS 9+3**

Analysis of variance – One way classification – CRD - Two – way classification – RBD - Latin square.

**5. RELIABILITY AND QUALITY CONTROL 9+3**

Concepts of reliability-hazard functions-Reliability of series and parallel systems- control charts for measurements (x and R charts) – control charts for attributes (p, c and np charts)

**LECTURES: 45**

**TUTORIALS: 15**

**TOTAL: 60**

*Note : Use of approved statistical table is permitted in the examination.*

**TEXT BOOKS**

1. J. S. Milton and J.C. Arnold, “Introduction to Probability and Statistics”, Tata McGraw Hill, 4<sup>th</sup> edition, 2007. (For units 1 and 2)
2. R.A. Johnson and C.B. Gupta, “Miller and Freund’s Probability and Statistics for Engineers”, Pearson Education, Asia, 7<sup>th</sup> edition, (2007)

## REFERENCES

1. Walpole, R. E., Myers, R. H. Myers R. S. L. and Ye. K, "Probability and Statistics for Engineers and Scientists", Seventh Edition, Pearsons Education, Delhi, 2002.
2. Navidi, W, "Statistics for Engineers and Scientists", Special Indian Edition, Tata McGraw-Hill Publishing Company Ltd, New Delhi,2008.
3. Spiegel, M.R, Schiller, J and Alu Srinivasan, R, "Schaum's Outlines Probability and Statistics", Tata McGraw-Hill Publishing Company Ltd. New Delhi ,2007.

**PRE-REQUISITE:****MAIN AIM(S) OF THE COURSE**

The course aims to develop skills of the Students in area of unit operations. This course will be a prerequisite for certain engineering subjects offered in the subsequent semesters.

**MAIN TOPICS OF STUDY**

<b>UNIT I</b>	<b>MIXING AND AGITATION</b>	<b>8</b>
Dimensional analysis; power for agitation; agitation of liquids; gas-liquid systems; gas-solid suspensions; agitator scale up.		
<b>UNIT II</b>	<b>FILTRATION</b>	<b>8</b>
Constant pressure, constant volume batch filtration; continuous filtration; industrial filters; settling and sedimentation; centrifugation.		
<b>UNIT III</b>	<b>MECHANISM OF HEAT TRANSFER</b>	<b>10</b>
Steady state conduction; combined resistances; unsteady state conduction; lumped heat capacity; extended surfaces; combined conduction and convection.		
<b>UNIT IV</b>	<b>CONVECTION HEAT TRANSFER</b>	<b>10</b>
Dimensional analysis; forced and natural convection; convection in flow over surfaces through pipes boiling and condensation.		
<b>UNIT V</b>	<b>HEAT EXCHANGERS</b>	<b>9</b>
Equipments; overall heat transfer coefficients; design of heat exchangers; NTU concept; evaporators; single and multiple effects; mass and enthalpy balances.		

**TOTAL PERIOD: 45****TEXTS PRESCRIBED:**

1. Geankoplis C.J. Transport Processes And Unit Operations. Prentice Hall India.2002.  
McCabe W.L., Smith J.C. Unit Operations In Chemical Engineering.5<sup>th</sup> Edition.Mcgrawhill.1993.

**REFERENCES:**

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

## **408BTT04 CHEMICAL THERMODYNAMICS AND BIO THERMODYNAMICS 3 0 0 3**

### **MAIN AIM(S) OF THE COURSE**

The course aims to expose the students to the area of chemical thermodynamics. This will serve as a prerequisite for courses like enzyme engineering, Mass transfer, etc

#### **UNIT I THERMODYNAMIC PROPERTIES OF FLUIDS 9**

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 9**

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 9**

Criteria for phase equilibria; v-l-e calculations for binary and multi component systems; liquid-liquid equilibria and solid-solid equilibria.

#### **UNIT IV CHEMICAL REACTION EQUILIBRIA 9**

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

#### **UNIT V THERMODYNAMIC ANALYSIS OF PROCESSES 9**

Concept of lost work; entropy generation; calculation of real irreversible processes; power cycle; liquefaction.

**TOTAL PERIOD: 45**

#### **TEXTS PRESCRIBED:**

1. Smith J.M., Van Ness H.C., Abbot M.M. Chemical Engineering Thermodynamics. 6<sup>th</sup> Edition. McGraw-Hill, 2001.
2. Narayanan K.V. A Text Book Of Chemical Engineering Thermodynamics. Prentice Hall India, 2001.

#### **REFERENCES:**

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



**MAIN AIM(S) OF THE COURSE**

The course aims to develop skills of the Students in the area of Microbiology particularly to identify microbes, their structure, their metabolism and their industrial applications. This will be a prerequisite for all courses offered in Bioprocess Technology.

**UNIT I INTRODUCTION 6**

Basic of microbial existence; history of microbiology, classification and nomenclature of microorganism, 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 12**

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

**UNIT III MICROBIAL NUTRITION, GROWTH AND METABOLISM 12**

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

**UNIT - IV CONTROL OF MICROORGANISMS 6**

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 9**

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

**TOTAL PERIOD: 45**

**TEXTS PRESCRIBED:**

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 LM, Harley JP, Klein DA, Microbiology, 3<sup>rd</sup> Edition, Wm. C. Brown Publishers, 1996.

**MAIN AIM(S) OF THE COURSE**

The course aims to develop the skills of students in area of microbiology. Here hands on training is offered for the students to study microbes, their identifications & characterization and their practical uses.

**EXPERIMENTS**

1. Laboratory safety and sterilization techniques
2. Microscopic methods in the identification of microorganisms
3. Preparation of culture media – nutrient broth and nutrient agar
4. Culturing of microorganisms – in broth and in plates (pour plates, streak plates, isolation and preservation of bacterial cultures)
5. Staining techniques – grams' and differential
6. Quantitation of microorganisms.
7. Effect of disinfectants on microbial flora
8. Isolation and identification of microorganisms from different sources – soil, water and milk
9. Antibiotic sensitivity assay
10. Growth curve – observation and growth characteristics of bacteria and yeast.
11. Effect of different parameters on bacterial growth (ph, temperature & UV irradiation)

**TOTAL: 60 PERIODS**

**REFERENCES :**

1. Micro Biology : Laboratory Theory and applications, M.J. Heboffee aw BE Pierce Morten Publishing House, 2006.

**EQUIPMENTS / APPARATUS**

Microbiological Hood for sterilization with UV lighting (One).  
Bunsen Burners – 15 Nos.  
Orbital Shaker and incubator – 2 Nos.  
Refrigerator – 1 No.  
Reagents and consumables – Required amount.

**MAIN AIM(S) OF THE COURSE**

To develop skills of students by providing hands on training in using various equipments used in biotechnology. This will be a pre-requisite for certain specialized project work that a student undertakes.

**EXPERIMENTS**

1. Precision and validity in an experiment using absorption spectroscopy and Validating Lambert-Beer's law using  $\text{KMnO}_4$
2. Finding the molar absorptivity and stoichiometry of the Fe (1, 10 phenanthroline) 3 using absorption spectrometry.
3. Finding the  $\text{pK}_a$  of 4-nitrophenol using absorption spectroscopy.
4. UV spectra of nucleic acids.
5. Estimation of Sulphate by nephelometry.
6. Estimation of  $\text{Al}^{+++}$  by fluorimetry.
7. Chromatography analysis using TLC and Column chromatography.
8. UV spectra of nucleic acids.
9. Limits of detection of colorimeter using aluminum alizarin complex.
10. Chromatography using column chromatography.
11. Job's plot for finding stoichiometry of iron salicylate complex.
12. UV – spectra of proteins.

**TOTAL: 60 PERIODS****REFERENCE:**

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

**LIST OF EQUIPMENTS**

1. UV – VIS Spectro photometer, Fluorimeter (optional).
2. TLC chamber (common to biochemistry)
3. Reagents and consumables
4. Measuring cylinders, bathometric flasks of various volumes.

1. Flow measurement
2. Pressure drop in pipes and packed columns
3. Fluidization
4. Filtration
5. Heat exchanger
6. Simple and steam distillation
7. Distillation in packed column
8. Liquid-liquid equilibria in extraction
9. Adsorption equilibrium

**TOTAL: 60 PERIODS**