BANNARI AMMAN INSTITUTE OF TECHNOLOGY
SATHYAMANGALAM – 638 401
(Autonomous Institution affiliated to Anna University, Coimbatore)

B.Tech. BIOTECHNOLOGY 2009 - 10 onwards

First Semester					
Code No.	Course	L	T	P	C
07G101	Engineering Mathematics –I*	3	2	0	4
07G102	Engineering Physics*	3	0	0	3
07G103	Engineering Chemistry*	3	0	0	3
07G104	'C' Programming*	3	0	0	3
07B105	Basics of Civil and Mechanical Engineering♣	4	0	0	4
07B106	Basics of Electrical and Electronics Engineering	3	1	0	4
07G001	Communication Skills – I**	3	0	0	3
07G108	'C' Programming Laboratory*	0	0	3	2
07B109	Engineering Physics Laboratory$	0	0	2	1
07B110	Engineering Chemistry Laboratory$	0	0	2	1
	Total	22	3	7	28

Second Semester					
Code No.	Course	L	T	P	C
07G201	Engineering Mathematics – II*	3	2	0	4
07G202	Environmental Science and Engineering*	3	0	0	3
07G203	Object Oriented Programming*	3	0	0	3
07B204	Materials science for Biotechnology	3	0	0	3
07B205	Biochemistry – I	3	0	2	4
07B206	Basic Biology	3	0	0	3
07G002	Communication Skills – II**	3	0	0	3
07G208	Object Oriented Programming Laboratory*	0	0	3	2
07B209	Engineering Graphics#	2	0	3	4
07B210	Workshop Practice#	0	0	2	1
	Total	23	2	10	30

* Common to all branches of B. E./B. Tech.
♣ Common to FT, BT, IT, ME & CE
$ Common to FT, CE, BT, CSE, TT & ME (first semester); ECE, EEE, EIE, IT (second semester)
# Common to ECE, EEE, EIE, IT (first semester); FT, CE, BT, CSE, TT & ME (second semester)
** Common to all branch of B.E / B.Tech. and evaluation by continuous assessment

Third Semester					
Code No.	Course	L	T	P	C
07B301	Numerical Methods and Statistics	3	1	0	4
07B302	Bioorganic Chemistry	3	1	0	4
07B303	Cell Biology	4	0	0	4
07B304	Microbiology	4	0	0	4
07B305	Basic Industrial Biotechnology	3	0	0	3
07B306	Basic Principles of Chemical Engineering	3	1	0	4
07B307	Concepts of Engineering Design	3	0	0	3
07B308	Bioorganic Chemistry Laboratory	0	0	3	2
07B309	Cell Biology Laboratory	0	0	3	2
07B310	Microbiology Laboratory	0	0	3	2
	Total	23	3	9	32

Fourth Semester					
Code No.	Course	L	T	P	C
07B401	Genetics	4	0	0	4
07B402	Plant Biotechnology	3	0	0	3
07B403	Instrumental Methods of Analysis	4	0	0	4
07B404	Molecular Biology	4	0	0	4
07B405	Biochemistry -II	3	0	0	3
07B406	Chemical Thermodynamics & Biothermodynamics	4	1	0	4
07G003	Professional Communication **	2	0	2	3
07B408	Instrumental Methods of Analysis Laboratory	0	0	3	2
07B409	Molecular Biology Laboratory	0	0	3	2
07B410	Chemical Engineering Laboratory	0	0	3	2
	Total	24	1	11	31

Fifth Semester					
Code No.	Course	L	T	P	C
07B501	Microbial Biotechnology	3	0	0	3
07B502	Food Technology	4	0	0	4
07B503	Genetic Engineering	3	0	0	3
07B504	Bioprocess Principles	3	1	0	4
07B505	Mass Transfer Operations	3	1	0	4
07B506	Plant Tissue Culture	3	0	0	3
07G005	Engineering Economics**	3	0	0	3
07B508	Bioprocess Laboratory I	0	0	4	2
07B509	Genetic Engineering Laboratory	0	0	3	2
07B510	Mini Project I	0	0	4	2
	Total	22	2	11	30

Sixth Semester					
Code No.	Course	L	T	P	C
07B601	Enzyme Engineering & Technology	3	0	0	3
07B602	Chemical Reaction Engineering	3	1	0	4
07B603	Bioprocess Engineering	3	1	0	4
07B604	Protein Engineering	4	0	0	4
07B605	Animal Biotechnology	3	0	0	3
	Elective I	3	0	0	3
07G006	Total Quality Management**	4	0	0	1
07B608	Bioprocess Laboratory II	0	0	5	3
07B609	Protein Purification Laboratory	0	0	4	2
07B610	Technical Seminar	0	0	2	1
	Total	23	2	11	28

** Common for all branches of B.E./B.Tech. and evaluation by continuous assessment

Seventh Semester					
Code No.	Course	L	T	P	C
07B701	Biodiversity and Bioresource Management	3	0	0	3
07B702	Downstream Processing	4	0	0	4
07B703	Immunology	3	0	0	3
07B704	Bioinformatics	3	0	0	3
	Elective II	3	0	0	3
	Elective III	3	0	0	3
07G007	Creativity and Innovation**	3	0	0	3
07B708	Downstream Processing Laboratory	0	0	4	2
07B709	Immunology Laboratory	0	0	4	2
07B710	Mini Project II	0	0	4	2
	Total	23	0	12	29

Eighth Semester					
Code No.	Course	L	T	P	C
07B801	Biosafety, IPR and Technology Transfer	3	0	0	3
	Elective IV	3	0	0	3
	Elective V	3	0	0	3
07G008	Organizational Behavior and Management **	3	0	0	3
07B805	Project	0	0	23	12
	Total	12	0	23	24

** Common for all branches of B.E./B.Tech. and evaluation by continuous assessment

List of Electives

Elective I
07B001 Agricultural Biotechnology
07B002 Environmental Biotechnology
07B003 Proteomics and Genomics

Elective II
07B004 Nanobiotechnology
07B005 Separation Techniques
07B006 Biological Spectroscopy

Elective III
07B007 Biomaterials
07B008 Biosensors and Microbial Fuel Cells
07B009 Biofuels

Elective IV
07B010 Cane Sugar and Alcohol Technology
07B011 Process Instrumentation and Control
07B012 Molecular Modeling and Drug Design

Elective V
07B012 Immunotechnology
07B014 Cancer Biology
07B015 Biopharmaceutical Technology and Drug Development
07B016 Professional Ethics

Syllabi of

B.Tech. Biotechnology

07G101 ENGINEERING MATHEMATICS – I
(vide Civil Engg)

.

07G102 ENGINEERING PHYSICS
(vide Civil Engg)

07G103 ENGINEERING CHEMISTRY
(vide Civil Engg)

07G104 C PROGRAMMING
(vide Civil Engg)

07B105 BASICS OF CIVIL AND MECHANICAL ENGINEERING
(vide Computer Science Engg. 07Z105)

07B106 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING
(vide Civil Engg 07C105)

07G001 COMMUNICATION SKILLS – I
(vide Civil Engg)

07G108 C PROGRAMMING LABORATORY
(vide Civil Eng)
07B109 ENGINEERING PHYSICS LABORATORY
(vide Civil Engg 07C109)

07B110 ENGINEERING CHEMISTRY LABORATORY
(vide Civil Engg 07C110)

07G201 ENGINEERING MATHEMATICS – II

(vide Civil Engg)

07G202 ENVIRONMENTAL SCIENCE AND ENGINEERING
(vide Civil Engg)

07G203 OBJECT ORIENTED PROGRAMMING
(vide Civil Engg)

07B204 MATERIALS SCIENCE FOR BIO-TECHNOLOGY

3 0 0 3

Unit I

Conducting Materials

Conducting Materials: Classical theory - Drude-Lorentz theory - Electrical conductivity- Thermal conductivity- Wiedemann - Franz law- Drawbacks of Classical theory- Quantum theory: Fermi distribution function- Density of energy states. Superconductivity: Superconducting phenomena - Properties of superconductors - Type I & Type II superconductors - High temperature perconductors – Applications.

10 Hours

Unit II

Semiconducting Materials

Intrinsic Semiconductors: Carrier concentration- Calculation of density of holes and electrons- Fermi level and its variation with temperature- Mobility and conductivity – Determination of band gap. Extrinsic Semiconductors: Expression for carrier concentration - n-type and p-type semiconductors- Variation of Fermi level with temperature and impurity concentration- Hall effect: Theory- Determination of Hall coefficient - Us

10 Hours

Unit III

Dielectrics and Magnetic materials

Dielectrics: Basic Definitions: Electrical susceptibility- Dielectric constant-Electronic, ionic, orientation and space charge polarizations- Frequency and temperature dependence of polarization- Internal field, Claussius-Mosotti relation (derivation)-Dielectric loss- Dielectric breakdown- Uses Magnetic Materials: Origin of magnetic moment: Bohr magneton- Domain theory of ferromagnetism- Hysteresis- Soft and Hard magnetic materials- Ferrites- Applications.

10 Hours

Unit IV

Fiber Optics and Non Destructive Testing

Fiber Optics: Principle of light transmission through fiber- Expression for acceptance angle- Numerical Aperture- Types of fibers- Single mode and Multimode – Fiber sensors: Basic principle, Classification of fiber optic sensor: Intensity change sensors. Non Destructive Testing: Liquid penetrant method- Ultrasonic flaw detector (block diagram)- X-ray Radiography: displacement method - X-Ray Fluoroscopy- Thermography

10

Hours

Unit V

Medical Physics

Medical physics: Introduction-ultrasound picture of human body-Block diagram of basic pulse echo system- different types of scanning: A scan, B scan and T-M scan- Physiological effect of ultrasound in therapy – Phonocardiography Nuclear Medicine: Sources of nuclear activity of nuclear medicine – Nuclear imaging techniques - Basic instrumentation and its clinical application-Radiation detectors: Gamma ray camera- G-M counter-Scintillation counter-Magnetic Resonance Imaging.

10

Hours

Total: 50 Hours

Text books

1 Arumugam.M, " Physics I", Fifth Edition, Anuradha Publications, Kumbokonam, 2005.
2 Palanisami P.K, "Physics For Engineers", Scitech Publications (India),Pvt Ltd, Chennai, 2002.

References

1. Pillai S. O., "Solid State Physics", Fifth Edition, New Age International Publications, New Delhi, , 2003.
2. Avadhanulu M.N. and Kshirsagar P.G., "A Text Book of Engineering Physics", 7th Enlarged Revised Edition, S.Chand&Company Ltd., New Delhi, 2005.
3. Raghavan V, "Materials Science and Engineering," A first course,. Prentice Hall of India, New Delhi, 2001.
4. Rajendran.V and Marikani.A., "Physics I", Tata Mc Graw Hill Publishers Company Ltd, New Delhi, 2004.
5. Arumugam.M, "Applied Physics" (Physical Science-Part I), Revised 3rd Edition, Reprint, Anuradha Publications, Kumbokonam, 2001.

07B205 BIOCHEMISTRY – I

3 0 2 4

Unit I

Chemical Bonding, Acid-Base Balance, and Introduction to Biomolecules

Ionic, covalent and co-ordinate bonding (overview only); Electronegativity of elements, polarity and dipole moment; Water and hydrogen bonding, van der Waal's forces; Metallic bonding; Water and its role in biological systems; Osmolarity and Osmolality; concept of pH, acids and bases, Henderson-Hasselbach equation, Titration; Introduction to buffers & biological buffers; Introduction to biomolecules and their major functions in living organisms. 10 Hours

Unit II

Carbohydrates

Nomenclature, classification and functions of monosaccharides and disaccharides; general structural aspects and Glucose and Fructose in detail; Reactions of monosaccharides; Glycosides and sugar

derivatives; Disaccharides – structures and properties (reducing vs non-reducing sugars, details of maltose, lactose and sucrose); Polysaccharides – classification, structures, and functions; Homopolysaccharides – with specific reference to starch, dextrins, cellulose, inulin, glycogen, and chitin; Heteropolysaccharides.

10 Hours

Unit III

Lipids

Lipid classification; Fatty acids – occurrence, saturated vs unsaturated, nomenclature, EFAs and PUFAs; Triacylglycerols – structures and properties; Phospholipids – structures and functions of glycerolipids and sphingolipids; Glycolipids, lipoproteins, steroids, cholesterol, amphipathic lipids.

10 Hours

Unit IV

Amino Acids and Proteins

Classification of amino acids; Structures, physical and chemical properties of standard amino acids, titration curves of glycine, alanine, glutamic acid, lysine, histidine; Non-standard amino acids; Proteins - primary structure (peptide bond and its features, Ramachandran plot, determination of primary structure); Secondary structures; Bonds that determine protein structure; Tertiary and quaternary structures of proteins - Insulin, Myoglobin and Hemoglobin as examples.

10 Hours

Unit V:

Nucleic Acids and Vitamins

Purines, pyrimidines, nucleosides, nucleotides; Ribonucleic and deoxyribonucleic acids - structure of DNA, Watson-Crick model, Chargaff's Rule, types of RNA (their structures and functions); Other functions of nucleotides - energy carriers, enzyme cofactors, regulatory molecules; Synthetic nucleotide analogs; Tests for RNA & DNA. Vitamins – classification, sources, biological importance (chemistry, biochemical functions, RDA, deficiency states) of Vit A, Vit D, Vit E, Vit K, Vit C, Vit B1, Vit B2, Niacin, Pyridoxine, Biotin, Panthothenic Acid, Folic Acid, Cobalamin; Anti-oxidants.

10 Hours

Lab component 15 Hours

1. Preparation of molar, normal and present solutions
2. Preparation of buffers (eg. Phosphate, Borate)
3. Qualitative analysis of carbohydrates
4. Test and differentiate pentoses from hexoses,& reducing from non-reducing sugars
5. Glucose estimation by DNSA and glucose oxidase methods
6. Protein estimation-Biuret and Lowry's methods
7. Estimation of DNA and RNA in a mixture
8. Hydroxyl, acid and iodine values of lipids

Total: 50 Hours + 15 Hours =65 Hours

Textbooks

1. Satyanarayana, U,"Biochemistry", Books and Allied (P) Ltd., 2006
2 Arti Nigam and Archana Ayyagari, "Lab Manual in Biochemistry, Immunology and Biotechnology", Tata McGraw-Hill, New Delhi, 2007

Reference Books

1. Nelson. D.L. and Cox, M.M. Lehninger,"Principles of Biochemistry", Fourth Edition (Low Price Edition), WH Freeman & Co., 2005
2. Stryer, W. H. "Biochemistry", Fourth Edition Freeman and Company, San Francisco, 2000
3. Voet, D. and Voet, J.G."Biochemistry", John Wiley and Sons Inc., 2003
4. Mathews, C.K. and van Holde, K.E, "Biochemistry", Benjamin/ Cummings Publishing Co. Inc., 1990
5. Mckee, T. and Mckee, J.R,"Biochemistry": An Introduction, International Edition 2, and McGraw-Hill, New Delhi, 1999

07B206 BASIC BIOLOGY

3 0 0 3

Unit I
Origin
The Origin and Early History of Life; the Evidence for Evolution; The Origin of Species; Evolution and Phylogeny. Fundamental properties of life; Characteristics & organization of living organisms.
10 Hours

Unit II
Diversity of Life on Earth
Systematics, cladistics and Classification ; Whittaker's Five kingdom classification Prokaryotes; Eukaryotes; Viruses; Plant diversity and Animal diversity.
10 Hours

Unit III
Plant Structures
Plants : Végétative development; Reproduction; Transport; Nutrition, Sensory System. 10 Hours

Unit IV
Animal Structures
Animals : Development; Digestion; Circulation; Respiration; Reproduction; Nervous System; Endocrine System ;Modes of locomotion. 10 Hours

Unit V
Ecology and Behaviour
Behavioural Biology; Population Ecology; Community Ecology; Dynamics of Ecosystems; The Biosphere; Conservation Biology. 10 Hours

Total: 50 Hours

Text Book
Raven, P.H. Johnson, G.B., Losos J.B. Singer ,S.R. Biology, 7th Edition Tata McGraw-Hill Pub., 2005

References
1. Soper, R., Taylor, D. J., Green, N.P.O., Stout, G.W, "Biological Science", 3rd Edition., Cambridge Univ Press, 1998

2. Eldon,D., Enger.,Fredrick C.Ross.,David B.Bailey, "Concepts in Biology", 11th Edition, Tata McGraw - Hill
Pub, 2005

07G002 COMMUNICATION SKILLS – II
(vide Civil Engg)

07G208 OBJECT ORIENTED PROGRAMMING LABORATORY
(vide Civil Engg)

07B209 ENGINEERING GRAPHICS

2 0 3 4

Concepts and Conventions
Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.
2 Hours

Unit I

Plane Curves and Projection of Points, Lines

Curves used in engineering practices

Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square, pentagon and circle.

Projection of Points and Lines

General principles of orthographic projection – First angle projection – Layout of views – Projection of points, located in all quadrant and straight lines located in the first quadrant – Determination of true lengths and true inclinations.

10 Hours

Unit II

Projection of Plane surfaces, Solids, and Section of solids

Projection of polygonal surface and circular lamina inclined to one reference plane.

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

Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane – Obtaining true shape of section. 10 Hours

Unit III

Development of surfaces and Intersection of solids

Development of lateral surfaces of simple and truncated solids – prisms, pyramids, cylinders and cones.

Development of lateral surfaces of solids with square and cylindrical cutouts, perpendicular to the axis.

Development of lateral surfaces of two Intersecting solids – cylinder & cylinder – prism & cylinder – Axis at right angles with no offset. 10 Hours

Unit IV

Isometric and Perspective projections

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

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

8 Hours

Unit V

Computer Aided Drafting (AutoCAD)

Introduction to AutoCAD and Drawing Setup: Getting Started with AutoCAD, Introduction to AutoCAD and Drawing setup – Getting started with AutoCAD – Advanced sketching , Drawing aids – Edit Commands .

Controlling the drawing display – Basic dimensioning - Edit dimensioning styles – Hatching – Blocks – Introduction to 3D – Simple exercises. 10 Hours

Total: 50 Hours

Text books

1. K.Venugopal and V Prabhu Raja “Engineering Graphics”, New Age International (P) Limited, Eight Edition (Revised) 2007
2. V Ramesh Babu, “Engineering Graphics”, VRB Publishers Pvt. Ltd., 2007

Reference

1. N.D. Bhatt “Engineering Drawing” Charotar publishing House 46th Edition, 2003.
2. K.V. Nataraajan “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2006.
3. K.R. Gopalakrishnan. “Engineering Drawing” (Vol. I & II) Subhas Publications
4. M.B. Shah and B.C. Rana, “Engineering Drawing”, Pearson Education, 2005
5. Sham Tickoo and Deepak Maini, “AutoCAD 2006 – for Engineers and Designers”. Dreamtech Publishers , New Delhi 2005.

07B210 WORKSHOP PRACTICE
(vide Civil Engg 07C210)

1. Study of domestic refrigerator and window Air- conditioner
2. Making simple gadgets like pen stand, Box and cellphone stand, etc. by using power tools and making the letters from A to Z by using carpentry tools with screw, bolt, and nut
3. Making threading on pipes and connection of basic pipe lines using PVC pipes
4. Study and operation of Audio – visual systems
5. Making simple gadgets like chair, sofa, Table and cellphone stand by using welding joints
6. Fluorescent lamp and sodium lamp wiring
7. Study / Demonstration of working of domestic appliances: Mixi, Electric Iron, Heater and washing machine
8. Laboratory safety; Cleaning of glassware; Maintenance of laminar hood
9. Use of microscope
10. Calculation and preparation of solutions and reagents
11. Calibration and use of equipments- pH meter, micropipettes, weighing balance, rotameter
12. Handling of centrifuge, distillation unit, water bath, incubator, hot air oven and autoclave

07O301 NUMERICAL METHODS AND STATISTICS

3 1 0 4

Unit I

System of Linear Equations and Eigen Values

Gauss elimination, crout's method, Gauss-seidel method, solution of tridiogonal equations, power method for finding dominant eigen value. 10 Hours

Unit II

Finite Differences and Interpolation

Finite difference operators (E , $\Delta, \nabla, \delta, \mu$), Difference table , Newton Gregory forward and backward interpolation, Lagrange' s interpolation formula, Newton divided difference interpolation formula, solution of linear second order difference equations with constant coefficient.

10 Hours

Unit III

Differentiation and Integration

Numerical differentiation using Newton – Gregory forward and backward interpolation. Numerical integration- Gaussian quatrature, Trapezoidal rule and simpson's one third rule and three-eighth rule. 10 Hours

Unit IV

Testing of Hypothesis

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.

10

Hours

Unit V

Design of Experiments and Quality Control

Completely randomized design, randomized block design, latin square design, process control, control charts of measurements and attributes, tolerance limits.

10 Hours

Total: 50 Hours

Textbooks

1. M.B.K.Moorthy , K.Senthilvadivu , " Numerical Methods ' VRB publishers intl., Chennai , 2005.
2. Kapur J.N. and Saxena H.C., "Mathematical Statistics", S Chand and Company Ltd., New Delhi, 1997.

References

1. M.K.Jain , S.R.K. Iyangar , R.K.Jain ; " Numericl Methods For Scientific & Engineering Computation " New Age International (P) Ltd , New Delhi , 2005.
2. 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.
3. Gupta, S.C, and Kapur, J.N., "Fundamentals of Mathematical Statistics", Sultan Chand, Ninth Edition, New Delhi, 1996.

07B302 BIOORGANIC CHEMISTRY

3 1 0 4

Unit I

Concepts in Organic Chemistry

Stereochemistry – R,S notation – re-si faces – e,z isomerism- conformers- ethane – cyclopropane - reactivities- mechanisms of SN1 SN2 reactions, E1 E2 reactions, stereochemistry of nucleophilic and elimination reactions – ester formation and hydrolysis, reaction rates – potential energy diagram, Hammond's postulate – Hammond effects. Classification of Catalysis – general acid – base and covalent catalysis. Multifunctional catalysis. Stereoelectronic control, Transition state Analogues

11 Hours

Unit II

Proteins and Nucleic Acids

Asymmetric Synthesis of amino acids, peptide bond, chemistry and structure of proteins and nucleic acids (DNA and RNA), chemical and biochemical syntheses of nucleic acids, interactions of DNA and RNA with various ligands. 6 Hours

Unit III

Enzymes: Structure, Stereochemistry And Mechanism

Stereospecific enzymatic reactions – fumarase catalysed reactions – NAD dependent oxidation and reduction reactions – chiral methyl group – chiral phosphate. The dehydrogenases – the proteases – ribonucleases – lysozyme- stability of proteins – stability – activity tradeoff. Catalysis by ribozymes and deoxyribozymes

15 Hours

Unit IV

Kinetics of Protein Folding

Basic methods – two state kinetics – multistate kinetics – transition states in protein folding–^{1}H-^{2}H exchange methods – folding of peptides. 9 Hours

Unit V

Folding Pathways & Energy Landscapes

Folding of CI2 – nucleation condensation mechanism – folding of barnase – time resolution – insights from theory – optimization of folding rates – molecular chaperones.

9 Hours

Tutorial: 15Hours

Total : 50 Hours + 15 Hours = 65 Hours

Textbook

Fersht, A. R.., Freeman, W.H, "Structure And Mechanism In Protein Science", A Guide to Enzyme Catalysis and Protein Folding,1999

References

1. Dugas, H, "Bioorganic Chemistry", Springer Verlag, 1999
2. Nelson. D.L. and Lehninger C,M.M., "Principles of Biochemistry", Fourth Edition (Low Price Edition), WH Freeman & Co, 2005
3. Mathews, C.K., Van Holde, K.E., and Ahern, . K.G, "Biochemistry", Pearson Education, New Delhi, Indian Reprint, 2003
4. Campbell, F, "Biochemistry", Thomson Books, New Delhi, Indian Reprint, 2007
5. George M. Malacinski .Freifelder's, "Essentials of Molecular Biology", Narosa Publishing Home, New Delhi, 2006

07B303 CELL BIOLOGY

4 0 0 4

Unit I

Cell Structure and Function of Organelles

Origin of life, process of evolution, History of cell biology; Comparison of eukaryotic and prokaryotic cells; biological membrane organization, Micelles, lipid bi-layer structure of membranes, membrane proteins; cytoskeleton - contractile proteins, microtubules, microfilaments and their role in organelle movements; organelles - endoplasmic reticulum, mitochondria, Golgi apparatus, chloropolasts, lysosomes (overview), Ultra structure and function of nucleus, chromosomes; extra cellular matrix (overview and MMPs).

12 Hours

Unit II

Cell Division and Cell Cycle

Types of cell division (details of mitosis & meiosis); details of cell cycle and molecules that control cell cycle (in somatic and terminally differentiated cells); reproduction in prokaryotes and eukaryotes; cell cycle and cancer, oncogenes; growth hormones and their roles; apoptosis and programmed cell death

12 Hours

Unit III

Transport across Cell Membranes and Receptors

Passive & Active transport, permeases, sodium potassium pump, Ca^{2+} ATPase pumps, lysosomal and vacuolar membrane ATP dependent proton pumps, co-transport (symport, antiport), transport into prokaryotic cells, endocytosis and exocytosis; receptor-mediated endocytosis; entry of viruses and toxins into cells; Autocrine, paracrine and endocrine models of action; Cytosolic, nuclear and membrane bound receptors, examples of receptors, quantitation and characterisation of receptors

12 Hours

Unit IV

Ion Channels and Signal Transduction

Types of Ion-channels; Ligand-gated and Voltage-gated ion channels; Neurotransmitters- mechanism of action, action potential, depolarization, nerve conduction. Ion-channel agonists and antagonists; Ion channel defects; Actin, myosin, excitation - contraction coupling, relaxation; Different models of signal amplifications; Second messengers - cAMP, Inositol phosphates, DAG, cGMP, G proteins, Ca; Protein kinases, serine – threonine kinases, TNF receptor families. 12 Hours

Unit V

Techniques in Cell Biology

Fixation and Staining; Flow-Cytometry; Cytophotometry; Centrifugation methods for characterizing individual cells; Principles and applications of Tracer Techniques – radiation dosimetry, radioactive isotopes, half-life of isotopes; Effect of radiation on biological systems; Autoradiography; Liquid Scintillation; Recent advances in cell biology - stem cells – definition, application.

12 Hours

Total: 60 Hours

Textbooks

1. Lodish, H., Berk, A., Zipurursky, S. L., Matsudaria, P., Baltimore D, and Darnell, J, “Molecular Cell Biology”, W. H. Free Man and Company, England, 2000
2. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., and Walter, P,”Molecular Biology of the Cell”, Garland Science., New York, 2002

References

1. Meyers, R. A, “Molecular Biology and Biotechnology” A comprehensive desk reference, VCH Publishers Inc., New York, 1995
2. Dabre. P. D, “Introduction to Practical Molecular Biology”, John Wiley and Sons Ltd., New York, 1998

07B304 MICROBIOLOGY

4 0 0 4

Unit I

Introduction

History of microbiology; classification and nomenclature of microorganism; Microscopy - Light, dark field, phase contrast, Fluorescence and Electron Microscopes - SEM, TEM; principles of staining techniques - Gram stain, acid fast, capsule, flagella and spore staining.

12 Hours

Unit II

Microbes - structure and multiplication

Colony Morphology and arrangement of bacterial cells; Structural organization and multiplication of bacteria, archaea, fungi, algae and viruses with a special mention of life history of mycoplasma, actinomycetes, yeast, and bacteriophage.

12 Hours

Unit III

Microbial nutrition, growth and metabolism

Nutritional requirements and different media used for bacterial culture; growth curve and kinetics, methods to quantitate bacterial growth, preservation techniques; Bacterial metabolism - respiration, fermentation and photosynthesis-classification based on nutrition. 12 Hours

Unit IV

Microbial control and host interaction

Physical and chemical control of microbes; antimicrobial drugs - mode of action and drug resistance; antibacterial, antifungal and antiviral agents; mechanisms of pathogenicity - mode of entry, penetration of host defences and damage. 12 Hours

Unit V

Industrial and Environmental Microbiology

Biofertilizers, biopesticides, microbial enzymes – sources and applications; role of microbes in food production, bioremediation; leaching of ores by microorganisms; biogeochemical cycles of Carbon, Nitrogen, Sulphur and Phosphorus; microbes in wastewater treatment.

12 Hours

Total: 60 Hours

Text book

Prescott L.M, Harley J.P and Klein D.A,"Microbiology", 3rd Edition, Wm. C. Brown Publishers, 1996.

References

1. Pelczar M.J, Chan E.C.S and Krein N.R, "Microbiology", Tata McGraw-Hill Edition, New Delhi, India, 2002.
2. Tortora G.J, Funke B.R and Case C.L, "Microbiology", Addison Wesley Longman, Inc. 2001.

07B305 BASIC INDUSTRIAL BIOTECHNOLOGY

3 0 0 3

Unit I

Introduction to Industrial Bioprocess

A historical overview of industrial fermentation process – traditional and modern biotechnology. - Microbial biotechnology-selection of strains-range of industrial products.Product recovery.

10 Hours

Unit II

Production of Primary Metabolites

A brief outline of processes for the production of some commercially important organic acids - citric acid, lactic acid and acetic acid; amino acids - glutamic acid, phenyalanine and aspartic acid and alcohols - ethanol and butanol. 10 Hours

Unit III

Production of Secondary Metabolites

Processes and production of various classes of secondary metabolites: antibiotics: beta lactams - penicillin and cephalosporin, aminoglycosides – streptomycin, macrolides - erythromycin, vitamins and steroids.

10 Hours

Unit IV

Production of Enzymes and other Bioproducts

Production of industrial enzymes - proteases, amylases, lipases and cellulases, Production of biopesticides, biofertilisers, single cell protein, biopreservatives - Nisin, cheese, biopolymers - xanthan gum and PHB.

10 Hours

Unit V

Production of Modern Biotechnology Products

Production of recombinant proteins having diagnostic and therapeutic applications, production of vaccines and monoclonal antibodies. Products of plant and animal cell culture. 10 Hours

Total : 50 Hours

Text books

1. Casida, L.E., “Industrial Microbiology”, New Age International (P) Ltd, 2005
2. Crueger, W and Anneliese Crueger, Biotechnology: “A Textbook of Industrial Microbiology”, Panima Publishing Corporation, Edition 2, 2003
3. Sathyanarayana, U., “Biotechnology”, Books and Allied (P) Ltd. Kolkata, 2005.

References

1. Presscott, Dunn, “Industrial Microbiology”, Agrobios (India), Edition 6, 2005
2. Colin Ratledge and Bjorn Kristiansen. “Basic Biotechnology”, Cambridge University Press, Edition 2, 2001
3. Michael J. Waites. “Industrial Microbiology:An Introduction”, Blackwell Publishing,2001
4. Stanbury PF, Whitaker A, and Hall SJ, “Principles of Fermentation Technology”, Elsevier Science Ltd., 1995

07B306 BASIC PRINCIPLES OF CHEMICAL ENGINEERING

3 1 0 4

Unit I

Process Calculation

SI Units- Conversion factors; Overall and Component Balances - Material Balance without Chemical reaction, recycle, by pass and purging; Unit operations.

9 Hours

Unit II

Basic Principles of Fluid Mechanics

Nature of fluids, hydrostatic equilibrium, Types of fluids and Reynolds number, Manometers; Continuity equation, Bernoulli equation; Flow of incompressible fluids in conduits and thin layers, friction factor and losses; Applications. 11 Hours

Unit III

Transportation of Fluids

Pumps- Types, Working Principle, Characteristics, Suction and Cavitation; Measurement of flowing fluids; Fluidization and flow through Packed Bed Column. 10 Hours

Unit IV

Mixing and Agitation, Filtration

Purpose of agitation, agitation equipment, flow patterns in agitator vessels, dimensional analysis for power correlation, agitation of liquids.

Principles of cake filtration filter medium and filter aids, Constant pressure and Constant Volume Batch filtration; Continuous filtration; Industrial filters. 10 Hours

Unit V

Heat Transfer and Its Applications

Nature of heat flow, heat transfer by conduction, Fourier law of heat conduction; Heat transfer coefficients; Heat exchanger equipments; Evaporators- single and multiple effects; Applications.

10 Hours

Tutorial= 15 Hours

Total: 50 Hours +15 Hours = 65 Hours

Text books

1. Anantharaman, N., and Venkataramani, V. Process Calculation, 2rd Edition, Prientice Hall of India., 2005
2. Mc-Cabe, W.L., Smith J.C., Harriot, P. Unit Operations in Chemical Engineering, 5th Edn., McGraw Hill Inc., New York ,1993

References

1. Geankoplis, C.J. Transport Processes and Unit Operations, Prentice Hall India., 2002
2. Bhatt B.I., and Vora S.M. Stoichiometry, 3rd Edition, Tata McGraw-Hill, 1977

07B307 CONCEPTS OF ENGINEERING DESIGN 3 0 0 3

Unit I

Engineering Design and Problem Identification

Engineering design introduction and definition, Design process, Engineering design interfaces, Principles of Engineering Design. Problem Identification - PDS criteria, Content of a PDS, Sample PDS, Principles, Exercises. 10 Hours

Unit II

Concept Generation and Selection

Introduction – Creativity Principle, Psychological 'set', Inversion, Analogy, Fantasy, Technological advances, Brainstorming, Morphological analysis, Presentation, Exercises. Concept selection - Subjective decision-making, Criteria ranking, Criteria weighting, Datum method, EVAD (Design Evaluation) method, Concept selection method, Principles of Computer aided decision making, Exercises. 10 Hours

Unit III

Design Process

Embodiment design - Introduction, Size and strength, Scheme drawing, Form design, Provisional material and process determination, Design for assembly and manufacture, Industrial design, Principles. Modeling - Introduction, Mathematical modeling, Optimization, Scale models, Simulation, Principles, Exercises. 10 Hours

Unit IV

Planning for Management and Manufacture

Design Management - Management of design for quality, Project planning and control, Production design specification (PDS), Quality function deployment (QFD), Design review, Value analysis/engineering, Principles. Detail Design - Introduction, Factor of safety, Selection procedure for bought out components, Material Selection, Robust design, Principles, Exercises 10 Hours

Unit V

Basic Considerations in Bioprocess Equipment Design

Nature of design, material of construction, design information and data, approaches to process design (equipment selection, specification and general design procedure – reactors, heat exchanger, plant sizing), process flow sheet, basic design as applied to biochemical reactor 10 Hours

Total: 50 Hours

Text Book(s)

1. Engineering Design Principles by Ken Hurst, Elsevier Science and Technology Books, 1999

Reference Book(s)

1. Understanding Engineering Design by Richard Birmingham, Graham Cleland, Robert Driver & David Maffin, Prentice Hall of India, 1996
2. Engineering Design by George E. Dieter, McGraw – Hill International 4th Edition 2009
   www.patentoffice.nic.in
3. ep.espacenet.com/advancedSearch
4. M.S. Peters, K.D. Timmerhaus, R.E. West, Plant Design and Economics for Chemical Engineers, fifth edition. McGraw-Hill, 2003
5. Coulson & Richardson,Chemical Engineering, 3rd Edition, Vol:6, R.KSinnott, Butterworth Heinemann
6. Plant Design & Economics for Chemical Engineers, Peters, Timmerhaus, & West, Fifth Edition, McGraw Hill, 2003

07B308 BIO-ORGANIC CHEMISTRY LABORATORY

0 0 3 2

1. Synthesis of aspirin
2. Polarimeter and Hydrolysis of sucrose
3. Preparation of pyruvic acid from tartaric acid
4. Preparation of oleic acid from olive oil
5. Transesterification of Jatropha oil
6. Preparation of α- D- glucopyranose pentaacetate
7. Preparation of 1,2,5,6 dicyclohexylidine α-D glucofuranose
8. Isolation of lycopene from tomato paste
9. Preparation of L-proline
10. Preparation of L-cysteine from hair
11. Preparation of s-ethyl hydroxybutanuate from ethyl acetoacetate using yeast
12. Resolution of s-ethyl hydroxybutanuate using 3,5- dinitrobenzoate.
13. Preparation of 5,10,15,20-tetrakisphenyl porphyrin.
14. Mini Project
15. Design Experiments

07B309 CELL BIOLOGY LABORATORY

0 0 3 2

1. Introduction to principles of sterile techniques and cell propagation.
2. Principles of research, 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 *Allium cepa* (Onion).
12. Staining for different stages of meosis in *Tradescantia*
13. Haemocytometer
14. Isolation of organelle – chloroplast or mitochondria
15. Cellular micrometry
16. Mini Project
17. Design Experiments

07B310 MICROBIOLOGY LABORATORY

0 0 3 2

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. Gram staining
6. Quantitation of microorganisms.
7. Effect of disinfectants on microbial flora
8. Antibiotic sensitivity assay
9. Isolation of microorganisms from soil and water
10. Growth curve – observation and growth characteristics of bacteria
11. Effect of different parameters on bacterial growth (pH, temperature & UV irradiation)
12. Mini Project
12. Design Experiments

07B401 GENETICS

4 0 0 4

Unit I

Mendelian Genetics

Mendels experiment and principle of segregation,monohybrid crosses – dominance, recessiveness, codominance, semidominance and lethals; principle of independent assortment – dihybrid crosses, multiple alleles – ABO blood type and Rh factor alleles. 12 Hours

Unit II

Sex determination, Linkage, crossing over and chromosomal mapping

Mechanism of sex determination, sex differentiation, sex linked inheritance, linkage, crossing over and chromosomal mapping. 12 Hours

Unit III

Genetic material and genetic transfer

Identification of genetic material by Hersey & Chase, Avery, Mcleod and Fraenkel - Singer experiments; chromosome structure in prokaryotes and eukaryotes, recombination in bacteria - transformation, transduction and conjugation.

12 Hours

Unit IV

Mutation and chromosomal inheritance

Mutations - spontaneous, physical and induced; applications of mutation, organization of DNA in mitochondria and plastids, cytoplasmic male sterility in plants.

12 Hours

Unit V

Population and evolutionary genetics

Genetic variation, random mating and Hardy-Weinberg method, inbreeding, outbreeding and assortative mating, genetic equilibrium and evolutionary genetics. 12 Hours

Total: 60 Hours

Text Book

1. Gardner, E.J. Simmons M.J and.Snustad. D.P, Principles of Genetics 8 ed., John Wiley, 2006.

References

1. Robert H.Tamarin, "Principles of Genetics" 7 ed., Tata McGraw Hill, 2002.
2. Daniel L., Hartl and Elizabeth W. "Essential Genetics" Jones, 3 ed., Jones and Bartlett publishers, Massachusetts, 2002.

07B402 PLANT BIOTECHNOLOGY

3 0 0 3

Unit I

Organization and expression of Plant genes

Introduction; an introduction to gene structure and gene expression; regulation of gene expression; implications for plant transformation; protein targeting; heterologous promoters; Arabidopsis and the new technologies.

10 Hours

Unit II

Techniques for Plant transformation

Agrobacterium-mediated gene transfer; Ti plasmid; Process of T-DNA transfer and integration; Direct gene transfer methods - particle bombardment, PEG mediated transformation, electroporation, silicon carbide fibres. 8 Hours

Unit III
Binary vectors for plant transformation
Introduction; Basic features of vectors for plant transformation - promoters and terminators, selectable markers, reporter genes, origins of replication, co-integrative and binary vectors; optimization; clean gene technology.

10 Hours

Unit IV
Genetic manipulation of herbicide and pest resistance
Introduction; use of herbicides in modern agriculture; strategies for engineering herbicide resistance; environmental impact of herbicide resistance crops; nature and scale of insect pest to crops; BT approach to insect resistance - use of Bt as biopesticides, Bt based modifications of plants, problems of insect resistance to Bt, environmental impact of Bt crops; Copy Nature strategy; insect resistance crops and food safety..

14 Hours

Unit V
Future prospects of GM Crops
Introduction; current status of transgenic crops; concerns about GM crops - antibiotic resistance genes, herbicide resistance and super-weeds, gene containment; regulation of GM crops and products; greener genetic engineering.

8 Hours

Total: 50 Hours

Textbooks

1. Slater A, Scott N and Fowler M, "Plant Biotechnology", Oxford Press, 2006
2. Singh B.D. "Text Book of Biotechnology", Kalyani Publishers, 1998
3. Primrose S , R.Twyman, and Old. B. "Principles of gene manipulation".6th Edition.2001

References

1. Heldt H.W. "Plant Biochemistry & Molecular Biology", Oxford University Press, 1997
2. Chawla. H.S "Introduction to Plant biotechnology",2nd Edition, Oxford & IBH Publishing Co.Pvt .Ltd. 2002

07B403 INSTRUMENTAL METHODS OF ANALYSIS

4 0 0 4

Unit I
Basics of Measurement
Classification of instrumental methods – calibration methods for instruments – electrical components in circuits and their function – signal to noise ratio – signal – noise enhancement-sofware and hardware techniques

7 Hours

Unit II
Optical Methods and Molecular Spectroscopy

General design of optical instruments – sources of radiation – wavelength selectors – materials for optical components and sample holders – radiation transducers – types of optical instruments – Fourier transform measurements-Theory and advantages
Measurement of transmittance and absorbance – Beer's law – Derivation. Types of Deviation in Beer Lambertz Law. Spectrophotometer analysis – qualitative and quantitative absorption measurements - types of spectrometers – UV – visible – IR – Raman spectroscopy – NMR-instrumentation – theory and applications.

22 Hours

Unit III
Thermal Methods
Thermo-gravimetric analysis – differential thermal analysis – differential scanning calorimetry.
Thermometric titrations- Theory, instrumentation and applications 7 Hours

Unit IV
Electro analytical Techniques

Potentiometry, Electrochemical cells, Ion-selective electrodes, Voltametry & Polarography, applications in life sciences 7 Hours

Unit V

Separation Methods

Introduction to chromatography – models – ideal separation – retention parameters – van – deemter equation – gas chromatography – stationary phases – detectors – kovats indices – HPLC – pumps – columns – detectors – ion exchange chromatography – size exclusion chromatography – supercritical chromatography – capillary electrophoresis. 17 Hours

Total : 60 Hours

Textbooks

1. Willard, H.H and Merrit, L.L. "Instrumental Methods of Analysis," Prentice Hall of India, 1999
2. Skoog, D. A . "Instrumental Methods of Analysis", 2000.

References

1. Ewing, G.W , "Instrumental Methods of chemical Analysis", Mc Graw Hill,1985
2. Robert D. Braun , " Introduction to Instrumental Analysis", Pharma Book Syndicate, Adithiya Art Printers, Hyd erabad, 1987.

07B404 MOLECULAR BIOLOGY 4 0 0 4

Unit I

DNA Replication & Transposable Elements

Properties of Genetic Material; Semiconservative Replication; Untwisting, Initiation, Unwinding and Elongation; DNA Pol III; Replication in Eukaryotic Chromosomes; Transposable Elements; Plasmids; Plasmid Transfer and Plasmid DNA Replication; Phage; Stages in the Lytic Cycle of Phage; Transducing Phage

12 Hours

Unit II

Transcription

Enzymatic Synthesis of RNA; Transcription Signals; Classes of RNA molecules; Transcription in Eukaryotes (Capping; Introns and Exons; RNA Polymerases; RNA Splicing; hnRNAs); Methods for Studying Intracellular RNA (Hybridization; Cloning; Southern Transfers); Antisense RNA and RNA interference

12 Hours

Unit III

Translation and DNA Repair

The Genetic Code; Wobble Phenomenon; Polycistronic mRNA; Polypeptide Synthesis (Initiation; Elongation; Termination); Inhibitors of Translation; Introduction to Mutations and Mutagenesis; Reversion; DNA Repair Mechanisms (Direct Reversal; Excision Repair; Recombinational Repair; The SOS Response)

12 Hours

Unit IV

Regulation of Gene Activity In Prokaryotes

Principles of Regulation; Transcriptional Regulation (Lac Operon; Galactose Operon; Arabinose Operon; Tryptophan Operon; Attenuation; Autoregulation; Constitutive Genes); Posttranscriptional Control; Feedback Inhibition and Allosteric Control

12 Hours

Unit V

Regulation of Gene Activity In Eukaryotes

Regulation of Transcription Initiation; Regulation of RNA Processing; Regulation of Nucleocytoplasmic mRNA Transport; mRNA Stability; Regulation of Translation; Regulation of Protein Activity; Overview of Gene Rearrangement in Immunoglobulin Genes 12 Hours

Total : 60 Hours

Text Book

1. Malacinski, G.M. Freifelder's Essentials of Molecular Biology, Fourth Edition, Narosa Publishing House,
2005

References

1. Watson, J.D, Hopkins, W.H, Roberts, J.W, Steitz, J.A, Weiner, A.M. "Molecular Biology of the Gene",1987
2. Benjamin Lewin , "Genes VII", Oxford University Press, 2000
3. Lodish, H., Berk, A., Zipursky, L. , Matsudaira, P., Baltimore, D., Darnell, J. "Molecular Cell Biology", Fourth Edition, WH Freeman & Co, New York, 2000

07B405 BIOCHEMISTRY -II

3 0 0 3

Unit I

Bioenergetics, Introduction to Metabolism

Overview of enzymes (nomenclature and classification, factors affecting enzyme activity, k values, km and Vmax, Michaelis Plot, active site, enzyme inhibition, enzyme specificity, coenzymes, mechanism of enzyme action, regulation of enzyme activity, units of enzyme activity, isoenzymes, enzymes in disease states). Digestion and absorption of carbohydrates, lipids, proteins, nucleic acids. Bioenergetics, High Energy compounds; Overview of metabolic pathways (Anabolism, Catabolism, Amphibolism, Integration).

10 Hours

Unit II

Metabolism of Carbohydrates and Lipids

Glycogenolysis, glycolysis, gluconeogenesis, glycogenesis (including regulation), Glycogen Storgae Diseases; Pentose Phosphate Pathway (HMP Shunt), Rapaport-Leubering Shunt, Futile cycles. Biosynthesis of Starch, Fatty Acid oxidation, Ketone Bodies, Fatty acid synthesis (including regulation), Triacylglycerol and phospholipid biosynthesis and degradation; Cholesterol biosynthesis, regulation & targets, and action of cholesterol lowering drugs; Metabolism of Glycolipids and Lipoproteins

10 Hours

Unit III

Kreb's cycle, Oxidative Phosphorylation

Importance of Acetly CoA, Conversion of Pyruvate to Acetly CoA, Fates of Acetyl CoA, Kreb's Cycle (significance, steps, stoichiometry, amphibolism, anaplerotic reactions, glucogenic and ketogenic amino acids, regulation); Reducing equivalents, organization of pathways in mitochondria, electronegativity and electron transport chain (members, steps, redox pairs, oxidative phosphorylation, chemiosmotic theory, coupling, inhibitors, uncouplers and ionophores).

10 Hours

Unit IV

Metabolism of Amino acids

Nitrogen metabolism and urea cycle. Biosynthesis of Gly, Ser and Cys; Biosynthesis of Met, Thr, Lys, Ile, Val, Leu, including regulation (concerted inhibition, allosteric regulation and enzyme multiplicity, sequential feed back); Biosynthesis of aromatic amino acids. Metabolic disorders associated with branched chain and aromatic amino acid degradation. One-carbon metabolism; Synthesis of auxins, DOPA, Serotonin, porphyrins, T3, T4, Adrenaline, Noradrenaline, Histamine, GABA, polyamines.

11 Hours

Unit V

Metabolism of Nucleotides, Protein targeting, Degradation

Biosynthesis of nucleotides, *denovo* and salvage pathways for purines and pyrimidines, regulatory mechanisms. Disorders of purine and pyrimidine metabolism. Degradation of nucleic acids by exo and endo nucleases. Metabolism of xenobiotics (overview only). Protein targeting, signal sequence, secretion, post-translational modifications (PTMs); Protein degradation and turnover; receptor-mediated endocytosis

9 Hours

Total: 50 Hours

Textbook

Satyanarayana, U, " Biochemistry", Books and Allied (P) Ltd, 2006

References

1. Nelson. D.L. and Cox, M.M. Lehninger, "Principles of Biochemistry", Fourth Edition (Low Price Edition), WH Freeman & Co, 2005.
2. Stryer, W. H , " Biochemistry", Fourth Edition Freeman and Company, San Francisco, 2000.
3. Voet, D. and Voet, J.G, " Biochemistry", John Wiley and Sons Inc, 2003.
4. Salway, J.G, "Metabolism at a Glance", 2nd Edition, Blackwell Science Ltd, 2000.

07B406 CHEMICAL THERMODYNAMICS AND BIOTHERMODYNAMICS

3 1 0 4

Unit I

Thermodynamic Properties of Pure Fluids

Introduction and Basic Concepts; The Laws of thermodynamics; First law of thermodynamics for Flow Process; P-V-T behaviour of Pure fluids; Volumetric properties of fluids exhibiting non ideal behavior; residual properties; estimation of thermodynamic properties using equations of state; calculations involving actual property changes; Maxwell's relations and applications; Liquefaction of gases.

12 Hours

Unit II

Thermodynamic Properties of Mixtures

Gibbs free energy; Partial molar properties; concepts of chemical potential and fugacity; activity and activity coefficient; ideal and non-ideal solutions; concepts and applications of excess properties of mixtures; Gibbs Duhem equations.

9 Hours

Unit III

Phase Equilibria

Criteria for phase equilibria; VLE calculations for binary and multi component systems; activity coefficient - composition models; fluid-fluid equilibria and fluid -solid Equilibria.

9 Hours

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 yield for single and multiple reactions.

9 Hours

Unit V

Biochemical Thermodynamics

Ionization of Biochemicals; Binding of a Ligand to a Substrate; Gibbs-Donnan Equilibrium and Membrane Potentials; Thermodynamic Analysis of Fermenters and Other Bioreactors.

10 Hours

Tutorial = 15 Hours
Total: 50 Hours + 15 Hours = 65 Hours

Text books

1. Smith, J.M., Van Ness, H.C., Abbot, M.M, "Chemical Engineering Thermodynamics", 6th Edn., McGraw-Hill, Inc., New York, 2001.
2. Narayanan, K.V, "A Text Book of Chemical Engineering Thermodynamics", 1st Edn., Prentice Hall, India , 2001.

Reference

1. Sandler, S.I, "Chemical, Biochemical, and Engineering Thermodynamics", 4th edition, John Wiley, India, 2006.

07G003 PROFESSIONAL COMMUNICATION
(vide Civil Engg 07G003)

07B408 INSTRUMENTAL METHODS OF ANALYSIS LABORATORY

0 0 3 2

1. UV spectrophotometer: Determination of molar extinction coefficient of tyrosine, tryptophan and histidine at their λ_{max} values. UV-spectra of nucleic acids
2. Validating Lambert-Beers Law using KMnO4
3. Concentration of two components in a binary mixture- Potassium dichromate and Potassium permanganate
4. Precision and validity of the experiment.
5. Finding the stochiometry of the (Fe^{2+} -1,10 phenanthroline complex) using absorption spectrometry.
6. Finding pKa of 4-nitrophenol using absorption spectroscopy
7. Chemical actinometry using potassium ferrioxalate
8. Estimation of SO_4^{2-} by Nephelometry
9. Emission spectrum of Alizarin –Aluminium(III) complex, limit of detection
10. Estimating AI^{3+} concentration using alizarin in the spectrometer
11. Operating principles of IR spectrum of hydrocarbons
12. Estimation of trace elements by flame photometry
12. Operation principles of DTA
14. Microbial electrochemical cells.
15. Mini Project
16. Design Experiment

07B409 MOLECULAR BIOLOGY LABORATORY

0 0 3 2

1. Isolation of bacterial DNA
2. Isolation of plant cell and animal cell genomic DNA
3. Extraction of Plasmid DNA
4. Agarose gel electrophoresis of circular and linear DNA
5. Elution of DNA from agarose gel
6. Restriction enzyme digestion of pUC19 Plasmid
7. Ligation of EcoRI digested pUC19 Plasmid
8. Preparation of competent cells, and transformation with pUC19 plasmid
9. Blue - white selection method for screening of recombinant transformants
10. Polyacrylamide gel electrophoresis of protein samples
11. Mini Project
12. Design Experiment

07B410 CHEMICAL ENGINEERING LABORATORY

0 0 3 2

1. Flow measurement
2. Flow through straight pipes
3. Pressure drop in packed bed columns
4. Fluidization
5. Filtration
6. Heat exchanger
7. Simple and steam distillation
8. Distillation in packed column
9. Liquid-liquid equilibria in extraction
10. Adsorption equilibrium
11. Leaching
12. Mini Project
13. Design Experiment

07B501 MICROBIAL BIOTECHNOLOGY

3 0 0 3

Unit I

Fermentation Technology

Types of bioreactors; operation of bioreactors; solid substrate fermentation; media for industrial fermentation; primary and secondary metabolites; genetic improvement of strains; principles of microbial growth and culture system. 10 Hours

Unit II

Biotransformations

Biotransformations - reactions, techniques, product recovery; biotransformation of steroids, antibiotics, arachidonic acid, glycerol; biotransformation for the production of ascorbic acid and indigo. 10 Hours

Unit III

Biomass, bioenergy and biomining

Sources and utilization of biomass, production of alcohol, acetone, glycerol, biogas, biohydrogen; commercial biobleaching process, biobleaching of copper, uranium; biosorption of metals. 10 Hours

Unit IV

Biodegradation and bioremediation

Definition, process of xenobiotic degradation, recalcitrant xenobiotics; biodegradation of hydrocarbons, pesticides, and herbicides, aromatic compounds, polychlorinated biphenyls; bioremediation – types and process, bioremediation of contaminated soils and waste lands. 10 Hours

Unit V

Microbial waste treatment

Biological treatment - aerobic and anaerobic suspended growth treatments and attached growth treatments, pond treatment processes; sludge and solid wastes - treatment and disposal. 10 Hours

Total: 50 Hours

Text books

1. Sathyanarayana, U., “Biotechnology”, Books and Allied (P) Ltd. Kolkata, 2005.
2. Wulf Crueger and Anneliese Crueger,”Biotechnology: A Textbook of Industrial Microbiology”, Panima Publishing Corporation, Edition 2, 2003.

References

1. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, “Principles of Fermentation Technology”, 2/e, Adithya Books (P) Ltd., New Delhi, 1997.
2. Colin Ratledge and Bjorn Kristiansen, “Basic Biotechnology”, Cambridge University Press Edition 2, 2001.

07B502 FOOD TECHNOLOGY

4 0 0 4

Unit I

Chemistry, Nutrition and Additives of food

Introduction to Food Chemistry, Constituents of food - carbohydrates, lipids, proteins, water, vitamins and minerals, dietary sources, role and functional properties in food, contribution to organoleptic and textural characteristics, energy value of foods and nutritional aspects of foodstuffs.

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

12 Hours

Unit II

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. 12 Hours

Unit III

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. 12 Hours

Unit IV

Principles of Food preservations, Processing and Packaging technology

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.

12 Hours

Unit V

Advances in Food Science and Engineering

Properties of solid food materials, flow properties of liquid foods, heat transfer, radiation heating, evaporation, extraction and leaching, distillation, drying, separation methods, particulate solids, food emulsions. Quality attributes safety and laws of foods. Production of additives, colours and flavours by biotechnological approaches, recent trends in food processing, export agencies and marketing technologies, utilization of computer databases.

12 Hours

Total: 60 Hours

Text books

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

References

1. Frazier W.C. and. Westhoff D.C,"Food Microbiology", 4th Ed., McGraw-Hill Book Co., New York 1988.
2. Jay J. M, "Modern Food Microbiology", CBS Pub. New Delhi, 1987

07B503 GENETIC ENGINEERING

3 0 0 3

Unit I

Tools of Genetic Engineering

DNA Exonucleases and Endonucleases- Restriction Enzymes – Type I, II, III , Restriction analysis of DNA, RNAses, Ligase, Polymerases, DNA Modifying enzymes. RNA, DNA and Protein blotting techniques

10 Hours

Unit II

Construction of Vectors

Plasmids; lambda phage; Ti plasmids; Bacterial expression vectors ;Yeast vectors; Baculoviruses; Plant, animal and viral vectors. 10 Hours

Unit III

Construction of Libraries

Construction of cDNA and genomic libraries; Screening of libraries with DNA probes and with antisera.

10 Hours

Unit IV

Polymerase Chain Reaction

Inverse PCR, Nested PCR, , RACE PCR, RAPD, Analysis of PCR products,Taqman assay, Molecular beacons ,Site directed mutagenesis - Methods of nucleic acid sequencing

10 Hours

Unit V

Applications of RDNA Technology

Cloning Strategies in plants, Transgenic and knockout animals, Applications in Medicine, Agriculture and Environment. 10 Hours

Total : 50 Hours

Text book

1. Old ,R.W and Primrose, ”S.B. Principles of Gene Manipulation: An Introduction To Genetic Engineering”, Blackwell Science Publications, 2001

References

1. Berger, S.l., and Kimmer, A.R , “Methods In Enzymology”, Vol. 152, Academic Press, 1987.
2. Ansubel, F.M, Brent ,R., Kingston ,R.E.,and Moore, D.D, “Current Protocols In Molecular Biology”, Greene Publishing Associates, NewYork , 1988.
3. Brown, T.A, “Gene Cloning an Introduction”, Blackwell Publishers, U.K, 2001.

07B504 BIOPROCESS PRINCIPLES

3 1 0 4

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.

6 Hours

Unit II

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.

9 Hours

Unit III

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 of optimal growth and product formation, examples of simple and complex media, design of various commercial media for industrial fermentations – medium optimization methods

11 Hours

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.

11 Hours

Unit V

Kinetics of Microbial Growth and Product Formation

Modes of operation - batch, fed batch and continuous cultivation. Simple unstructured kinetic 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.

13 Hours

Tutorial = 15 Hours

Total: 50 Hours + 15 Hours = 65 Hours

Text books

1. Bailey,E., and Ollis.F, “Biochemical Engineering Fundamentals”, 2nd Ed., McGraw-Hill, 1986.
2 Michael, L., Shuler and Fikret Kargi, “Bioprocess Engineering - Basic Concepts”, 2nd Edition Prentice-Hall International Series in the Physical and Chemical Engineering Sciences, 2002.

References

1. Pauline Doran, M.,“Bioprocess Engineering Principles”, Academic Presss Limited, 1995.
2. Peter, F., Stanbury., Stephen J. and Whitaker, A, “Principles of Fermentation Technology”, Adithya Books (P) Ltd., New Delhi, 1997.
3. Harvey, W. Blanch., Douglas S., and Clark, “Biochemical Engineering”, Marcel Dekker, Inc., New York, 1997.

07B505 MASS TRANSFER OPERATIONS

3 1 0 4

Unit I

Introduction to Mass Transfer and Diffusion

Introduction to Mass Transfer Operations; Fick's Law of Diffusion, Gas diffusion and Liquid diffusion; Diffusivity estimation (Stefan's experiment); permeability, distribution of gas and liquid components through solid, diffusion of biological solutes in liquids, diffusion in biological gels. 11 Hours

Unit II

Mass Transfer Co-efficient (MTC)-Definition of MTC, F-type, K-type coefficients, Dimensionless numbers; estimation of MTC. Interphase mass transfer, gas phase controlling, and liquid phase controlling operations.

9 Hours

Unit III

Gas-Liquid Operations

Absorption: Definition, Solubilities of gases in liquids, Single- component absorption; Absorption with Chemical Reaction; Design principles of absorbers; Types of Industrial absorbers; HTU, NTU Concepts. Distillation: VLE, single stage equilibrium distillation, simple distillation and steam distillation operation; continuous distillation (McCabe Thiele method only). 13 Hours

Unit IV

Liquid – Liquid Operations

Liquid-Liquid extraction: LLE, types of equilibrium system, Singe stage extraction, Multi stage cross and counter current operations. 5 Hours

Unit V

Solid –Liquid Operations

Drying: Mechanism, Drying curves, Time of Drying; Batch and Continuous dryers.

Adsorption: Physical adsorption, Chemisorption, Adsorption hysterisis, adsorption isotherm, Single stage operation, fixed bed adsorption. Leaching: Solid Liquid Equilibria, Single stage leaching. 12 Hours

Tutorial = 15 Hours

Total: 50 Hours + 15 Hours = 65 Hours

Textbooks

1. Treybal, R.E, "Mass Transfer Operations", 3rd edition. McGraw-Hill, New York,1981.
2. Geankoplis, C.J, "Transport Processes and Unit Operations", 3rd edition, Prentice Hall, India, 2002.

References

1. Coulson, J.M.,and Richardson, J.F, "Chemical Engineering", Vol. I&II, Pergamon Press, 1998.
2. Mc-Cabe, W.L., Smith J.C., Harriot, P, "Unit Operations in Chemical Engineering", 6th Edn., McGraw-Hill Inc., New York , 2005.

07B506 PLANT TISSUE CULTURE

3 0 0 3

Unit I

Introduction and Techniques

Introductory history; laboratory organization and instrumental setup; medium components - media preparation; aseptic techniques for plant tissue culture.

6 Hours

Unit II

Culture types

Cellular totipotency: vascular differentiation - single cell and suspension culture, callus culture; micropropagation - meristem culture and virus elimination – virus indexing, shoot tip culture, organ culture; protoplast fusion and protoplast culture and somatic hybridization; anther and pollen culture.

14 Hours

Unit III

Somatic embryogenesis and synthetic seeds

Somatic embryogenesis - stages of embryo development in monocot and dicot plants, applications of somatic embryogenesis; quality control in tissue culture plants; synthetic seeds preparation and applications; somaclonal variation and its applications.

12 Hours

Unit IV

Production of natural products by plant cell tissue and organ culture

Types and functions of secondary metabolites; methods and advantages of producing natural products from cell culture systems; biotransformation; bioreactors for plant cell cultures.

10 Hours

Unit V

Germplasm conservation

Modes of conservation; cryopreservation; cold storage; low pressure and low oxygen storage; *in vitro* gene banks; *in vitro* clonal multiplication. 8 Hours

Total: 50 Hours

Text books

1. Razdon M.K., “Introduction to Plant Tissue Culture” ,2 ed, Oxford & IBH Publishing company, New Delhi, 2006.
2. Timir Baran Jha & Biswajit Ghosh, “Plant Tissue Culture – Basic and Applied” Universities Press (India) Pvt. Ltd. Hyderabad, 2006.

References

1. Narayanaswamy.S, “Plant Cell & Tissue Culture” ,Tata McGraw-Hill, 2008
2. Adrian Slater, Nigel Scott & Mark Fowler, “Plant Biotechnology” Oxford University Press, 2006

07G005 ENGINEERING ECONOMICS
(vide Civil Engg)

07B508 BIOPROCESS LABORATORY - I

0 0 4 2

.

1. Growth of Bacteria – estimation of biomass, calculation of specific growth rate, yield coefficient
2. Growth of Yeast – estimation of biomass, calculation of specific growth rate, yield coefficient
3. Medium optimization – Plackett Burman design
4. Medium optimization – response surface methodology
5. Enzyme kinetics – Michelis Menton parameters
6. Enzyme activity – effect of Temperature and pH
7. Enzyme inhibition kinetics
8. Enzyme immobilization – gel entrapment
9. Enzyme immobilization – cross linking
10 Preparation of bioreactor, utilities for bioreactor operation
11. Solid state fermentation
12. Biological Oxygen Demand
12. Mini project
14. Design Experiment

07B509 GENETIC ENGINEERING LABORATORY

0 0 3 2

1. Gel Electrophoresis
2. SDS-PAGE
3. Genomic DNA extraction
4. Plasmid DNA extraction
5. Restriction enzyme digestion
6. Bacterial transformation and blue white selection
7. Southern and Northern blotting Techniques
8. PCR for Gene Isolation
9. Mini project
10. Design Experiment

07B601 ENZYME ENGINEERING AND TECHNOLOGY

3 0 0 3

Unit I

Introduction to Enzymes

Principles of catalysis – collision theory, transition state theory; role of entropy in catalysis. Enzymes as catalysts, Classification of enzymes. Mechanisms of enzyme action; concept of active site and energetics of enzyme substrate complex formation; specificity of enzyme action; mechanism of reaction catalyzed by enzyme without cofactors, metal-activated enzyme and metalloenzyme, coenzymes in enzyme catalyzed reactions. Applications in pharmaceutical, food and process industries; diagnostics, research.

10 Hours

Unit II

Kinetics and mechanism of Enzyme Action

Kinetics of single substrate reactions; Estimation of Michelis – Menten parameters, Lineweaver– Burk Plot, Multisubstrate reactions-introduction to ping-pong bi-bi mechanism, random – order mechanism and compulsory order mechanisms; Turnover number; types of inhibition & models for substrate and product. Allosteric regulation of enzymes, Monod - Changeux -Wyman model, pH and temperature effect on enzymes & deactivation kinetics. Identification of binding sites and catalytic site, three dimensional structure of active site

15 Hours

Unit III

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. 6 Hours

Unit IV

Enzyme Immobilization and Enzyme engineering

Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages. applications Analysis of Film and Pore Diffusion Effects on Kinetics of immobilized Enzyme Reactions; Formulation of dimensionless group and calculation of Effectiveness Factors. Immobilised enzyme bioreactors.

Enzyme Engineering: Chemical and genetic methods, Property alteration, Prediction of enzyme structure, design and construction of novel enzymes. Applications; Extreme conditions; reactions in organic solvents; antibodies as enzymes, Ribozymes. 15 Hours

Unit V

Enzyme Biosensors

Application of enzymes in analysis; design of enzyme electrodes, Classification and Design of enzyme biosensors and their application in industry, healthcare, food and environment

7 Hours

Total: 50 Hours

Text books

1. Wiseman, “Enzyme Biotechnology”, Ellis Horwood Publishers.1995.
2. Chaplin and Bucke, “Enzyme Technology”, Cambride University Press, Cambridge. 1990.
3. Price and Stevens, “Fundamentals of Enzymology”, Oxford University Press.2002.

References

1. Blanch, H.W., and Clark, D.S. “Biochemical Engineering”, Marcel Dekker, Inc. 1996.
2. James. E. Bailey, J.E., and Ollis, D.F, “Biochemical Engineering Fundamentals”, McGraw Hill. 1986.
3. .Pye, E. K., and Wingard, L. B, “Enzyme Engineering II”, Plenum Press. 1974.

07B602 CHEMICAL REACTION ENGINEERING

3 1 0 4

Unit I

Chemical Reaction Rate Process and Chemical Kinetics

Classification of chemical reactions ,order and molecularity, rate equation, rate constant; Activation energy, Concentration and temperature dependence; Search for reaction mechanism, Methods of analyzing kinetic data-Integral, differential, analysis of total pressure data.

10 Hours

Unit II

Ideal Reactors

Design of performance equations -for batch, plug flow and mixed flow reactors; Space time and Space velocity; Recycle reactor and autocatalytic reactions.

10 Hours

Unit III

Non Ideal Reactors

RTD function and measurement; RTD in plug flow and mixed flow reactor ;conversion in non ideal flow, relation among E,F and C curve, non - ideal flow models- tank in series and dispersion models.

10 Hours

Unit IV

Heterogeneous Reacting System

Rate equation, resistances ;Contacting patterns; Kinetics of fluid particle reactions-Progressive conversion model and shrinking core model - Determination of rate controlling step; Gas solid and gas liquid reactions

10 Hours

Unit V

Industrial Reactors

G/l reactions on solid catalysis; Thiele modulus; Trickle bed, slurry reactors; Three phase-fluidized beds; Reactors for fluid-fluid reactions. 10 Hours

Tutorial = 15 Hours

Total: 50 Hours + 15 Hours = 65 Hours

Textbook

1. Levenspiel, O, “Chemical Reaction Engineering”, 3rd Edition. John Wiley. 1999.

Reference Book

1. Missen, R.W., Mims, C.A., and Saville, B.A, “Introduction To Chemical Reaction Engineering And Kinetics”, John Wiley. 1999.
2. Fogler,H.S., “Elements of Chemical Reaction Engineering”, Prentice Hall .,India. 2002.

07B603 BIOPROCESS ENGINEERING 3 1 0 4

Unit I

Products of Fermentation

Microbial biomass production - enzyme, Antibiotic and steroid fermentations, Food & Beverage fermentation, Ethanol production from conventional and non-conventional substrates, Industrial wastewater treatment- Aerobic and anaerobic fermentation processes; Bioenergy production; Solid state and submerged fermentation and their applications; Mixing in fermentation broths

10 Hours

Unit II

Analysis of Fermenters

Packed bed reactor, airlift reactor, fluidized bed reactor bubble column reactors – non-ideality, RTD and stability analysis.

10 Hours

Unit III

Masstransfer Operations And 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.

10 Hours

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.

10 Hours

Unit V

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.

10 Hours

Tutorial = 15 Hours

Total: 50 Hours + 15 Hours = 65 Hours

Textbooks

1. D.G.Rao,"Introduction to Biochemical Engineering" McGraw-Hill. 2005.
2. James E. Bailey & David F. Ollis, "Biochemical Engineering Fundamentals", McGraw-Hill.2nd ed 1986

References

1. Shule and Kargi, "Bioprocess Engineering", Prentice Hall,1992
2. Atkinson, "Handbook of Bioreactors",
3. Harvey W. Blanch, Douglas S. Clark, "Biochemical Engineering", Marcel Decker Inc.
4. Stanbury,P.F.Whitaker,A&Hall,S.J , "Principles of fermentation Technology", 2nd Ed , Elsevier Science Publishers, BV,Amsterdam. 1998.

07B604 PROTEIN ENGINEERING

4 0 0 4

Unit I

Basic Structural Principles of Proteins

Amino Acids properties (size, solubility, charge, pKa), Kyle-Doolittle (Hydropathy) Index; Peptides as building blocks of proteins; Torsional (dihedral) angles, Ramachandran Plot; Secondary Structures of proteins; Loops – Types and Functions; Lesk, Richardson and Topology Schematics; Biosynthesis and chemical synthesis of Peptides; Edman, Sanger, High-throughput peptide sequencing; sequencing by Mass Spectrometry.

12 Hours

Unit II

Motifs, Domains, and Alpha Domain Structures

Super-secondary structures (Motifs); Helix-turn-helix (DNA-binding and Calcium-binding motifs); EF Hand; Hairpin Beta Motif; Greek Key Motif; beta-alpha-beta motif. Introduction to Domains; Classes of

Protein Structures; Coiled-coil alpha helices; Four-Helix Bundle; Globin Fold (universality; geometric considerations for packing; helix movements to accommodate mutations; sickle-cell hemoglobin)

12 Hours

Unit III

Alpha/ Beta and Beta Structures

Parallel Beta strands (TIM Barrel, Rossman Fold, Leucine-rich Motifs, Horseshoe Fold); alpha/ beta barrels in Triosephosphate Isomerase, Dehydrogenases, Methylmalonyl-coenzyme A mutase, and Pyruvate Kinase; Double Barrels. Alpha/ beta domains in Tyrosyl-tRNA synthetase, Carboxypeptidase, and Arabinose-binding protein. Up-and-Down Barrels in Retinol-binding protein, Neuraminidase; Greek Key motifs in antiparallel beta structures; Jelly Roll motif with specific example of Hemagglutinin; Parallel beta-helix domains

12 Hours

Unit IV

Folding and Structure-Function Relationship

Kinetic factors in folding; single and multiple folding pathways; enzymes in disulphide bond formation; Isomerization of proline residues; Chaperonins (functions of GroEL and GroES); Conformational changes in Protein Kinase, Calmodulin, and Serpins; Membrane proteins: General characteristics, Trans-membrane segments, prediction, Bacteriorhodopsin and Photosynthetic reaction center, Immunoglobulins: Domains of antibodies; antibody diversity; immunoglobulin fold; abzymes

12 Hours

Unit V

Protein Structure Prediction and Design

Homologous proteins; Prediction methods for secondary structures (sequence homology; scaffolds and rotamer databases; threading methods). Methods to make proteins more stable (disulphide bridges; role of glycine and proline residues; alpha helix dipoles). Protein engineering by combinatorial methods and Protein structure design from first principles; Determination of Protein Structures – X-ray crystallography, Diffraction and Phase Determination; Nuclear Magnetic Resonance (NMR); Protein structure on the World Wide Web

12 Hours

Total: 60 Hours

Textbook

Branden, C. and Tooze, J. , “Introduction to Protein Structure”, 2nd Edition Garland Pub, NY, USA 1999.

References

1. Creighton, T.E. , “Proteins, Second Edition”, W.H. Freeman. 1993.
2. Moody, P.C.E. and Wilkinson, A.J. , “Protein Engineering”, IRL Press, Oxford, UK 1990.

07B605 ANIMAL BIOTECHNOLOGY

3 0 0 3

Unit I

Introduction to Animal Cell Culture

Introduction to basic animal cell culture techniques – minimal facilities, contamination, aseptic methods and sterilization, advantages and limitations of tissue culture, risks and safety regulations; Culture media – natural and artificial media, important physicochemical properties of culture media, balanced salt solutions, supplements; serum and serum-free media; Characteristics of cultured cells, cell adhesion, proliferation and differentiation, metabolism and characterization; Measurement of growth parameters of cultured cells; Cell separation methods, senescence and apoptosis. 10 hours

Unit II

Cell Lines and Scale-up Methods

Primary culture; mechanical and enzymatic disaggregation; primary explant technique; medical ethics; Cell lines (finite and continuous; commonly used cell lines, maintenance of cell lines); subculture of adhesion and suspension cultures; Stem cell cultures. Types of culture processes for scale-up (batch vs continuous); Scale-up in suspension (stirrer, biostat, air-lift fermenter, rotating chambers, perfused chambers); Scale-up in monolayer (roller bottles, microcarrier, fixed-bed and fluidized-bed); Monitoring of cell growth in scale-up cultures.

10 hours

Unit III

Cell Viability, Cell Cloning and Organ Cultures

Assays for cell viability and cytotoxicity – viability assays, survival assays, metabolic assays, transformation assays, inflammation assays; Transformation of cells, tumorigenicity, cell cloning (dilution cloning and suspension cloning); Organ cultures, Histiotypic cultures, Organotypic cultures; Sources of cells for tissue engineering (autologous, allogeneic and xenogeneic), cell support materials, design and engineering of tissues; use of embryonic stem cells in tissue engineering.

9 hours

Unit IV

Gene Therapy, and Disease Diagnosis

Approaches for gene therapy; ex vivo method (vectors used; therapy for ADA deficiency, hypercholesterolemia, Lesh-Nyhan syndrome, hemophilia); in vivo methods (vectors used; therapy for cystic fibrosis, cancer, AIDS); anti-sense therapy, aptamers and ribozymes; Methods for DNA assay; diagnosis of infectious diseases; diagnosis of genetic diseases; DNA fingerprinting or profiling; DNA markers (RFLPs, VNTRs, STRs and SNPs); Hybridoma Technology, production of Monoclonal Antibodies (MAbs); diagnostic and therapeutic applications of MAbs. 10 hours

Unit V

Assisted Reproduction, and Transgenic Animals

Manipulation of reproduction in animals and humans (Embryo Transfer, MOET, IVF and Cloning); Micromanipulation and Cryopreservation. Concepts of transgenic animal technology; Transgenic mice - introduction of transgene by retroviral, microinjection and embryonic stem cell methods; gene knockout, and applications of transgenic mice; Transgenic cattle; Transgenic sheep & goats; Transgenic pigs; Transgenic chickens and fish; Animal bioreactors; Transgenic animals in xenotransplantation; Transgenic organisms to interrupt disease cycles; Strategies for the production of transgenic animals and their importance in biotechnology; stem cell cultures in the production of transgenic animals

11 hours

Total: 50 hours

Textbook

Satyanarayana, U., “Biotechnology” ,Books and Allied (P) Ltd. Kolkata, 2005.

Reference 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.
3. Masters, J.R.W. , “Animal Cell Culture: Practical Approach”, Oxford University Press, 2000.

07G006 TOTAL QUALITY MANAGEMENT

(vide Civil Engg)

07B608 BIOPROCESS LABORATORY II

0 0 5 3

1. Thermal death kinetics
2. Batch sterilization design
3. Batch cultivation, estimation of kla – dynamic gassing method, exhaust gas analysis – carbon balancing, gas balancing
4. Fed batch cultivation, exhaust gas analysis – carbon balancing, gas balancing
5. Total cell retention cultivation, exhaust gas analysis – carbon balancing, gas balancing
6. Estimation of kla – sulphite oxidation method
7. Estimation of kla – power correlation method
8. Residence time distribution
9. Estimation of overall heat transfer coefficient
10. Continuous cultivation – x-d diagram, pulse and shift method, evaluation of kinetic
11. Parameters exhaust gas analysis – carbon balancing, gas balancing.
12. Ethanol Production
13. Mini Project
14. Design Experiment

07B609 PROTEIN PURIFICATION LABORATORY

0 0 4 2

1. Ammonium Sulphate/TCA precipitation
2. Dialysis
3. Thin Layer Chromatography
4. Ion Exchange Column Chromatography
5. Sephadex Column Chromatography
6. High Performance Thin Layer Chromatography
7. Gas Chromatography
8. SDS-PAGE
9. Elution of proteins from gel
10. Ultrafiltration using tangential-flow membrane separation
11. Mini Project
12. Design Experiment

07B701 BIODIVERSITY AND BIORESOURCE MANAGEMENT 3 0 0 3

Unit I

Biodiversity - Definition-Types, Diversity of genes (genetic diversity), species (species diversity and ecosystems (ecosystem diversity); Goals and constraints of Biodiversity Science. Genetic Diversity - Nature and origin of Genetic Variation, Measuring Genetic Variation by Allozyme, RFLP, RAPD Techniques (Elementary account on each one of these only); Species Diversity – Measurement, Concepts of species richness, abundance, and turnover, species/area relationships, global distribution of species richness; Centres of species diversity, megadiversity centres, Hot Spot analysis; A general account on Ecosystem diversity.

10 Hours

Unit II

Loss of Biodiversity and Human influence on Biodiversity - Species Extinction- Fundamentals causes, Deterministic and Stochastic processes, Current and Future Extinction rates; methods of estimating loss of biodiversity- Threatened species, The IUCN threat Categories (Extinct, Endangered, Vulnerable, Rare,

Intermediate and Insufficiently known); The threat factors (Habitat loss, over-exploitation for uses, introduction of Exotics, Diseases, habitat fragmentation etc.); Common threat plant and animal taxa of India - Red data Books.

10 Hours

Unit III

Biodiversity and Human Welfare -A very general account on uses of Bioresources- plant uses: food, timber, medicinal ornamental and other uses- animal uses: food animals (terrestrial and aquatic), non food uses of animals, Domestic livestock- uses of microbes. Valuing Biodiversity-Instrumental (Goods, Services, and Information and Psychospiritual values) and Inherent or Intrinsic values, ethical and aesthetic values-An outline account on methods of valuing biodiversity.

10 Hours

Unit IV

Information Resources of Biodiversity

Libraries, Electronic Media, Directories of biodiversity information, Catalogues, Indexes, Indexes and registers for described species, Identification aids .Literature search using electronic research tools - search engines, ebooks, ejournals, edatabases, subject gateways/subject directories, news feeds.

10 Hours

Unit V

Sustainable Management and Conservation of Biodiversity and Bioresources

Sustainable management - National polices and Instruments relating the protection of the wild/ domesticated flora and fauna as well as habitats; International policies and Instruments - A general account on multilateral treaties- the role of CBD, IUCN, GEF, IBPGR, NBPGR, WWF, FAO, UNESCO and CITES. Conservation - Why conservation and conservation biology?, Current Practices in conservation - Habitat or ecosystem approaches, Species based approaches, Social approaches; Chipko movement; *In situ* (Afforestation, Social Forestry, Agro forestry, Botanical Gardens, Zoos, Biosphere Reserves, National Parks, Sanctuaries, Sacred Groves and Sthalavrikshas) and *Ex situ* (Cryopreservation, Gene Banks, Seed Banks, Pollen Banks, Sperms Banks, DNA Banks, Tissue Culture and Biotechnological Strategies)

10 Hours

Total : 50 Hours

Textbooks

1. Groombridge, B, "Global Biodiversity – Status of the Earth's Living Resources", Groombridge, B (ed.). Chapman and Hall, London. 1992.
2. Virchow, D, "Conservation and Genetic Resources", Springer – Verlag, Berlin. 1998.

Reference

Gary, K.M. and Ronald C. C, "Principles of Conservation Biology", Sinauer Associates, Inc., Massachusetts. 1994.

07B702 DOWNSTREAM PROCESSING

4 0 0 4

Unit I

Role of downstream processing in Biotechnology

Role and Importance of downstream processing in biotechnological processes; Problems and requirements of bioproduct purification; Economics of downstream processing in Biotechnology, cost -cutting strategies, characteristics of biological mixtures; Cell disruption for product release – mechanical, enzymatic and chemical methods; Pretreatment and stabilization of bioproducts

12 Hours

Unit II

Physical Methods of Seperation

Unit operations for solid-liquid separation - flocculation and sedimentation, centrifugation and filtration methods. Perevaporation. 12 Hours

Unit III

Isolation of Products

Isolation -adsorption, liquid-liquid extraction, aqueous two-phase extraction: Membrane separation –micro, ultra filtration and reverse osmosis, dialysis:Precipitation of proteins by different methods.

12 Hours

Unit IV
Product resolution/Fractionation
Chromatography – principles, instruments and practice, adsorption, reverse phase, ion-exchange, size exclusion, hydrophobic interaction, bioaffinity and pseudo affinity chromatographic techniques. 12 Hours

Unit V
Final Product Formulation and Finishing Operations
Gel Permeation Crystallization, drying and lyophilization in final product formulation.

12 Hours

Total: 60 Hours

Text books
1. Belter, P.A., Cussler E.L., and Wei-Houhu, " Bioseparations – Downstream Processing For Biotechnology", Wiley Interscience 1988.
2. Jenkins, R.O., "Product Recovery In Bioprocess Technology – Biotechnology By Open Learning Series", Butterworth-Heinemann , Pub.1992.

References
1. Janson., J.C., and. Ryden, L, "Protein Purification – Principles", High Resolution Methods And Applications, VCH Pub, 1989.
2. Scopes, R.K. , "Protein Purification – Principles And Practice", Narosa Pub, 1994.

07B703 IMMUNOLOGY

3 0 0 3

Unit I
Introduction
History of immunology: innate and acquired immunity; History of Vaccines and immunization: Small pox; Rabies. Blood groups. Theories : Clonal selection. Antigens; haptens and adjuvants. Types of immune response. 10 Hours

Unit II
Cellular Responses
Human body resistance: Lymphoid organs. Development, maturation, activation and differentiation of T-cells and B-cells; Antibodies: structure function and classification; genes and diversity. Antigen-antibody reactions; monoclonal antibodies: principles and applications; Processing and presentation for immune response. Cytokines Complement: classification and their role in immunity (classical and alternate pathways). Major histocompatibility complex

10 Hours

Unit III
Infection and Immunity
Injury and inflammation; immune responses to infections: immunity to viruses, bacteria, fungi and parasites;; Immunosuppression tolerance; Immunodeficiency (AIDS) and autoimmunity. Allergy and hypersensitivity. 10 Hours

Unit IV
Transplantation and Tumor Immunology
Transplantation: genetics of transplantation; Tumor immunology. Monoclonal antibodies

10 Hours

Unit V
Autoimmunity
Autoimmunity, Autoimmune disorders and diagnosis. 10 Hours

Total: 50 Hours

Textbooks

1. Roitt I, Male, Brostoff. “Immunology”, Mosby Publ., 2002.
2. Kuby J, “Immunology”, WH Freeman & Co., 2000.

References

Ashim K. Chakravarthy, “Immunology”, Tata McGraw-Hill, 1998.

07B704 BIOINFORMATICS

3 0 0 3

Unit I

Introduction

Kernel,Software,Hardware-Basic Unix commands – Linux – protocol – topology -search engines – search algorithms. 10 Hours

Unit II

Databases

Data management – data mining technology – biological databases –nucleic acid and protein databases 10 Hours

Unit III

Bioinformatic Algorithms and Its Applications

Dynamic programming,Use of algorithms in bioinformatics- Pairwise sequence alignment – local vs. global alignment – multiple sequence alignment – dot matrix analysis – substitution matrices — bayesian methods – tools – BLAST – FASTA- 10 Hours

Unit IV

Phylogeny

Introduction;Cladistics , population genetics,homology,mutations; irrelevant mutations; mutations as a measure of time; distances; reconstruction; distances between species; Additive and non additive matrices. 10 Hours

Unit V

Advanced Topics in Bioinformatics

Biomolecular and cellular computing – micro array analysis – systems biology and its application 10 Hours

Total: 50 Hours

Text books

1. Bergeron, B. , “Bioinformatics Computing”, PHI,. 2002
2. Westhead, D.R., Parish, J.H., Twyman, R.M. “Instant Notes In Bioinformatics”, BIOS Scientific Publishers. 2000

Reference

1. Gibas, C. and Jambeck, P. , “Developing Bioinformatics” Skills, O'Reilly. 1999

07G007 CREATIVITY AND INNOVATION

(vide Civil Engg)

07B708 DOWNSTREAM PROCESSING LAORATORY

0 0 4 2

1. Solid liquid separation – centrifugation, microfiltration
2. Cell disruption techniques – ultrasonication, French pressure cell
3. Cell disruption techniques – dyno mill – 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 – gel filtration chromatography
10. Product polishing – spray drying, freeze drying
11. Biosorption –Batch and Continuous.
12. Distillations
13. Mini Project
14. Design Experiment

07B709 IMMUNOLOGY LABORATORY

0 0 4 2

.

1. Raising antisera and determination of primary and secondary responses
2. Antigen antibody reactions and quantitation:
    (a) Slide Agglutination
    (b) Precipitin test
    (c) Single and double diffusion
    (d) Immunoelectrophoresis – Rocket Electrophoresis
3. Direct and indirect ELISA
4. Direct and Indirect immunofluorescence
5. Identification of cells in a blood smear.
6. Characterization of blood group antigens and Rh factor.
7. Complement fixation test
8. Isolation of lymphocytes
9. Isolation of IgG from chicken embryos
10. SDS-PAGE of blood proteins
11. Clinical immunology : Widal test
12. Mini Project
13. Design Experiment

07B801 BIOSAFETY, IPR AND TECHNOLOGY TRANSFER

3 0 0 3

Unit I

Biosafety regulations-I

Legal and socio economic impacts of Biotechnology - National and international level biosafety regulations, trials on field and upscaling, coordination and capacity establishment, risk versus benefits. 10 Hours

Biosafety regulations-II

Hazardous materials used in Biotechnology, handling and disposal; good manufacturing practices, good laboratory practices and principles. 10 Hours

Unit III

Intellectual Property Rights-I

Intellectual property rights, and Intellectual Property protection, patents and methods of application of patents, Trade Secrets copyrights, Trade Marks, legal implications, farmers rights, plant breeder's rights.

10 Hours

Unit IV

Intellectual Property Rights-II

International and National conventions on biotechnology and related areas, WTO guidelines.

10 Hours

Unit V

Technology Transfer

Conceptions of technology transfer, the diffusion process, the change process, diffusion of technology Innovations, technology transfer models and vehicles, technology transfer and culture, strategies for facilitating transfer. 10Hours

Total : 50 Hours

Textbooks

1. Radhakrishnan R. and Balasubramanian, S. "Intellectual Property Rights", Excel Books, I ed., 2008.
2. Subbaram N.R. "Handbook of Indian Patent Law and Practice", S. Viswanathan (Printers and Publishers) Pvt. Ltd., 1998.

References

1. Sree Krishna, V, "Bioethics and Biosafety in Biotechnology", New Age Internationsl Publishers, 2007
2. Eli Whitney, United States Patent Number : 72X, Cotton Gin, March 14, 1794.
3. Goel Cohen, "Technology Transfer", Sage Publications, 2004.

07G008 ORGANIZATIONAL BEHAVIOUR AND MANAGEMENT

(vide Civil Engg)

07B001 AGRICULTURAL BIOTECHNOLOGY

3 0 0 3

.

Unit I

Agricultural Science – Need and importance

Introduction to Traditional Vs Modern agriculture, agronomy, horticulture, entomology, animal husbandry, agricultural engineering, soil chemistry, agricultural economics, water management and soil management.

10 Hours

Unit II

Agricultural Products and Sustainable Development

Petrocrops; Aquaculture; Sericulture; Improvement of nutritional value of storage protein, starch and oil in seed; Polyploids and their importance in agriculture; Role of biofertilizers and biopesticides in sustainable agriculture. Convention on biodiversity.

10 Hours

Unit III

Molecular Marker Aided Plant/Animal breeding

Molecular breeding - Concept and methodology of different types of molecular markers, Role of molecular markers in crop and farm animal improvement; Molecular mapping of genes of agricultural importance; whole genome cloning; Breeding hybrids-plants and animals.

10 Hours

Unit IV

Genetic Engineering of Plants and Animals

Transgenic plants; Transgenic animals; Transgenic fish.Molecular farming: Use of plants and animals for production of neutraceuticals, biopharmaceuticals, edible vaccines and other desired products.

10 Hours

Unit V

Transgenics in Crop Improvement

Introduction to transgenic crop; Resistance genes from microbes, higher plants and animals; resistance to biotic and abiotic stress; resistance to diseases – bacterial, fungal, viral and nematode, herbicide, pesticide; Transgenics as bioreactors.

10 Hours

Total: 50 Hours

Textbook

3. Chrispeels, M.J. and Sadava D.E. ," Plants, Genes and Crop Biotechnology", American Society of Plant Biologists, Jones and Bartlett Publishers, 2nd Edition, USA, 2003

Reference

4. Buchanan, B.B., Gruissem ,W., and Jones, R.L. "Biochemistry and Molecular Biology of Plants", American Society of Plant Biologists, USA. 2000

07B002 ENVIRONMENTAL BIOTECHNOLOGY

3 0 0 3

Unit I

Fundamentals of Micro-Organisms

Microbial flora of soil, growth, ecological adaptations, interactions among soil microorganisms, biogeochemical role of soil microorganisms.

10 Hours

Unit II

Degradation of Xenobiotic Compounds

Simple aromatics, chlorinated polyaromatic petroleum products, pesticides and surfactants.

10 Hours

Unit III

Industrial Waste Water Management

Waste water characteristics, biological waste water treatment, unit operations, design and modeling of activated – sludge process, mathematics modeling of anaerobics – digested dynamics.

10 Hours

Unit IV

Treatment Of Industrial Wastes

Dairy : general Characteristics of Dairy waste waters, treatment of dairy effluent waste water Pulp : Process and production, problems related with Pulp and Paper industry,physico chemical characteristics of pulp and paper mill effluent Dye: Source and origin of dyes, characterization of waste effluents, Environmental impact of dye and its intermediates, treatment technologies of dyes, Leather and Pharamaceuticals: general Characteristics of leather and pharmaceuticals, treatment methods of leather and Pharmaceutical wastes, Solid waste management , types of wastes, treatment and disposal methods, general remedial Measures of solid wastes, Hazardous waste management , hazardous waste treatment process.

10 Hours

Unit V

Molecular biology

Latest elements, developments pertaining to environmental biotechnology. 10 Hours

Total: 50 Hours

Textbooks

1. Indu, S. T. "Environmental Biotechnology – Basic concepts and Applications", I. K. International Pvt. Ltd. , Mumbai. 2006.
2. Foster, C.F. and John Ware D.A. "Environmental Biotechnology", Ellis Honwood Ltd., 1987.

References

1. Karnely, D., Chakrbarty, K., and Omen, G. S., "Biotechnology and Biodegradation, Advances in Applied Biotechnology Series", Gulf Publications Co., London 1989.

2. Stanir, R.Y., Ingraham, J. L., Wheelis, M. L., and Painter, R.R., "General Microbiology", McMillan Publications. 1989.

07B003 PROTEOMICS AND GENOMICS

3 0 0 3

Unit I

Introduction to Genomes, Transcriptomes, Proteomes

Introduction to genomes, transcriptomes and proteomes; Organisation and structure of genomes, the science of genomics, DNA sequencing methods [Sanger (chain-terminator or dideoxy method), Maxam-Gilbert (chemical method), modifications of chain-terminator method, automated sequencing, capillary array sequencing, basecalling, high-throughput sequencing].

10 Hours

Unit II

Proteomics - 1

Methods to separate proteins; Expression proteomics – including 2-D electrophoresis (sample prep, isoelectric focusing, second dimension electrophoresis, detection of protein spots, image analysis, spot handling, spot cutting, protein cleavage methods), mass spectrometry, ionization, ion separation, MALDI-TOF, tandem mass spec, protein ID by database search and peptide mass fingerprinting

10 Hours

Unit III

Proteomics - 2

Product ion sequence data, de novo sequencing, 2D-MS, LC-MS/MS, and quantitative proteomics; Automation in proteomics, proteomics tools, applications of proteome analysis (drug development and toxicology, phosphorylation site analysis, glycobiology, mapping of protein-protein interactions), protein chips and microarrays, bridging the gap between genomics and proteomics

10 Hours

Unit IV

Genome Mapping and Sequencing

Genetic Mapping [DNA markers for sequencing (RFLPs, SNPs), linkage analysis], Physical Mapping (restriction mapping, FISH, STS mapping, Polymorphic sequence-tagged sites,), whole genome sequencing, shotgun sequencing, sequence assembly methods, Human Genome Project, the use of PCR in sequencing and its limitations, randomly amplified polymorphic DNA (RAPD), AFLP, SAGE, TOGA, hybridization mapping, cytogenetic maps, integration of mapping methods

10 Hours

Unit V

Functional Genomics

Genome annotation (case study of annotation of the *Saccharomyces cervesiae* genome sequence), studying the transcriptome, metabolome and biological systems, comparative genomics, protein structural genomics, global expression profiling, mutant libraries, applications of genome analysis and genomics (genetic diseases, pharmacogenomics, bacterial pathogenecity, impact on agriculture)

10 Hours

Total: 50 Hours

Textbooks

1. Brown T.A. , “Genomes 3”. Garland Science, 2007.
2. Primrose, S.B and Twyman, R.M. , “Principles of Genome Analysis and Genomics”, Reprinted Third Edition, Blackwell Publishing Co. 2005.

References

1. Westermeier, R. and Naven T. , “Proteomics in Practice: A Laboratory Manual of Proteome Analysis”, Third Edition, Wiley-VCH, 2002.
2. Pennington, S. R and Dunn, M.J. , “Proteomics: from Protein Sequence to Function First Indian Edition”, Viva Books Private Limited, 2002.

07B004 NANOBIOTECHNOLOGY

3 0 0 3

Unit I

Basics of Nanobiology and Self –Assembly Systems

Introduction to nanobiology, nanobiotechnology, molecular nanotechnology; Benefits of molecular nanotechnology; Nanodendrimers; Buckyball and nanotube; Self assembly of biomolecules - Van der Waal forces, hydrogen bonding, models, synthesis and measurement; Molecular assembly and applications.

10 Hours

Unit II

Structure of biological macro molecules

Principles of protein structure; Principles of DNA structure; Sequence/Structure relationships of DNA; Structural motifs; Introduction to in-silico prediction of 3D-structure and structure/function relationships, examples. 10 Hours

Unit III

Patterning of biomolecules and other biological substances

Necessity of patterning of biomolecules and other biological substances on surfaces; Chemical/physical binding of biomolecules on surfaces. Patterning methods-microspotting, mechanical methods, dip-pen lithography, microcontact printing methods (soft lithography related methods); Other emerging methodologies; Potential applications and comparison of patterning methods.

10 Hours

Unit IV

Microscopy for Nano science

Basic principles and applications of Scanning probe microscopy (SPM), Scanning tunneling microscopy, Atomic force microscopy (AFM), Scanning optical probe microscopy (SOPM),
Confocal FRET, SEM, TEM in nanotechnology. 10 hours

Unit V

Applications of Nanobiotechnology

Application of nanobiotechnology in Medicine - pharmaceutical applications,Drug delivary, tissue repair and implantation; Environment, Agriculture; Molecular electronics; Nano-Bio Devices & Systems.

10 hours

Total : 50 Hours

Textbooks

1. Pradeep .T., "NANO: The Essentials Understanding Nanoscince and Nanotechnology", McGraw – Hill Education (India) Ltd, 2007
2. Ratner,M. Ratener,D. "Nanotechnology A Gentle Introduction to the Next Big Idea", Prentice Hall, ISBN: 0121014005, 2003

Reference

1. SJ Rosenthal and DW Wright "NanoBiotechnology Protocols in Methods in Molecular Biology Series", Humana Press, ISBN: 1-58829-276-2, 2007.
2. Ralph S. Greco, Fritz B. Prinz, R. Lane , "Nanoscale Technology in biological systems", Smithm CRC Press, 2005.

07B005 SEPARATION TECHNIQUES

3 0 0 3

Unit I

Chromatographic Separations: Introduction

Classification of techniques, distribution coefficients, retention chromatography, sorption mechanisms, retention parameters, factors affecting retention, qualitative and quantitative aspects of chromatography peak shape, sorption isotherms, column efficiency band broadening processes, selectivity and resolution. Solvent polarity, Solubility parameter, δ, theory and application to solvent extraction, Two dimensional chromatography. 10 Hours

Unit II

Classical Chromatography

Stationary phases, biological applications of ion-exchange, affinity, size exclusion, bonded phase chromatographic techniques, TLC-HPTLC., Chiral chromatography -Principles - types of columns - scope and limitations – applications, Super critical chromatography-principles and applications

14 Hours

Unit III

High Performance Liquid Chromatography

Introduction - design of a typical HPLC machine - types of columns and detectors - applications.

15 Hours

Unit IV

Gas Chromatography

Introduction - instrumentation - columns –detectors, qualitative and quantitative aspects of gas chromatography, pyrolysis-GC

8 Hours

Unit V

Electrophoresis

Theory -gel, disc, paper and capillary electrophoresis – state-of-the-art-applications, preparation of gels, 1D and 2D gels, pulsed field electrophoresis, micro-chip capillary electrophoresis, isoelectric focusing, detection modes, detection limits, Electrophoresis of nucleic acids and proteins, SDS-PAGE-DNA sequencing

8 Hours

Total: 50 Hours

Textbooks

1. Sewell, P. A., and Clarke, B. , "Chromatographic Separations", John Wiley & Sons. 1991.
2. Lindsay, B. , "High performance liquid chromatograph",John Wiley & Sons. 1991.
3. Willard, H.H., Merrit, L.L ,.Dean, J.A., and Settle, Jr, F.A., "Instrumental methods of analysis", CBS Publishers and Distributors, New Delhi. 1986

References

1. Takayuki Shibamoto (Ed). , "Lipid chromatographic analysis" ,NewYork, 1994.
2. Srivasteva, V. K., and Kishore, K., "Introduction to chromatography: Theory and Practice",S. Chand and Company Ltd, New Delhi. 1991.

07B006 BIOLOGICAL SPECTROSCOPY

3 0 0 3

Unit I

UV-Visible Atomic and Molecular Spectroscopic Techniques

Atomic absorption, emission and fluorescence spectrometry-physical basis and biological applications. Electronic energy levels in molecules- Electronic transitions, Selection rule, Absorption range of biological chromophores, transition metal d-d transition-charge transfer spectra, application of UV spectra to proteins, properties associated with the transition dipole moments and interaction between them. Fluoresence spectroscopy and its biological applications. Polarized light – optical rotation – circular dichroism – theory and applications to bimolecules. 12 Hours

Unit II

Infra-Red and Raman Spectroscopic Techniques

Measurement of Fourier – Transform Infrared spectrum - Physical basis of infrared spectra, Infrared of Polyatomic molecules, biological examples, infrared of oriented samples. Raman spectroscopy- Physical principle, polarization ratio and biological applications. 6 Hours

Unit III

Resonance Spectroscopy

Nuclear Magnetic Resonance Spectroscopy: Spectral parameters-Intensity-Chemical shifts – spin – spin coupling – line widths, relaxation mechanisms and times(T1 and T2), – nuclear overhauser effect – multidimensional nmr spectroscopy – determination of macromolecular structure by NMR – magnetic resonance imaging , nuclear overhauser of NMR in biology , assignment in NMR, studies of Macromolecules, ligand binding, ionisation studies and pH kinetics, molecular motion.

Electron Spin Resonance Spectroscopy: Introduction-Resonance condition-measurement-spectral parameters, intensity g values-spectral anisotropy, time scale of EPR-spin labels, transition metal ions, spins trapping, and applications to biomolecules.

12 Hours

Unit IV

Mass Spectrometry

Ion sources sample introduction – mass analyzers and ion detectors – biomolecule mass sepctrometry – peptide and protein analysis – carbohydrates and small molecules – specific applications., TOF mass spectrometry.

10 Hours

Unit V

X-ray Analysis and Electron Spectroscopy

Scattering by x- rays – diffraction by a crystal – measuring diffraction pattern – bragg reflection – unit cell – phase problem – anomalous diffraction – determination of crystal structure – X-ray fluorescence, photoelectron spectroscopy (XPS), ultraviolet photo electron spectroscopy (UPS), electron impact spectroscopy and auger electron spectroscopy –physical basis and applications.

10 Hours

Total : 50 Hours

Textbooks

1. Campbell I.D., and Dwek, R.A. , "Biological Spectroscopy", Benjamin Cummins and Company. 1986.
2. Atkins P.W. , "Physical Chemistry", 6th Edition, Oxford. 1990.

References

1. Ewing, G. W. , "Instrumental methods of chemical analysis", McGraw-Hill Book Company. 1985.
2. Jag Mohan., Organic spectroscopy, Principles and Applications, Narosa Publishing House. 2007

07B007 BIOMATERIALS 3 0 0 3

Unit I

Classification and Properties

Biomaterials: Definition, Classification: Polymers , metals and alloys, ceramics (biosorbable and bio active) and composites, migration of additives, Hydrophobic and hydrophilic Surface, physical and chemical properties of materials - mechanical properties of implants-(tensile, wears , fatique, fracture toughness etc) in-vivo and invitro, corrosion studies , structure –property relations. property improvements Polymers filled with osteogenic fillers(e.g.hydroxyapatite). Effects of physiological fluid on the properties.

10 Hours

Unit II

Bulk and Surface Characterization

Structure of solids and solid imperfections. Characterization of biomaterials. Bulk analysis- XRD, FTIR, SEM/EDX,DSC, TGA, DEA, etc; Surface analysis- XPS, SIMS, AES, SERS, AFM/STM,etc. Structural properties of tissues- Bone , Teeth ,Elastic tissues. Plasma membrane: structure and functions. Sterilisation techniques: ETO, gamma radiation, autoclaving. Effects of sterilization on material properties. Standards in biomaterials - Product development and regulations

8 Hours

Unit III

Biomechanics

Biomechanics - Principles of mechanics, viscoelasticity, generalized theory of elasticity, creep-recovery, stress relaxation, strain rate sensitivity, aging and environmental stress cracking, mechanics of soft and hard tissues, kinematics of human motion, forces and stress of human joints, mechanics of hips, knee and other joints, mechanics of spine.

10 Hours

Unit IV

Biomaterials as body implants

Hard tissue replacement implant: , Orthopedic implants, (Hip, Knee, etc.), Dental implants- Adhesives and Sealants, Soft tissue reolacement implant, skin implants, Burn (wound) dressings /Synthetic Skin, dialysis membranes, Scaffolds , Vascular implants, Heart valve implants- . Artificial Kidneys & Livers, Sutures, Biomaterials for gene delivery: mechanisms and applications, Hydrogels as Stimuli-sensitive biomaterials Ophthalmologic Implants, Biomaterials for drug delivery.

10 Hours

Unit V

Biocompatibility

Definition, blood and tissue compatibility of biomaterials and their invitro and invivo assessment, biomimicery, inflammation and Wound healing process-bone healing, tendon healing. Material response: Function and Degradation, Tissue response to biomaterials , importance of interfacial tissue reaction (e.g. ceramic/bone tissue reaction).Effects of wear particles. Qualification of implants (Invitro and Invivo), blood-materials interaction, animal models, mineralisation and encrustation, microbial biofilm formation, bacterial adhesion toxicology, Degradation of biomaterial in biological environments, toxicity of biomaterials, acute and chronic toxicity studies (in situ implantation, tissue culture, haemolysis, thrombogenic potential test, systemic toxicity, intracutaneous irritation test), sensitization, carcinogenicity, mutagenicity and special test. Implant associated infection, Immunology. Enhancement of biocompatibility using Corona discharge and plasma processes. Surface coatings (Silver/silver oxide, silicone hydrogels, UV curable systems ,PC coatings, Heparin loaded systems)

12 Hours

Total: 50 Hours

Text books

1. Ratner, Hoffman, and Schoen, Lemons. , Biomaterials Science – An Introduction to Materials in Medicine, Academic Press 1996
2. Park, J.B. , Biomaterials - Science and Engineering, Plenum Press. 1984
3. Yannas, I. V., Tissue and Organ Regeneration in Adults, New York: Springer. 2001

References

1. Sharma C.P., and Szycher, M. , Blood compatible materials and devices, Technomic Publishing Co. Ltd. 1991
2. John P. Fisher, J.P., Mikos, A.G., and Bronzino, J. D. , Tissue Engineering, CRC, Press,2007

07B008 BIOSENSORS AND MICROBIAL FUEL CELLS

3 0 0 3

.

Unit I

Introduction and Types

What are Biosensors? Advantages and limitations, various components of biosensors; biocatalysis based biosensors- mono-enzyme electrodes; bi-enzyme electrodes: enzyme sequence electrodes and enzyme competition electrodes; Inhibition-based biosensors;Cell-based biosensors;. bioaffinity based biosensors & microorganisms based biosensors, biologically active material and analyte. Biochips and biosensor arrays; Problems and limitations. Types of membranes used in biosensor constructions.

8 Hours

Unit II

Transducers in Biosensors

Types of transducers, principles and applications - Calorimetric, acoustic,optical (absorption,fluorescence,bio/chemiluminescence, surface plasmon resonance(SPR)), potentiometric / amperometric, conductrometric /resistormetric, piezoelectric, semiconductor(ion sensitive field effect transistor(ISFET), enzyme field effect transistor (ENFET)), impedimetric, mechanical and molecular electronics based transducers. Chemiluminiscence - based biosensors. An overview of performance and applications.

12 Hours

Unit III

Bioselective layers and mass transport

Bioselective layers: Enzymes; Oligonucleotides and Nucleic Acids; Lipids (Langmuir-Blodgett bilayers, Phospholipids, Liposomes); Membrane receptors and transporters; Microbial metabolism; Tissue and organelles (animal and plant tissue); Cell culture; Immunoreceptors; Chemoreceptors; Methods for application of bioselective layers in desired patterns- pin-based spotting, ink-jet dispensing, and microstamp printing. Limitations & problems. Mass transport : Mass transport of analytes to the surface of the biosensor transducer and its effect on the detected signal. The kinetics of diffusion-limited mass transport in stagnant systems. The design of microfluid flow systems that interface with biosensors. Different assay types (displacement, competitive, sandwich, and direct).

10 Hours

Unit IV

Biosensor Engineering and Applications

Methods for biosensors fabrication: self-assembled monolayers, screen printing, photolithography, microcontact printing, micro-electromecjanical system(MEMS). Engineering concepts for mass production. Applications: Clinical chemistry; Test-strips for glucose monitoring; Clark electrode, Urea and cholesterol determination; health care, Implantable sensors for long-term monitoring; Drug development and detection; Industrial on-line monitoring, Environmental monitoring; Technological process control; veterinary, agriculture, Food quality control; Forensic science benefits; Problems & limitations.

10 Hours

Unit V

Microbial fuel cells

Introduction, microbes/bacteria used, microbial population, feed-stock(fuels), voltage and power generation, MFC materials(electrodes-reference, working and counter), membranes, saltbridge), architecture and fabrication, mass transfer to bacteria and biofilms, bioreactor design, Electrochemistry of MFC, fundamentals of electron transfer (mechanism), thermodynamic principle, anodic and cathodic reactions, Nernst equation, electrode configuration, cathode and anode mediators, electrode catalysts, current-voltage and current- potential characteristics, current efficiency, power and power density, Stacked MFC and its behaviour, MFC as a BOD sensor and applications.

10 Hours

Total: 50 Hours

Textbooks

1. Buerk, D. G. , Biosensors: Theory and Applications, pp. 1-18. Technomic, Lancaster, U.K . 1993
2. Logan, B. E. , Microbial Fuel Cells, Wiley, John & Sons. 2008

References

1. Ursula Spichiger-Keller. (1998), Chemical Sensors and Biosensors for Medical and Biological Applications", Wiley-VCH. 1998
2. Zhuwei Du , Haoran Li and Tingyue Gu., A state of the art review on microbial fuel cells: A promising technology for wastewater treatment and bioenergy", Biotechnology Advances: vol. 25, pp 464–482. 2007

07B009 BIOFUELS

3 0 0 3

Unit I

Classification and resources

Introduction. Biofuel as a renewable energy. Why biofuel? Biofuel in energy management. Classification of biofuels: First , second , third and fourth generation biofuels. Agriculture and biofuel. Different plant sources as biofuel feed stocks and their cultivation. Biomass- Chemistry and composition for each biomass source. Edible and non-edible oils as fuels.- Their extraction, economic and chemistry. Physical and chemical characteristics of vegetable oils-iodine number, hydroxyl and acid values. Rancidity, hydrogenolysis, hydrolysis and combustion properties of oils. Food vs energy.

12 Hours

Unit II

Biodiesel

What is biodiesel? Basics and chemistry of biodiesel. Vegetable oils in biodiesel production. Transesterification: Chemical methods and catalyst- Enzymatic methods. Transesterification using heterogeneous catalyst. Isolation and purification. Physical properties and characterization of biodiesel. Cloud point, pour point, cold filter plugging point, flash point, viscosity, Cetane number.Energetics and combustion characteristics. Commercial production of biodiesel. Washing and drying options (bubble and mist washing).Storage. 10Hours

Unit III

Quality biodiesel and Environment

Producing Quality Biodiesel. Quality control, Test methods, ASTM specifications. Oxidative and thermal stability. Estimation of mono, di, triglycerides and free glycerol. Engine performance test, blending of ethanol with biodiesel, blending of biodiesel with high speed diesel (HSD) and their combustion properties. Biodiesel and Environment. Comaparison of biodiesel with high speed diesel.

8 Hours.

Unit IV

Bioethanol

Ethanol as a fuel. Microbial and enzymatic production of ethanol from biomass, sugarcane, sugar beet, corn and wheat starch, sorghum. Wet and dry milling processes.

Saccharification-chemical and enzymatic. Fermentation of sugars to ethanol. Enzymes Employed. Sugar-cane ethanol, efficiency vs. corn ethanol. Ethanol assay.

10 Hours

Unit V

Biorefineries

Concept of Biorefineries. Co-products of biorefineries-oil cake and glycerol- Purification of glycerol obtained in biodiesel plant. Its application in chemical, pharmaceutical and polymer industries. Oil cake in biofertiliser formulation. Bio and thermal gasification of oilcakes. Anaerobic gasification of biomass. Economics of biorefineries.

10 Hours

Total= 50 Hours

Text Books

1. Caye Drapcho , John Nghiem and Terry Walker, Biofuels Engineering process technology, , McGraw-Hill Professional; 1st edition, 2008
2. Lisbeth Olsson, Biofuels (Advances in Biochemical Engineering / Biotechnology) (Editor) Springer, 2007
3. Mousdale, Biofuels, CRC Press, 2008

References

1. Ahindra Nag, Biofuels Refining and Performance, , McGraw-Hill Professional; First edition, 2007
2. William H. Kemp, Biodiesel Basics and Beyond: A Comprehensive Guide to Production and Use for the Home and Farm, Aztext Press, 2006
3. P.P.Bhojvaid , Biofuel, Publication: Terribookstore, 2007

07B010 CANE SUGAR AND ALCOHOL TECHNOLOGY

3 0 0 3

Unit I

Sugarcane Development, Procurement and Extraction of Juice for Sugar Processing

Sugarcane Varities – Agronomy Practices – Harvesting and Transporting – Milling to Extract Juice – Technology Involved in Milling – Collection and Handling of Juice for Processing – By-Product Bagasse Utilisation 10 Hours

Unit II

Canejuice Processing to Crystalline Sugar

Juice Pre-Heating - Flocculation, Secondary Heating and Separation of Suspended Solids as Pressmud (By-product) – Concentration of Clear Juice in Evaporators to Sugar Syrub – Pan Boiling and Crystalisation of Sugar – Separation of Sugar – Drying – Grading – Storage – Issues; Final Molasses (By-product) Separation and Storage

10 Hours

Unit III

Alcohol Scenario and its Production by Fermentation

Introduction to Alcohol – Current World Scenario on Alcohol – Scenario in India – Major Raw Materials for Alcohol Production – Availability – Fermentation Process for Alcohol Production – Equipments – Parameters to be Monitored 10 Hours

Unit IV

Separation of Alcohol from Fermented Wash by Distillation Technique

Kind of Distillation Coloumns and its Function – Separation of Alcohol Using the Distillation technique – Quality Alcohol Extraction method for Industrial Alcoholic Beverages and Fuel Ethanol Needs 10 Hours

Unit V

Environmental Management System in Sugar and Alcohol

Environmental Management System in Sugar and Alcohol Industry – Conservation of Energy – Utilisation of Spent Residues to Valuable Products – Future Scenario of Sugar and Alcohol

10 Hours

Total: 50 Hours

Textbooks

1. Peter Honig, “Principles of Sugar Technology”, Volume1, 2 & 3, Elsevier Publishing Company 1959
2. Jacques K, Lyons T.P, Kelsall D.R., “The Alcohol Text Book”, Nottingham University Press, Third edition, 1999

References

1. Ram Behari Lal Mathur “ Handbook of Cane Sugar and Technology”, 2nd Ed., Oxford & IBH Publishing Company, New Delhi, 1981
2. Hugot E .and Jenkins .G. H., “Hand Book of Sugar Engineering”, Elsvier Publishing Company, 1986
3. Manohar Rao.P.J., “Industrial Utilization of Sugarcane and its Co-products”, First Edition, Edited and Published by P.J. International Group Consultants, New Delhi, 1997
4. Metcaf and Eddy , “Waste Water Engineering: Treatment Disposal Reuse”, 5th Reprint,

Tata Mc Graw – Hill Publishing Company Ltd, New Delhi, 1985.

07B011 PROCESS INSTRUMENTATION AND CONTROL

3 0 0 3

Unit I

Laplace Transform and its application in Process Control

Laplace transformation, transform of standard functions, derivatives and integrals, inversion, theorems in Laplace transformation, application .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, transfer function for chemical reactors and dynamics.

10 Hours

Unit II

Control Systems and Types

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

10 Hours

Unit III

Frequency Response Analyses

Introduction to frequency response of closed-loop systems; control system design by frequency, Bode diagram, stability criterion, Nyquist diagram; Tuning of controller settings.

10 Hours

Unit IV

Types of Control

Controller mechanism, introduction to advanced control systems, cascade control, feed forward control, control of distillation towers and heat exchangers, introduction to microprocessors and computer control of chemical processes.

10 Hours

Unit V

Measuring Instruments

Principles of measurements and classification of process control instruments, measurements of temperature, pressure, fluid flow, liquid weight and weight flow rate, viscosity and consistency, pH, concentration, electrical and thermal conductivity, humidity of gases, composition by physical and chemical properties and spectroscopy. 10 Hours

Total: 50 Hours

Textbooks

1. Coughnowr .,and Koppel, Process Systems Analysis and Control, McGraw-Hill, New York, 1986
2. George Stephanopoulos., , Chemical Process Control, Prentice-Hall of India Pvt. Ltd., New Delhi, 2003

References

1. Thomas, E.Marlin., Process Control, 2nd Edn, McGraw-Hills International Edn., 2000,
2. Norman H.Ceaglske, , Automatic Process Control for Chemical Engineers, John Wiley & Sons, Japan, 1995
3. Emenule, S.Savas., ,Computer Control of Industrial Processes, McGraw-Hill, London, 1965

07B012 MOLECULAR MODELING AND DRUG DESIGN

3 0 0 3

Unit I
Introduction to Classical Mechanics
Newton's laws of motion – time intervals- algorithms 10 Hours

Unit II
Introduction to Statistical Mechanics
Boltzman's Equation – Ensembles – Distribution law for non interacting molecules – Statistical mechanics of fluids. 10 Hours

Unit III
Quantum Mechanics
Photoelectric effect – De Broglies hypothesis – Uncertainty principle – Schrodingers time independent equation – particle in a one -dimensional box.

10 Hours

Unit IV
Gromos, Gromacs, Amber & Dock
Energy minization, application of Fourier transformer – force fields – principal components analysis – RMSD calculation – applications – dynamics of a molecule – concepts of parallezing work. 10 Hours

Unit V
Gaussian 98

Methods – Basic sets – Model chemiststrix – inputs – outputs – uses. 10 Hours

Total : 50 Hours

Textbooks
1. McQuarrie, D. Narosa, "Statistical Mechanics", 1999.
2. McQuarrie, D. Narosa, "Quantum Mechanics", 1999.

Reference
1. GROMOS Handbook.

07B012 IMMUNOTECHNOLOGY 3 0 0 3

Unit I
Antigens
Types of antigens, their structure, preparation of antigens for raising antibodies, handling of animals, adjuvants and their mode of action.

3 Hours

Unit II
Antibodies and Immunodiagnosis
Monoclonal and polyclonal antibodies – their production and characterization, western blot analysis, immuno electrophoresis, SDS-PAGE, purification and synthesis of antigens, ELISAs-principle and applications, radio immuno assay (RIA), chemiluminescence.

10 Hours

Unit III
Assement of Cell Mediated Immunity
Identification of lymphocytes and their subsets in blood. T cell activation parameters, estimation of cytokines, macrophages activation, macrophage microbicidal assays, in-vitro experimentation-application of the above technology to understand the pathogenesis of infectious diseases.

10 Hours

Unit IV
Immunopathology

Preparation and storage of tissues, identification of various cell types and antigens in tissues, isolation and characterization of cell types from inflammatory sites and infected tissues, functional studies on isolated cells, immuno cytochemistry – immuno fluoresecence, immuno enzymatic and immuno ferrtin techniques, immuno electron microscopy.

10 Hours

Unit V

Molecular Immunology

Preparation of vaccines, application of recombinant, production of antidiotypic antibodies, catalytic antibodies, application of PCR technology to produce antibodies and other immunological reagents, immuno therapy with genetically engineered antibodies. 10 Hours

Unit VI

Current Topics in Immunology

Hybridoma technology; mice systems; preparation of tumor specific antibodies; DNA technology for the preparation of tumour specific antigens. 10 Hours

Total : 50 Hours

Textbooks

1. Talwar G.P., and Gupta S.K., "A Hand Book of Practical and Clinical Immunology", Vol. 1 & 2, CBS Publications, 1992.
2. Weir D.M., "Practical Immunology", Blackwell Scientific Publications, Oxford, 1990.

Reference

1. Austin J.M. and Wood K.J., "Principle of Cellular and Molecular Immunology", Oxford university
press, Oxford, 1993.

07B014 CANCER BIOLOGY 3 0 0 3

Unit I

General Principles of Cancer Biology

Regulation of cell cycle, Cell proliferation and apoptosis; signal transduction pathways of apoptosis and signaling molecules; defective apoptotic pathways leading to cancer; mutations that cause changes in signal molecules, effects on receptor, signal switches, modulation of cell cycle in cancer; Mechanism of spread; Different forms of cancers; Diet and cancer. 10 Hours

Unit II

Principles of Carcinogenesis

Causation of cancer; Theory of carcinogenesis, Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis, x-ray radiation-mechanisms of radiation carcinogenesis.

10 Hours

Unit III

Molecular Cell Biology of Cancer

Signal targets and cancer, activation of kinases; Oncogenes, identification of oncogenes, mechanism of oncogene activation, retroviruses and oncogenes, detection of oncogenes. Oncogenes/proto oncogene activity; tumor suppressor genes - Rb, p53, APC, BRCA paradigms; Growth factors related to transformation. Telomerases.

10 Hours

Unit IV

Principles of Cancer Metastasis

Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three step theory of invasion, proteinases and tumour cell invasion; Recent approaches to identify key factors controlling metastasis; Angiogenesis.

10 Hours

Unit V

Cancer Therapy

Therapy forms – surgery, chemotherapy, radiation therapy; Detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection, Detection using biochemical assays and molecular; Different types of tumour markers; New approaches of cancer therapy – mAbs, vaccines, gene therapy, stem cell therapy.

10 Hours

Total: 50 Hours

Textbooks

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

References

1. Kufe, DW, Pollock, RE, Weichselbaum, RR, Bast R.C., Gansler TS., Holland JF Frei, E, “Cancer edicine”, 6th Edn, BC Deckker Inc., Toranto, Canada, 2003.

07B015 BIOPHARMACEUTICAL TECHNOLOGY AND DRUG DESIGN

3 0 0 3

Unit I

Introduction

Drugs: definition, drug target-lipid, protein, carbohydrate and Nucleic acids; Routes of drug administration.

8 Hours

Unit II

Mechanism and Metabolism of Drugs

Mechanism of drug action; Biotransformation- Absorption, metabolism and removal of drugs from body. Drug metabolism. Toxicity testing.

10 Hours

Unit III

Pharmacokinetics and Drug Design

Introduction; Types of reaction-Zero, First, Second order reactions; Compartment modeling and their types. Drug design: Pharmacokinetic issues , solubility and membrane permeability, making drug more resistance to hydrolysis and drug metabolism, making drugs less resistant to drug metabolism, targetting drug, reducing toxicity. Combinatorial drug design, Cimetidine –a rational approach to drug design.(Overview).

12Hours

Unit IV

Drug Manufacture: Principles, Process and Applications

Tablets - principle, process-Compression and granulation of tablets, tablet presses' coating of tablets; Capsule preparation-principle, process and types; Oral liquids and Semisolids–process and topical applications; Radio pharmacology.

10 Hours

Unit V

Packing of Drugs and Biopharmaceuticals

Preservation of drugs; Analytical methods and other tests used in drug manufacture; Packing techniques; Quality management; GMP-cGMP; Economics and regulatory aspects. Various categories of therapeutics-Mode of action and metabolism with one example - vitamins, laxatives, analgesics, contraceptives, antibiotics and hormones.

10 Hours

Total : 50 Hours

Textbooks

1. Katzung,B.G., "Basic and Clinical Pharmacology", 9th Edition., McGraw- Hill, Inc., New York, 2004

2. Lachman,L. , Lieberman,H.A., and Kanig, J.L., "The Theory and Practice of Industrial Pharmacy", 3rd edition., Varchese publishing house ., India 1991.

3. Patrick, G.L. "An Introduction to Medicinal Chemistry", 2nd edition., McGraw- Hill, Inc., New York 2001.

References

1. Troy, D. B [Ed].,"Remington : The Science and Practice of Pharmacy", 21st edition .,Vol I & II.,Lippincott Williams & Wilkins., NewYork 2006.

2. Thomas, G., "Medicinal Chemistry- An introduction", John Wiley., NewYork 2000.

07B016 PROFESSIONAL ETHICS

3 0 0 3

Unit I

Human Values

Morals, Values and Ethics – Integrity – Work Ethic – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-Confidence – Character – Spirituality –Life and Messages of Bharathiyar – Periyar – Vivekanandar – Valluvar. **10 Hours**

Unit II

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 – Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories. **10 Hours**

Unit III

Engineering as Social Experimentation

Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger - case study – Life of BillGates — Life of Visveswaraiah – Edison & Einstiene - Steve Jobs. **10 Hours**

Unit IV

Safety, Responsibilities and Rights

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three mile island and chernobyl case studies – Fundamental Rights and Duties of Indian Citizens- Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - Intellectual Property Rights - discrimination – Indian Constitution – Responsibilities of Citizen **10 Hours**

Unit V

Global Issues

Multinational corporations - Environmental ethics and Environmental Protection Act - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership-sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers (IETE), India, etc. **10 Hours**

Total: 50 Hours

Text Book (s) :

1. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.

Reference Book(s):

1. Mike Matrin and Roland Schinzinger, “Ethics in engineering”, McGraw-Hill, New York 1996
2. Charles D. Fleddermann, “Engineering Ethics”, Pearson Education/ Prentice Hall, New Jersey, 2004 (Indian Reprint)
3. Charles E Harris, Michael S. Protchard and Michael J Rabins, “Engineering Ethics – Concepts and Cases”, Wadsworth Thompson Learning,