PROGRAMME: B. TECH BIOTECHNOLOGY CURRICULUM

SEMESTER- 1

S. No.	COURSE CODE	COURSE	L	T	P	C	PAGE No.
1.	SCH1101	Environmental Science and Engg	3	0	0	3	16-17
2.	SPH1101	Physics of Engineering Materials	3	0	0	3	9-10
3.	SCY1101	Engineering Chemistry	3	0	0	3	12
4.	SMT1101	Engineering Mathematics I /	3	1	0	4	2
	SMT1102	Statistics	3	1	0	4	3
5.	SCS1102	Fundamentals of Programming	3	0	0	3	18
6.	SBT 1101	Cell and Molecular Biology	3	0	0	3	74
PRACTICAL							
7.	SPH4051	Engineering Physics Lab	0	0	2	1	126
8.	SCY4051	Engineering Chemistry Lab	0	0	2	1	126
9.	SCS4101	Programming in C Lab	0	0	4	2	126

TOTAL CREDITS: 23

SEMESTER- 2

S. No.	COURSE CODE	COURSE	L	T	P	C	PAGE No.
1.	SHS1101	English for Science and Technology	3	0	0	3	1
2.	SMT1105	Engineering Mathematics II	3	1	0	4	4
	SMT1106	Engineering Mathematics II	3	1	0	4	5
3.	SBT1102	Biochemistry /	3	0	0	3	75
	SCY1103	Chemistry of Industrial Materials /	3	0	0	3	13
	SCY1104	Bio Organic Chemistry /	3	0	0	3	14
	SCY1105	Physical Chemistry	3	0	0	3	15
4.	SBT 1103	Microbiology	3	0	0	3	76
5.	SBT1104	Genetics	3	0	0	3	77
6.	SCH1103	Principles of Chemical Engineering	3	0	0	3	96
PRACTICAL							
7.	SBT4051	Microbiology Lab	0	0	4	2	138
8.	SBT4052	Cytogenetics Lab	0	0	4	2	138

TOTAL CREDITS: 23

L - LECTURE HOURS, T – TUTORIAL HOURS, P – PRACTICAL HOURS, C – CREDITS

SEMESTER- 3

S. No.	COURSE CODE	COURSE	L	T	P	C	PAGE No.
1.	SMT1201	Engineering Mathematics III /	3	1	0	4	6
	SMT1202	Engineering Mathematics III	3	1	0	4	7
2.	SBT1201	Molecular Biotechnology	3	0	0	3	78
3.	SBT1202	Immunology	3	0	0	3	79
4.	SBT1203	Enzymology	3	0	0	3	80
5.	SBT1204	Biochemical Thermodynamics	3	1	0	4	81
6.	SCH1211	Introduction to Unit operations and process calculations	3	1	0	4	107
PRACTICAL							
7.	SBT4054	Biochemistry Lab	0	0	4	2	139
8.	SBT4055	Immunology Lab	0	0	4	2	140

TOTAL CREDITS: 25

SEMESTER- 4

S. No.	COURSE CODE	COURSE	L	T	P	C	PAGE No.
1.	SBT1205	Genetic Engineering	3	0	0	3	82
2.	SBT1206	Protein Engineering	3	0	0	3	83
3.	SBT1207	Analytical Techniques in Biotechnology	3	0	0	3	84
4.	SBI1208	Bioinformatics	3	0	0	3	41
5.	SCH1212	Chemical Reaction Engineering	3	0	0	3	108
6.	SCH1213	Bioprocess Instrumentation Dynamics and Control	3	1	0	4	109
PRACTICAL							
7.	SBT4056	Molecular Biology Lab	0	0	4	2	140
8.	SBI4059	Bioinformatics Lab	0	0	4	2	133
9.	S23PT1	Professional Training-1	0	0	10	5	

TOTAL CREDITS: 28

SEMESTER- 5

S. No.	COURSE CODE	COURSE	L	T	P	C	PAGE No.
1.	SBT1301	Bioprocess Engineering I	3	0	0	3	85
2.	SBT1302	Pharmaceutical Biotechnology	3	0	0	3	86
3.	SBT1303	Design and Operation of Bioreactors	3	0	0	3	87
4.	SBT1304	Marine Biotechnology	3	0	0	3	88
5.	SBI1309	Fundamentals of Genomics and Proteomics	3	0	0	3	50
6.	SCH1312	Modelling and Transport Phenomena for Bio Processes	3	1	0	4	121
PRACTICAL							
7.	SBT4057	Genetic Engineering Lab	0	0	4	2	141
8.	SBT4058	Bioprocess Engineering Lab I	0	0	4	2	141

TOTAL CREDITS : 23

SEMESTER- 6

S. No.	COURSE CODE	COURSE	L	T	P	C	PAGE No.
1.	SBT1305	Animal Biotechnology	3	0	0	3	89
2.	SBT1306	Bioprocess Engineering II	3	0	0	3	90
3.	SBT1307	Nanobiotechnology	3	0	0	3	91
4.	SBI1310	Molecular Modeling and Drug Designing	3	0	0	3	51
5.	SCH1313	Mass Transfer for Biological Systems	3	1	0	4	122
6.		Elective I	3	0	0	3	
PRACTICAL							
7.	SBT4059	Bioprocess Engineering Lab II	0	0	4	2	141
8.	SBT4060	Animal Biotechnology Lab	0	0	4	2	142
9.	S23PT2	Professional Training-II	0	0	10	5	

TOTAL CREDITS: 28

SEMESTER- 7

S. No.	COURSE CODE	COURSE	L	T	P	C	PAGE No.
1.	SBT1401	Bio-safety, Bioethics and IPR	3	0	0	3	92
2.	SBA1101	Principles of Management and Professional Ethics	3	0	0	3	20
3.		Elective II	3	0	0	3	
4.		Elective III	3	0	0	3	
PRACTICAL							
5.	SBT4061	Bio-Instrumentation Lab	0	0	4	2	142
6.	SBT4062	Plant Biotechnology Lab	0	0	4	2	142
7.		PROJECT WORK PHASE-I					

TOTAL CREDITS : 16

SEMESTER- 8

S. No.	COURSE CODE	COURSE	L	T	P	C	PAGE No.
1.	SBT1402	Plant Biotechnology	3	0	0	3	93
2.	SBT1403	Concepts in Stem Cell Research	3	0	0	3	94
3.		Elective IV	3	0	0	3	
4.	S23PROJ	PROJECT WORK PHASE-I & II	0	0	30	15	

TOTAL CREDITS: 24

TOTAL CREDITS FOR THE PROGRAMME: 190

LIST OF ELECTIVES

DEPARTMENT ELECTIVES

S. No.	COURSE CODE	COURSE	L	T	P	C	PAGE No
Group I							
1.	SBT1601	Neuroscience	3	0	0	3	177
2.	SBT1602	Food Biotechnology	3	0	0	3	178
3.	SBT1603	Agriculture Biotechnology	3	0	0	3	179
4.	SBT1604	Industrial Biotechnology	3	0	0	3	180
5.	SBT1605	Environmental Biotechnology	3	0	0	3	181
Group II							
1.	SBT1606	Cancer Biology	3	0	0	3	182
2.	SBT1607	Food Processing and Preservation	3	0	0	3	183
3.	SBT1608	Aquaculture	3	0	0	3	184
4.	SBT1609	Industrial Safety	3	0	0	3	185
5.	SBT 1610	GMP and Quality Concepts	3	0	0	3	186
6.	SPR 1307	Resource Management Technique	3	0	0	3	159

UNIVERSITY ELECTIVES

1.	SHS 1601	Life and Employability Skills	3	0	0	3	204
2.	SHS 1602	Technical Writing for Scientists	3	0	0	3	205
3.	SHS 1603	Professional Communication & Advanced Rhetoric	3	0	0	3	206
4.	SCI 1619	Disaster Management	3	0	0	3	207
5.	SBI 1101	Introduction to Bioinformatics	3	0	0	3	33
6.	SBI 1207	PERL Programming	3	0	0	3	40
7.	SBI 1605	Python	3	0	0	3	164
8.	SBM 1304	Biomaterials	3	0	0	3	65
9.	SBM 1404	Hospital Management	3	0	0	3	73
10.	SBM 1606	Biomems and Nanotechnology	3	0	0	3	171
11.	SBT1610	GMP and Quality Concepts	3	0	0	3	186
12.	SBT 1611	Biology for Engineers	3	0	0	3	187
13.	SCH 1616	Environmental Impact Assessment	3	0	0	3	203

14.	SCY 1601	Spectroscopy	3	0	0	3	208
15.	SCY 1602	Energy Sources	3	0	0	3	209
16.	SPH 1601	Energy Physics	3	0	0	3	210
17.	SPH 1602	Geophysics	3	0	0	3	211
18.	SPH 1603	Space Physics	3	0	0	3	212
19.	SPH 1604	Astrophysics	3	0	0	3	213
20.	SPH 1605	Atomic and Nuclear Physics	3	0	0	3	214
21.	SIT 1402	Mobile Application Development	3	0	0	3	215
22.	SIT 1606	Big Data	3	0	0	3	216
23.	SIT 1609	Game Programming	3	0	0	3	217
24.	SIT 1608	Green Computing	3	0	0	3	218
25.	SCS 1302	Computer Graphics and Multimedia Systems	3	0	0	3	219

SCH1101	ENVIRONMENTAL SCIENCE AND ENGINEERING (Common to ALL Branches of B.E/ B. Tech.)	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

To impart knowledge on the issues related to environment and to emphasize the importance of a clean environment

UNIT 1 INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES 10 Hrs.

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

UNIT 2 ECOSYSTEMS AND BIODIVERSITY 10 Hrs.

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

UNIT 3 ENVIRONMENTAL POLLUTION 9 Hrs.

Definition - causes, effects and control measures of: (a) air pollution (b) water pollution (c) soil pollution (d) marine pollution (e) noise pollution (f) thermal pollution (g) nuclear hazards. Solid waste management: causes, effects and control measures of urban and industrial wastes, role of an individual in prevention of pollution, pollution case studies, disaster management: floods, earthquake, cyclone and landslides.

UNIT 4 SOCIAL ISSUES AND THE ENVIRONMENT 8 Hrs.

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

UNIT 5 HUMAN POPULATION AND THE ENVIRONMENT 8 Hrs.

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

SPH1101	PHYSICS OF ENGINEERING MATERIALS (Common to ALL Branches of B.E/ B. Tech.)	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

To expose the students to different classes of materials and present the fundamentals of materials science; to develop the understanding of the behaviour of materials, their properties and structures; to facilitate selection of suitable material for particular engineering application.

UNIT 1 CHARACTERIZATION OF MATERIALS 9 Hrs.

Introduction, Structural characterization - X-ray diffraction, Bragg's law, Determination of crystal structure - powder X-ray diffractometer (Debye Scherrer camera) and Single crystal XRD with principle, construction and working, Microstructural characterization - Introduction, electromagnetic lens system, Determination of surface morphology by Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM) and Atomic Force Microscope (AFM) with principle, construction and working. Microhardness testing -Determination of microhardness by Vickers hardness test, Knoop hardness test and Nanohardness test with principle, construction, and working.

UNIT 2 MAGNETIC MATERIALS 9 Hrs.

Introduction, Origin of magnetic moment - orbital, spin and nuclear magnetic moments; Bohr magneton; Classification of magnetic materials based on spin- dia, para, ferro, antiferro and ferri- Curie temperature, Neel temperature.; Magnetic domains- Domain theory of Ferro magnetism (Weiss theory) - Observation of domain (bitter powder pattern), Energies involved in domain formation - magnetostatic energy, anisotropic energy, magnetostrictive energy and domain wall energy; Hysteresis Curve -based on domain theory; Types of magnetic materials - soft and hard magnetic materials; Magnetic bubbles - formation and propagation of magnetic bubbles-T-bar, read/write operation**.**

UNIT 3 SUPERCONDUCTING MATERIALS 9 Hrs.

Introduction to superconductivity- Properties of superconductor - electrical resistance, Meissner Effect, effect of heavy magnetic field, effect of heavy current (Silsbee's rule), effect of high pressure , isotope effect, entropy, specific heat capacity, energy gap, London Penetration depth, Coherence Length, Ginzburg Landau Parameter, Flux Quantization and thermal conductivity. Theory of superconductivity - London Theory (Macroscopic), Bardeen, Cooper and Schrieffer Theory (Microscopic) - explanation based on formation of Cooper pairs and existence of energy gap. Types of superconductors - Type I and Type II superconductors, D.C. and A.C Josephson Effect, I-V Characteristics and applications of Josephson junction. Applications - cryotron, magnetic levitation train and SQUIDS. Problems of Part-A type.

UNIT 4 OPTICAL MATERIALS 9 Hrs.

Introduction, refractive index, absorption and dispersion, reflections. Classification of optical materials, absorption in metals, semiconductors and insulators (dielectrics), Excitons- Frenkel and Mott-Wannier excitons, Point detects -Frankel and Schottky defects, Traps - trapping and recombination centres - Colour Centres - types - F-Centre, R-Centre, V-Centre (V1 and V2), M -Centre. Luminescence - Principle and classification - Mechanism and working of Photo luminescence (Fluorescence and Phosphorescence). Problems of Part-A type.

UNIT 5 SEMICONDUCTING MATERIALS 9 Hrs.

Introduction - Band theory (qualitative), types of semiconductors- intrinsic semiconductor - carrier concentration and Fermi level in intrinsic semiconductor - extrinsic semiconductor - carrier concentration and Fermi level in extrinsic semiconductor (p type and n type) - Experimental determination Band gap of semiconductor -Hall Effect - experimental determination of Hall Voltage, Applications of Hall effect. Problems of Part-A type.

MAX. 45 HOURS

SCY1101	ENGINEERING CHEMISTRY (Common to ALL Branches of B.E/ B. Tech.)	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the properties and various synthetic methods for the preparation of nanomaterials and their applications.
- To know about the quality parameters of water and methods to estimate the toxic elements and softening methods.
- To give an overview about types of batteries and fuel cells, corrosion mechanisms and preventive methods.
- To have a basic idea about polymers and various moulding techniques.

UNIT 1 SYNTHESIS OF NANOMATERIALS 9 Hrs.

Introduction: Nanomaterials: Definition - Classification based on dimensions - Size dependent properties. Types of nanomaterials: Nanoparticles: Synthesis by chemical reduction method. Nanoporous materials: Synthesis by sol-gel method. Nanowires: Synthesis by VLS mechanism. Carbon Nanotubes (CNTs): Single walled and multi walled nanotubes - Mechanical and electrical properties of CNTs - Applications of CNTs - Synthesis of CNTs by electric arc discharge method and laser ablation method.

UNIT 2 WATER TECHNOLOGY 9 Hrs.

Introduction: Water quality parameters - Contamination of water by arsenic, lead, fluoride, mercury and their removal. Hardness: Types - Expression - Units. Estimation of hardness of water by EDTA method - Problems. Estimation of iron, calcium and magnesium: AAS method. Water softening: Zeolite process - Demineralization process. Desalination: Reverse osmosis - Electrodialysis.

UNIT 3 ELECTROCHEMICAL POWER SOURCES 9 Hrs.

Electrochemistry: Galvanic cell - Electrochemical cell representation - EMF series and its significance. Batteries: Terminology - Lead-acid accumulator - Nickel-cadmium batteries. Lithium batteries: Li/$SOCl_2$ cell - Li/I_2 cell - Lithium ion batteries. Fuel Cells: Hydrogen-oxygen fuel cells - Solid oxide fuel cell (SOFC).

UNIT 4 CORROSION SCIENCE 9 Hrs.

Introduction: Definition. Types: Dry corrosion: Mechanism - Pilling-Bedworth rule - Wet Corrosion: Mechanism. Types: Galvanic corrosion and differential aeration cell corrosion. Galvanic series and its significance. Factors influencing corrosion. Corrosion prevention: Material selection and design - Cathodic protection. Protective coatings: Paints - Constituents. Mechanism of drying of drying oils.

UNIT 5 POLYMER CHEMISTRY 9 Hrs.

Introduction to polymers: Nomenclature - Functionality. Types of polymerization. Mechanism of polymerization: Free radical mechanism - Cationic mechanism - Anionic mechanism. Plastics: Types - Thermoplastics and thermosetting plastics. Properties: Strength - Crystalline and amorphous state - Average molecular weight - Polydispersity. Compounding of plastics. Moulding of plastics: Compression moulding - Injection moulding - Extrusion moulding. Introduction to conducting polymers.

MAX. 45 HOURS

TEXT / REFERENCE BOOKS

1. Jain P.C. and Monica Jain, Engineering Chemistry, 15th Edition Dhanpat Rai Publishing Co., 2009.
2. Dara S.S., Text Book of Engineering Chemistry, S. Chand & Co, 2008.
3. Sheik Mideen A., Engineering Chemistry (I & II),13th Edition, Shruthi Publishers, 2010.
4. Kuriakose J.C. and Rajaram J., Chemistry in Engineering and Technology". Vol.1 & 2, 5th reprint, Tata McGraw Hill Publishing Company (P) Ltd., 2010.
5. Sharma B.K., Engineering Chemistry, 2nd Edition, Krishna Prakasam Media (P) Ltd., 2001.
6. Mars G Fontana, Corrosion Engineering, 3rd Edition, Tata McGraw Hill, 2008.
7. David Linden, Thomas B Reddy, Handbook of Batteries, 4th Edition, McGraw-Hill, 2010.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 Questions of 2 marks each-No choice **20 Marks**

PART B : 2 Questions from each unit of internal choice, each carrying 12 marks. **60 Marks**
(Out of 80 marks, maximum of 10% problems may be asked)

SMT1101	ENGINEERING MATHEMATICS - I (Common to ALL branches except BIO GROUPS)	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

The ability to identify, reflect upon, evaluate and apply different types of information and knowledge to form independent judgments. Analytical, logical thinking and conclusions based on quantitative information will be the main objective of learning this subject.

UNIT 1 MATRICES 12 Hrs.

Characteristic equation of a square matrix - Eigen values and Eigen vectors of a real matrix- properties of Eigen values- Cayley-Hamilton theorem (without proof) - verification , finding inverse and power of a matrix - Diagonalisation of a matrix using orthogonal transformation - Reduction of quadratic form to canonical form by orthogonal transformation.

UNIT 2 GEOMETRICAL APPLICATIONS OF DIFFERENTIAL CALCULUS 13 Hrs.

Curvature -centre, radius and circle of curvature in Cartesian co- ordinates - Evolutes - Envelope of family of curves with one and two parameters. - Evolute as envelope of normals.

UNIT 3 FUNCTIONS OF SEVERAL VARIABLES 11 Hrs.

Introduction to partial derivatives - Jacobians - Taylor's expansion - Maxima and minima of functions of two variables - Constrained maxima and minima using Lagrange's multiplier method.

UNIT 4 ORDINARY DIFFERENTIAL EQUATIONS 11 Hrs.

First order exact differential equations - Second order linear differential equations with constant coefficients - Particular Integral for e^{ax}, sinax or cosax, x^n, $x^n e^{ax}$, e^{ax}sinbx or e^{ax}cosbx - Equations reducible to linear equations with constant co-efficients using $x = e^t$ - Simultaneous first order linear equations with constant coefficients - Method of Variation of Parameters

UNIT 5 THREE DIMENSIONAL ANALYTICAL GEOMETRY 13 Hrs.

Direction cosines and ratios - Plane - Plane through intersection of two planes - Straight Line - Coplanar lines - Planes and Straight lines - Shortest distance between two Skew lines - Sphere -Plane section of a sphere - Great Circle.

Max. 60 Hours

TEXT / REFERENCE BOOKS

1. Veerarajan T, Engineering Mathematics for First Year, II Edition, Tata McGraw Hill Publishers, 2008.
2. Kandaswamy P & co., Engineering Mathematics for First Year, IX revised edition, S.Chand & Co Pub., 2010.
3. Moorthy M.B.K, Senthilvadivu K ,Engineering mathematics-I, Revised Edition, VRB Pub., 2010,
4. Arumugam S & co. Engineering Mathematics Vol-I , Revised Edition, SciTech Pub., 2010
5. Venkataraman M.K., Engineering Mathematics - First Year (2nd edition), National Publishing Co., 2000.
6. Kreyszig. E, Advanced Engineering Mathematics, 10th edition, John Wiley & Sons, Singapore, 2012.
7. Grewal B. S, Higher Engineering Mathematics, 41th Edition, Khanna Publications, Delhi,2011.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice, each carrying 12 marks **60 Marks**

SMT1102	STATISTICS (Common to BIO GROUPS)	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

The ability to identify, reflect upon, evaluate and apply different types of information and knowledge to form independent judgments. Analytical, logical thinking and conclusions based on quantitative information will be the main objective of learning this subject.

UNIT 1 DESCRIPTIVE STATISTICS 13 Hrs.

Measures of central tendency: Mean, Median, Mode - Measures of dispersion: Quartile Deviation and Standard deviation-Coefficients of variation, Skewness and Kurtosis (Pearson's and Bowley's)

UNIT 2 CORRELATION AND REGRESSION 11 Hrs.

Karl Pearson's Correlation Coefficient, Spearman's Rank Correlation Coefficient, Tied ranks - Linear Regression Analysis - Fitting of straight line and parabola by the method of least squares.

UNIT 3 PERMUTATIONS AND COMBINATIONS 12 Hrs.

Fundamental principal of counting - Permutation - Circular permutation - Combination - Relation between Permutation and Combination (simple problems) - Binomial Theorem (positive Integral Index only) - General term - Term independent of x - Coefficient of x^n .

UNIT 4 INTRODUCTION TO PROBABILITY 11 Hrs.

Definitions, Sample Space, Events, Addition Law of probability, Multiplication law of probability - Conditional probability - Baye's theorem (without proof).

UNIT 5 RANDOM VARIABLES 13 Hrs.

Definition of a random variable - Discrete and continuous random variables, Probability Mass function, Probability Density Function, Cumulative Distribution Function (Definition only) - Mathematical expectation - Mean and Variance (Definition and properties only) - Binomial Distribution, Poisson Distribution and Normal Distribution - Mean, Variance and applications only.

Max. 60 Hours

TEXT / REFERENCE BOOKS

1. John E Freund, Irvin Miller & Marylees Miller Mathematical Statistics, Edition-6, Prentice Hall, 1999.
2. Irvin Miller, John E Freund, Probability and Statistics for Engineers, Prentice Hall, 1997.
3. Veerarajan T, Probability, Statistics and Random Process, 4th Edition, Tata Mcgraw Hill, 2008.
4. Murray R. Spiegel, Schaum's Outline of Theory and Problems of Probability and Statistics, McGraw Hill, 1975.
5. Vittal P R, Allied Mathematics, Margham Publications, 3rd Edition, 2002.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice, each carrying 12 marks **60 Marks**

SCS1102	FUNDAMENTALS OF PROGRAMMING (Common to ALL Branches of B.E/ B. Tech.)	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the basic programming concepts.
- To understand the concept of arrays, functions and pointers.
- To gain knowledge about memory management.

UNIT 1 INTRODUCTION 9 Hrs.

Introduction: Algorithms, Pseudocodes & flowcharts, Overview of C, features of C, Structure of C program, Compilation & execution of C program. Identifiers, variables, expression, keywords, data types, constants, scope and life of variables, and local and global variables. Operators: arithmetic, logical, relational, conditional and bitwise operators. Special operators: sizeof () & comma (,) operator. Precedence and associativity of operators & Type conversion in expressions.

Basic input/output and library functions: Single character input/output i.e. getch(), getchar(), getche() & putchar(). Formatted input/output: printf() and scanf().

UNIT 2 CONTROL STRUCTURES AND FUNCTIONS 9 Hrs.

Control structures: Conditional control (if, nested if, switch case), Loop control (for, while, do while) and Unconditional control structures (goto)

Functions: The Need of a function, user defined and library function, prototype of a function, calling of a function, function argument, passing arguments to function, return values, nesting of function, recursion.
Library Functions: Concepts, mathematical and string functions.

UNIT 3 ARRAYS AND STRINGS 9 Hrs.

Arrays: Single and multidimensional arrays, array declaration and initialization of arrays, array as function arguments.

Strings: Declaration, initialization and string handling functions.

Structure and Union: Defining structure, declaration of structure variable, accessing structure members, nested structures, array of structures, structure assignment, structure as function argument, function that returns structure, union.

UNIT 4 STORAGE CLASSES AND POINTERS 9 Hrs.

Storage class specifier - auto, extern, static & register

Pointers: The '&' and '*' operators, pointers expressions, pointers Vs arrays

UNIT 5 MEMORY MANAGEMENT 9 Hrs.

Pointer to functions, Function returning pointers

Direct Memory Access functions: malloc(), calloc(), sizeof(), free() and realloc(). Preprocessor directives.

Command line arguments

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Balaguruswami. E., Programming in C, TMH Publications,1997
2. Yashavant P. Kanetkar., Let us C, Fifth Edition, .2013
3. Gottfried , Programming with C, Schaums Outline Series, TMH publications,1997
4. Mahapatra , Thinking in C, PHI publications,2nd Edition,1998.
5. Subburaj . R , "Programming in C" , Vikas Publishing, First Edition, 2000

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice, each carrying 12 marks **60 Marks**

SBT1101	CELL AND MOLECULAR BIOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Pre-requisite-Basic knowledge in Life sciences. At the end of the course, the students would have gained extensive knowledge in cell structure, functions, cell signaling pathways and transfer across membranes in cells.
- The course aims to develop skills of the students in the area of Molecular biology. This will be necessary for studies of genetic material and also a prerequisite for other biology etc.,

UNIT 1 CELL STRUCTURE AND CELL DIVISION 11 Hrs.

Structure and function of Prokaryotic and Eukaryotic cells. Structure and functions of cell organelles - Mitochondria, ER, Ribosome, Golgibodies, Nucleus. Organization of Plasma membrane, Membrane models. Cell division-Mitosis & Meiosis, Cell cycle and its Regulation

UNIT 2 TRANSPORT ACROSS CELL MEMBRANE 11 Hrs.

Passive and active transports, Permeases, Sodium **-**potassium pumps, Ca^{2+} ATPase pump, ATP dependant proton pumps, co-transport, symport, antiport, Endocytosis and Exocytosis. Introduction to intra and extra cellular products of medicinal use (Eg:Insulin, mAb).

UNIT 3 CELL RECEPTORS AND CELL SIGNALING 9 Hrs.

Membrane bound, cytosolic and nuclear receptors, autocrine, paracrine and endocrine signaling, signal amplification, CAMP, role of IP_3, CAMP and G-protein role in signal transduction, Ca^{2+} influx and its role in cell signaling.

UNIT 4 NUCLEIC ACIDS & REPLICATION 7 Hrs

Structure of DNA **-** Watson & Crick model, Base equivalence in DNA, different forms of DNA; RNA and its types including miRNA, siRNA. DNA Replication **-** Conservative, Semi-Conservative and bidirectional

UNIT 5 GENE REGULATION 7 Hrs.

Genetic code, Prokaryotic Transcription, Translation and post translational modifications, Operon Concept- Lac, gal, trp operon.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Ajoy Paul, A text Book of Cell and Molecular Biology, Books and Allied Publishers 2007.
2. Darnell J Lodish,H. Baltimore, Molecular cell biology, Free Man,1990.
3. David Freifelder, Molecular Biology- 2 nd Edition, Narosa publishing house, 1998.
4. De Roberties and De Roberties.JR, Cell and Molecular Biology- BI publishions ,1987.
5. Stryer, L., Biochemsitry, 4th Edition, W.H. Freeman & Co., 2000.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SPH4051	ENGINEERING PHYSICS LAB (Common for all branches of B.E/B.Tech)	L	T	P	Credits	Total Marks
		0	0	2	1	50

SUGGESTED LIST OF EXPERIMENTS

1. Quincke's method – Determination of magnetic susceptibility of a liquid.
2. Semiconductor diode - Determination of the forbidden energy gap.
3. Optical Fibre – Determination of Numerical aperture and attenuation loss.
4. Torsional pendulum – Determination of Moment of inertia and Rigidity modulus of the wire.
5. Young's modulus – non-uniform bending- Determination of Young's modulus of the material of beam.
6. Spectrometer – Hallow prism – Determination of Refractive index of a liquid.
7. Copper Voltameter – determination of electrochemical equivalent of copper.
8. Lees Disc – Determination of thermal conductivity of bad conductor.
9. LASER grating – Determination of wavelength of laser light.
10. Newton's Rings – Determination of Radius of Curvature of convex lens.

SCY4051	ENGINEERING CHEMISTRY LAB (Common for all branches of B.E/B.Tech)	L	T	P	Credits	Total Marks
		0	0	2	1	50

SUGGESTED LIST OF EXPERIMENTS

1. Estimation of ferrous ion by potentiometric method.
2. Determination of pKa value of glycine using pH meter.
3. Estimation of mixture of acids by conductometric method.
4. Estimation of Nickel by using photocolorimeter.
5. Determination of viscosity of polymers by using Ostwald's viscometer.
6. Estimation of total hardness of water sample by EDTA / AAS method.

SCS4101	PROGRAMMING IN C LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

SUGGESTED LIST OF EXPERIMENTS

1. Program to understand the basic data types and input/output functions.
2. Program for Looping and decision statements.
3. Program on Functions.
4. Program on Arrays.
5. Program on String Manipulations
6. Program on Structures and Union.
7. Program on Pointers.
8. Program to demonstrate the Command Line Arguments.
9. Program using Dynamic memory allocation.
10. Program to implement the Random Access in Files.
11. Program to implement math function.
12. Program to Implement sorting algorithms
13. Program to Implement searching algorithms
14. Programs to solve some of the Engineering applications.

SHS1101	ENGLISH FOR SCIENCE AND TECHNOLOGY (Common to ALL branches of B.E/B.Tech)	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

To equip the learners with English communicative skills to handle the present and future needs by exposing them to situations and tasks in the areas of LSRW, genre and register related to EST by following content based teaching.

UNIT 1 BASIC COMMUNICATION 9 Hrs.

Listening for specific information, Self Introduction, Reading Comprehension, Kinds of Sentences, Parts of Speech, Tenses & its Types, Impersonal Passive, Elements of Effective Writing, Letter Writing, Concord, Prefixes & Suffixes

UNIT 2 NUANCES OF EST 9 Hrs.

Listening for inference, Describing a process, Cloze Reading and its types, Transcoding - Encoding & Decoding, Flow Chart, Bar chart, Pie Chart, Tabular Column, Tree Diagram, Technical Definitions, Connectives & Discourse Markers, Word Association- connotations

UNIT 3 EST NOW AND THEN 9 Hrs.

Listening and Note taking, Role-play, Reading and interpreting visual material (pictures/newspapers) Essay Writing - Note Making - WH questions - Question Tags - Types of sentences - Compound Nouns, Technical Definitions.

UNIT 4 APPLICATIONS OF EST 9 Hrs.

Listening and Classifying information, Group discussion, Reading and identifying the topic sentence, - Writing a Project Proposal, Recommendations and Instructions - Manual Writing, Use of abbreviations and acronyms, Editing (Spelling, Grammar, Punctuation) Idioms & Phrases.

UNIT 5 PREPARING FOR FUTURE 9 Hrs.

Listening and summarizing, Making presentations on given topics - Giving impromptu talks Reading and Summarizing, E-mail writing, Rearranging the Jumbled sentences Reported Speech, Homophones/Homonyms, Creative Writing & Poster making using similes/metaphors.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Sangeetha Sharma & Meenakshi Raman, Technical Communication: Principles and Practice. Oxford University Press, New Delhi, 2011.
2. Sanjay Kumar & Pushp Lata**,** *Communication Skills, 2*nd Edition, *Oxford University Press,* New Delhi, 2011.
3. Nira Konar, Communication Skills for Professionals, PHI Publishers, Eastern Economy Edition, New Delhi, 2011.
4. Sharon J Gerson & Steven M Gerson, Technical Communication: Process and Product, 8th Edition, Orient Longman, 2013.
5. Tyagi Kavita and Misra Padma, Basic Technical Communication PHI Publishers, Eastern Economy Edition, New Delhi, 2011.
6. Nagini,P S et al. Excellence Through communication, Shri Jai Publications, Chennai, 2005.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice; with equal distribution to each unit -(10 x 2) **20 Marks**
(Task types can include Multiple choice, open ended, gap filling, completion and rewriting the sentences, matching type etc.)

PART B : 2 questions from each unit with internal choice; each carrying 12 marks (5 X 10) **60 Marks**
(Questions types should testing vocabulary, grammar, reading and writing with equal distribution to all. For example Reading Comprehension type can include skimming, scanning, comprehensive with evaluative, inferential and hypothetical question/ fixed type questions or cloze exercise , Academic paragraph writing based on Flow chart, Tree diagram, Bar diagram, Table and Pie chart to describe process, comparative and contrast, differentiate , Formal letter writing - Application for a Job & Resume Preparation/ Email-Letter inviting a dignitary-Accepting/Declining (or) Rearranging the jumbled sentences in the right order, (or) Requesting for Practical Training/ Letter to the Editor. Writing a Project Proposal / Project Report (or) Essay Writing**-** Writing an Essay on a given topic, Summary writing or Making notes in the standard format with title. Grammar Rearranging the jumbled sentences in the right order or editing the paragraph for errors based on syllabus**)**

SMT1105	ENGINEERING MATHEMATICS - II (Common to ALL branches except BIO Groups)	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

Analytical, logical thinking and conclusions based on quantitative information will be the main objective of learning this subject.

UNIT 1 MULTIPLE INTEGRALS 13 Hrs.

Double integrals in cartesian and polar co-ordinates - Change the order of integration - Change of variables from cartesian to polar coordinates- Area of plane curves using double integrals- Triple integrals - Volume using triple integrals in cartesian co-ordinates (simple applications).

UNIT 2 BETA AND GAMMA INTEGRALS 11 Hrs.

Properties of definite Integrals and problems - Beta and Gamma integrals - Relation between them - Properties of Beta and Gamma integrals with proofs - Evaluation of definite integrals in terms of Beta and Gamma function - Simple applications (evaluation of double integrals).

UNIT 3 VECTOR CALCULUS 12 Hrs.

Gradient, divergence and curl - Directional derivative - Irrotational and Solenoidal vector fields - Vector Integration - Simple problems on line, surface and volume Integrals, Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (without proofs)- Simple applications involving cubes and rectangular parallelopipeds.

UNIT 4 LAPLACE TRANSFORMS 14 Hrs.

Laplace transform - Transforms of standard functions - properties- Transforms of derivatives and integrals - Transforms of the type $e^{at}f(t)$, $tf(t)$, $f(t)/t$ - Transform of periodic functions - Transform of unit step function and impulse function - Inverse Laplace transforms - Convolution theorem - Initial and final value theorems

UNIT 5 APPLICATIONS OF LAPLACE TRANSFORM 10 Hrs.

Llinear ordinary differential equation with constant co-efficients - Integral equations - Integral equations of convolution type -simultaneous linear differential equations with constant co-efficients.

Max. 60 Hours

TEXT / REFERENCE BOOKS

1. Kreyszig. E, Advanced Engineering Mathematics, 10th edition, John Wiley & Sons, Singapore, 2012.
2. Grewal B. S, Higher Engineering Mathematics, 41th Edition, Khanna Publications, Delhi,2011.
3. Bali N.P and Manish Goyal, A Text book of Engineering Mathematics, Eigth Edition, Laxmi Publications Pvt Ltd., 2011.
4. Venkatraman M.K, Engineering Mathematics, National Publishing Company, 2000.
5. NarayananS., Manicavachagom Pillay T.K., Ramanaiah G., Advanced Mathematics for Engineering students, Volume I, 2nd Edition, S. Viswanathan Printers and Publishers, 1992.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice, each carrying 12 marks **60 Marks**

SMT1106	ENGINEERING MATHEMATICS - II (Common to BIO Groups)	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

The ability to identify, reflect upon, evaluate and apply different types of information and knowledge to form independent judgments.

UNIT 1 MATRICES 12 Hrs.

Rank of a Matrix - Consistency of linear Algebraic equations - Characteristic equation of a matrix - Eigenvalues and Eigen vectors of a real matrix- Properties of Eigenvalues and Eigenvectors, Cayley-Hamilton theorem (without proof) verification - Finding Inverse and Power of a matrix using Cayley-Hamilton Theorem .

UNIT 2 DIFFERENTIAL CALCULUS 11 Hrs.

Definitions - Derivative of standard functions (Results only) - Addition, subtraction, Multiplication and Quotient rules of differentiation - Differentiation of function of function - Logarithmic derivatives - Derivatives of implicit function, Successive differentiation ,Partial derivatives (Simple Problems only)

UNIT 3 INTEGRAL CALCULUS 13 Hrs.

Integral of standard functions (Results only) -Integration by the method of substitution- Integration using partial fractions - Integration by parts -Generalization of integration by parts (Bernoulli's formula) - Definite integral - Properties - Simple problems.

UNIT 4 VECTOR CALCULUS 12 Hrs.

Scalar field and Vector field - Differentiation of a vector function - Gradient, Divergence and Curl - Directional Derivative - Identities (without proof) - Irrotational and Solenoidal fields

UNIT 5 THEORY OF SAMPLING AND TESTING OF HYPOTHESIS 12 Hrs.

Test of Hypothesis - Test of significance - Large samples - Z test - Single proportion - Difference of proportions - Single mean - Difference of means - Small samples - Student's t test - Single mean - Difference of means -Test of variance - Fisher's test - Chi square test - Goodness of fit - Independence of attributes.

Max. 60 Hours

TEXT / REFERENCE BOOKS

1. Vittal P R, Allied Mathematics, Margham Publications, 3rd Edition, 2002
2. Venkataraman M.K., Engineering Mathematics - First Year, 2nd Edition, National Publishing Co., Chennai, 2000.
3. Frank Ayres and NBSP Elliot Mendelson, Schaum's Outline of Theory and Problems of Differential and Integral Calculus, Tata McGraw Hill, 1990.
4. Narayanan S., Manicavachagom Pillay T.K., Ramanaiah G., Advanced Mathematics for Engineering students, Volume I, 2nd Edition,S.Viswanathan Printers and Publishers, 1992.
5. Kreyszig.E, Advanced Engineering Mathematics, 8th Edition, John Wiley & Sons, Singapore, 2001.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice, each carrying 12 marks **60 Marks**

SBT1102	BIOCHEMISTRY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To give an insight into the chemical aspects of biological macromolecules and their importance

UNIT 1 CARBOHYDRATES 9 Hrs

Introduction. Classification, Properties and Biological importance. Isomers, epimers, enantiomers, mutarotation, open chain and closed chain structures of glucose.

UNIT 2 AMINOACIDS AND PROTEINS 9 Hrs.

Aminoacids: classification- essential and non-essential amino acids, protein and non-protein amino acids, Zwitter ions. Proteins: Classification- based on i) shape and solubility and ii) increasing complexity of structure. Structure of proteins: primary, secondary, tertiary and quaternary, biological significance. Concept of isoelectric point and its significance.

UNIT 3 LIPIDS 9 Hrs.

Introduction, Classification, Properties and Biological importance. Fatty acid nomenclature and structure, Lipids in cell membrane
Cholesterol and Steroids, Hormones **-** structure and function

UNIT 4 NUCLEIC ACIDS 9 Hrs

Introduction- Nitrogeneous bases - Purines and Pyrimidines **-** Nucleosides and Nucleotides **--** Structure of nucleic acids **-** DNA, RNA: m-RNA, t-RNA, r-RNA **-** Biological importance of nucleic acids. 16s rRNA and its significance.

UNIT 5 VITAMINS AND MINERALS 9 Hrs

Vitamins: fat soluble and water soluble vitamins. Minerals: Micro and Macro minerals. Biological importance of vitamin and minerals, deficiency symptoms

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Lehninger, Nelson and Cox, Principles of Biochemistry, W.H.Freeman, 4th Edition, 2005
2. Donald Voet, Judith Voet and Charlotte Pratt, Principles of Biochemistry, John Wiley and Sons, 2008
3. Pamela C.Champe, Richard A.Harvey and Denise R.Ferrier, Biochemistry, Lippincott's Illustrated reviews, 4th edition, 2007
4. Stryer, L., Biochemsitry, 4th Edition, W.H. Freeman & Co., 2000.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SCY1103	CHEMISTRY OF INDUSTRIAL MATERIALS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To know the different types of coal, their analysis and gaseous fuels.
- To have a basic understanding about terms related to phase rule and its applications to various systems.
- To understand the requirements, classification of explosives and propellants used in aerospace industries.
- To provide an idea about lubrication mechanisms, properties and to learn the science of composites and abrasives.

UNIT 1 FUELS 9 Hrs.

Fuels: Introduction - Classification of fuels - Characteristics of a fuel - Determination of calorific value of a fuel by Bomb calorimeter. Coal: Classification of coals based on energy content. Chemistry and analysis of coal: Proximate analysis and ultimate analysis. Manufacture of metallurgical coke: Otto-Hoffmann's method. Cracking: Fluidized bed catalytic cracking. Knocking in compression ignition and spark ignition engines. Gaseous fuels: CNG - LPG - Producer gas. Ethanol as a fuel.

UNIT 2 PHASE EQUILIBRIA 9 Hrs.

Introduction: Definition of phase rule - Terms involved in phase rule with examples. One component system: Water system. Two component alloy systems: Classification - Reduced phase rule - Thermal analysis. Simple eutectic system: Lead-silver system. Congruent system: Zinc-magnesium system. Incongruent system: Sodium-potassium system.

UNIT 3 EXPLOSIVES AND ROCKET PROPELLANTS 9 Hrs.

Explosives: Requirements - Classification of explosives: Low explosives - Primary explosives - High explosives. Assessment of explosives: Sand bomb test - Drop height - Velocity of detonation. Rocket propellants: Types of rocket engines - Basic principle of rocket propulsion system - Specific impulse (I_{SP}) - Thrust: Momentum thrust and pressure thrust. Requirements of a good propellant. Classification of chemical propellants - Liquid fuels - Liquid oxidizers - Solid fuels - Solid oxidizers.

UNIT 4 LUBRICANTS 9 Hrs.

Introduction: Requirements and functions of lubricants. Mechanism of lubrication: Hydrodynamic lubrication - Boundary lubrication - Extreme pressure lubrication. Properties of lubricants: Viscosity index - Cloud point - Pour point - Flash point - Fire point - Oiliness - Sligh oxidation test - Aniline point. Classification of lubricants: Liquid lubricants - Semisolid lubricants - Solid lubricants.

UNIT 5 COMPOSITES AND ABRASIVES 9 Hrs.

Introduction: Definition. Constituents of composites: Matrix phase and dispersed phase - Examples. Metal matrix composites: Al matrix; Mg matrix and Ti matrix composites. Ceramic matrix composites: SiC marix and Alumina matrix composites. Polymer matrix composites: Fiber reinforced plastics (FRP) and its types. Application of composites. Cermets: Oxide base cermets - Carbide base cermets - Properties and applications. Abrasives: Definition - Properties: Moh's scale of Hardness. Classification: Natural and synthetic abrasives. Manufacture of abrasive paper and abrasive cloth.

MAX. 45 HOURS

TEXT/REFERENCE BOOKS

1. Jain P. C., and Monica Jain, Engineering Chemistry, 15th Edition, Dhanpat Rai Publishing Co., 2009.
2. Sheik Mideen A., Engineering Chemistry (I & II), 13th Edition, Shruthi Publishers, 2010.
3. Dara.S.S., Text Book of Engineering Chemistry, S.Chand & Co, 2009.
4. Kuriakose J. C., and Rajaram. J, Chemistry in Engineering and Technology, Vol.1 & 2, Tata McGraw Hill Publishing Company (P) Ltd., 2009.
5. Puri Br., Sharma Lr., Madhan S Pathania, Principles of Physical Chemistry, 41st Edition, Vishal Publishing Co., 2004.
6. Uppal M.M., Engineering Chemistry, 6th Edition, Khanna Publishers, 2006.
7. Agarwal O.P., Engineering Chemistry, 3rd Edition, Khanna Pubishers., 2003.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 Questions of 2 marks each-No choice **20 Marks**

PART B : 2 Questions from each unit of internal choice, each carrying 12 marks. **60 Marks**
(Out of 80 marks, maximum of 10% problems may be asked)

SCY1104	BIO ORGANIC CHEMISTRY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the fundamentals of classification, synthesis, properties and structural elucidation of carbohydrates, amino acids and proteins.
- To know the classification and properties of lipids and enzymes.
- To have overall idea about the structure and biological aspects of steroids, hormones, vitamins and nucleic acids.

UNIT 1 CARBOHYDRATES 9 Hrs.

Introduction: Classification: Sugars and Non-sugars. Building up of the sugar series: Aldoses. Conversion of higher to lower homologue and vice versa: Ascending and descending series - Kiliani Fischer synthesis - Ruff degradation. Glucose: Physical properties - Chemical properties: Epimerization - Mutarotation. Structural elucidation of glucose: Open chain and closed chain structure. Structure and biological importance of disaccharides: Sucrose - Maltose - Lactose. Structure and biological importance of polysaccharides: Starch - Cellulose - Chitin - Heparin - Peptidoglycan.

UNIT 2 AMINOACIDS AND PROTEINS 9 Hrs.

Aminoacids: Classification - α, β, and γ aminoacid - acidic, basic and neutral amino acids - Essential and non essential amino acids. Preparation: HVZ reaction - Strecker synthesis - Gabriel Phthalimide synthesis. Physical properties: Isoelectric point. Chemical properties: Reaction of amino group - Carboxyl group and both. Proteins: Classification based on shape and solubility - Classification based on increasing complexity of structure. Structure of proteins: Primary - Secondary - Tertiary - Quaternary.

UNIT 3 LIPIDS AND ENZYMES 9 Hrs.

Lipids: Occurrence and classification of lipids - Simple lipids: Fats - Distinction between fats and oils - Occurrence - Properties: Hydrolysis - Auto oxidation - Addition reactions. Analysis of fats and oils: Saponification value and Iodine number. Compound Lipids and Derived lipids.

Enzymes: Classification and nomenclature - Enzyme Kinetics: Michaelis-Menton equation. Enzyme activity - Mechanism of enzyme action.

UNIT 4 STEROIDS, HORMONES AND VITAMINS 9 Hrs.

Steroids: Introduction - Nomenclature. Cholesterol: Constitution (excluding synthesis) and biological importance.

Hormones: Introduction - Difference between hormones and vitamins. Classification - Structure and functions of steroid hormones: Androsterone - Progesterone - Testosterone - Estrone. Adrenocortical hormones: Cortisone.

Vitamins: Structure and importance of Vitamin D - Folic acid - Nicotinamide.

UNIT 5 NUCLEIC ACIDS 9 Hrs.

Introduction: Purines and Pyrimidines - Nucleosides and Nucleotides - Nitrogeneous bases - Structure of nucleic acids - DNA, RNA, m-RNA, t-RNA, r-RNA - 70s and 80s - Biological importance of nucleic acids - Sequencing of nucleic acids - Maxam-Gilbert's method and Sanger's method.

Max. 45 HOURS

TEXT / REFERENCE BOOKS

1. Jain J. l., Nitin Jain, Sunjay Jain, Fundamentals of Biochemistry, 6th Edition, S. Chand and Sons, 2013.
2. David L. Nelson, Michael M. Cox, Lehninger Principles of Biochemistry, 6th Edition, W. H. Freeman, 2013.
3. Gurdeep R Chatwal, Organic Chemistry of Natural Products Vol II , 2nd Revised Edition, Himalaya Publishing House, 1986.
4. Tewari K.S., Vishnoi N.K. and Mehrotra S.N., A Text Book of Organic Chemistry, 2nd Revised Edition, Vikas Publications, 2004.
5. Rastogi S.C., Biochemistry, 6th Reprint, Tata McGraw Hill Publishing Limited, 2007.
6. Styer L., Biochemistry, . 4th Edition, W.H. Freeman & Co, 1995.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 Questions of 2 marks each-No choice **20 Marks**

PART B : 2 Questions from each unit of internal choice, each carrying 12 marks. **60 Marks**
(Out of 80 marks, maximum of 10% problems may be asked)

SCY1105	PHYSICAL CHEMISTRY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the fundamentals related to the phase diagrams and their applications.
- To know about the types and properties of solutions.
- To expose the students for various separation techniques for the purification of compounds.
- To provide an idea about the chemical kinetics in terms of order, molecularity and their derivations involved.
- To give an overview about the advanced electrochemical applications.

UNIT 1 PHASE RULE 9 Hrs.

Phase diagram - Information from phase diagram - Terminology used in phase diagram. Gibb's phase rule - Derivation. One component system: Water system. Two component alloy systems: Classification - Reduced phase rule - Thermal analysis. Simple eutectic system: Lead-silver system. Congruent System: Zinc-magnesium system. Incongruent system: Sodium-potassium system. Phase diagram of simple three component system.

UNIT 2 SOLUTIONS 9 Hrs.

Introduction: Solid solution - Hume Rothery's rule. Types of solid solutions: Liquid solutions: Solubility of partially miscible liquids - Phenol-water system. Colligative properties: Lowering of vapour pressure. Raoult's law: Derivation - Osmotic pressure - Isotonic solution - Relationship between osmotic pressure and vapour pressure. Depression in freezing point - Derivation. Elevation in boiling point - Derivation - Problems.

UNIT 3 SEPARATION TECHNIQUES 9 Hrs.

Distillation techniques: Fractional distillation - Steam distillation - Vacuum distillation. Chromatography: Elution analysis - Paper chromatography - Thin layer chromatography - Liquid chromatography - High performance liquid chromatography (HPLC) - Gas chromatography (GC).

UNIT 4 CHEMICAL KINETICS 9 Hrs.

Introduction: First and second order reactions: Integration - Integration of n^{th} order reaction. Methods of determining order and molecularity. Collision theory of bimolecular gaseous reactions - Activated complex of bimolecular reactions - Lindemann theory of unimolecular equation - Kinetics of complex reactions: Reversible reaction - Consecutive reaction - Chain reactions - Autocatalysis - Problems.

UNIT 5 ADVANCED ELECTROCHEMISTRY 9 Hrs.

Introduction: Cell constant - Equivalent conductance - Molar conductance. Ionic mobility: Transport number - Moving boundary method - Hittorff's method. Debye Huckel theory of strong electrolytes. Concentration cells: Types - Concentration cells without transference and with transference. Potentiometric tritrations: Redox titration. Polarography - Applications of polarography.

Max. 45 HOURS

TEXT / REFERENCE BOOKS

1. Puri B.R., Sharma L. R., Madan. S.Pathania, Principles of Physical Chemistry, 41st Edition , Vishal Publishing co., 2004.
2. Keith J. Laidler, Chemical Kinetics, Third Edition, Pearson education limited, 2004.
3. Atkins P. W., Physical Chemistry, 6th edition, Oxford University press, 1998.
4. Barrow G. M., Physical Chemistry, 5th edition, McGraw-Hill, 1988.
5. Glasstone S., A Text book of Physical Chemistry, Macmillan Ltd, 1976.
6. Jayakumar V., Engineering Metallurgy, ARS publications, 2012.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 Questions of 2 marks each-No choice **20 Marks**

PART B : 2 Questions from each unit of internal choice, each carrying 12 marks. **60 Marks**
(Out of 80 marks, maximum of 10% problems may be asked)

SBT1103	MICROBIOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To enable students to learn about the principles of Microbiology to emphasize structure and biochemical aspects of various micro organisms.
- To know the control and preventive measures of microbial infections and environmental pollutions.

UNIT 1 INTRODUCTION TO MICROBIOLOGY 11 Hrs.

Introduction, History and scope of microbiology, Contributions of Leewenhoek, Pasteur, Koch, Jenner and Fleming, Microbial classification: Classical and Current systems, Methods of identifying microbes.

Basics of Microscopy, Staining: simple, differential (Gram staining, Acid fast staining), special staining (flagella,capsule,endospore)

UNIT 2 MICROBIAL STRUCTURE AND REPRODUCTION 9 Hrs.

Morphology and Reproduction: Bacteria **-** General structure and forms, Reproduction methods **-** Fission, budding and sporulation, Virus **-** TMV, HIV & T4 bacteriophage **-** lytic, lysogenic cycle, Fungi **-** Fungal morphology **-** Mycelial and yeast forms **-** sexual and asexual Reproduction, Actinomycete

UNIT 3 MICROBIAL GROWTH AND PHYSIOLOGY 7 Hrs.

Microbial Growth and Nutrition, Types of media **-** Based on Consistency, Nutritional components, Funtional uses and application, Microbial types based on nutrition, Growth of microbes in culture **-** Pure culture techniques, Batch & Continous **-** Growth curve **-** Enumeration methods , Types of fungal growth media. Aerobic and Anaerobic metabolism of sugars, mixed acid fermentation.

UNIT 4 CONTROL OF MICROORGANISMS 9 Hrs

Definitions of frequently used terms - Pattern or Rate of Microbial Death, Physical methods of Microbial Control: Heat (Moist & Dry), Low temperature, Filtration, High pressure, Desiccation, Osmotic pressure, Radiation. Chemical methods of Microbial Control: Liquids - Alcholos, Aldehydes, Phenolics, Halogens - Heavy metals, Surface active agents & Dyes, Gases **-** Formaldehyde, Ethylene Oxide, Plasma **-** Physico-chemical methods - Chemotherapeutic agents - Evaluation of effectiveness of antimicrobial agents. Difference between cleaning **-** sanitizing **-** sterilizing agents. Moist heat sterilization: D, Z and F Values and significance.

UNIT 5 APPLICATIONS OF MICROBIOLOGY 9 Hrs.

Microbial ecology: Microbe-Microbe interaction - Mutualism, Commensalism, Altruism, Microbe **-** host interactions - Colonization and Infection**-** Causes and Transmission of Infectious Diseases, Emerging and re-emerging infectious diseases **-** Mechanism and examples, Multidrug resistance **-** MRSA, Diagnostic Microbiology, Childhood and adult vaccinations **-** MMR, Polio, Rabies etc, bioterrorism agents, Biofilm - Quorum sensing,

Max. 45 Hours.

TEXT / REFERENCE BOOKS

1. Pelczar, Jr E.C.S Chan and noel R.Krieg, Microbiology, 5th edition Tata McGrawHill -2006
2. Joanne M. Willey, Linda Sherwood, Christopher J. Woolverton, Prescott's Microbiology, 8th Edition, McGraw-Hill Higher Education, 2008
3. Jawetz, Melnick and Adelberg's Medical Microbiology . McGraw-Hill Medical, 2007
4. University of South Carolina School of Medicine (http://pathmicro.med.sc.edu/book/bact-sta.htm)

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT1104	GENETICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To introduce a fascinating and controversial area of contemporary science, this course presents basic terms, principles, and research methods used in the study of genetics.
- To learn about the transmission, distribution, arrangement, and alteration of genetic information and how it functions and is maintained in populations.

UNIT 1 MENDELIAN PRINCIPLE **9 Hrs.**

DNA as hereditary material, Mendel and his experiments, laws of inheritance, variations in Mendel's Theme: incomplete dominance, co-dominance and multiple allele, Gene interactions; Epistasis, Duplicate, Complementary, Supplementary and Lethal genes

UNIT 2 CHROMOSOMES **9 Hrs.**

Structural organization, variation in the number and structure of chromosome; Haploids, missing and extra chromosome (Euploid and aneuploid); Deletion, Duplication, Translocation and other structural rearrangements. Chromosomal studies **-** karyotyping. Chromosomal theory of inheritance; clues from inheritance of sex, linkage, crossing over.

UNIT 3 GENETIC MATERIAL AND MUTATION **9 Hrs.**

Evidence for DNA and RNA as genetic material; Mutations **-** types and causes of mutation, DNA repair Mechanisms. Physiochemical properties of DNA: Denaturation, Annealing and C-value paradox.

UNIT 4 BACTERIAL GENETICS **9 Hrs.**

Bacterial gene transfer; conjugation, transformation, transduction **-** general, restricted and abortive transductions; Bacterial plasmids: structure, properties and its types; transposons, types of transposons.

UNIT 5 HUMAN GENETICS **9 Hrs.**

Human Chromosomes, Dosage Compensation, Chromosomal abnormalities - sex chromosomal and autosomal. Inherited disorders, Genetic engineering, gene therapy, inborn errors of metabolism and Genetic counseling. Knock down and gene silencing.

Max. 45 Hours.

TEXT / REFERENCE BOOKS

1. David Friefelder, Molecular Genetics, Narosa publishing house, India, 2006.
2. Kavita B Ahluwalia, Genetics, New age international publishers, India. 2008.
3. Gardner, E.J, Simmons, Snustad, Principles of Genetics, 8th Edition John Wiby & Sons ltd, 1991.
4. Griffith, Fundamentals of Genetics analysis, 7th Edition, W.H. Freeman & Company, Newyork, 2000.
5. Robert Tamarin, Principles of Genetics, 7th Edition, Tata McGraw-Hill Edition, New York.2002.
6. Molecular Biology of Genes **-** Watson, 7th Edition, Benjamin Cummings, 2013

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SCH1103	PRINCIPLES OF CHEMICAL ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- The aim of the course is to develop skills of the Students in the area of Chemical Engineering which will be necessary for certain other course offered in the subsequent semesters.

UNIT 1 INTRODUCTION 9 Hrs.

Introduction to chemical engineering sciences and its role in the design & analysis of biological processes, overview of unit operations and processes in the chemical industry. Basic and derived units, conversion factor, introduction to dimensional analysis, dimensionless numbers.

UNIT 2 FLUID FLOW AND MIXING 9 Hrs.

Definition, Classification of fluids- Newtonian and non Newtonian, types of flow, basic equations of fluid flow-continuity and Bernoulli's equation, Hagen-Pouseuille equation, Fluid mixing, mixing equipments, assessing effectiveness of mixing and power consumption in mixing, Rheology of fermentation broths.

UNIT 3 HEAT TRANSFER 9 Hrs.

Introduction to various modes of heat transfer, Conduction- Fourier's law of heat conduction, thermal conductivity, Convection- individual and overall heat transfer coefficient, LMTD, radiation, Typical heat exchange equipment, counter current and parallel-current flows, Double pipe exchanger, shell-and-tube exchanger, condensers, kettle-type boilers.

UNIT 4 MASS TRANSFER 9 Hrs.

Introduction to Mass transfer and diffusion, Ficks law for molecular diffusion, Molecular diffusion in gases-steady-state diffusion of A through non diffusing B and equimolar counter diffusion in gases. Molecular diffusion in liquids-steady state diffusion of A through non diffusing B and equimolal counter diffusion. Molecular diffusion in biological solutions and gels.

UNIT 5 THERMODYNAMICS 9 Hrs.

Concept of system and surroundings, intensive and extensive properties, energy and work in transit, state function, path function, Internal energy, enthalpy, entropy, zeroth, first and second laws of thermodynamics, Gibbs free energy, thermodynamic analysis of processes **-** lost work, irreversibility.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. David H.Himmelblau., Basic principles and calculations in chemical engineering, 6th Edition, Eastern Economy 2003.
2. Richard G. Griskey., chemical engineering for chemists 1st Edition, American chemical society, 1997.
3. Pauline M. Doran., Bioprocess Engineering Principles, 4th Edition, Academic Press, 1995.
4. Stanbury P.F., Whitaker A. and Hall S.J., Principles of Fermentation Technology, 3rd Edition, Elsevier Science Publishers, 1998
5. Stefaan J R simons, Concepts of chemical engineering for chemists, 2nd Edition, RSC publishers, Royal society of chemistry,2007.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80. **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBM4060	THERAPEUTIC INSTRUMENTATION LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

SUGGESTED LIST OF EXPERIMENTS

1. Surgical Diathermy
2. Defibrillator (Demo)
3. Haemodialysis
4. Ventilators
5. Anesthesia Machine
6. Nebulizer
7. Pacemaker (Demo)
8. Humidifiers
9. Shockwave Therapy
10. Cerebellar Stimulators
11. Physiotherapy equipment – Digi laser, Indsonic, Indotherm – 500W

SBT4051	MICROBIOLOGY LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

SUGGESTED LIST OF EXPERIMENTS

1. Laboratory rules and regulations
2. Understanding use of chemical and biological indicators
3. Preparation of Glassware's and sterilization
4. Understanding autoclave, hot air oven and their functions
5. Preparation of culture media for bacteria – Nutrient broth and Nutrient Agar
6. Workshop on the key challenges during large scale media preparation
7. Isolation and Pure culture of bacteria – Pour plate method , spread plate method and streak plate method & membrane filtration method.
8. Staining – Simple, Gram's and Negative staining.
9. Motility of bacteria – Hanging drop method and stabbing culture technique.
10. Isolation and observation of fungi – Lactophenol cotton blue staining.
11. Antibiotic sensitivity test.
12. Identification of bacteria by Biochemical Tests : Different carbon source utilization test , IMVic test and catalase and oxidase test.

SBT4052	CYTOGENETICS LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

SUGGESTED LIST OF EXPERIMENTS

1. Studying of plant, animal and bacterial cell structures by microscopy
2. Study of mitotic stages
3. Study of meiotic stages
4. Preparation of buccal smear for identification of Barr Bodies
5. Preparation of Idiogram
6. Study of Chromosomal abnormalities (with the help of permanent slides)
7. Study of cancer cells (with the help of permanent slides)

SMT1201	ENGINEERING MATHEMATICS - III (Common to ALL branches except BIO GROUPS, CSE & IT)	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

The ability to identify, reflect upon, evaluate and apply different types of information and knowledge to form independent judgments. Analytical, logical thinking and conclusions based on quantitative information will be the main objective of learning this subject.

UNIT 1 COMPLEX VARIABLES 11 Hrs.

Analytic functions - Cauchy- Riemann equations in cartesian and polar form - Harmonic functions - properties of analytic functions - Construction of analytic functions using Milne - Thompson method - Bilinear transformation.

UNIT 2 COMPLEX INTEGRATION 12 Hrs.

Cauchy's integral theorem - Cauchy's integral formula - problems - Taylor's and Laurent's series - Singularities - Poles and Residues - Cauchy's residue theorem and problems.

UNIT 3 FOURIER TRANSFORMS 12 Hrs.

The infinite Fourier transform - Sine and Cosine transform - Properties - Inversion theorem - Convolution theorem - Parseval's identity - Finite Fourier sine and cosine transform.

UNIT 4 PARTIAL DIFFERENTIAL EQUATIONS 13 Hrs.

Formation of equations by elimination of arbitrary constants and arbitrary functions - Solutions of PDE - general, particular and complete integrals - Solutions of First order Linear PDE (Lagrange's linear equation) - Solution of Linear Homogeneous PDE of higher order with constant coefficients.

UNIT 5 THEORY OF SAMPLING AND TESTING OF HYPOTHESIS 12 Hrs.

Test of Hypothesis - test of significance - Large samples - Z test - single proportion - difference of proportions - Single mean - difference of means - Small samples - Student's t test - single mean - difference of means -Test of variance - Fisher's test - Chi square test - goodness of fit - independence of attributes.

Max. 60 Hours

TEXT / REFERENCE BOOKS

1. Kreyszig, E., Advanced Engineering Mathematics (8th Edition), John Wiley and Sons (Asia)Pvt. Ltd., Singapore, 2001.
2. Grewal,B.S., Higher Engineering Mathematics, Tata Mcgraw Hill Publishing Co., New Delhi, 1999.
3. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., Engineering Mathematics, (4th Revised Edition), S.Chand&Co., New Delhi, 2001.
4. Veerarajan,T., Engineering Mathematics Tata Mcgraw Hill Publishing Co., NewDelhi, 1999.
5. S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics, S.Chand & Company, 2012.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice, each carrying 12 marks **60 Marks**

SMT1202	ENGINEERING MATHEMATICS - III (Common to BIOTECHNOLOGY, BIOINFORMATICS and BIOMEDICAL)	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

The ability to identify, reflect upon, evaluate and apply different types of information and knowledge to form independent judgments. Analytical, logical thinking and conclusions based on quantitative information will be the main objective of learning this subject.

UNIT 1 ORDINARY DIFFERENTIAL EQUATIONS 12 Hrs.

Formation of ODE - Solution of first order exact equations - Solution of second order linear differential equations with constant coefficients - Particular integrals for eax, sinax, cosax, xn, xneax, eax sinbx, eax cosbx.

UNIT 2 PARTIAL DIFFERENTIAL EQUATIONS 13 Hrs.

Formation of equations by elimination of arbitrary constants and arbitrary functions - Lagrange's linear equations

UNIT 3 INTERPOLATION AND NUMERICAL SOLUTIONS OF ALGEBRAIC AND TRANSCENDENTAL LINEAR EQUATIONS 11 Hrs.

Interpolation - Newton's Method - Lagrange's Method. Numerical solution of Algebraic and Transcendental equations - Newton Raphson method - Gauss Jordan method - Crout's Method - Gauss Seidel method.

UNIT 4 NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 12 Hrs.

Numerical Solution of first order ordinary differential equations - Taylor's series method - Modified Euler's method - Runge-Kutta method of fourth order.

UNIT 5 NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS 12 Hrs.

Classification of PDE - Elliptic Equations - Poisson's equations - Leibmann's Iteration Process - Parabolic Equations - Bender Schmidt Scheme - Hyperbolic Equations.

Max. 60 Hours

TEXT / REFERENCE BOOKS

1. Veerarajan T., Engineering Mathematics, Tata McGraw Hill Publishing Co., New Delhi, 1999.
2. Kandasamy P., Thilagavathy K., Engineering Mathematics, Volumes II & III (4th revised edition), S. Chand & Co., New Delhi, 2001.
3. T. Veerarajan, Probability, Statistics and Random Process, 4th Edition, Tata McGraw Hill,2008.
4. Irivin Miller John E Freund, Probability and Statistics for Engineers, Prentice Hall, 1977.
5. Grewal B.S., Higher Engineering Mathematics, 35th Edition, Khanna Publishers, Delhi, 2000.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

Part A : 10 questions of 2 marks each - No choice **20 Marks**

Part B : 2 questions from each unit of internal choice, each carrying 12 marks **60 Marks**

SBT1201	MOLECULAR BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- The course introduces the basic concepts of cloning and its application in various fields of biotechnology.

UNIT 1 INTRODUCTION **9 Hrs.**

Introduction to rDNA technology- Scope and milestones. Isolation of plasmid DNA and genomic DNA from bacteria, phage, isolation of RNA. Separation by agarose gel electrophoresis. Enzymes involved in rDNA technology- restriction enzymes **-**types and their uses, polymerases, ligases, DNA modifying enzymes. Blunt and cohesive end ligation- use of linkers and adaptors, homopolymer tailing.

UNIT 2 CLONING VECTORS **9 Hrs.**

Cloning vectors **-** plasmid and phage vectors for E.coli- pBR 322 and its derivatives, λ vectors, cosmids, phagemids, M13 phages. Yeast vectors and their types, Yeast artificial chromosomes. BAC ,Shuttle Vector, Broad Host range vectors. Vectors for plants - Ti plasmids, CaMV, Geminiviruses. Vectors for animals - SV 40 vectors, Adenovirus, Retrovirus. Mammalian expression vectors. Model organisms **-** E coli, CHO.

UNIT 3 GENE TRANSFER TECHNOLOGY **9 Hrs.**

Gene transfer technology- chemical transfection methods: calcium chloride, PEG, polyplex, DEAE dextran. Physical methods: electroporation, microinjection, particle bombardment, ultrasonication, liposome mediated transfer. Biological methods: use of vectors. Gene cloning strategies- genomic and cDNA library construction, PCR based cloning.

UNIT 4 SELECTION & SCREENING OF RECOMBINANTS **9 Hrs.**

Methods for clone identification-direct screening (insertional inactivation of marker gene, visual screening methods), indirect screening (immunological techniques, rescue techniques, colony hybridization and dot blot hybridization), hybridization techniques **-** Southern blotting, Northern blotting, Western blotting.

UNIT 5 APPLICATIONS OF rDNA TECHNOLOGY **9 Hrs.**

Application of rDNA technology **-** Antisense and ribozyme technology, Human genome project and its application, Gene therapy prospects and future, DNA vaccine, Transgenic plants,Transgenic animals , current production of rDNA products, Bio-safety measures and regulations for rDNA work.- Outline of cell line characterization (Ref:www.biooutsource.com)

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Primrose SB and R. Twyman Principles Of Gene Manipulation & Geneomics ,Blackwell Science Publications, 2006.
2. Principles of Genome Analysis and Genomics by S.B.Primrose and R.M.Twyman, Third Edition (Blackwell Publishing), 2003.
3. Ansubel FM, Brent R, Kingston RE, Moore DD, Current Protocols In Molecular Biology, Greene Publishing Associates, NY, 1988.
4. Berger Sl, Kimmer AR, Methods In Enzymology, Vol 152, Academic Press, 1987.
5. Brown T.A., Genomes, 3 by Third Edition (Garland Science Publishing), 2007.
6. US FDA guidelines on the genetically modified organisms

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT1202	IMMUNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To know the fundamentals of innate and acquired immunity.
- To understand how immune system fights and combats the infection and diseases.
- To get an insight about the principle mechanism of immunity.

UNIT 1 FUNDAMENTAL CONCEPTS OF IMMUNOLOGY 9 Hrs.

History and Scope of Immunology, Innate and Acquired Immunity; Hematopoiesis, Cells of the immune system, Primary and Secondary lymphoid organs, Characteristics of T and B cell receptors, T and B cell maturation, activation and differentiation.

UNIT 2 HUMORAL IMMUNITY 11 Hrs.

Antigens: Characteristics and Types of Antigens, Factors affecting the immunogenicity, Haptens, Antigenic Determinants, Adjuvants, Vaccines, Routes of Immunization.
Theory of clonal selection, Immunoglobulins: Basic structures, classes and sub classes; Molecular Biology of Immunoglubulin synthesis, Effector functions; Isotope, Allotype, Idiotype, Monoclonal antibodies, Complement system **-** Alternate, Classical and Lectin pathways.

UNIT 3 CELL MEDIATED IMMUNITY 7 Hrs.

Structure, types and function of MHC, Phagocytosis, Exogenous and Endogenous pathways of antigen processing and presentation; Cytokines - Structure, function, application and regulation of the immune response.

UNIT 4 IMMUNOTECHNOLOGY 9 Hrs.

Antibody affinity and antibody avidity, Cross reactivity, Precipitation reactions, Agglutination reactions - Immunodiffusion and Immunoelectrophoretic techniques, Immunofluorenscence, Immunoelectroscopy, RIA, ELISA.. Detection of bacterial endotoxins using immunological methods (LAL Test)

UNIT 5 IMMUNE SYSTEM IN HEALTH AND DISEASES 9 Hrs.

Inflammatory mediators, Hyper-sensitivity, Immune Tolerance, Autoimmunity, Transplantation immunology **-** Immunosuppresive drugs, Tumor immunology, AIDS.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Ivan M. Roitt, Brostoff J. and Male D., Essential Immunology, 6th edition, Mosby Harcourt Publishers, 2001.
2. Ivan M. Roitt, Essential Immunology, 4th edition, Blacwell scientific publications, Oxford, London, 1980.
3. Ivan M. Roitt, Jonathan Brostoff and David K. Male Glower,Immunology, 1st edition, Medical publishers, London, 1958.
4. Richard A.Goldsby, Thomas J. Kindt, Barsara A. Osborne, Janis Kuby, Immunology, 5th edition, WH Freeman & Company, 1991
5. Ashim K. Chakravarthy, Immunology, Tata Mcgraw-Hill, 1998.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**
PART A : 10 questions of 2 marks each - No choice **20 Marks**
PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT1203	ENZYMOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To learn about enzymes, characteristics and their reactions
- To learn the kinetics of enzyme activity

UNIT 1 INTRODUCTION TO ENZYMES **9 Hrs.**

Nature and function of enzymes, Enzyme nomenclature, classification of enzymes, mechanisms of catalysis - Acid base catalysis, electrostatic catalysis, covalent catalysis and enzyme catalysis. Role of co-enzymes and co-factors.

UNIT 2 ENZYME KINETICS **9 Hrs.**

Michaelis-Menton kinetics, determination of Km, Lineweaver Burke plot, Eadie-Hofstee plot, Hanes-Woolf plot. Enzyme inhibitor - Types of enzyme inhibition, competitive inhibition, uncompetitive inhibition, non-competitive inhibition, mixed inhibition, partial inhibition, substrate inhibition, allosteric inhibition, irreversible inhibition, inactivation kinetics.

UNIT 3 ENZYME IMMOBILIZATION **9 Hrs.**

Classifcation of enzyme immobilization, physical and chemical techniques for enzyme immobilization - adsorption, matrix entrapment, encapsulation, cross-linking, covalent bonding, advantages and disadvantages, application of immobilized enzymes, mass transfer effect on immobilization, properties of immobilized enzymes.

UNIT 4 ENZYME SPECIFICITY **9 Hrs.**

Types of specificity, active site, Fischer hypothesis and Koshland hypothesis, Turnover number, extraction of soluble enzymes, membrane bound enzymes, preliminary purification procedures, criteria of purity.

UNIT 5 CLINICAL AND INDUSTRIAL APPLICATIONS OF ENZYMES **9 Hrs.**

Application of enzymes in medicine, Lactate dehydrogenase, alkaline phosphatase, acid phosphatase, enzyme biosensors, design of enzyme electrodes.

Max. 45 Hours.

TEXT / REFERENCE BOOKS

1. Trevor Palmer, Enzymes:Biochemistry, Biotechnology & Clinical Chemistry Horwood, East West Press, 2001.
2. James E Bailey, David F. Ollis, Biochemical Engineering Fundamentals, McGraw Hill Intl. Edition, 2nd Edition, 1986.
3. Ashok Pandey, Colin Webb, Carlos Ricardo Soccol, Christian Larroche, Enzyme Technology, Asiatech Publishers Inc., 2006.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT1204	BIOCHEMICAL THERMODYNAMICS	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

- To introduce basic thermodynamic principles and apply these concepts in metabolic processes to understand them better. This will in turn help in the production of biotech products (metabolites).

UNIT 1 BASIC THERMODYNAMICS **12 Hrs.**

Introduction and fundamental concepts of thermodynamics terms. First law of thermodynamics **-** Enthalpy, Internal energy and specific heat. Second law of thermodynamics, concept of entropy, entropy and unavailable energy. Third and zeroth law of thermodynamics and thei implications.

UNIT 2 THERMODYNAMIC PRINCIPLES IN BIOLOGY **12 Hrs.**

Gibbs free energy, entropy and enthalpy, standard free energy change, endergonic and exergonic processes, criteria for spontaneity, oxidation and reduction reactions, redox reactions, Reversible and irreversible reactions, chemical equilibrium, high energy bonds and compounds.

UNIT 3 INTERMEDIARY METABOLISM **12 Hrs.**

Glycolysis, Pentose phosphate pathway, gluconeogenesis, glycogen metabolism, citric acid cycle, fatty acid oxidation and biosynthesis. Outline of amino acid biosynthesis, amino acid degradation, urea cycle. Biosynthesis and degradation of nucleotides.

UNIT 4 ENERGY PRODUCTION **12 Hrs.**

Oxidative phosphorylation, Electron transfer reactions in mitochondria, ATP synthesis. Photophosphorylation **-** cyclic and non-cyclic, Central photochemical event, light driven electron flow, ATP synthesis by photophosphorylation.

UNIT 5 APPLICATIONS OF BIOENERGETICS **12 Hrs.**

Enzymes as analytical agents, Biosensors **-** components and application, Inborn errors of metabolism **-** diagnosis and treatment (Phenylketonuria, albinism, maple syrup urine disease, homocystinuria, alkaptonuria).

Max. 60 Hours.

TEXT / REFERENCE BOOKS

1. Lehninger, Nelson and Cox, Principles of Biochemistry, W.H.Freeman, 4th Edition, 2005
2. Donald Voet, Judith Voet and Charlotte Pratt, Principles of Biochemistry, John Wiley and Sons, 2008
3. Smith J.M and Van Ness H.C., Introduction to Chemical Engineering Thermodynamics, McGraw Hill, 2005
4. Pamela C.Champe, Richard A.Harvey and Denise R.Ferrier, Biochemistry, Lippincott's Illustrated reviews, 4th edition.2009

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SCH1211	INTRODUCTION TO UNIT OPERATIONS AND PROCESS CALCULATIONS	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

- To expose the students to various unit operations so as to enable them to improve the design and operation of the bioprocess plant

UNIT 1 UNIT OPERATIONS 12 Hrs.

Unit operations, schematic representations of unit operations, Fermentation Process (Ethanol), Agrochemical (Urea,Biofertilizer), Pharmaceutical (Penicilin & Insulin) , Acid (Citric acid).

UNIT 2 UNIT PROCESSES 12 Hrs.

Unit process- alkylation, amination, aromatization, calcination, carbonization, chlorination, cracking, dehydration, gasification, esterification, Trans esterification.

UNIT 3 INTRODUCTION TO CHEMICAL ENGINEERING CALCULATIONS 12 Hrs.

Introduction to chemical engineering, units and systems, fundamental and derived units, basic chemical calculations, mole, atomic weight, molecular weight, concepts of units and conversion factors, dimensional analysis.

UNIT 4 MATERIAL BALANCES WITH AND WITHOUT CHEMICAL REACTIONS 12 Hrs.

Material Balance without chemical reaction **-** Distillation ,Evaporation, Crystillasation and Mixing. Material Balance with chemical reaction-limiting reactant, excess reactant, conversion,and selectivity . Recyce ,purge and bypass operations.

UNIT 5 ENERGY BALANCE AND COMBUSTION 12 Hrs.

Introduction to thermophysics and thermo chemistry, heat capacities of solid, liquid and gases at constant pressure and volume ,evaluation of enthalpy, standard heat of reaction, standard heat of combustion and standard heat of formation, fuels, calorific value, proximate analysis, ultimate analysis.

Max.60 Hours

TEXT / REFERENCE BOOKS

1. David H.Himmelblau,Basic principles and calculations in chemical engineering, 6th Edition, Eastern Economy 2003.
2. Warren McCabe, Julian Smith and Peter Harriott, Unit Operations of Chemical Engineering, 7th Edition., McGraw Hill Inc., New York 2005.
3. Bhatt, B.I, and Vora S.M., Stochiometry, 3rd Edition, Tata McGraw Hill Publishing Co., 2004
4. George T. Austine, Shreves chemical process industries,5th Edition, McGraw Hill, 1984.
5. Richard M. Felder, Ronald W. Rousseau, Elementary Principles of Chemical Processes, 3rd Edition John Wiley & Sons, Inc. Singapore, 2000.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT4053	MICROBIOLOGY & BIOCHEMISTRY LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

SUGGESTED LIST OF EXPERIMENTS

Microbiology Lab

1. Study and Handling of Microscope
2. Laboratory rules and regulations
3. Staining Procedures
   a). Smear preparation
   b). Simple staining
   c). Grams staining
   d). Capsule staining
4. Sterilization procedures and preparation of solid and liquid media
5. Streak plate method
6. Decimal dilution method
7. Spread plate method
8. Pour plate method
9. Antibiotic Sensitivity test

Biochemistry Lab

1. Estimation of Protein by Lowry's Method
2. Preparation of casein from milk
3. Preparation of Aspirin from salicylate
4. Amino acid Analysis
5. Carbohydrate Analysis

SBT4054	BIOCHEMISTRY LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

SUGGESTED LIST OF EXPERIMENTS

1. Units, Volume and weight measurements, concentration units,
2. pH measurement & calibration of pH meter
3. Preparation of buffers
4. Working principle and standardization of colorimeter
5. Working principle of centrifuge
6. Qualitative analysis of Carbohydrates
7. Qualitative analysis of amino acids
8. Titrimetric estimation of Ascorbic acid
9. Quantitative estimation of Protein by Lowry's method
10. Quantitative estimation of Urea by DAM method
11. Determination of saponification number

SBT4055	IMMUNOLOGY LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

ABO blood grouping

1. Differential count
2. WBC and RBC count
3. Isolation of PBMC
4. Ouchterlony immuno diffusion
5. WIDAL test
   a). Slide test
   b). Tube test
6. RPR test
7. Pregnancy test
8. ELISA test
9. Radial immuno diffusion
10. Rocket immunoelectrophoresis

SBT4056	MOLECULAR BIOLOGY LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

I. Nucleic acid Isolation Procedures:

1. Isolation of Plasmid DNA from E.coli.-Alkaline lysis method
2. Isolation of Genomic DNA from E.coli.-Phenol/Choroform method
3. Isolation of genomic DNA from Onion extract-SDS method

II. Quantitation of Nucleic acids/proteins:

1. Estimation of DNA /RNA by diphenylamine method
2. Estimation of proteins by Bradfords method

III. Separation Techniques:

1. Agarose gel electrophoresis
2. PAGE -SDS/Native

IV. Staining techniques

1. Staining of proteins
   i. Silver staining
   ii. Coomasie brilliant blue
2. Staining of Nucleic acids
   i. Fluorescent dyes
   ii. Silver staining

SBT1205	GENETIC ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- The objective of this paper is to consider a few topics in Molecular Biology in depth. It is designed to give a good background in current Molecular Biology, which should allow for easy continuation to master's programmes.

UNIT 1 INTRODUCTION AND TOOLS FOR GENETIC ENGINEERING 9 Hrs.

Milestones in genetic engineering. Molecular tools in genetic engineering: Restriction endonucleases and other DNA modifying enzymes, special vectors: expression vectors, binary vectors, Cointegrating vectors, transposons.

UNIT2 TECHNIQUES USEFUL IN GENETIC ENGINEERING AND THEIR APPLICATIONS 9 Hrs.

Genome mapping: Direct mapping, indirect mapping, DNA foot printing, Chromosome Walking, Chromosome Jumping.

PCR: Normal PCR and real time PCR (cyber green and taqman chemistry). DNA fingerprinting: basic genetic principle, Single locus and multilocus DNA fingerprinting. DNA library: Types and importance, genomic and cDNA library. Differential gene expression: DDRT and SSH. DNA sequencing: MAXAM AND GILBERT chemical method, SANGER AND COULSON enzymatic chain termination method, Pyrosequencing, Automated DNA sequencing.

UNIT 3 CLONING STRATEGIES 9 Hrs.

Preparation of DNA: Isolation and purification of DNA and genes, modification of cut ends and ligation of transgene. Gene transfer techniques: physical, Chemical and biological methods. Expression and Characterization of transgene: genomic level, transcript level and translational level. Gene Silencing Techniques; Introduction to siRNA; siRNA technology; Micro RNA; Construction of siRNA vectors. Transgenic and gene knock out technologies.

UNIT4 GENETICALLY MODIFIED ORGANISMS 9 Hrs.

Exploitation of genetic engineering: Expression and Purification of Recombinant Proteins in *E.coli*, Yeast, Animal cell lines. (CHO, VERO, BHK 21) Transgenic organisms and Metabolic Engineering. Transgenic plants: transgenic tomatoes, insect resistance (Bt. protein), golden rice, designer flowers, terminator seeds. Transgenic animals: examples and their use

UNIT5 HAZARDS AND IMPACT OF GMOS 9 Hrs.

Biosafety Considerations: Biological risks, ethical issues, economic issues, legal issues. International regulations controlling GMOs

Max. 45 Hours

TEXT/ REFERENCE BOOKS

1. DM Glover: Genecloming: The mechanism of DNA manipulation IRC Press, Oxford University, 1984.
2. Primrose S.B., Twyman TM and Old RW, Principles of Gene Manipulation, Blackwell Science Ltd., USA, 6Th Edition, 2001.
3. Ray D.S., Dehardt DT, Dressler D., Single Stranded DNA phages, Cold Spring Harbor Monograph archeiver, Vol 8., 1978,
4. Jose Cibelli, Robert P Lanza, Keith H.S. Campbell, Michael D. West, Principles of cloning, Academic press, 2002.
5. Ernet L Winnacker, From genes to clones, Panima publishing corporation, India, 2003.
6. S.S. Purohit, Biotechnology fundamentals and applications, Agrobios (Ind.) Jothpur 2002.
7. Brown T.A , Gene Cloning an Introduction, VNR (UK) Co.Ltd. 1988.
8. Sambrook A. and Russell D.W., Molecular Cloning. A Laboratory Manual, Cold Spring Harbor Laboratory Press, New York, USA,3rd Edition, Volume 1-3, 2001.
9. Ausubel F.M., Brent R., Kingston R.E. and Moore D.D., Current Protocols in Molecular Biology, John Wiley & Sons, Inc., Broo
10. Benjamin Lewin, "Genes VI and Genes VII", Oxford University Press, Cambridge, 1996.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT1206	PROTEIN ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To enhance the fundamental knowledge of structures and properties of proteins and analysis by biophysical methods
- To provide foundation on protein engineering methods and their applications in improving their desired biological activities.

UNIT 1 PROTEIN STRUCTURE **9 Hrs.**

Primary structure, secondary structure, tertiary structure, quaternary structure, Ramachandran plots. Protein folding pathways

UNIT 2 STRUCTURAL CHARACTERIZATION OF PROTEINS **9 Hrs.**

Primary structure: peptide mapping, peptide sequencing - automated Edman method & mass-spectroscopy, an overview of spectroscopic techniques for the analysis of protein secondary and tertiary structure; an overview of techniques for analysis of protein quaternary structure.

UNIT 3 PROTEIN ENGINEERING **9 Hrs.**

Strategies for protein engineering; Random and site- directed mutagenesis; Various PCR based strategies; Role of low-fidelity enzymes in protein engineering; Gene shuffling and Directed evolution of proteins; Protein backbone changes; Antibody engineering

UNIT 4 PROTEIN STRUCTURE PREDICTION **11 Hrs.**

Protein structure on the World Wide Web (Different databases and their uses), similar structure and function of homologous proteins; Role of multiple alignment; Homology and *ab-initio* method for protein structure prediction, computer methods in protein modeling

UNIT 5 APPLICATION OF PROTEIN ENGINEERING **7 Hrs.**

Increasing the stability and Biological activity of proteins: Addition of disulfide bonds, Changing Asparagine to other amino acids, reducing the free sulfhydryl groups, Single amino acid changes, Improving Kinetic properties of enzymes

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Donald Voet, Charlotte W. Pratt, Judith G. Voet., Principles of Biochemistry, Fourth Edition. John Wiley and Sons, 2013.
2. Branden C. and Tooze J., Introduction to Protein Structured, Second Edition,Garland Publishing, NY, USA, 1999
3. Paul R. Carey., Protein engineering and design by, academic press, 1996, 361 pages.
4. Creighton T.E. Proteins, Freeman WH, Second Edition, 1993
5. Moody P.C.E. and Wilkinson A.J. Protein Engineering, IRL Press, Oxford, UK, 1990
6. Structure and Mechanism in Protein Science, Alan Fersht, Freeman, 1999.
7. Protein engineering in Industrial biotechnology, Ed. Lilia Alberghina, Harwood Academic Publishers, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT1207	ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To give an insight into the working principles of optical methods, radioisotopes, spectroscopy and separation methods. This will enable the students to carry out the research work innovatively

UNIT 1 BASIC INSTRUMENTATION 9 Hrs.

Cell disruption techniques, Basics of Microscope and its types **-** Bright field Microscope, Dark field Microscope, Phase contrast Microscope, Fluorescent Microscope, Electron Microscope (TEM, SEM, Tunnelling EM) & Confocal Microscope, Microtechnique, pH meter.

UNIT 2 BASIC SPECTROSCOPY 9 Hrs.

Principles and Working of colorimetry, Spectroscopy : Basic principles, nature of electromagnetic radiation, Beer-Lambert laws- UV- Visible Spectrophotometry, Fluorescence Spectrophotometry, Atomic Absorption Spectrophotometry, FTIR, Raman Spectroscopy, Mass Spectrometry, Nuclear Magnetic Resonance (NMR) **-**Electron Spin Resonance(ESR).

UNIT 3 SEPARATION AND PURIFICATION TECHNIQUES 9 Hrs.

Centrifugation - Principles & types - Differential, Rate zonal and Isopycnic centrifugation. Electrophoresis of nucleic acids **-** Agarose , PAGE and Pulse field Electrophoresis. Electrophoresis of proteins **-** SDS-PAGE, IEF and 2D PAGE. Protein purification methods, Chromatography - Principles, methodology and applications of chromatography: paper, Thin layer, column (gel filtration, ion exchange, affinity), GC and HPLC. Basics of flow cytometry

UNIT 4 RADIO ISOTOPE TECHNIQUES 9 Hrs.

Radioactive isotopes **-** storage, safety, handling and radioactive waste management. Liquid Scintillation counter - α-counter and β-counter. X- ray Diffraction, Crystallography, Autoradiography. Magnetic Resonance Imaging (MRI) and CT scan.

UNIT 5 MOLECULAR TECHNIQUES 9 Hrs.

Quantification of proteins, DNA and RNA. Blotting techniques **-** Southern, Northern and Western blotting. Gene transfer and transfection methods. PCR and its types. Biosensors and types Biosensors

Max. 45 Hours.

TEXT / REFERENCE BOOKS

1. David T. Plummer, An introduction to Practical Biochemistry, Tata McGraw Hill Edition, 1988
2. Keith Wilson and John Walker, Practical Biochemistry **-** Principles and techniques, Cambridge University Press, U.K; 5th Edition, 2003.
3. Rapley and Walker, Molecular Biomethods Handbook, Humana Press, Totowa, NewYork, 2003.
4. Biophysical chemistry : Principles and Techniques **-** Upadhayay and Nath **-** Himalaya publishing house , 2nd Review Edition, 2009.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks : 80 **Exam Duration : 3 Hrs.**
PART A : 10 questions of 2 marks each - No choice **20 Marks**
PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBI1208	BIOINFORMATICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To equip the students with the requisite background in areas of modern biology (biochemistry, cell biology, genetics and molecular biology) and computer science (programming languages, databases, algorithms, graphics, data mining, data security etc.).
- To expose the students into core areas of Bioinformatics like multiple sequence alignment, phylogenetic trees. Enabling the students to apply the knowledge of computational analysis for biological data analysis

UNIT 1 INTRODUCTION **9 Hrs.**

Overview and Definition, Scope and applications of Bioinformatics. Different fields in Bioinformatics. Sequence file formats used in Bioinformatics databases and tools.

UNIT 2 DATABASES **9 Hrs**

Introduction and classification of biological databases. Nucleic acid Sequence databases: NCBI, DDBJ, EMBL. Protein sequence databases - PIR, Swissprot. Structure databases **-** PDB, PUBCHEM. Secondary databases **-** PROSITE and PFAM. Structure classification databases **-** SCOP, CATH. Open access bibliographic resources and databases **-** OMIM, PUBMED, BioMed Central.

UNIT 3 SEQUENCE ANALYSIS **9 Hrs.**

Introduction to sequence analysis and alignment - Global and Local Alignments **-** Pairwise and Multiple sequence alignment. Tools for sequence alignments - BLAST, FASTA, Clustal W. Phylogenetic analysis

UNIT 4 PROTEOMICS **9 Hrs.**

Introduction to protein structure **-** primary, secondary and tertiary structures, domains, motifs and their uses. Secondary structure prediction - tools used. 3D structure prediction - Homology modeling, Threading & Abinitio Methods. Gene prediction.

UNIT 5 INTERNET AND PROGRAMMING IN BIOINFORMATICS **9 Hrs.**

World Wide Web, Internet and its Uses in Bioinformatics. Introduction to computer architecture and Operating Systems. Introduction to PERL - Using PERL to facilitate biological analysis - Strings, numbers, variables - Basic input & output- File handles- Conditional Blocks & loops - Pattern matching- Arrays - Hashes.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press, 2002.
2. Attwood T.K. and Parry D.J., Smith, Introduction to Bioinformatics, Pearson Education; 2001.
3. Andreas D Baxevanis, Francis Ouellette B.F., Bioinformatics, A practical guide to the analysis of genes and proteins; John Wley and sons, 2nd Edition, 2004.
4. Jean Michel Claverie and Cedric Notrdame, BIOINFORMATICS - A BEGINNER's GUIDE, Wiley dreamtech India Pvt. Ltd., 2nd Edition, 2004.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks : 80 **Exam Duration : 3 Hrs**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SCH1212	CHEMICAL REACTION ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

To impart basic knowledge on the principles of different kinds of reaction, reaction kinetics and to introduce various types of reactors that are used in Chemical Engineering operations.

UNIT 1 CHEMICAL KINETICS 9 Hrs.

Introduction to reactor, reaction system, chemical kinetics, rate equation, Elementary and non- elementary reactions. Molecularity and order, dependence of rate on concentration ,temperature dependent term of a rate equation, concept of activation energy -Arrhenius theory, collision theory, transition state theory, determination of rate equation for non elementary reactions.

UNIT 2 IDEAL REACTORS 9 Hrs.

Introduction to Batch reactor, semi batch reactor, Plug flow reactor, Mixed flow reactor, Packed bed reactor, Fluidised bed reactor,Concept of ideal flow, space time and velocity, performance or design equations for batch reactor, Plug flow reactor, Mixed Flow reactor, methods to determine order of a reaction- Integral &differential method of analysis of data, Half life method & ostwald's isolation method..

UNIT 3 SINGLE AND MULTIPLE REACTOR SYSTEMS 9 Hrs.

Design for single reaction: size comparison of single reactors, Multiple reactor system-PFR in series/parallel, equal size MFR in series, determination of best system for cstr, introduction to multiple reactions-series, parallel and independent reactions, qualitative analysis of product distribution **-**Determination of quantity of reactants to be maintained in the system, Various contacting patterns.

UNIT 4 IDEAL AND NON-IDEAL FLOW 9 Hrs.

Reason for non ideality, Residence time distribution, E curve, F curve, relationship between E and F curve, relationship between mean residence time and space time, State of aggregation- micro and macro fluid, Earliness or lateness of mixing, basic models for non ideal reactor like tanks in series model.

UNIT 5 HETEROGENEOUS REACTIONS 9 Hrs.

Introduction to catalytic reactions, promoters, poisons, preparation of catalyst, determination of surface area and pore volume, Fluid solid reactions: selection of a model, Introduction to shrinking core model, determination of the rate controlling step- resistance offered by gas film, chemical reaction, diffusion.

Max.45 Hours

TEXT / REFERENCE BOOKS

1. Levenspiel. O, Chemical Reaction Engineering, 3rd Edition, John Wiley and sons, 1999.
2. Fogler H.S., Elements of chemical reaction engineering, 4th Edition, Prentice Hall Publishing Co, 2006.
3. Smith J.M., Chemical Engineering Kinetics, 3rd Edition, McGraw-Hill, 2003.
4. Missen R.W., Mims C.A., Saville B.A. Introduction to Chemical Reaction Engineering and Kinetics, 1st Edition, John Wiley,1999.
5. Gavhane K.A.,Chemical Reaction Engineering **-** I &II, 5th Edition, Nirali Prakashan Publishers, 2009.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SCH1213	BIOPROCESS INSTRUMENTATION, DYNAMICS AND CONTROL	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

- The course depicts the fulfillment of learning skills from instrumentation and to impart knowledge on controllers

UNIT 1 INTRODUCTION TO LAPLACE TRANSFORM 12 Hrs.

Properties of transforms, Linear open loop system: Examples of first order systems- mercury in glass thermometer, liquid level process- mixing process, Response of first order system to standard forcing function.

UNIT 2 SECOND ORDER SYSTEM 12 Hrs.

Damping vibrator, first order system in series- interacting and non-interacting system, response of second order system to standard forcing function.

UNIT 3 LINEAR CLOSED LOOP SYSTEM 12 Hrs.

Introduction to Control system, open loop controler ,closed loop controller **-** P,PI,PID, controller mechanism, final control element- control valve, valve characteristics, Block diagram reduction, transient response of simple control system, stability analysis -Routh stability.

UNIT 4 FREQUENCY RESPONSE ANALYSIS OF LINEAR PROCESS 12 Hrs.

Introduction, Concept- Bode diagram-Bode stability criteria **-** gain and phase margin, Ziegler **-** Nichols tuning, Cohen coon tuning.

UNIT 5 INSTRUMENTATION AND CONTROL 12 Hrs.

Physical and chemical sensors for the medium and gases, online and offline sensors, process control- Concept of Cascade control, Selective control system, split range control, Feed forward & Feedback control, Ratio control, Adaptive control and Inferential control. Computer based control **-** Basic functional elements, Computer interfaces for fermentation process and Cascade control of metabolism.

Max. 60 Hours

TEXT / REFERENCE BOOKS

1. Coughanowr D.R and Koppel L.M.,Process Systems Analysis and Control, 3rd Edition,McGraw Hill,NewYork,1991.
2. Harriot P., Process Control, 3rd Edition, Tata McGraw Hill, New Delhi, 2008.
3. Eckman D.P., Industrial Instrumentation, 2nd Edition, Wiley Eastern Ltd, 1996.
4. George stephanopolus., Chemical Process Control, 2nd Edition, Prentice Hall of india Pvt. Ltd 1910.
5. Vyas.R.P., Process control and instrumentation, 2nd Edition, Central Techno Publications, Nagpur 2005.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT4055	IMMUNOLOGY LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

ABO blood grouping

1. Differential count
2. WBC and RBC count
3. Isolation of PBMC
4. Ouchterlony immuno diffusion
5. WIDAL test
   a). Slide test
   b). Tube test
6. RPR test
7. Pregnancy test
8. ELISA test
9. Radial immuno diffusion
10. Rocket immunoelectrophoresis

SBT4056	MOLECULAR BIOLOGY LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

I. Nucleic acid Isolation Procedures:

1. Isolation of Plasmid DNA from E.coli.-Alkaline lysis method
2. Isolation of Genomic DNA from E.coli.-Phenol/Choroform method
3. Isolation of genomic DNA from Onion extract-SDS method

II. Quantitation of Nucleic acids/proteins:

1. Estimation of DNA /RNA by diphenylamine method
2. Estimation of proteins by Bradfords method

III. Separation Techniques:

1. Agarose gel electrophoresis
2. PAGE -SDS/Native

IV. Staining techniques

1. Staining of proteins
   i. Silver staining
   ii. Coomasie brilliant blue
2. Staining of Nucleic acids
   i. Fluorescent dyes
   ii. Silver staining

SBI4059	BIOINFORMATICS LAB	L	T	P	Credits	Total Marks
		0	0	0	2	100

SUGGESTED LIST OF EXPERIMENTS

1. Search and Retrieval of Nucleic Acid Sequence from NCBI and EMBL.
2. Search and Retrieval of Protein Sequence from SWISSPROT.
3. Structure Database-PDB.
4. Pairwise Global Alignment-NEEDLE
5. Pairwise Local Alignment-WATER
6. Homology Search using BLAST and FASTA.
7. Multiple Sequence Alignment using CLUSTALW.
8. Secondary Structure Prediction.
9. Molecular Visualization-RASMOL

SBI4060	SYSTEMS BIOLOGY LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

SUGGESTED LIST OF EXPERIMENTS

1. Modeling and Visualization
2. E cell
3. Gepasi
4. Copasi
5. Construction and Analysis of gene expression networks
6. Mat lab I
7. Mat Lab II
8. Cell Designer
9. Cytoscape

SBI4061	MOLECULAR DYNAMICS & SIMULATION LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

SUGGESTED LIST OF EXPERIMENTS

1. Protein simulation using different force fields
2. Dynamic simulation of Peptide / Protein.
3. Solvation of Peptide / Protein / Biomolecule.
4. Local and Global Minimization of peptide / Protein
5. Simulation of peptiude using Quantum Mechanics & Molecular Mechanics.
6. Optimisation of Protein using various ensembles.
7. Simulations of Complex molecules (Protein – Ligand, protein – protein, protein – metal and protein – Nucleic Acids)
8. Membrane Protein dynamics

SBT1301	BIOPROCESS ENGINEERING I	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To develop skills of the students in the area of Bio process engineering with emphasis on basic requirements for fermentation process, medium design.
- To understand the concepts of sterilization and growth kinetics of microorganisms.

UNIT 1 CONCEPTS OF BIOPROCESS 9 Hrs.

Historical of bioprocess technologies, role of bioprocess engineer in the biotechnology industry, concept of Bioprocess, outline of an integrated bioprocess and the various (upstream and downstream) unit operations involved in bioprocesses, Isolation and preservation of industrially important organisms. Production of industrial important enzymes and their applications. Modes of operation including batch, fed-batch and perfused systems.

UNIT 2 DESIGN OF FERMENTATION PROCESS 9 Hrs.

Medium requirement for fermentation processes; development of inocula for industrial fermentations. Different types of fermentation processes: aerobic and anaerobic processes and their application in the biotechnology industry. Construction of fermentor and ancillaries, solid-substrate fermentation and its applications. Media for fermentation processes, Types of media: microbial culture medium, plant and animal cell culture medium

UNIT 3 MEDIA AND AIR STERILIZATION 9 Hrs.

Definitions, Modes of media sterilization- FSIP and ESIP, modes of air sterilization, media sterilization by membrane filtration method. thermal death kinetics, batch sterilization, equipment for continuous sterilization, air sterilization, Validation Issues.

UNIT 4 STOICHIOMETRY OF CELL GROWTH AND PRODUCT FORMATION 9 Hrs.

Growth Stoichiometry and elemental balances, Product stoichiometry, degrees of reduction, theoretical prediction of yield coefficient, theoretical oxygen demand.

UNIT 5 MICROBIAL GROWTH KINETICS 9 Hrs.

Phases of cell growth in batch cultures, quantifying cell growth, batch growth kinetics, environmental conditions affecting the growth kinetics, heat generation by microbial growth, quantifying growth kinetics: unstructured kinetic models for microbial growth, growth models of filamentous organisms, growth kinetics of Monod model.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Pauline.M.Doran., Bioprocess Engineering Principles; Academic press. 1995
2. Stanbury P.F., Whitaker A. and Hall S.J., Principles of Fermentation Technology, Elsevier Science Publishers, B.V, Amsterdam, 1998
3. Michael L.Shuler and Fikret Kargi, Bioprocess Engineering Basic concepts, Prentice Hall, 1992.
4. Biotechnology, Second completely revised edition-Bioprocess,Volume 3-1993.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT1302	PHARMACEUTICAL BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To learn about the development and monitoring of the drugs
- To understand the preparation of medicines according to the norms.

UNIT 1 INTRODUCTION **9 Hrs.**

Development of Drug and Pharmaceutical Industry -Therapeutic agents, their uses and economics; Routes of drug administration. Selection criteria for route of administration.

UNIT 2 DRUG METABOLISM AND PHARMACOKINETICS **9 Hrs.**

ADME of Drugs, Drug metabolism**-** pharmacokinetics-action of drugs on human bodies, Factors in influencing metabolism

UNIT 3 IMPORTANT UNIT PROCESSES AND THEIR APPLICATIONS **9 Hrs.**

Bulk drug Manufacture: Types of Reactions in Bulk drug Manufacture and Processes. Special Requirements for Bulk Drug Manufacture and its regulatory aspects.

UNIT 4 PRODUCT FORMS AND DEVELOPMENT **9 Hrs.**

Compressed tables, wet granulation-dry granulation or slugging-direct compression-tablet presses, coating of tablets, capsules sustained action dosage forms-parental solutions-oral liquids-injections-ointments-Topical Application, Preservation, analytical methods and test for various drugs and pharmaceuticals, Labeling, Packing-Packing Techniques, Quality Management, GMP.

UNIT 5 PHARMACEUTICAL PRODUCTS **9 Hrs.**

Therapeutic categories such as laxatives **-** analgesics **-** non steroidal contraceptives **-** external antiseptics **-** antacids and other, antibiotics **-** biological **-** hormones **-** vitamins with respect to system.
Pharmaceutical Development: Introduction to drug regulations, pre clinical and clinical trials.

Max. 45 Hours.

TEXT / REFERENCE BOOKS

1. Leon Lachman Theory and Practice of Industrial Pharmacy, 3rd Edition, Lea and Febiger, 1986.
2. Remington's Pharmaceutical Sciences, 17th Edition, Mark Publishing & cop 1985
3. Gary Walsh, Biopharmaceuticals: Biochemistry and Biotechnology. Wiley **-** Blackwell 2003

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

MaxMarks : 80 **Exam Duration : 3 Hrs.**
PART A : 10 questions of 2 marks each - No choice **20 Marks**
PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT1303	DESIGN AND OPERATION OF BIOREACTORS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To develop skills of the students in the area of bioprocess with emphasis on various types of bioreactors and their designing and operation.

UNIT 1 INTRODUCTION TO BROAD SCOPE OF BIOCHEMICAL ENGINEERING 9 Hrs.

Definitions, processes and everyday products. Medium optimization-Plackett Burman method. Introduction to bioreactor configuration-Basic mode of operation batch, fed-batch and continuous reactor-bioreactor lay out-Kinetics of batch and continuous culture. Understanding a Piping and Instrumentation diagram of a Bioreactor.

UNIT 2 IDEAL CONTINUOUS STIRRED TANK BIOREACTOR 9 Hrs.

Material balance-Evaluation of Monod Kinetic parameter-Comparison of batch and CSTB-Multiple CSTB connected in series-CSTB with cell recycling.

UNIT 3 SUBSTRATE-LIMITED GROWTH 9 Hrs.

Monod equation: alternatives to Monod equation-Blackman, Tessier, Moser, Contois equation. Unstructured and structured models. Models with growth inhibitors- Substrate inhibition, Product inhibition-Competitive and Noncompetitive product inhibition.

UNIT 4 AGITATION AND AERATION DESIGN 9 Hrs.

Henry's Law - mass transfer, Two film Theory, Definitions of oxygen Transfer Rate, Oxygen Uptake Rate, Specific Oxygen Uptake Rate. Mass transfer and rheology: Rheology of broths - impact on transfer processes Oxygen transport from the bubble to the cell.

UNIT 5 DESIGN CONSIDERATIONS 9 Hrs.

Animal and plant cell bioreactors. Determination of kLa **-** Correlation for kLa. Introduction to Single Use Bioreactors (SUBs),

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. 1. Shuler.M.L. and Kargi.F, Bioprocess Engineering Basic concepts, Pearson Education India, 1st Edition, 2003.
2. 2. Stanbury P.F., Whitaker A., and Hall S.J., Principles of Fermentation Technology, 2nd Edition, 1997.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT1304	MARINE BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To develop skills of the students in the area of marine biotechnology with emphasis on various types of marine products.

UNIT 1 INTRODUCTION TO MARINE ENVIRONMENT AND BIODIVERSITY 9 Hrs.

Physical and chemical properties of sea water. Zonation of sea: Euphotic **-** mesopelagic **-** bathopelagic-benthos - deep sea. Marine ecosystems and biodiversity**:** Diversity & adaptation. Marine microbial diversity: Marine microbial habitats - Microbial distribution in the oceans - Factors that impact marine microbial diversity - Interactions between marine microbes and invertebrates - Marine viruses

UNIT 2 AQUACULTURE AND FISH GENETICS 9 Hrs.

Aquaculture: Definition- Criteria of selection of aquaculture species. Culture practices of marine fish, shrimp, crab, lobster, edible oyster, pearl oyster and seaweeds. Fish genetics: Gynogenesis, androgensis, polyploidy, artificial insemination, eye stalk ablation- cryopreservation.

UNIT 3 IMPORTANCE OF MARINE ORGANISMS 9 Hrs.

Screening for new metabolites from marine microorganisms - Production of marine microalgae **-** Bio fuel production- Marine enzymes - Production of omega-3 fatty acids from marine organisms. Marine pharmacology: New antibiotics and medicines from marine organisms. Secondary metabolites from marine bacteria, actinomycetes and marine endophytic fungi**-** Probiotics.

UNIT 4 BIOMATERIALS AND BIOPROCESSING 9 Hrs.

Marine by products: Fish oil, isinglass, fish glue, fish silage, fin rays, chitin, chitosan, agar, alginates, carrageenan and heparin.

UNIT 5 ENVIRONMENTAL IMPACTS OF MARINE BIOTECHNOLOGY 9 Hrs.

Human impacts on marine microbial diversity - Usage of marine microbes to ameliorate environmental deterioration. Control of oil spills and bioremediation. Effects of bio-fouling and bio-deterioration on marine structures. Protection methods against corrosion and fouling. Red tides: Causative factors and effects on the organisms of marine environment.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Pillay, T.V.R. Aquaculture Principles & Practices. Fishing News (Books) Limited, Londonm, 1990
2. Santhanam R. N. Ramanathan and G. Jegatheesan, Coastal Aquaculture in India, CBS publishers. 1990
3. Le Gal, Y., Ulber, R, Marine Biotechnology I : Advances in Biochemical Engineering/Biotechnology (Series editor: T. Scheper) Springer-Verlag Berlin Heidelberg.2005
4. Le Gal, Y., Ulber, R Marine Biotechnology II: Advances in Biochemical Engineering/Biotechnology (Series editor: T. Scheper) Springer-Verlag Berlin Heidelberg, 2005
5. Jennie Hunter-Cevera, David Karl and Merry Buckley Marine microbial diversity: The key to earth's habitability: A Report from the American academy of microbiology, Published by American Academy of Microbiology, held (April 8- 10, 2005) in San Francisco, California. pp. 28. 2005

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBI1309	FUNDAMENTALS OF GENOMICS AND PROTEOMICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- The principal objective of this course is for students to acquire knowledge about high throughput tools of genome science.
- This knowledge should enable students to explain the fundamental principles underlying various functional genomics techniques and their applications in various biological systems.

UNIT 1 INTRODUCTION TO GENOMICS 9 Hrs.

Organization and main features of prokaryotic and eukaryotic genomes. Genome sequencing methods: Maxim **-** Gilbert and Sanger's method, automated sequencing, pyro-sequencing. Sequence assembly: Clone contig and shotgun approaches. Genome Projects: Aims and objectives, Brief outlook of various Genome Projects - Human genome Project, Plant and animal genome projects. Genome databases

UNIT 2 GENOME MAPPING 9 Hrs.

Genetic and physical maps. RFLP, SSLP, STRs, VNTRs, EST, STS, FISH, Radiation hybrids. Sequence markers **-** SNPs. Determination of the functions of genes: gene inactivation (knock-out, anti-sense and RNA interference) and gene over expression. Gene expression analysis **-** DNA microarray approach.

UNIT 3 INTRODUCTION TO PROTEOMICS 9 Hrs.

Introduction, Branches of proteomics. Proteome Project. Interactions in Proteomics: Protein-Protein Interactions. Methods **-** Yeast Two hybrid analysis, Phage display, Databases. Protein-DNA Interactions **-** DNA binding Motifs.

UNIT 4 PROTEOMIC STUDIES 9 Hrs.

Characterization of Proteome: Protein purification, Protein separation: 2-D gel electrophoresis and affinity chromatography, HPLC. Protein identification: Mass Spectrometry. Protein sequence analysis: N-terminal determination methods. Protein modifications. Protein expression profiling: Protein microarrays.

UNIT 5 OMICS CONCEPTS 9 Hrs.

Transcriptomics and SAGE; Pharmacogenomics, Comparative Genomics, Population genomics,Metabolomics & KEGG, Fluxomics, Glycomics, Nutrigenomics, Epigenomics

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Brown T.A, Gene Cloning, Chapman and Hall, 2004.
2. Brown T.A, Genomes, Bios Scientific Publishers Ltd 2002.
3. Greg Gibson and Spencer V. Muse, A Primer of Genome Science, 3rd Edition, Sinauer Associates, Inc., 2009

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 80 **Exam Duration: 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SCH1312	MODELING AND TRANSPORT PHENOMENA FOR BIOPROCESSES	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

- To understand the mechanism of fluids in motion under different conditions and to give an overview of various methods of bioprocess modeling techniques

UNIT 1 VISCOSITY AND THE MECHANISM OF MOMENTUM TRANSPORT 12 Hrs.

Newton's law of viscosity, Molecular momentum transport, Pressure and temperature dependency of viscosity, Molecular theory of the viscosity of gases at low density, Molecular theory of viscosity of liquids,viscosity of biological suspensions and emulsions, Convective momentum transport, Shell momentum balance and boundary conditions, Equation of Motion, Flow of a falling film, Flow through circular tube, Flow through annulus.

UNIT 2 THERMAL CONDUCTIVITY AND THE MECHANISM OF ENERGY TRANSPORT 12 Hrs.

Fourier's law of Heat Conduction, Molecular energy transport, Measurement of thermal conductivity, Temperature and pressure dependence of thermal conductivity, Theory of thermal conductivity of gases at low density, theory of thermal conductivity of liquids, Thermal conductivity of solids and composite solids, Shell energy balance and boundary conditions**,** Equation of energy, Steady state heat conduction in Flat slabs, slabs in series, cylinder, hollow cylinder, sphere.

UNIT 3 DIFFUSIVITY AND THE MECHANISM OF MASS TRANSPORT 12 Hrs.

Ficks law of binary diffusion, Temperature and pressure dependence of diffusivities, Theory of diffusion in gases at low density, Theory of diffusion in binary liquids, Theory of diffusion on colloidal suspensions, Theory of diffusion in polymers, Convective mass transport, Maxwell stefan's equation for multicomponent diffusion in gases at low density, Shell mass balance and boundary conditions, Equation of continuity, Fick's second law of diffusion.

UNIT 4 MATHEMATICAL MODELING OF BIOLOGICAL PROCESSES 12 Hrs.

Modeling cycle, System and types, Macroscopic approach, Modeling of microbiological processes, Macroscopic balance for - defined chemical compounds, intracellular compounds, Pseudo steady state approximation for intracellular compounds, Black box description of microbial growth. Application of metabolic information, generalized treatment of aerobic microbial growth and product formation, Application of the principle of - element conservation and energy conservation.

UNIT 5 MECHANISM OF BIOLOGICAL TRANSPORT 12 Hrs.

Electrokinetic phenomena, Pressure diffusion and ultracentrifuge, concentration diffusion and driving force, Applications of generalized Maxwell-Stefan Equations, Centrifugation of proteins, Proteins as hydrodynamic particles, Diffusion of salts in aqueous solutions, Departure from local electroneutrality, Electro-osmosis, Transport across selectively permeable membrane, Transport in porous media.

Max. 60 Hours.

TEXT / REFERENCE BOOKS

1. Bird, R.B, Stewart, W.E, and Lightfoot, E.N, Transport Phenomena, 2nd Edition, J. Wiley & Sons, New York, 1960.
2. Plawsky, J.L., Transport Phenomena Fundamentals, 1st Edition, Marcel-Dekker, New York, 2001.
3. Treybal, R.E., Mass Transfer Operations", 3rd Edition, McGraw Hill, 2004.
4. Nigel.J.Titchener-Hooker.,Bioprocess Technology:Modeling and transport phenomena, 1st Edition,Butterworth Heinemann, 1992.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT4057	GENETIC ENGINEERING LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

SUGGESTED LIST OF EXPERIMENTS

1. Isolation of genomic DNA from leaf samples - CTAB Precipitation method
2. Estimation of DNA / RNA by UV spectrophotometry
3. Restriction digestion of DNA
4. Construction of restriction map - plasmids
5. DNA ligation
6. Polymerase Chain Reaction - Amplification of DNA of interest/ RAPD
7. Purification of PCR products
8. Southern blotting / Western blotting / northern blotting
9. Cloning of PCR products (competent cell preparation, CaCl2 transformation, blue - white screening of transformants).

SBT4058	BIOPROCESS ENGINEERING LAB I	L	T	P	Credits	Total Marks
		0	0	4	2	100

SUGGESTED LIST OF EXPERIMENTS

1. Growth
   (a) Estimation of biomass, calculation of specific growth rate, yield coefficient of Bacteria.
   (b) Estimation of biomass, calculation of specific growth rate, yield coefficient of Yeast.
2. Optimization of growth conditions – physical & chemical (pH, temperature, time, nutrients – carbon, nitrogen & phoshorous)
   (a) Medium optimization by placket burman design.
   (b) Medium optimization – response surface methodology.
3. Glucose assay by dDNS method
4. Evaluations of enzyme kinetic parameters (Michaelis - Menten)
5. Enzyme activity calculation
6. Batch cultivation, estimation of kLa – dynamic gassing method, sulphide oxidation method
7. Immobilized by alginate gel method
8. Understanding a piping and instrumentation diagram for a bioreactor
9. Understanding of a Process flow diagram (PFD)

SBT4059	BIOPROCESS ENGINEERING LAB II	L	T	P	Credits	Total Marks
		0	0	4	2	100

SUGGESTED LIST OF EXPERIMENTS

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. TLC, Column chromatography, affinity chromatography, ion exchange chromatography, gel filtration chromatography

SBT1305	ANIMAL BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To offer the fundamentals in animal cell culture and impart knowledge about the micromanipulation and transgenic animals

UNIT 1 INTRODUCTION TO TISSUE CULTURE 9 Hrs.

Techniques of Cell & Tissue Culture: Importance of Aseptic Techniques in cell culture, Culture Environment & Culture Media, Serum. Primary Culture - Chick embryo Fibroblast, Chicken Liver & Kidney culture- Secondary culture, Suspension, Organ culture Stem cell Culture etc., Maintenance & Storage of Cultures.

UNIT 2 GROWTH AND SCALE UP 9 Hrs.

Cell growth characteristics and kinetics, Scale up of Suspension Cultures **-** Bag fermentors. Scale up of Monolayer (Continuous) cultures - Micro-carrier attached growth, perfusion and hollow fiber reactor. Advantages & Disadvantages of continuous cultures.

UNIT 3 ANIMAL TRANSGENESIS 9 Hrs.

Transgenic models- Methods of producing transgenic mice, Chicken & Livestock. Embryonic stem cell, pronucleus method-random and target gene insertion, knockout and knockin mice.

UNIT 4 *IN VITRO* FERTILIZATION TECHNIQUES 9 Hrs.

Manipulation of reproduction in animals-artificial insemination, embryo transfer. *In vitro* fertilization technology- *in vitro* maturation of oocytes, culture of *in vitro* fertilized embryos, embryo cloning- quadriparental hybrid, nuclear transplantation (Dolly), Embryonic stem cells

UNIT 5 APPLICATIONS OF ANIMAL BIOTECHNOLOGY 9 Hrs.

Hybridoma Technology, Uses of Monoclonal Antibodies DNA Fingerprinting & RFLP in Domestic Animals. Gene Therapy-Techniques & Developments and Future prospective. Applications of Biotechnology in Medicine, Environmental Biotechnology and Agriculture. IPR & Biosaftey.

Max. 45 Hours.

TEXT / REFERENCE BOOKS

1. Ian Freshney R.,Culture of Animal Cells,3 Edition, Wiley-Liss, 2005.
2. John R.W. Masters, Animal Cell Culture Practical Approach, Oxford University Press,3 Edition, 2000.
3. Butler M. & Dawson M., Cell Culture Labfax, Bios Scientific Publications Ltd., 1992
4. Martin Clynes, Animal Cell Culture Techniques, Springer, 1998.
5. Jenni P. Mather and David Barnes, Methods in Cell Biology, Vol. 57, Animal Cell Culture Methods. Academic Press, 1998.
6. R. Basega, Cell Growth and Division: A Practical Approach, IRL Press. 1989.
7. P.Ramadass,Animal Biotechnology Recent Concepts & Developments,MJP Publishers 2008.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT1306	BIOPROCESS ENGINEERING II	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the basic concepts of Downstream processing in fermentation technology
- To develop skills of the students in the area of downstream processing with emphasis on product purification

UNIT 1 BIOMOLECULES OF COMMERCIAL IMPORTANCE 9 Hrs.

Importance of Down Stream Processing (DSP) in biotechnology, characteristics of products, criteria for selection of bio-separation techniques. Role of DSP methods in bioprocess economics. Cell Disruption Methods: Various cell disruption methods, need for cell disruption for (Homogenizer, French press & Dynomill) intracellular products, cell disruption equipment. Applications in bio-processing. Flocculation: Principles of flocculation various flocculating agents, applications in bio-processing. Coagulation: Principles of coagulations and its applications in bio-processing.

UNIT 2 TECHNIQUES AND INSTRUMENTATION 9 Hrs.

Primary Separation and Recovery Process, Cell disruption methods for intracellular products, removal of insoluble, biomass (and particulate debris) separation techniques, flocculation and sedimentation, Filtration, centrifugation- stand alone and continuous centrifuges.

Liquid-liquid extraction, Aqueous two phase system, Supercritical fluid extraction, spectrometry, automation, bioassay, automated sequencers, mass spectrometry, ORD, CD

UNIT 3 MEMBRANE SEPARATION PROCESSES 9 Hrs.

Basic principles of membrane separation, membrane characteristics, different types of membranes, and their materials of construction (MCE, PVDF, PTFE), criteria for selection of membranes. Chromatographic separation and Electrophoretic Methods: Principles of chromatographic separation methods, different types of chromatographic methods, viz; adsorption chromatography, ion - exchange chromatography, gel chromatography, affinity chromatography etc. with applications in bio-processing. Principles of electrophoresis, SDS- PAGE, 2D gel electrophoresis, capillary electrophoresis.

UNIT 4 EVAPORATION 9 Hrs.

Theory of evaporation, BPR, single effect and multiple effect evaporation, steam economy, efficiency of evaporators, various evaporation equipments. Crystallization: Principles of crystallization, crystallization equipment. Applications in bioprocessing. Drying: Various types of drying methods, principles of drying, EMC-RH data, drying curves, various types of industrial dryers and their criteria for choice. Freeze drying technique and its advantages over other methods. Applications in bio-processing.

UNIT 5 A GENERAL STUDY OF VARIOUS CLASSES OF COMMERCIAL PRODUCTS 9 Hrs.

Blood products, vaccines, therapeutic antibodies and enzyme hormones and growth factors, interferon, interleukins, industrial enzymes, non-catalytic industrial proteins. Bulk organics (ethanol), Biomass (Bakers Yeast), Organic acids (Citric Acid), Amino Acids (L-Lysine), Microbial Transformations (Steroids), Antibiotics (Penicillin), Extra Cellular Polysaccharides (Xanthan Gum), Nucleotides (5-GMP), Vitamins (B12), Pigments (Shikonin)

Max. 45 HOURS

TEXT / REFERENCE BOOKS

1. Gary Walsh, Protein: Biochemistry and Biotechnology, John Wiley & Sons Ltd., 2002
2. S.N. Mukhopadhyay, Process Biotechnology Fundamentals, Viva Books Private Limited, 2001
3. James E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, McGraw-Hill. 1986
4. Shuler and Kargl, Bioprocess Engineering, Prentice Hall , 1992
5. James M. Lee, Biochemical Engineering, PHI, USA. 2009
6. EMT.EL-Mansi.CFA.Bryce, A.L.Demain, AR.Allman: Fermentation Microbiology and Biotechnology, Second Edition 2007.
7. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Decker Inc. 1997

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT1307	NANOBIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To introduce the basics of nanoscience, preparation and characterization of nanomaterials and their application

UNIT 1 INTRODUCTION TO NANO BIOSCIENCE 9 Hrs.

Definition, concepts and principles, types of approaches, four generations, self assembly, properties and application of nanotechnology and nanobiotechnology

UNIT 2 GENERAL CHARACTERIZATION TECHNIQUES 9 Hrs.

UV **-** Vis- NIR - absorption and reflectance Spectroscopy, X- Ray Diffraction studies **-** Bragg's law **-** particle size **-** Scherrer's equation **-** Photoluminescence (PL) studies **-**Fourier Transform Infrared Spectroscopy(FTIR) **-** FT Raman studies **-**Surface Enhanced Infrared spectroscopy, Resonance Raman Spectroscopy.

UNIT 3 PRODUCTION OF NANOPARTICLES 9 Hrs.

Physical, Chemical, Biological Methods, Principles- Application, Fabrication Technology, Characterization,

UNIT 4 NANO BIO-TECHNOLOGY 9 Hrs.

Proteins, DNA, biological molecular complexity, Biocompatibility, Bionanopore, Nanomotors- Production of artificial nano motors, Sensor, drug delivery, Biological Nano Containers and Nanoversatility Construction.

UNIT 5 NANO TOXICITY 9 Hrs.

Environmental impact of Nano dimension to society and Implication of Nano technology, New trends and Application of nano technology, toxicity assessment testing both *in vitro* and *in vivo* models

Max. 45 Hours.

TEXT / REFERENCE BOOKS

1. C.M Niemeyer and C.A. Mirkin, Nano biotechnology **-** concepts, applications and perspectives, Wiley-VCH, Verlag Publication, 2001.
2. K.K. Jain, Nano biotechnology in molecular diagnostics **-** current techniques and applications. Taylor and Francis publications, 2006.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBI1310	MOLECULAR MODELLING AND DRUG DESIGNING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To understand the critical relationship among biomolecular structure, function and force field models.
- To be able to utilize basic modeling techniques to explore biological phenomena at the molecular level.
- To emphasize Modelling drug/receptor interactions in detail by molecular mechanics, molecular dynamics simulations and homology modeling.

UNIT 1 CONCEPTS IN MOLECULAR MODELING 9 Hrs.

Introduction, Coordinate systems, Energy surfaces. Introduction to Quantum mechanics - Schrodinger wave equation, Born-Oppenheimer Approximation.

UNIT 2 MOLECULAR MECHANICS 9 Hrs.

Force field - Bond Stretching, Angle bending and Torsion angle, Covalent bond, Non-bonding interactions. Introduction to Energy minimization, Computer simulations, Conformational analysis.

UNIT 3 DRUGS 9 Hrs.

Prodrugs- classification, Soft drugs. Drug targets - Enzymes, Receptors, Proteins, Nucleic acids, Lipids. Drug solubility - Effect of pH, Effect of polarity and pKa. Drug Metabolism **-** Absorption, Distribution, Metabolism, Elimination.

UNIT 4 COMPUTER AIDED DRUG DESIGN 9 Hrs.

Molecular modeling in drug design: Steps in drug Development, Active site prediction, Screening, Lead discovery, Pharmacophore, Molecular docking. Structure based methods to identify lead compound, De novo ligand design, QSAR.

UNIT 5 COMPUTATIONAL REPRESENTATION OF MOLECULES 9 Hrs.

Chemical Databases **-** PDB LIGAND, PUBCHEM. Sources of data for 3D structures **-** PDB, PDB Sum. SMILES Notation.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Andrew Leach - Molecular Modelling: Principles and Applications, 2nd Edition. Pearson Education EMA, 2001.
2. R.K. Prasad - Quantum Chemistry, 3rd Edition, 2006.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SCH1313	MASS TRANSFER FOR BIOLOGICAL SYSTEMS	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

This course explains the fundamentals of mass transfer operations and techniques involved in diffusion, convective mass transfer, drying, crystallization and heat transfer operations.

UNIT 1 BASIC SEPARATION PROCESSES 12 Hrs.

Introduction to separation processes, Distillation, Types of distillation, absorption-packed and plate columns, Adsorption-chemisorption ,physical adsorption, isotherms, membrane separation process, Industrial applications of distillation, absorption and adsorption.

UNIT 2 PRINCIPLES OF UNSTEADY-STATE AND CONVECTIVE MASS TRANSFER 12 Hrs.

Introduction to convective mass transfer, Convective mass transfer coefficients. Types of mass transfer coefficients. Analogy between Mass, Heat and momentum transfer- Reynolds, Prandtl, Von karman and Chilton and colburn J-factor analogy. Mass transfer for flow inside pipes-equations for laminar, turbulent and flow inside wetted-wall towers.

UNIT 3 EVAPORATION 12 Hrs.

Introduction. Types of evaporators- natural circulation, forced-circulation and agitated-film evaporators. Methods of operation of evaporators-single-effect and multiple-effect evaporators, Effect of process variables on evaporator operation, Evaporation of Biological materials- fruit juices, sugar solution and paper-pulp waste liquors.

UNIT 4 CRYSTALLIZATION 12 Hrs.

Crystal types, Equilibrium solubility in crystallization, Crystallization theory, Equipments for crystallization, Tank, scraped surface, circulating **-**liquid evaporator and circulating **-**magma vacuum crystallizer. Rate of crystal growth and its law.Particle-size distribution of crystals and MSMPR Model Crystallizer.

UNIT 5 DRYING 12 Hrs.

Equipments for drying,-Tray dryer, Vacuum-shelf indirect dryers, continuous tunnel dryers, rotary dryers, drum and spray dryers. Humidification, Dehumidification, Dew point and wet bulb temperature. Equilibrium moisture content of materials. Bound and unbound water. Free and equilibrium moisture., Rate of Drying curves, Calculation methods for constant rate drying period, Calculation methods for falling rate drying period, Freeze drying and Sterilization of Biological materials, Pasteurization.

Max. 60 Hours

TEXT / REFERENCE BOOKS

1. Treybal, R.E, Mass Transfer Operations, 3rd Edition, McGraw Hill, 2004.
2. McCabe and Smith., Unit Operations of Chemical Engineering, 7th Edition, McGraw Hill, 2009.
3. Coulson J.M. and Richardson J.F., Chemical Engineering, 6th Edition, Pergamon Press, 2002.
4. Sherwood T.K., Pigford R.L. and Wilke C.R., Mass Transfer, 2nd Edition, McGraw Hill, 1960.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT4057	GENETIC ENGINEERING LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

SUGGESTED LIST OF EXPERIMENTS

1. Isolation of genomic DNA from leaf samples - CTAB Precipitation method
2. Estimation of DNA / RNA by UV spectrophotometry
3. Restriction digestion of DNA
4. Construction of restriction map - plasmids
5. DNA ligation
6. Polymerase Chain Reaction - Amplification of DNA of interest/ RAPD
7. Purification of PCR products
8. Southern blotting / Western blotting / northern blotting
9. Cloning of PCR products (competent cell preparation, CaCl2 transformation, blue - white screening of transformants).

SBT4058	BIOPROCESS ENGINEERING LAB I	L	T	P	Credits	Total Marks
		0	0	4	2	100

SUGGESTED LIST OF EXPERIMENTS

1. Growth
   (a) Estimation of biomass, calculation of specific growth rate, yield coefficient of Bacteria.
   (b) Estimation of biomass, calculation of specific growth rate, yield coefficient of Yeast.
2. Optimization of growth conditions – physical & chemical (pH, temperature, time, nutrients – carbon, nitrogen & phoshorous)
   (a) Medium optimization by placket burman design.
   (b) Medium optimization – response surface methodology.
3. Glucose assay by dDNS method
4. Evaluations of enzyme kinetic parameters (Michaelis - Menten)
5. Enzyme activity calculation
6. Batch cultivation, estimation of kLa – dynamic gassing method, sulphide oxidation method
7. Immobilized by alginate gel method
8. Understanding a piping and instrumentation diagram for a bioreactor
9. Understanding of a Process flow diagram (PFD)

SBT4059	BIOPROCESS ENGINEERING LAB II	L	T	P	Credits	Total Marks
		0	0	4	2	100

SUGGESTED LIST OF EXPERIMENTS

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. TLC, Column chromatography, affinity chromatography, ion exchange chromatography, gel filtration chromatography

SBT4060	ANIMAL BIOTECHNOLOGY LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

SUGGESTED LIST OF EXPERIMENTS

1. Media preparation for animal tissue culture
2. Primary cell culture-Chick Embryo Fibroblast
3. Sub culturing of normal cell/Cancer cell
4. Cryopreservation and Retrieval
5. Viability checking (Trypan Blue) and cell counting by Hemocytometer
6. Cytotoxicity assay
   a). Direct Microscopic Observation
   b). MTT assay
   c). Staining and observation of cells
7. DNA fragmentation assay

SBT 4061	BIOINSTRUMENTATION LAB	L	T	P	C	Max. Marks
		0	0	4	2	100

SUGGESTED LIST OF EXPERIMENTS

1. Handling of Micropipette accurately & calibration
2. Calculation –Molar conversion: Prepararion of 1N Hcl and 1n NaOH
3. Perparation of standard protein solution using SMF
4. Change in absorbance with concentration of potassium permanganate.
5. Absorption maxima– change in absorbance in potassium permanganate withwavelength.
6. Concentration of two components in a binary mixture. Absorption of light by potassium dichromate and potassium permanganate.
7. Absorption spectra of biomolecule.
8. Separation of pigments by paper chromatography Determination of Rf value.
9. Separation of plant pigment using thin layer chromatography
10. Calculation of Molar Extinction Co-efficient using UV-VisibleSpectroscopy

SBT4062	PLANT BIOTECHNOLOGY LAB	L	T	P	C	Max. Marks
		0	0	4	2	100

SUGGESTED LIST OF EXPERIMENTS

1. Plant tissue culture media preparation
2. Direct organogenesis
3. Indirect organogenesis
4. Anther and pollen culture
5. Embryo culture
6. Somatic embryogenesis
7. Cell suspension culture
8. Synthetic seeds
9. Protoplast culture
10. Hardening and Planting in field

SBT1401	BIOSAFETY, BIOETHICS AND IPR	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To explain the fundamentals of biosafety and to impart knowledge of bioethics both of which will mold better professionals. An introduction to intellectual property rights would instigate novel ideas.

UNIT 1 BIOSAFETY **9 Hrs.**

Introduction, Biosafety issues in biotechnology **-** Historical background; Introduction to biological safety cabinets; Biosafety levels, Primary containment for biohazards.

UNIT 2 BIOSAFETY GUIDELINES **9 Hrs.**

Biosafety guidelines and regulations (National and International) **-** operation of biosafety guidelines and regulations of Government of India; Definition of GMO's and LMO's; Roles of institutional biosafety committee, RCGM, GEAC, etc., for GMO applications in food and agriculture.

UNIT 3 INTELLECTUAL PROPERTY RIGHTS **9 Hrs.**

Types of IPR: Patents, Trademarks, Copyright & related rights, Industrial design, Traditional knowledge, Geographical indications **-** Importance of IPR. Patent filing procedures **-** National and PCT filing procedure.

UNIT 4 AGREEMENTS AND TREATIES **9 Hrs.**

History of GATT and TRIPS agreement; Madrid agreement; Hague agreement; WIPO treaties; Budapest treaty; PCT; Indian patent Act 1970 and Recent amendments.

UNIT 5 ENGINEERING ETHICS AND BIOETHICS **9 Hrs.**

Engineering ethics **-** professional ideals and virtues **-** Engineers as responsible experimenters **-** Research ethics. Framework for ethical decision making; Biotechnology and Ethics, Biowarfare and Biopiracy.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Mike Martin and Roland Schinzinger, Ethics in Engineering, McGraw Hill, 2005.
2. Kankanala C, Genetic Patent law and Strategy, First edition, Manupatra Information solution Pvt.Ltd.,2007.
3. Sasson A, Biotechnologies in developing countries present and future, UNESCO Publishers, 1993.
4. Singh K, Intellectual Property Rights on Biotechnology, Kalyani Publication, 2nd Edition, 2008.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBA1101	PRINCIPLES OF MANAGEMENT AND PROFESSIONAL ETHICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

To familiarize engineering students with the concepts of Management useful for Managing their own enterprise or to work in a professional organization in Managerial capacity and to provide them an ethical outlook.

UNIT 1 MANAGEMENT FUNCTIONS & STRUCTURE 9 Hrs.

Management - Definition -Role of managers- Levels of management-Basic Function - Contribution of Taylor & Fayol. Types of structures - Line, staff, Functional, Committee and Project & Matrix - Structures. Departmentalization - Centralization - Decentralization - Span of control. Management by COURSE OBJECTIVES (MBO)- Management by Exception (MBE).

UNIT 2 MANAGEMENT OF ORGINASATION 9 Hrs.

Forms of Business / Industrial Ownership - Sole Trader, Partnership, Joint stock Company, Performance Appraisal - Basic Principles - Pitfalls - Methods to Overcome. Industrial Safety - Causes of Accidents - Cost of Accidents - Measures to avoid Accidents. Plant Layout & Maintenance - Need, Types & Managerial Aspects.

UNIT 3 ORGANISATIONAL BEHAVIOUR 9 Hrs.

Organisational Behaviour - Definition - Nature & Scope - Contributing Disciplines - Importance of OB to Managers. Personality - Definition - Theories - Factors Influencing Personality. Motivation - Definition - Theories. Transactional Analysis. Morale & Job Satisfaction - Factors Influencing Job Satisfaction.

UNIT 4 GROUP DYNAMICS 9 Hrs.

Group - Definition - Types - Determinants of Group Cohesiveness. Communication - Process - Barriers - Effective Communication. Leadership-Definition- leadership styles- Theories of leadership - Factors Contributing to Effective Leadership. Trade Unions- Role of Trade Union in Organizations - Types and Functions of Trade Unions.

UNIT 5 PROFESSIONAL ETHICS 9 Hrs.

Ethics in Workplace - Formulation of Ethics - Managerial Ethics - Managing Ethical Behaviour - Codes of Ethics - Encouraging Ethical Behaviour - Ethical Leadership - Ethical Decision making. Corporate Social Responsibility (CSR) - Intellectual Property Rights (IPR)- Meaning- Laws relating to Intellectual Property Rights (IPRs)

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Gupta C.B., Management Theory and Practice, 14th Edition, Sultan Chand & Sons, 2009.
2. Dr. Prasad L.M., Principle & Practice of Management, 7th Edition, Sultan Chand & Sons, 2008.
3. Aswathappa, Organisational Behaviour, 8th Edition, Himalaya Publishing House, 2010.
4. Dr. Prasad L.M., Organisational Behaviour, 4th Edition, Sultan Chand & Sons, 2008.
5. Harold Koontz, Principles of Management, 1st Edition, Tata McGraw Hill, 2004.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 5 questions from each unit of internal choice, each carrying 12 marks **60 Marks**

SBT4060	ANIMAL BIOTECHNOLOGY LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

SUGGESTED LIST OF EXPERIMENTS

1. Media preparation for animal tissue culture
2. Primary cell culture-Chick Embryo Fibroblast
3. Sub culturing of normal cell/Cancer cell
4. Cryopreservation and Retrieval
5. Viability checking (Trypan Blue) and cell counting by Hemocytometer
6. Cytotoxicity assay
   a). Direct Microscopic Observation
   b). MTT assay
   c). Staining and observation of cells
7. DNA fragmentation assay

SBT 4061	BIOINSTRUMENTATION LAB	L	T	P	C	Max. Marks
		0	0	4	2	100

SUGGESTED LIST OF EXPERIMENTS

1. Handling of Micropipette accurately & calibration
2. Calculation –Molar conversion: Prepararion of 1N Hcl and 1n NaOH
3. Perparation of standard protein solution using SMF
4. Change in absorbance with concentration of potassium permanganate.
5. Absorption maxima– change in absorbance in potassium permanganate withwavelength.
6. Concentration of two components in a binary mixture. Absorption of light by potassium dichromate and potassium permanganate.
7. Absorption spectra of biomolecule.
8. Separation of pigments by paper chromatography Determination of Rf value.
9. Separation of plant pigment using thin layer chromatography
10. Calculation of Molar Extinction Co-efficient using UV-VisibleSpectroscopy

SBT4062	PLANT BIOTECHNOLOGY LAB	L	T	P	C	Max. Marks
		0	0	4	2	100

SUGGESTED LIST OF EXPERIMENTS

1. Plant tissue culture media preparation
2. Direct organogenesis
3. Indirect organogenesis
4. Anther and pollen culture
5. Embryo culture
6. Somatic embryogenesis
7. Cell suspension culture
8. Synthetic seeds
9. Protoplast culture
10. Hardening and Planting in field

SBT1402	PLANT BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To introduce the concepts of plant tissue culture
- To provide the basics on transgenic plants

UNIT 1 INTRODUCTION TO PLANT CELL AND TISSUE CULTURE 9 Hrs.

History, Definition and Principle of plant tissue culture, Laboratory organization, Culture environment, Methods of sterilization, Nutritional components of tissue culture media, Plant growth regulators, Types of culture, Different areas and applications of plant tissue culture, Factors affecting *in vitro* culture.

UNIT 2 TISSUE CULTURE TECHNIQUES 9 Hrs.

Regeneration of plants, Organogenesis, Micropropagation with shoot apex and nodal cultures (Clonal Propagation), Somatic embryogenesis and synthetic seeds, Embryo culture and embryo rescue method, *in vitro* pollination and fertilization, Production of haploid plant through Androgenesis and Gynogenesis.

UNIT 3 CELL AND CALLUS CULTURE 9 Hrs.

Isolation and culture of protoplasts, Protoplast fusion and somatic hybridization, Selection systems for somatic hybrids / cybrids and their characterization, Somoclonal variations, Production of secondary metabolites by plant cell cultures, Germplasm conservation and cryopreservation.

UNIT 4 TRANSGENIC PLANTS 9 Hrs.

Structure and organization of plant genome, Chloroplast and Mitochondrial genome,Genetic Transformation methods for production of transgenic plants (Direct, Indirect), Direct: Particle bombardment, Electroporation, Microinjection, Chemical gene transformation, Indirect: *Agrobacterium* mediated genetic transformation-Ti plasmid, Plant virus-CaMV, Gemini viruses.

UNIT 5 APPLICATION AND SAFETY REGULATIONS 9 Hrs.

Production of genetically modified plants for herbicide and pest resistant, Transgenic plants for quality traits, Industrial enzymes, Molecular farming for therapeutic protein (Plantibodies, Plantigens, Edible Vaccines), Safety regulation for transgenic plants, Current issues related to transgenic plants.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Adrian Slater, Nigel Scott, and Mark Fowler, Plant Biotechnology, Oxford University Press, NewYork, 2008.
2. Old R.W. and Primrose S.B., An Introduction to Genetic Engineering, University of California press, 1980.
3. Satyanarayana, U. Biotechnology, Allied Pvt. Ltd. Kolkata, 2007.
4. Purohit S.S., Agricultural Biotechnology, Agrobios Indi., Jodhpur, 2002.
5. Chawla H.S., Introduction to Plant Biotechnology, 2nd Edition, Oxford and IBH Press, 2003.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT1403	CONCEPTS IN STEM CELL RESEARCH	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To advance knowledge about organism develops from a single cell and how healthy cells replace damaged cells in adult organisms.

UNIT 1 STEM CELL BASICS **9 Hrs.**

Introduction to Stem cells, Unique properties of stem cells **-** embryonic stem cells - adult stem cells **-** umbilical cord stem cells **-** similarities and differences between embryonic and adult stem cells. Properties of stem cells **-** pluripotency **-** totipotency

UNIT 2 EMBRYONIC STEM CELLS AND ETHICAL ISSUES **9 Hrs.**

Embryogenesis, *In vitro* fertilization **-**culturing of embryos-isolation of human embryonic stem cells **-** blastocyst **-** inner cell mass **-** Growing ES cells in lab **-** laboratory tests to identify ES cells **-** properties of ES cells and Embryonic stem cell markers. Governance of hESC research, Ethical issues at stake, regulation in European member states regarding human ESC research, Regulation in some Non European countries regarding hESC research.

UNIT 3 ADULT STEM CELLS **9 Hrs.**

Somatic stem cells, Test for identification of adult stem cells, Adult stem cell differentiation **-** Trans differentiation **-**Plasticity **-** Different types of adult stem cells- Isolation of haemopoietic stem cell, Muscle and Cardiac stem cell and their applications.

UNIT 4 ADVANCEMENT OF STEM CELL IN TISSUE ENGIEERING **9 Hrs.**

Tissue engineering triad, ECM components and their role in tissue development, Tissue engineering application **-** Production of complete organ - Kidney **-** Eyes - Heart **-** Brain.

UNIT 5 THERAPEUTIC APPLICATION OF STEM CELLS **9 Hrs.**

Gene therapy **-** genetically engineered stem cells **-** stem cells and Animal cloning **-** transgenic animals and stem cells **-** Therapeutic applications **–** Parkinson's disease - Neurological disorder **-** limb amputation **-** heart disease - spinal cord injuries **-** diabetes **-**burns - HLA typing- Alzheimer's disease.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Kursad and Turksen, Embryonic Stem cells, Humana Press, 2002
2. Stem cell and future of regenerative medicine. By committee on the Biological and Biomedical applications of Stem cell Research,12 National Academic press, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**
PART A : 10 questions of 2 marks each - No choice **20 Marks**
PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT1601	NEUROSCIENCE	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To know the general organization of brain and spinal cord.
- To provide knowledge on the pathology and diseases related to nervous system.

UNIT 1 INTRODUCTION 9 Hrs.

An overview of neuroscience and Biotechnology - Neurons and Neuroglia – Neuronal membrane at rest, Action Potential – Synaptic transmission- neurotransmitter system

UNIT 2 NERVOUS SYSTEM 11 Hrs.

The structure of nervous system – gross anatomy – Brain spinal cord and peripheral nerves.

UNIT 3 NEUROSCIENCE METHODS AND TECHNIQUES 9 Hrs.

Techniques to understand the functions of nervous system: Patch clamp techniques, intracellular recording, extra cellular recording, mass unit recording, Evoked potentials and electro encephalographic (EEG), Techniques to understand the chemistry of nervous system: Brain Imaging, CT scan, PET, MRI, FMRI, Angiography.

UNIT 4 PATHOLOGY OF THE NERVOUS SYSTEM 9 Hrs.

Molecular and cellular mechanisms – pathological features & genetics of multiple sclerosis-Parkinson's Disease- Huntington's Disease – Alzheimer's disease.

UNIT 5 BIOTECHNOLOGY AND DISEASES OF NERVOUS SYSTEM 7 Hrs.

Stem cell therapy, Gene therapy and development of transgenic mice- ethical concern.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Eric R. Kandel, James H.S. Chwarts and Thomas M. Jessel, Principles of Neural Science 4th Edition, 2006.
2. Gupta, Basic Neuro anatomy, McGraw Hill, 5th Edition, 2006.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT 1602	FOOD BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- The course describes the interaction of the food and microorganisms, their negative impact and the methods of food preservation by modern biotechnological process.

UNIT 1 INTRODUCTION 9 Hrs.

History of Microorganisms in food, Historical Developments. The Role and significance of Microorganisms, Primary sources of Microorganisms found in foods. Microbial Intrinsic and Extrinsic parameters of foods. Microbiological quality testing of foods – enumeration and detection of food borne organisms - Culture, Microscopic and Sampling Methods, Conventional, SPC, Membrane Filters, Microscopic Colony Counts, Agar droplets, Dry films, MPN, DMC, Dye reduction, Roll Tubes, Microbiological Examination of surfaces and sampling, Metabolically Injured Organism, Enumeration and Detection of food borne organisms.

UNIT 2 FOOD MICROBIOLOGY 11 Hrs.

Microbiological role in food process operation and production: new protein foods: SCP; mushroom; food yeasts, algal proteins. Food Fermentation method of preparing and preserving foods -pickling, alcoholic beverages and other products. Food additives: Need for food additives, types of food additives. Development of novel food and food ingredients; SCP, polysaccharides, low calorie sweeteners, naturally produced flavor modifier, food coloring agent, food supplements and Nutraceuticals. Genetically modified foods and consumer preference – prebiotic and probiotic foods.

UNIT 3 STORAGE & PRESERVATION 9 Hrs.

General principle of spoilage, factors affecting spoilage; Spoilage of fruits and Vegetables, Spoilage of Miscellaneous Foods. Food preservation- Characteristics of Radiations of Interest in Food Preservation, Destruction of Microorganisms and Applications, Radappertization, Radicidation and Radurization of food, legal status of food irradiation. Storage and Stability of irradiated foods .Preservation: High and Low Temperature, Drying

UNIT 4 FOOD PROCESSING 9 Hrs.

Mechanism of enzyme functions and reactions in process techniques: starch and sugar conversion process or baking by amylases; de-oxygenation and desugaring by glucose oxidase; beer mashing and chill- proofing and cheese making by proteases and various other enzymes, catalytic actions in food processing. Process wastes: whey; molasses; starch substances and other food wastes for bioconversion to useful products.

UNIT 5 PACKAGING 7 Hrs.

Introduction to Food Packaging, interaction of food material with packaging materials, preservation of food products. Genetically modified and transgenic food development, processing- nutritional and economic aspects.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. James. M. Jay, Martin J. Loessner and David A.Golden, Food Microbiology, Springer Publication, 7th Edition, 2005.
2. Frazier, Food Microbiology, McGraw Hill Publication, 4th Edition, 2001
3. Shetty K., G. Paliyath et al. – Food Biotechnlogy – 2nd Edition- Taylor and francis, 2006.
4. Keshav Trehan, Biotechnology, New Age International (P) Ltd. Publishers, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT 1603	AGRICULTURE BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the organization of plant genome
- To provide an insight into the applications of tissue culture and transformation

UNIT 1 INTRODUCTION 9 Hrs.

History, Definition, Structure and organization of plant genome, Chloroplast and Mitochondrial genome, Totipotency, Plasticity and cytodifferentiation, Culture environment, Plant Tissue culture media and their components, Methods of sterilization, Different types of culture, Factors affecting *in vitro* culture.

UNIT 2 TISSUE CULTURE TECHNIQUES 9 Hrs.

Regeneration of plants, Organogenesis, Micropropagation with shoot apex and nodal cultures (Clonal Propagation), Somatic embryogenesis and synthetic seeds, Embryo culture and embryo rescue method, In vitro pollination and fertilization, Production of haploid plant through Androgenesis and Gynogenesis.

UNIT 3 TISSUE CULTURE APPLICATION 9 Hrs.

Isolation and culture of protoplasts, protoplast fusion and somatic hybridization, Selection systems for somatic hybrids / cybrids and their characterization, Somoclonal variations, Production of secondary metabolites by plant cell cultures, Germplasm conservation and cryopreservation.

UNIT 4 PLANT TRANSFORMATION 9 Hrs.

Genetic Transformation methods for production of transgenic plants (Direct, Indirect), Direct Gene Transfer (DGT) methods, Agrobacterium mediated genetic transformation (Indirect), Chloroplast transformation and production of transplantomics.

UNIT 5 APPLICATION AND SAFETY REGULATIONS 9 Hrs.

Production of genetically modified plants for herbicide and pest resistant, transgenic plants for quality traits, Industrial enzymes, Molecular farming for therapeutic protein (Plantibodies, Plantigens, Edible Vaccines), Safety regulation for transgenic plants, Current issues related to transgenic plants.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Adrian Slater, Nigel Scott, and Mark Fowler, Plant Biotechnology, Oxford University Press, NewYork, 2008.
2. Old R.W. and Primrose S.B., An Introduction to Genetic Engineering, University of California press, 1980.
3. Satyanarayana, U. Biotechnology, Allied Pvt. Ltd. Kolkata, 2007.
4. Purohit S.S., Agricultural Biotechnology, Agrobios Indi., Jodhpur, 2002.
5. Chawla H.S., Introduction to Plant Biotechnology, 2nd Edition, Oxford and IBH Press, 2003.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT 1604	INDUSTRIAL BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To create general understanding amongst the students in the subject of Industrial Biotechnology through in-depth lectures

UNIT 1 HISTORY AND DEVELOPMENT 9 Hrs.

Physiological significance of Fermentation to the fermenting organism. History of traditional and modern fermentation process. Isolation, screening and strain improvement of industrially important microorganisms. Identification of metabolites, Culture preservation and Innoculum development. Substrates for bioconversion processes and design of media, significance of media components in relation to product formation. General fermentation process economics and costing of products.

UNIT 2 FERMENTATION AND BIOPRODUCTS 11 Hrs.

Concepts of Upstream and Downstream Processes. Process development, Bioreactors/Fermentors, Yeast technology, Industrial Processing-Recovery, Extraction and Purification of fermentation products. Chromatography in purification of products: Affinity-Ion Exchange-Hydrophobic Interaction chromatography techniques. Metabolite production and commercial applications of chemicals, antibodies, solvents, organic acids, amino acids, enzymes, vitamins, single cell proteins and food substances derived from brewing and dairy industry.

UNIT 3 BIOPOLYMER AND BIOTHERAPEUTICS 9 Hrs.

Microbial biopolymer production, Bioconversion of lingo - cellulosic wastes. Production of biofuels (bioethanol and biodiesel). Biotransformation-Microbial transformation of steroids. Medical applications-Viral Vaccines, Interferons, Monoclonal antibody technology, Biosensors.

UNIT 4 PRIMARY AND SECONDARY METABOLITES 9 Hrs.

Process considerations and Scale up of Microbial processes, Production of cell biomass and primary metabolites (Ethanol, acetone-butanol, citric acid, dextran and amino acids). Microbial production of Industrial enzymes (glucose isomerase, cellulase etc). Production of secondary metabolites (Penicillin and tetracycline).

UNIT 5 ETHICAL AND REGULATORY ASPECTS 7 Hrs.

Genetically modified organisms and products, Food, Pharmaceutical and enzyme industries. Products of animal and plant cell culture. Ethical aspects of Biotechnology, Biotechnology in developed and developing countries, Current applications, regulatory issues, patent issues. Industrial safety-rules and regulations.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. M.Y.Youngs, Comprehensive Biotechnology, Volume 1-4: Elsevier India Pvt Ltd, India, 2004.
2. W.Crueger and A.Crueger, Biotechnology: A text book of industrial Microbiology, 2nd Edition, Panima Publishing Corporation, New Delhi, 2000.
3. S.N.Mukhopadhya , Process Biotechnology, Viva Books Pvt Ltd, India, 2001
4. L.E Casida, Industrial Microbiology New Age International Publishers, 1989

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT 1605	ENVIRONMENTAL BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To bring about an insight on the basic concepts and advanced research area in Environmental Biotechnology

UNIT 1 INTRODUCTION 9 Hrs.

Water, soil and air pollution – types, sources and effects-. Microbial flora of soil – Interactions among soil microorganisms – Nitrogen cycle – Carbon cycle – Sulphur cycle – Phosphorous cycle

UNIT 2 BIOLOGICAL WASTEWATER TREATMENT PROCESS 9 Hrs.

Primary, secondary and tertiary treatment of wastewater–Comparison between aerobic and anaerobic processes, Activated sludge process – Trickling filter – Rotating biological contactors – Fluidized bed reactor – anaerobic digester, emerging process in waste water treatment and their applications - municipal and industrial wastewater treatment.

UNIT 3 BIOREMEDIATION AND MICROBIAL LEACHING TECHNOLOGIES 9 Hrs.

Bioremediation- *Insitu* and *Exsitu*- bioventing,Biosparging and Phytoremediation. Role of microbes in improving soil fertility- Mycorrhiza. Microbial leaching of heavy metals - extraction of metals from ores- Bioaccumulation-Biosorption and Bioprecipitation of heavy metals.

UNIT 4 BIOPRODUCTS FROM RENEWABLE SOURCES 9 Hrs.

Composting- types, systems, quality- vermicomposting. Biofertilizers – Biopesticides - Biofuel production - Bioethanol – Biohydrogen and Biodiesel.

UNIT 5 BIODEGRADATION OF XENOBIOTICS COMPOUNDS 9 Hrs.

Aerobic and Anaerobic degradation of recalcitrants - aliphatic, aromatic polyaromatic - hydrocarbons-Alkyl ketones – halogenated organic compounds. Role of GEM in degradation of industrial pollutant.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Alan Scragg, Environmental Biotechnology, Longman, 1999
2. Bhattacharya, B.C. and Banerjee, R., Environmental Biotechnology, Oxford University Press, 2007.
3. Bruce Rittmann and Perry McCarty, Environmental Biotechnology: Principles and Applications, McGraw-Hill, 2001
4. H. Polasa (ED.) Microbial Gene Technology, South Asian Publishers, New Delhi. 1991.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT 1606	CANCER BIOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To introduce the basics of cancer biology
- To understand the pathways of disease mechanisms

UNIT 1 THE BASICS OF CANCER BIOLOGY 9 Hrs.

Nomenclature - oncogenesis - Cell cycle & check points, Receptors, Signal molecules, Signal transduction. Incidence of cancer, Factors related to Environment, Geography, Genetic modification – telomerase study. Prevention and treatment of cancer.

UNIT 2 CARCINOGENESIS AND DETECTION OF CANCER 9 Hrs.

Types of carcinogens – physical, chemical and biological carcinogenesis. Diagnostic tools for detection of cancer, Identification of cancer using signalling molecules and growth factors - New techniques for early detection of cancers.

UNIT 3 CANCER SPREADING PATHWAYS & METASTASIS 9 Hrs.

Differentiation, rate of growth, local invasion, invasion of extracellular matrix - Metastasis, pathways of spread – vascular dissemination.

UNIT 4 MOLECULAR CHANGES IN CANCER CELLS 9 Hrs.

Proto-oncogenes, oncogenes and oncoprotein. Tumor suppressor genes – p53 gene, activation-study. Evasion of apoptosis – DNA repair defects and instability of genes in cancer cells - chromosomal changes, amplification of genes. Molecular profile of cancer cells.

UNIT 5 TYPES OF CANCER TREATMENT METHODS 9 Hrs.

Different types of cancer treatment - Radiation, chemotherapy, immunotherapy, hormonal therapy, gene therapy and conventional methods of cancer treatments.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Maly B.W.J. Virology: A Practical approach IRL Press, Oxford. 1987.
2. Dunmock N.J and Primrose S.B. Introduction to Modern virology, Blackwell Scientific publication, oxford, 1988
3. Margaret A. Knowles and Peter T. Selvo. An introduction to cellular and molecular biology of cancer, Oxford Medical publication, 1991

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT 1607	FOOD PROCESSING AND PRESERVATION	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To know about the spoilage of foods because of microbes and to gain knowledge about the processing of food and techniques of preservation

UNIT 1 INTRODUCTION 9 Hrs.

History –food spoilage- Food borne diseases – food infection and food intoxication – symptoms, causes and control.Scope and importance of food processing. Traditional methods of food processing-pickling, salting, sun drying.

UNIT 2 MICROBIAL SPOILAGE IN FOODS 9 Hrs.

Types of microorganisms in food like meat, poultry, sea foods, dairy products, fruits and vegetables. Assessing microbial population in food- meat, poultry, fish and dairy products- microbial spoilage of fruits, vegetables, cereal and bakery products, meat products and egg.

UNIT 3 FOOD PROCESSING 9 Hrs.

Benefits and drawback of food processing, parameters for food processing. Processing of milk, vegetables, meat, oil processing, grind milling. Food additives-safety and their effects. Processing method- size reduction,mixing, separation and concentration of food components, High hydrostatic pressure, phytochemical processes. Effects of food processing on food nutrition.

UNIT 4 METHODS OF FOOD PRESERVATION 9 Hrs.

Preservation by temperature- moist heat, dry heat, low temperature-refrigeration and freeze drying. Heat Resistance of microbes and spores. Preservation by fermentation, food irradiation. Chemical preservation

UNIT 5 PACKAGING OF FOODS 9 Hrs.

Solid, liquid, modified atmosphere packing- labeling of foods- materials of packing- food grade- retort pouch. food and agricultural organization (FAO)

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Fennema R., Principles of Food Sciences, Technology and Engineering, 1978.
2. Sivashakar B., Food processing preservation, Prentice Hall of India, Pvt, Ltd, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT 1608	AQUACULTURE	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To provide knowledge on the basics of aquaculture and hatcheries
- To understand the chromosomal manipulations and their effects

UNIT 1 INTRODUCTION TO AQUACULTURE: 9 Hrs.

Aquaculture: Definition-Site selection, design and construction of aquaculture pond - Criteria for selecting the candidate species for aquaculture - Types and methods: Extensive, semi-intensive and intensive culture - Composite fish culture and integrated fish farming - Types of culture systems: pen culture, Cage culture, raft culture and Pond culture.

UNIT 2 HATCHERY AND GROW- OUT PRODUCTION OF AQUATIC ORGANISMS 9 Hrs.

Design and construction of a fish hatchery - Types of hatcheries and management practices - Live feed culture: culture of microalgae, rotifers and crustaceans (Artemia) - Selection of brooder, nutrition, gonadal changes, hormonal regulation - Culture of economically important marine species: *Litopenaeus vannamei* (shrimp), *Lates calcarifer* (seabass), Lobster, seaweeds - Culture practices of freshwater species: Prawns, carps, catfish, murrels and ornamental fishes.

UNIT 3 POND MANAGEMENT AND POST HARVEST TECHNOLOGY 9 Hrs.

Pond management: Nursery and grow-out pond maintenance, pond fertilization. Water quality management: Dissolved Oxygen, CO_2, Ammonia, pH, salinity, temperature and turbidity.

Harvest and post-harvest technology: Types of harvest, sorting, cleaning, packing, transportation of live organisms and preservation. Fish processing: Types of processing and canning, Quality assurance: Standards of sanitation and hygiene. Implementation of HACCP (Hazard Analysis and Critical Control Point) concept and food safety in fish industry.

UNIT 4 CHROMOSOME MANIPULATION AND FISH BIOTECHNOLOGY 9 Hrs.

Genetic improvement: Inbreeding and cross breeding; Hybridization, Genetic manipulation: Sex-reversal and sex control; role of steroids in sex reversal, chromosomal manipulation, polyploidy, androgenesis and gynogenesis; cryopreservation of gametes. Fish Biotechnology: Production of transgenic fishes, micro injection technique, Cloning and expression of GnRH.

UNIT 5 FISH DISEASES AND CONTROL MEASURES 9 Hrs.

Disease diagnosis: Principles of disease diagnosis in finfish and shell fish. Microbial diseases: Diseases caused by bacteria (Vibriosis) - Fungi and viruses (WSSV). Parasitic diseases: Diseases caused by protozoa and metazoa (crustaceans, helminthes). Non–infectious diseases: Nutritional and environmental diseases. Aquafarm pollutants. Prevention and control of diseases: Symptoms, prevention, control and treatments (prophylactic and therapeutic).

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Pillay, T.V.R., Aquaculture Principles & Practices, Fishing News (Books) Limited, London, 1990
2. Santhanam R. N. Ramanathan and G. Jegatheesan, Coastal Aquaculture in India, CBS publishers, 1990
3. V. Sundararaj, M.J. Prince Jeyaseelan and S. Felix, Shrimp health Management, Mala Publishers, Chennai. 1993
4. T.V.R. Pillay, Coastal Aquaculture in the Indo-Pacific region, FAO, Rome, Italy. 1962
5. Donald R. Swift, Aquaculture training manual, Fishing News Books Ltd. 1993
6. Hand Book on aqua farming by MPEDA, Cochin. 2005

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT 1609	INDUSTRIAL SAFETY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To promote safety in industries, reduce hazards and maintain high standards in industries. Also to help maintain healthy work practices and promote quality work keeping in mind environmental preservation.

UNIT 1 INDUSTRIAL SAFETY PRINCIPLES 9 Hrs.

History of Safety movement –Evolution of modern safety concept- general concepts of management – planning safety for optimization of productivity -productivity, quality and safety-line and staff functions for safety-budgeting for safety-safety policy. Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, evaluation of performance of supervisors on safety.

UNIT 2 ENVIRONMENTAL SAFETY 9 Hrs.

Hazardous waste management in India-waste identification, characterization and classification technological options for collection, treatment and disposal of hazardous waste-selection charts for the treatment of different hazardous wastes-methods of collection and disposal of solid wastes-health hazards-toxic and radioactive wastes-incineration and vitrification - hazards due to bio-process dilution- standards and restrictions – recycling and reuse.

UNIT 3 BIOLOGICAL AND ERGONOMICAL HAZARDS 9 Hrs.

Classification of Biohazardous agents – examples, bacterial agents, rickettsial and chlamydial agents, viral agents, fungal, parasitic agents, infectious diseases - Biohazard control program, employee health program-laboratory safety program-animal care and handling-biological safety cabinets - building design. Work Related Musculoskeletal Disorders –carpal tunnel syndrome CTS- Tendon pain-disorders of the neck- back injuries.

UNIT 4 OCCUPATIONAL PHYSIOLOGY 9 Hrs.

Man as a system component – allocation of functions – efficiency – occupational work capacity – aerobic and anaerobic work – evaluation of physiological requirements of jobs – parameters of measurements – categorization of job heaviness – work organization – stress – strain – fatigue – rest pauses – shift work – personal hygiene.

UNIT 5 BIOSAFETY 9 Hrs.

Biosafety issues in Biotechnology – primary containment for Biohazards – National and international biosafety guidelines and regulations – operation of biosafety guidelines and regulations of Government of India – Risk analysis – risk assessment – risk management.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Heinrich H.W. Industrial Accident Prevention McGraw-Hill Company, New York, 1980.
2. Blake R.P., Industrial Safety, Prentice Hall Inc., New Jersey, 2nd Edition, 1963.
3. Hand book of"Occupational Safety and Health, National Safety Council, Chicago, 1982

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT 1610	GMP AND QUALITY CONCEPTS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To introduce students about Good manufacturing practices quality concepts which would expose them to industrial scenario.

UNIT 1 INTRODUCTION 9 Hrs.

Basic Concepts: Quality concepts, Quality Control, Quality Assurance, Good Manufacturing Practices, Good Laboratory Practices, Responsibilities. Quality Control: Quality control laboratory: Responsibilities, good laboratory practices, routine controls, instruments, protocols.

UNIT 2 GMP 9 Hrs.

Good Manufacturing Practice. Legal requirements pertaining to GMP: GMP Guidelines, Standards, Regulatory agencies. Basic Components of GMP: Organization & Personnel, Premises, Equipments, Raw Materials, Complaints and recalls, Specifications, Self inspection.

UNIT 3 GLP 9 Hrs.

Good Laboratory Practice (GLP) – an overview and basic information, Scope. Principles of GLP: Test Facility Organization and Personnel, Quality Assurance Programme, Facilities, Test Systems, Test and Reference Items, Standard Operating Procedures, Performance of the Study, Reporting of Study Result, Storage and Retention of Records and Materials.

UNIT 4 INSPECTION 9 Hrs.

Inspections, Quality Audit and Quality System Reviews: Inspections, role of quality audit, role of inspectors, methods of inspection- routine, concise, follow-up and special inspections, frequency and duration of inspections, preparations for inspections, conduct, report and regulatory actions.

UNIT 5 REGULATION 9 Hrs.

Regulatory bodies – Need and role of regulatory bodies. Different regulatory bodies – FDA, HACCP and their scope. Importance of regulatory approval. ISO 9000 – regulations.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Sidney H. Willig, Good manufacturing Practices for Pharmaceuticals, 5th Edition, Revised and Expanded, Marcel Dekker, Inc. New York, 2005.
2. Jose Rodriguez-Perez, The FDA and Worldwide Current Good Manufacturing Practices and Quality System requirements guidebook for finished pharmaceuticals, American Society for Quality, ASQ Quality Press, Milwaukee, Wisconsin, 2014.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SPR1307	RESOURCE MANAGEMENT TECHNIQUES	L	T	P	Credits	Total Marks
		2	1	0	3	100

COURSE OBJECTIVE

To develop in a student efficient and effective deployment of an organization's resources when they are needed. Such resources may include financial resources, inventory, human skills, production resources, or information technology.

UNIT 1 INTRODUCTION AND LINEAR PROGRAMMING 9 Hrs.

Operations Research(OR)- Nature – Characteristics – Phases - Role of OR in Decision making - Outline of OR Models Linear Programming – Formulation of L.P.problems –Solution by graphical method, simplex method, Two Phase Method, Big M methods, Dual Simplex method

UNIT 2 TRANSPORTATION AND ASSIGNMENT MODEL 9 Hrs.

Transportation problem – Initial Basic feasible solution- Northwest corner method, Least Cost method, Vogel's approximation method – Test for optimality-MODI method. Assignment problems- Hungarian assignment models- Travelling salesman problems

UNIT 3 RESOURCE SCHEDULING AND NETWORK ANALYSIS 9 Hrs.

Problem of Sequencing – Problem with N jobs and 2 machines N Jobs 3 machines N Jobs and m machines and 2 Jobs m machines (Graphical method). Project Management -Basic concepts–Network construction and scheduling Critical Path Method (CPM) & Program evaluation review technique (PERT) and resource leveling by network techniques, time – Cost trade off.

UNIT 4 INVENTORY CONTROL 9 Hrs.

Inventory Control – Various Types of inventory models – deterministic inventory models – Production model, Purchase model– with and without shortage- Economic Order Quantity (EOQ) – Buffer stock – Shortage quantity, Probabilistic inventory models – Quantity Discount and Price Breaks

UNIT 5 QUEUEING THEORY AND REPLACEMENT MODELS 9 Hrs.

Queuing theory – Poisson arrivals and exponential service times, Single channel models only, Replacement policy for items whose maintenance cost increases with time- Consideration of time value of money - Replacement policy- Individual, Group replacement of items that fail completely and suddenly.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1.. R.Panneerselvam,Operation research, 2nd Edn., Prentice Hall, 2001.
2. S.D Sharma, Operation research Theory,Methods and Application, 17th Edn., Kedar Nath Ram Nath Publication, 2010.
3. Nita H Shah, Ravi M Gor & Hardik Soni, Operation research, 4th Edn., PHI, 2010.
4. Hamdy A.Taha, Opeartion Research, 8th Edn, PHI, 2008
5. Hiller & Liberman., Introduction to Operations Research, 5th Edition, Mc Graw Hill, 2001
6. Ravindran,Phillips &Solberg, Operations Research: principles and practice, 2nd Edn., Wiley India Lts, 2007
7. Ronald L. Rardin, Optimization in Operations Research, Prentice Hall, 1998

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SHS1601	LIFE AND EMPLOYABILITY SKILLS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

The course aims at equipping students to be competent in facing the challenges in today's globalized context, by providing an insight to soft skills for success and life skills for survival at the workplace.

UNIT 1 ACHIEVEMENT MOTIVATION 9 Hrs.

Time Management - Positive and negative aspects of time log - Formula for successful time management.

UNIT 2 SELF-AWARENESS AND EMPATHY 9 Hrs.

Work-Life Balance – Project completion Techniques – Effective Planning and Organisation - Strategies to improve team communication.

UNIT 3 DECISION MAKING 9 Hrs.

Decision making techniques- types of decisions- Setting Goals and Plans - Problem Solving Techniques.

UNIT 4 EFFECTIVE COMMNICATION 9 Hrs.

Non-verbal communication - means of communication – Personality development – Language and body language for interviews- Self Empowerment.

UNIT 5 NEGOTIATION SKILLS 9 Hrs.

Negotiation skills – skill acquisition strategies – effective persuading skills.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Gravells, Ann. “Delivering Employability Skills in the Lifelong Learning Sector Further Education and Skills”, United Kingdom: SAGE Publications Ltd, 2010.
2. Hind, David W.G., Stuart Moss, “Employability Skills,” Business Education Publishers Ltd., United Kingdom :Tyne & Wear, 2005.
3. Rao M.S., “Enhancing Employability: Connecting Campus with Corporate”, New Delhi: I K International Publishing House Pvt. Ltd, 2010

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each – No choice **20 Marks**

PART B : 2 questions from each unit of internal choice, each carrying 12 marks **60 Marks**

SHS1602	TECHNICAL WRITING FOR SCIENTISTS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

To provide with an introduction to professional writing as a disciplinary field.

UNIT 1 INTRODUCTION TO TECHNICAL WRITING 9 Hrs.

Technical Writing – Principles and procedure of technical writing; Role of a Technical writer, Various forms of Technical Writing

UNIT 2 ONLINE TOOLS 9 Hrs.

Printed documentation and Online Help Systems, Working with images and illustrations, designing graphic aids.

UNIT 3 PROCESS OF WRITING 9 Hrs.

Collecting and Organizing information, Drafting information verbally and visually, Producing Information, Documentation Process.

UNIT 4 REACHING THE AUDIENCE 9 Hrs.

Technical Writing Process Templates and Page design, Audience Profiling.

UNIT 5 PRESENTATION 9 Hrs.

Writing specialized forms as abstracts, instructions, proposals and project and lab reports

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Mike Markel's "Technical Communication", New York: Bedford/St. Martin's, 2009
2. Joseph M. Williams book Style: "Toward Clarity and Grace", Chicago, University of Chicago Press, 1995

END SEMESTER EXAM QUESTION PAPER PATTERN:

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each – No choice **20 Marks**

PART B : 2 questions from each unit of internal choice, each carrying 12 marks **60 Marks**

SHS1603	PROFESSIONAL WRITING AND ADVANCED RHETORIC	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

To educate the learners on written communication and provide exposure to practical aspects of writing for wider audience and for scientific community.

UNIT 1 BASICS OF PROFESSIONAL COMMUNICATION 9 Hrs.

Technical Writing and Business communication (process, networks, importance, cultural variations, today's globalized workplaces), Practical aspects of communication, Principles and procedure of technical writing, Role of a Technical writer , attention to analyzing audience and purpose, Understanding and Inventing Pedagogies for Professional Writing.

UNIT 2 PROCESS OF PROFESSIONAL COMMUNICATION 9 Hrs.

Technical Writing Process Today, Genres of Technical Communication, Writing Proposals, Formats for Letters, Memos, abstracts, instructions, and proposals, and Email Messages.

UNIT 3 PRACTICAL ASPECTS OFPROFESSIONAL COMMUNICATION 9 Hrs.

Drafting and Documentation, Collecting and Organizing information , Drafting information verbally and visually, Producing Information, Documentation Process, Argument, Persuasion, Propaganda, Audience and Style, Readers and Context of Use, The participatory model of writing.

UNIT 4 PROFESSIONAL ETHICS & STRATEGIES IN CHANGING SCENARIO 9 Hrs.

Ethics in Professional Communication, Applying theory to practice- analysis of papers and speeches, Writing on line-Principles while designing web sites, Creating effective presentation slides, Speech writing- basics, scrutiny and observation, Speech writing techniques and application.

UNIT 5 PROFESSIONAL COMMUNICATION & FUTURE 9 Hrs.

Future of Technical Communication, multimedia genre, Identity, Authority, and Learning to Write in New Workplaces, Writing work, technology, and pedagogy in the present era

Max. 45 Hours

TEXT / REFERENCE BOOKS

3. Dubinsky, James, ed., "Teaching Technical Communication: Critical Issues for the Classroom". Bedford, 2004
4. Hawk, Byron. "Toward a Post-Techne: or, Inventing Pedagogies for Professional Writing." (TCQ)
5. Mara, Andrew and Byron Hawk. "Posthuman Rhetorics and Technical Communication."
6. Henry, Jim. "Writing Workplace Cultures: An Archaeology of Professional Writing". SIUP, 2000.
7. Johnson-Sheehan, Richard. "Technical Communication Today" 3rd ed. NY: Longman, 2010.
8. Locker, Kitty O. and Donna S. Kienzler., "Business and Administrative Communication". 9th ed. McGraw Hill, 2010.
9. Mike Markel's Technical Communication, New York: Bedford/St. Martin's, 2009
10. Spilka, Rachel, ed. "Digital Literacy in/for Technical Communications". Routledge, 2009.
11. Spinuzzi, Clay. "Tracing Genres through Organizations: A Sociocultural Approach to Information Design (Acting with Technology)". MIT, 2003

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each – No choice **20 Marks**

PART B : 2 questions from each unit of internal choice, each carrying 12 marks **60 Marks**

SCI1619	DISASTER MANAGEMENT	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To create an awareness towards natural and man-made disasters, disaster preparedness and disaster management

UNIT 1 INTRODUCTION TO DISASTERS 12 Hrs.

Natural resources and its importance - understanding on fragile eco-system - characteristics and types of Disasters, Geological and Mountain Area Disasters: Earthquakes, Volcanic eruption, landslides - Wind and Water Related Natural Disaster: Floods, Droughts, Cyclones, Tsunamis - Man Made Disasters: Forest fires, Nuclear, Biological and Chemical disaster - Causes and effects - Disaster Profile of India - Disaster Management cycle.

UNIT 2 DISASTER PREPAREDNESS 8 Hrs.

Disaster management, mitigation and preparedness: Disaster Preparedness for People and Infrastructure, CommUNITy based Disaster Preparedness Plan - Roles & Responsibilities of Different Agencies and Government: Education, Communication & Training, Central, State, District and local administration, Armed Forces, Police, Para Military Forces, International Agencies, and NGO's - Disaster Mitigation: Strategies, Emerging Trends, Mitigation management and Role of Team and Coordination.

UNIT 3 REHABILITATION, RECONSTRUCTION & RECOVERY 10 Hrs.

Damage assessment – Development of Physical and Economic Infrastructure - Nature of Damage to Houses and Infrastructure due to Disasters - Funding Arrangements for Reconstruction - Monitoring and Evaluation of Rehabilitation Work: Training, Rescue and planning the rescue activities and rehabilitations - Role of Government and NGO's - Participative Rehabilitation Process: Case Studies

UNIT 4 DISASTER RESPONSE AND DISASTER MANAGEMENT 8 Hrs.

Disaster Response Plan: Communication, Participation and Activation of Emergency Preparedness Plans, Search, Rescue, Evacuation and other logistic management - Human Behaviour and Response Management: Psychological Response and Psychological Rehabilitation, Trauma and Stress Management, rumour and Panic Management, Medical and Health Response to Different Disasters - Relief Measures: Minimum Standard of Relief, essential components of Relief Management, and funding.

UNIT 5 RISK ASSESSMENT AND VULNERABILITY ANALYSIS 7 Hrs.

Hazard, Risk and Vulnerability: Concept and Relationship: Disaster Risk Reduction, People Participation in Risk Assessment - Vulnerability Analysis, Vulnerability Identification - Vulnerability profile of India - Strategies for Survival - Social Infrastructure for Vulnerability Reduction.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Bryant Edwards, "Natural Hazards", Cambridge University Press, U.K, 2005
2. Carter, W. Nick, "Disaster Management, Asian Development Bank", Manila, 1991.
3. Government of India, "Vulnerability Atlas of India", New Delhi, 1997.
4. Sahni, Pardeep et.al. (eds.), "Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi, 2002
5. Sahni, Pardeep and Ariyabandu, Madhavi Malalgoda, 2012: "Disaster risk reduction in South Asia", Phi learning pvt. Ltd.-publisher, New Delhi, 2012.
6. Sharma, R.K. & Sharma, G.,(ed), "Natural Disaster", APH Publishing Corporation, New Delhi, 2005.
7. Taori, K, "Disaster Management through Panchayati Raj", Concept Publishing Company, New Delhi, 2005.

Websites:

8. NOAA Coastal Services Center, "Linking People Information and Technology",
9. "Risk and Vulnerability Assessment Tool", at, http://www.csc.noaa.gov/rvat/criticalEdd.html

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each – No choice **20 Marks**

PART B : 2 questions from each unit of internal choice, each carrying 12 marks **60 Marks**

SBI1101	INTRODUCTION TO BIOINFORMATICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To enable the students to understand the tools used in Bioinformatics & how to use them. This will facilitate the students to undertake projects in modern biology.

UNIT 1 INTRODUCTION **9 Hrs.**

Introduction to bioinformatics, biological information, the Central Dogma, Bioinformatics: Definition and overview Bioinformatics, Branches of Bioinformatics, Aim, Scope and Research areas of Bioinformatics. Genome projects, human genome project- Databases and human chromosomes, role of Bioinformatics in biological sequences. Biological data- DNA sequence protein sequence, macromolecular structure.Challenges in bioinformatics.

UNIT 2 COMPUTING IN BIOINFORMATICS **9 Hrs.**

Introduction to internet-facilities used on the internet-www- web browsers, introduction to network basics- LAN, wan, network topology, protocol. Basic principles of computing in bioinformatics - database system, programming languages for bioinformatics- Perl, python. Introduction to computational biology.

UNIT 3 BIOLOGICAL DATABASES **9 Hrs.**

Databases and programs, Information retrieval from databases of nucleic acid and proteins. Pair wise alignment and database searching, Multiple Sequence Alignment database searching, DNA analysis, protein analysis, Data information and Knowledge Management, Concepts in Bioinformatics, Databases and Data Warehouses in Bioinformatics. Challenges, combining multiple types of data, Information Retrieval system in bioinformatics.

UNIT 4 TOOLS APPLICATIONS IN BIOINFORMATICS **9 Hrs.**

Bio-algorithms and Tools- Identifying genes, Overview of sequence annotation. Gene prediction methods- Human variation and disease identification, Visualizing and comparing nucleic acids and Protein Introduction to Phylogenetic analysis definition, concepts of tree, steps in constructing Phylogenetic analysis. Introduction to microarray.

UNIT 5 SOFTWARES IN BIOINFORMATICS **9 Hrs.**

Basic software tools used in bioinformatics - Sequence analysis- GCG, Emboss - Cn3D viewer- Rasmol, Swiss pdb viewer, Pymol, Jmol. Modeling- Discovery studio 2.0, Docking -Auto dock,HEX.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Des Higgins and Willie Taylor, Bioinformatics sequence structures and databases, by Oxford University press, 1st ed., 2000.
2. Atwood, Paey Smith, Introduction to bioinformatics, Woodhead Publisher Ltd., 2001.
3. Arthur M.Lesk, Introduction to bioinformatics, Oxford University Press, 2002.
4. David W. Mount, Bioinformatics: Sequences and genome analyses, Cold Spring Harbor Laboratory press, 2000.
5. Westhead, Parish and Twyman, Instant notes: Bioinformatics, 2003.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBI1207	PERL PROGRAMMING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To understand the basics of PERL programming and its role and applications in Bioinformatics discipline.

UNIT 1 INTRODUCTION TO PERL PROGRAMMING 9 Hrs.

Introduction to Perl for Bioinformatics- Comprehensive PERL Archive Network-Variables in Perl: Scalars, Arrays and Hashes. Basic structure of Perl language- a functional approach **-** constructing atgc.pl. tr/// function **-**text formatting **-** formatting numerical output with printf **-** trapping errors at run time **-** the s/// operator **-** the chop and chomp operators.

UNIT 2 INTRODUCTION TO ARRAYS AND HASHES 9 Hrs.

Introduction to arrays and Hashes Variables **-** Printing hash data, accessing and removing elements. Special variable $[Accessing elements in an array. Function list **-** reverse- sort- join- split- pop- push- shift- unshift-split function**-**advanced array operation **-** copying and creating arrays **-** populating arrays with sequential data **-** qw function **-** determination of the size of an array **-**counting arrays **-** accessing first element in an array, accessing last element in an array, accessing other elements in an array **-** adding elements to the end of an array **-** adding elements**-** removing elements **-** appending elements ,altering elements **-** array slices **-** splicing array **-** sorting arrays **-** reversing arrays **-** arrays from strings. Merging arrays, Transforming strings to arrays, transforming arrays to strings (Split and join functions).

UNIT 3 PERL REGULAR EXPRESSIONS AND CONTROL STRUCTURES. 9 Hrs.

Perl regular expressions **-** special characters (+, *,?, [ ]) **-** regex operator **-** pattern modifier operator **-** conditional matching operator **-** range operator **-** match quantifiers **-** matching boundaries, grouping matching. Perl control statements **-** control structures **-** if statements **-** if-else **-** if-elsif **-** if-elsif-else **-** while loop **-** until loop **-**unless for loop **-** foreach loop **-**scoping of variables.

UNIT 4 FILES AND DIRECTORY MANIPULATIONS 9 Hrs.

Files- Operating modes: read, write, append function- File variable, Die function**-** terminating a program, Reading complete file, Reading a file line by line, Closing a file. File test operators (d, e, l, r, s, w, x, B, T)- Manipulation Functions **-**link, unlink, rename, truncate, removing files. Directory Manipulation functions **-** mkdir, chdir, opendir, readdir, closedir, rmdir, chmod.

UNIT 5 INTRODUCTION TO PERL MODULES 9 Hrs.

Introduction to modules and Subroutines- BioPerl module, Getopt: Long module and LWP: Simple Module- Cwd module **-** creating perl module tree, system function **-**Perl subroutines and functions. Introduction and applications of Common Gateway Interfaces (CGI).

Max. 45 Hours.

TEXT / REFERENCE BOOKS

1. Harshawardhan P Bal, Perl Programming for Bioinformatics, Tata McGraw Hill Publishing Company Limited, 2003.
2. Tim Bunce and Alligator Descartes, Programming the Perl DBI, O'Reilly Media, USA, 2000.
3. Michael Moorhouse and Paul Berry, Bioinformatics, Biocomputing and PERL, John Wiley and Sons Ltd., UK, 2004.
4. James Tisdall, Beginning Perl for Bioinformatics, O'Reilly & Associates, USA, 2001.
5. Steven Holzner, PERL, Black Book, Dreamtech Publications, 2nd Edition, 2001.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBI1605	PYTHON	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To learn to appreciate the programming language that can be used for a wide variety of programming tasks and to expose the student to the standard scripting language. At the end of the course, the student will be developing adequate skills in programming and will be known to understand the implementation of various applications using powerful assortment of built-in types in python.

UNIT 1 INTRODUCTION TO PYTHON 9 Hrs.

Introduction to PYTHON- History -Features –installation - Setting up path -Working with Python -Basic Syntax -–Operator

UNIT 2 VARIABLE AND DATA TYPES 9 Hrs.

Native datatypes – Booleans –Numbers – Strings - Bytes and byte arrays-Lists- Tuples – Sets - Dictionaries

UNIT 3 REGULAR EXPRESSIONS 9 Hrs.

Python regular expressions – Match function -Search function -Matching *Vs* Searching -Modifiers -Patterns.

UNIT 4 CONTROL STATEMENTS 9 Hrs.

Conditional Statements -If , If- else , Nested if-else , - Looping- For , While , Nested loops,- Control Statements- Break , Continue , Pass

UNIT 5 FUNCTIONS AND MODULES 9 Hrs.

Functions - Defining a function -Calling a function -Types of functions -Function Arguments -Anonymous functions -Global and local variables, Modules- Importing module -Math module -Random module -Packages – Composition

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Hetland., Beginning Python , Apress, 2008
2. Mark Pilgrim, Dive Into Python, Apress, 2004
3. Martin C. Brown, Python: The Complete Reference (English) ,McGraw-Hill/Osborne Media, 2001.
4. Mark Summerfield, Programming in Python 3 2nd ed (PIP3) - Addison Wesley ISBN: 0-321-68056-1,2009

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBM1304	BIOMATERIALS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- The course provides an intriguing insight in chemistry, engineering, biology and medicine that has a significant impact on biomaterials.
- It highlights the way in which modern biology and medicine is inextricably linked to scientific discipline and helping us to understand the complex world of biomaterials.

UNIT 1 INTRODUCTION AND METALS 9 Hrs

Biomaterials - Overview, Classification of biomaterials, Interfacial Phenomena and tissue response to biomaterials, Metals and alloys for orthopedic implants-Stainless steel, Cobalt chromium alloy, Titanium and its alloys, Precious metal alloys, Other metal alloys. Dental implants - materials, types and designs

UNIT 2 REPLACEMENT AND FIXATION DEVICES 9 Hrs

Bioelectric effect, Wolff's Law, Types of orthopedic fixation devices-pins, screws and plates, Intra Medullary and spinal nails. Interface Problems with artificial joints and various fixation methods, Hard tissue replacements - total hip and knee joint replacements. Soft Tissue replacements- Sutures -Tapes, Staples, Adhesives. Maxillofacial Implants

UNIT 3 POLYMERS AND APPLICATIONS 9 Hrs.

Polymers in biomedical use, Hydrogels, silicone rubber, biodegradable polymers, Polymer Sterilization, Deterioration of polymers

UNIT 4 BIOCERAMICS AND COMPOSITES 9 Hrs

Bioceramics, types and - bioactive resorbable, non - resorbable, bioceramic coatings on metallic and implants and bone bonding reactions on implantation. Hydroxyapatite - properties and applications. Composites - Types and Applications, Bioglass

UNIT 5 OPTHALMOLOGY, CORROSION AND TESTS 9 Hrs

Ophthalmology- Introduction, Contact lenses, Eye shields, Viscoelastic solutions, Vitreous implants, Acrylate adhesives, Scleral buclikng materials for retinal detachment, artificial tears. Corrosion, Biocompatibility and Hemocompatibility, Biological Tests. Material surface characterization

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Sujata V Bhat, Biomaterials, Narosa Publishing House, New Delhi, 2002.
2. Rolando Barbucci, Integrated Biomaterials Science, Plenum Publishers, New York, 2002.
3. A.F. Von Recum, Handbook of Biomaterials Evaluation - Scientific, Technical and Clinical Testing of Implant Materials, 1998.
4. 2nd Edition, Taylor & Francis, Philadelphia,1999.
5. 4. J.B Park and R.S Lakes, Biomaterials: An Introduction, Second Edition, Plenum press, New York, 1992.
6. 5. Joseph D Bronzino, The Biomedical Engineering Hand Book, Vol - 11, CRC press, 2000.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBM1404	HOSPITAL MANAGEMENT	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- The paper provides opportunities for training and research in all aspects of hospital / health administration. It helps to promotesscientific management of hospital and advancement of health care systems so as to make it rational, responsive and cost efficient.
- The student is thus educated in the development of high quality of hospital care in the community and the country so as to provide a satisfactory environment to the patient and clinical research

UNIT 1 STANDARD OF HOSPITAL 9 Hrs

Concept of Hospital Management **-** Role of Administrator **-** Responsibilities of Administrator **-** Hospital Design **-** Outlines for establishing Departmental Zones **-** Hospital Engineering

UNIT 2 HOSPITAL ORGANIZATION 9-Hrs.

Organization of Out-Patient Services **-** Problems encountered in functioning of O.P Department **-** Organization of In- Patient Services **-** Casualty & Emergency Services - Organization and management of Operation theatres

UNIT 3 SERVICES IN HOSPITAL 9 Hrs

Organization of Ancillary Services: Lab Services **-** Department of Physiotherapy & Occupational Therapy **-** Organization of Blood Transfusion Services **-** Department of Radio **-** diagnosis **-** Hospital Pharmacy

UNIT 4 STERILIZATION AND HOSPITAL SAFETY 9 Hrs

Disease transmission, Sterilization and disinfection methods, Hospital safety **-** Radiation Safety, hazardous safety, safety disposal of biological waste - Maintenance of Equipments & Instruments.

UNIT 5 SUPPORTIVE SERVICES IN HOSPITAL 9 Hrs

Organization and management of Nursing services and Dietary Services in hospital **-** House-keeping and maintenance **-**Medical Records -Staffing the hospital - Human resources management in hospital - Management Assisted by Computers: Reservation, Admission, Registration & Discharge Module

Max.45 Hours.

TEXT / REFERENCE BOOKS

1. Dr. L.L. Rao, Hospital Management.Annamalai University Press
2. R. D. Lele, Computers in Medicine, Tata McGraw Hill, 2008
3. Mohan Bansal, Medical informatics, Tata McGraw Hill, 2005

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**
PART A : 10 questions of 2 marks each - No choice **20 Marks**
PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBM1606	BIOMEMS AND NANOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To enable the student to acquire adequate knowledge on micro mechanical devices and their applications in drug delivery and nanotechnology.

UNIT 1 INTRODUCTION **9 Hrs.**

MEMS – definition. Origin of MEMS – Types – Materials used and their properties. MEMS Technology. Applications in health care. Integrated MEMS and microsystem.

UNIT 2 PROCESSING: MICRO MACHINING TECHNOLOGY **9 Hrs.**

Lithography- etching- Ion implantation- wafer bonding- Integrated processing- Bulk micro machining- surface micro machining- coating technology and CVD-LIGA process.

UNIT 3 MICROSYSTEMS AND MICROFLUIDS **9 Hrs.**

General principles- Microsensors – Actuators- Electrostatic forces- Piezoelectric crystals – Intelligent materials and structures. Fundamentals of micro fluids, lab – on – a chip devices - Silicon and glass micromachining for micro total analysis systems.Surface chemistry in polymer microfluidic systems.

UNIT 4 APPLICATION IN MEDICINE **9 Hrs.**

Trends in MEMS for health care. Drug delivery systems - Biochip – Micro needles- Microelectrodes- Neural prosthesis – shape memory implants.

UNIT 5 BIOMEDICAL NANOTECHNOLOGY **9 Hrs.**

Nanotechnology- Medical applications of Nanotechnology- Drug synthesis and delivery- Nanofabrication methods – Nanomaterials in human body- Toxicity in nanomaterials.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Tai-Ran Hsu, MEMS & Microsystem, Design and manufacture, Mc. Graw Hill 2002.
2. Malsch, NeelinaH., ed., Biomedical Nanotechnology, Washington, DC: CRC Press, 2005
3. Marc J. Madou, Fundamentals of Microfabrication and Nanotechnology, 3rd Edition, Three-Volume Set,CRC Press 2011.
4. Mohamed Gad-el-Hak, The MEMS Handbook, CRC Press, 2005
5. HocineYahia, Shape Memory Implants Springer Verlag 2000.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT 1610	GMP AND QUALITY CONCEPTS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To introduce students about Good manufacturing practices quality concepts which would expose them to industrial scenario.

UNIT 1 INTRODUCTION 9 Hrs.

Basic Concepts: Quality concepts, Quality Control, Quality Assurance, Good Manufacturing Practices, Good Laboratory Practices, Responsibilities. Quality Control: Quality control laboratory: Responsibilities, good laboratory practices, routine controls, instruments, protocols.

UNIT 2 GMP 9 Hrs.

Good Manufacturing Practice. Legal requirements pertaining to GMP: GMP Guidelines, Standards, Regulatory agencies. Basic Components of GMP: Organization & Personnel, Premises, Equipments, Raw Materials, Complaints and recalls, Specifications, Self inspection.

UNIT 3 GLP 9 Hrs.

Good Laboratory Practice (GLP) – an overview and basic information, Scope. Principles of GLP: Test Facility Organization and Personnel, Quality Assurance Programme, Facilities, Test Systems, Test and Reference Items, Standard Operating Procedures, Performance of the Study, Reporting of Study Result, Storage and Retention of Records and Materials.

UNIT 4 INSPECTION 9 Hrs.

Inspections, Quality Audit and Quality System Reviews: Inspections, role of quality audit, role of inspectors, methods of inspection- routine, concise, follow-up and special inspections, frequency and duration of inspections, preparations for inspections, conduct, report and regulatory actions.

UNIT 5 REGULATION 9 Hrs.

Regulatory bodies – Need and role of regulatory bodies. Different regulatory bodies – FDA, HACCP and their scope. Importance of regulatory approval. ISO 9000 – regulations.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Sidney H. Willig, Good manufacturing Practices for Pharmaceuticals, 5th Edition, Revised and Expanded, Marcel Dekker, Inc. New York, 2005.
2. Jose Rodriguez-Perez, The FDA and Worldwide Current Good Manufacturing Practices and Quality System requirements guidebook for finished pharmaceuticals, American Society for Quality, ASQ Quality Press, Milwaukee, Wisconsin, 2014.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBT 1611	BIOLOGY FOR ENGINEERS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To understand the essentials of basic biological principles

UNIT 1 INTRODUCTION TO CELLS 9 Hrs.

Cell: Functional unit of living organisms - Cell theory - Prokaryotic and eukaryotic cell – bacterial, plant, animal cells - cell components - functions- cell organization – tissues - basic types -cell division: Mitosis, meiosis, cell cycle regulation

UNIT 2 SOCIAL IMPORTANCE 9 Hrs.

Application of biological sciences and biotechnology to the society - human health care and medicines - pharmaceuticals and nutraceuticals -food and agriculture- pollution management and environment - Biofuels

UNIT 3 INTRODUCTION TO BIOMOLECULES 9 Hrs.

Biomolecules - classification, salient features - biological significance - carbohydrates, proteins and amino acids - lipids and fats - nucleic acids - vitamins-Enzymes

UNIT 4 HUMAN PHYSIOLOGY 9 Hrs.

Human Physiology - Different systems associated with humans- Tissues, organ and physiology of the various systems: Digestive, respiratory, circulatory, skeletal, nervous, excretory and reproductive system - Artificial memory and neural network

UNIT 5 MEDICAL IMPORTANCE 9 Hrs.

Infectious and non infectious diseases- causative agents, epidemiology, pathogenicity, control and prevention, treatment of AIDS, tuberculosis, Pathology of non infectious and genetic diseases and disorders - cancer, diabetes mellitus, cardiac diseases- neurological disorders-Parkinson's disease

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Satyanarayana, U. Biotechnology, 4th Edition, Books and Allied Pvt. Ltd. Kolkata, 2007.
2. Lehninger A.L, Nelson D.L, Cox .M.M, Principles of Biochemistry. CBS Publications 1993

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

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SCY1601	SPECTROSCOPY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To make the students to understand the basic concepts about the analytical techniques

UNIT 1 UV-VIS SPECTROSCOPY 9 Hrs.

Principles of radiation – Frank condon principle – Various electronic transitions (185-800 nm) – Beer-Lambert law – Instrumentation of single beam and double beam spectrophotometer – Woodward and Fieser rule – Applications of UV-Visible spectroscopy.

UNIT 2 IR AND RAMAN SPECTROSCOPY 9 Hrs.

Principles of IR spectra – Instrumentation of IR spectroscopy – Force constant – Effect of hydrogen bonding – Applications of IR spectroscopy – Raman spectroscopy: Principle – Strokes line and antistrokes line – Instrumentation – Applications of Raman spectroscopy.

UNIT 3 ^{1}H NMR AND ^{13}C SPECTROSCOPY 9 Hrs.

General introduction and definition: Chemical shift – Spin-spin interaction – Shielding mechanism – Coupling constants. Nuclear overhauser effect (NOE). Instrumentation of ^{1}H NMR and ^{13}C spectroscopy.

UNIT 4 MASS SPECTROMETRY 9 Hrs.

Principle of Mass spectra – Instrumentation – Principle of fragmentation – Nitrogen rule – McLafferty rearrangement – Representation of Mass spectrum – Applications of mass spectra.

UNIT 5 IMAGING TECHNIQUES 9 Hrs.

Scanning electron microscopy – Energy dispesrve X-ray spectroscopy – Transmission electron microscopy – Atomic force microscopy – Scanning tunneling microscopy – X-ray photoelectron spectroscopy.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Banwell C.N., and McCash E. M., “Fundamentals of Molecular Spectroscopy”, 4th Edition, Tata McGraw Hill, 2000.
2. Silverstein R. M., and Webster F. X., “Spectroscopic Identification of Organic Compounds”, 6th Edition, John Wiley & Sons, 2003.
3. Levine I. N., “Molecular Spectroscopy”, John Wiley & Sons, 1974.
4. Williams D. H., and Fleming I., “Spectroscopic Methods in Organic Chemistry”, 4th Edition, Tata McGraw-Hill Publishing Company, 1988.
5. Kemp W., “Applications of Spectroscopy”, English Language Book Society, 1987.

END SEMESTER EXAM QUESTION PAPER PATTERN:

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each – No choice **20 Marks**

PART B : 2 questions from each unit of internal choice, each carrying 12 marks **60 Marks**

(10% problems may be asked)

SCY1602	ENERGY SOURCES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To know the various sources of energy available and to face the future challenges arising due to energy crisis.

UNIT 1 GLOBAL AND INDIAN ENERGY SCENARIO 9 Hrs.

Bio-fuels – Nuclear energy – Their utilization pattern in the past, present and future projections of consumption pattern. Power sector reforms – Restructuring of energy supply sector – Energy strategy for future.

UNIT 2 HYDROGEN ENERGY 9 Hrs.

Hydrogen as a renewable energy source: Sources of Hydrogen – Fuel for Vehicles. Hydrogen Production: Direct electrolysis of water – Thermal decomposition of water – Biochemical methods of hydrogen production. Storage of Hydrogen: Gaseous, Cryogenic and Metal hydride.

UNIT 3 ELECROCHEMICAL ENERGY 9 Hrs.

Fuel cells: Principle of working, construction and applications of phosphoric acid fuel cell – Solid oxide fuel cell – Molten carbonate fuel cell – Polymer electrolyte membrane fuel cell. Batteries: Lead-acid battery – Nickel-cadmium battery – Lithium batteries – Nickel hydride batteries.

UNIT 4 BIOENERGY 9 Hrs.

Thermo-chemical Conversion: Pyrolysis – Combustion – Gasification – Liquification. Bio-Chemical Conversion: Aerobic and Anaerobic conversion – Fermentation. Ethanol as a fuel for I.C. engines. Isolation of methane from Biogas and packing and its utilization.

UNIT 5 NUCLEAR ENERGY 9 Hrs.

Nuclear Energy – Nuclear Chain reaction – Fuel enrichment – Different Types of Nuclear Reactors: Pressurised water reactor – Boiling water reactor – Fast Breeder reactor. Nuclear waste disposal – Nuclear Fusion.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Culp A. W., “Principles of Energy Conversion”, 2nd Edition, McGraw-Hill, 1991.
2. Maths D. A., “Hydrogen Technology for Energy”, Noyes Data Corp., 1976.
3. Linden D., Handbook: “Batteries and Fuel cell”, Mc.Graw Hill, 1984.
4. Bansal N. K., and Kleeman M. K., “Renewable Sources of Energy and Conversion Systems”, Tata McGraw Hill, 1990.
5. White L. P., “Biomass as Fuel”, Academic Press, 1981.
6. Raymond Murray, Keith Holbert, “Nuclear Energy: An Introduction to the Concepts, Systems, and Applications of Nuclear Processes”, 7th Edition, Elsevier Science & Technology, 2014.
7. Arniker H. J., “*Essentials of Nuclear Chemistry”,* New Age Publications, 1996.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each – No choice **20 Marks**

PART B : 2 questions from each unit of internal choice, each carrying 12 marks **60 Marks**
(10% problems may be asked)

SPH1601	ENERGY PHYSICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

To expose the students to the basic principles of energy conversions, materials for energy conversion and energy storage devices.

UNIT 1 ENERGY AND THERMODYNAMICS 9 Hrs.

Forms of Energy, Conservation of Energy, Entropy, Heat capacity, Thermodynamic cycles: Brayton, Carnot Diesel, Otto and Rankin cycle; Fossil fuels, time scale of fossil fuels and solar energy as an option,.

UNIT 2 ENERGY CONVERSION MATERIALS 9 Hrs.

Single, poly – and amorphous silicon, GaAs, CdS, Cu2S, CuInSe2, CdTe etc. technologies for fabrication of single and polycrystalline silicon solar cells, amorphous silicon solar cells and tandem cells, solar cell modules, photovoltaic systems, space quality solar cells

UNIT 3 PHOTOVOLTAIC CONVERTORS 9 Hrs.

Introduction- Photovoltaic effect-conversion of solar energy into electrical energy- behaviour of solar cells-basic structure and characteristics of solar cells-single, multi and thin film silicon solar cells-solar cell arrays- PV modules, generators-interfacing PV modules to loads, direct connection of load to PV modules and connection of PV modules to a battery and load together-energy storage alternatives to PV systems..

UNIT 4 THERMOELECTRIC CONVERTERS 9 Hrs.

Thermoelectric effects, solid state description of thermoelectric effect, Kelvin's thermodynamic relations, analysis of thermoelectric generators, basic assumptions, temperature distribution and thermal energy transfer for generator, co-efficient of performance for thermoelectric cooling,.

UNIT 5 ENERGY STORAGE DEVICES 9 Hrs.

Cuprates and MgB2 superconductors and their properties, superconducting wires, Role of superconductor in Electric generator, Magnetic energy storage devices and power transmission. Energy storage systems, Faradaic and non-Faradaic processes, Types of capacitors and batteries, Comparison of capacitor and battery, Charge-discharge cycles, experimental evaluation using Cyclic voltammetry, and other techniques.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Richard C. Neville, "Solar energy conversion: The solar cell", Elsevier Science; 2 edition, 1995
2. Peter Aue, "Advances in Energy systems and technology", Academic Press, 1978.
3. Frank Kreith and Jang Kreider, "Principles of solar engineering", CRC Press; 2 edition, 2000.
4. A. E. Dixon & J. D. Leslie, "Solar energy conversion", Science Direct, 1999.
5. A.Goetzberger, V.U.Hoffmann, "Photovoltaic solar energy generation", Springer-Verlag, 2005.
6. Castaner, S.Silvestre, "Modelling Photovoltaic systems", Pspice John Wiley & Sons, 2002.
7. R.J.Komp, Practical Photovoltaics, "Electricity from solar cells", 3rd edition, Aatec Publ., 2001.
8. R.Messeiger, J.Ventre, "Photovoltaic systems Engg", 2nd edition, CRC Press, 2004.
9. Stanley W Angrist, "Direct energy conversion" (4th edition) –Allyn and Bacon, Inc., 1982
10. B. E. Conway, "Electrochemical supercapacitors", Kluwer Academic Press. *Springer* US, Apr 30, 1999
11. David Linden, "Handbook of Batteries and Fuel Cells", McGraw-Hill, 1984
12. A.G. Milnes and D. L. Feucht, "Heterojunction and metal – semiconductor junctions", Academic Press, 1972.
13. B.G. Streetman, "Solid state electronic devices", 5th Edition, Prentice Hall, 2000.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each – No choice **20 Marks**

PART B : 2 questions from each unit of internal choice, each carrying 12 marks - (10% problems may be asked) **60 Marks**

SPH1602	GEOPHYSICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

To provide a qualitative idea on the fundamentals of seismology and theoretical understanding of various physical properties of earth.

UNIT 1 SEISMOLOGY 9 Hrs.

Introduction-Seismology-P-waves-S waves, their velocities-the location of epicenters-Effect of Boundaries-Major discontinuities-.Seismic energy sources-Detectors-Interpretation of time and distance curves.-Derivation of properties from the velocities.

UNIT 2 INTERNAL STRUCTURE OF EARTH 9 Hrs.

Introduction-Seismic waves-Rayleigh waves and love waves-Study of earth by seismic waves-Earthquake seismology-Horizontal and vertical seismograph-Seismograph equation-Internal structure of earth..

UNIT 3 EARTHQUAKES AND GRAVITY 9 Hrs.

Earthquakes: Focus, Magnitude, Frequency–Detection and prediction–Gravity–Absolute and relative measurements of gravity-Worden gravimeter-Application of gravity methods.

UNIT 4 GEOMAGNETISM 9 Hrs.

Geomagnetism-Definitions, magnetic field,-Measurements Proton precession magnetometer, Alkali vapour magnetometer–Theory of Earth magnetism-Dynamo theory of earth magnetism-Magnetic surveying-application.

UNIT 5 GEOCHRONOLOGY AND GEOTHERMAL PHYSICS 9 Hrs.

Geochronology-Radioactivity of the earth-Radioactive dating of rocks and minerals-Geological time scale Geothermal Physics: Flow of heat to the surface of earth–Sources of heat within earth--Process of heat transport-Internal temperature of earth..

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Cook,A.H., “Physics of the Earth and Planets”, I Ed, McMillan Press, London ,1973
2. William Lourie, “Fundamentals of Geophysics”, II Ed, Cambrige University Press, 1982
3. Garland .G.D., “Introduction to Geophysics”, 11 Ed, WB Saunder Company, London.1979
4. Ramachandra Rao M.B., “Out lines of Geophysical prospecting-A manual for Geologists”, Prasaranga University of Mysore, Mysore, 1975
5. Telford, W.M. Geldart, L. P. Sheriff R.E. and Keys .D.A., “Applied Geophysics:, Oxford–IBH Publishing Co.Pvt.Ltd. New Delhi. 1976
6. Rama Rao.B.S., Murthy I.V.R., “Gravity and magnetic methods of prospecting”, Arnold Heinemann Publishers, New Delhi, 1978

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each – No choice **20 Marks**

PART B : 2 questions from each unit of internal choice, each carrying 12 marks - **60 Marks**

SPH1603	SPACE PHYSICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

To provide the Windows to the Universe, Solar System, and Planetary Atmospheres and also to expose the students to the instruments related with space physics.

UNIT 1 ASTRONOMY FUNDAMENTALS, TELESCOPES FOR ASTRONOMY 9 Hrs.

Radiation from space, radiation laws, Basic terminology used in astronomy, Introduction to the various types of astronomy: optical, radio, IR, UV, X-ray, γ ray, Gravitational etc. Introduction to Optical, IR, X ray, γ ray telescopes, brief description of the various instruments.

UNIT 2 RADIO TELESCOPES AND RECEIVERS 9 Hrs.

Antennas, Types of interferometers, array, Radio telescopes of the world including GMRT, OOTY, PRL, Radio telescope receivers, total power receiver, Dicke receiver, correlation receiver, noise temperature. Noise sources.

UNIT 3 SOLAR SYSTEM, TERRESTRIAL AND JOVIAN PLANETS 9 Hrs.

Origin of solar system, occurrence of planetary systems, celestial mechanics, properties of the sun. Orbital and physical characteristics, atmosphere, Studies of Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and their moons. Recent explorations of various planets..

UNIT 4 SCINTILLATION, PLASMA, IONIZATION 9 Hrs.

Interplanetary scintillation, interstellar scintillation, methods for probing solar wind, use of IPS in measurement of solar wind, study of irregularities in the interplanetary medium, properties of plasma at different distances from earth, photoionisation, cosmic ray ionization, meteoric ionization, various resonances in plasma, various waves in plasma, measurement procedures.

UNIT 5 DIAGNOSTIC TECHNIQUES FOR PROBING IONOSPHERE 9 Hrs.

Radio wave propagation in absence and presence of magnetic field, Formation of Chapman layer, Appleton Hartree equation and its explanation, propogation of radio waves at different frequencies. Ground based, balloon based, space based techniques, Ionosonde, air glow, P.R.Radar, radio scintillation, magnetometer, Langmuir probe, electrostatic analyzer, mass spectrometer, radiosonde.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Glasstone. Van Nostrand, **"Sourcebook on the Space Sciences"**, Princeton, N.J., 1965
2. John Daniel Kraus Cygnus, "Radio Astronomy: Quasar Books"; 2nd edition, 1986
3. W.N.Christiansen & J.A.Hogbom, " Radiotelescopes, Radio Telescopes", 1st edition, Cambridge University Press 1969
4. H.Karttunem, P.Kroger, H.Oja, M.Poutanen, K.J.Donner, "Fundamental Astronomy", Springer-Verlag; 2nd edition, 1994
5. N.Henbest, M.Marten, "The new Astronomy", Cambridge University Press, 1996
6. S.K.Alurkar, "Solar and Interplanetary Disturbances", World Scientific Publishing Company, 1997.
7. J.A.Ratcliffe, "An introduction to ionosphere and magnetosphere", Cambridge : Cambridge University Press, 1972
8. A.Giraud, M.Petit, "Ionosphere techniques and phenomena", First Edition, D. Reidel Pub Co, 1978.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each – No choice **20 Marks**

PART B : 2 questions from each unit of internal choice, each carrying 12 marks **60 Marks**

SPH1604	ASTROPHYSICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

To provide qualitative description of interesting astronomical aspect and evolution of structures in the Universe.

UNIT 1 GRAVITY 9 Hrs.

Newtonian gravity and basic potential theory, Simple orbits – Kepler's laws and precession, flat rotation curve of galaxies and implications for dark matter, virial theorem and simple applications, role of gravity in different astrophysical systems,.

UNIT 2 RADIATIVE PROCESSES 9 Hrs.

Overview of radiation theory and Larmor formula, Different radiative processes : Thomson and Compton scattering, Bremsstrahlung, Synchrotron [detailed derivations are not expected] Radiative equilibrium, Planck spectrum and properties; line widths and transition rates in QT of radiation, qualitative description of which radiative processes contribute in which waveband/ astrophysical system, distribution function for photons and its moments, elementary notion of radiation transport through a slab, concept of opacities.

UNIT 3 GAS DYNAMICS 9 Hrs.

Equations of fluid dynamics; equation of state in different regimes [including degenerate systems]; Models for different systems in equilibrium, Application to White dwarfs/Neutron stars, Simple fluid flows including supersonic flow, example of SN explosions and its different phases.

UNIT 4 STELLAR SYSTEM 9 Hrs.

Basic equations of stellar structure, Stellar energy sources; qualitative description of numerical solutions for stars of different mass, homologous stellar models, Stellar evolution, Evolution in the HR-Diagram.

UNIT 5 GALACTIC DYNAMICS 9 Hrs.

Milky Way Galaxy, Spiral and Elliptical galaxies, Galaxies as self gravitating systems; spiral structure, Supermassive black holes, Active galactic nuclei.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Bradley W. Carroll, D.A.Ostlie, "Modern Astrophysics", Addison-Weseley, 1996.
2. Frank H. Shu,"The physical universe: An Introduction to Astronomy", University Science books, 1982.
3. Frank H. Shu, "The Physics of Astrophysics", Volume I and II, University Science books, 2010.
4. T. Padmanabhan, "Theoretical Astophysics", Volumes I, II and III, Cambridge University Press; First edition, 2001.
5. Arnab Rai Choudhuri, "The Physics of fluids and plasmas", Cambridge University Press, 1998.
6. Martin. Harwitt, "Astrophysical concepts", 3rd edition, Springer Science & Business Media, 1998.
7. James Binney & Michael Merrifield, "Galactic Astronomy", Princeton University Press, 1998.
8. James Binney & Scott Tremaine, "Galactic dynamics", 2nd edition, Princeton University Press, 2008.
9. A. K. Kembhavi and J. V. Narlikar, "Quasars and Active Galactic Nuclei", Cambridge University Press, 1999.
10. Bradley M. Peterson, "An Introduction to Active Galactic Nuclei", Cambridge University Press, 1997.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each – No choice **20 Marks**

PART B : 2 questions from each unit of internal choice, each carrying 12 marks **60 Marks**

SPH1605	ATOMIC AND NUCLEAR PHYSICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

To enable the students understand the laws that govern the structure and properties of the atom, molecules and the nucleus. Also to provide an introduction to the elementary particles.

UNIT 1 IONS, ELECTRONS AND ATOMIC STRUCTURE 9 Hrs.

Detection of charged particles in electric and magnetic fields-Dunnigton's method for e/m-positive ray analysis: Thomson's parabola method-Bohr's atom model-Sommerfeld's relativistic atom model-the Vector atom model and the quantum numbers-comparison with quantum model. Coupling schemes: L-S coupling and j-j coupling–Pauli's exclusion principle-Magnetic moment due to (i) orbital motion of the electron (ii) due to spin-Stern and Gerlach experiment

UNIT 2 ATOMIC AND MOLECULAR SPECTRA 9 Hrs.

Spin-orbit interaction in atomic spectra-fine structure and sodium doublet-Zeeman effect: experiment-classical result-Quantum mechanical explanation-anomalous Zeeman effect-Paschen Back effect-Stark effect (qualitative) Origin of a pure rotational spectra of a rigid linear molecule-vibrating diatomic molecule as a quantum harmonic oscillator-pure vibrational spectra-Spectroscopy (Schematic): Ultraviolet-Infrared-absorption-Raman.

UNIT 3 PROPERTIES OF NUCLEI AND RADIOACTIVITY 9 Hrs.

Isobars, isotopes, mirror nuclei-Nuclear mass and binding energy-Parity-Nuclear spin–Mass defect and packing fraction-Stable nuclei–Nuclear size, nuclear magnetic moment-Electric quadrapole moment-Nuclear energy levels. Radioactivity: Range and stopping power of alpha particles.-Geiger-Nuttal law-Feature of alpha decay Tunnelling–Beta ray spectrum-Energetic of beta decay-Detection of neutrino-Gamma ray absorption in matter.

UNIT 4 NUCLEAR MODELS, FISSION AND FUSION 9 Hrs.

Neutron: Discovery, Mass, Half life, Magnetic Moment, sources and detection–Shell model, Liquid drop theory-Nuclear fission–Spontaneous fission and potential barrier-Self sustaining Chain Reaction–Neutron balance in Nuclear Reactor-Uncontrolled chain reaction-Nuclear Fusion–radiation hazards and safety measures-Controlled fusion-Fusion in stars..

UNIT 5 ELEMENTARY PARTICLE PHYSICS 9 Hrs.

Discovery of cosmic rays-primary and secondary rays-cosmic ray showers-discovery of positron–the mesons–origin of cosmic rays-the Big-Bang theory-thermal history of the Universe-Hubble's law–the future of the universe-dark matter. Particles and anti-particles-antimatter-the fundamental interactions–elementary–particle quantum numbers–conservation laws and symmetry–the Quark model–quantum chromodynamics-the standard model–unification of interactions–Grand unified theories. (Qualitative).

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. R.Murugeshan and Kiruthiga Sivaprasath, "Modern Physics" 14thEd, S.Chand and Company Ltd, 2009
2. A.B. Gupta and Dipak Ghosh, "Atomic and Nuclear Physics", Books and Allied(P)Ltd, Calcutta, 1997
3. Ronald Gautreau and William Savin, "Modern Physics, Schaum's outline series, 2nd Ed., Tata McGraw Hill P.Ltd, 2004
4. K.Gopla Krishnan, Atomic and Nuclear Physics", 3rd Ed. ,MacMillan India Ltd. 1994
5. H.S.Mani and Mehta (G.K) , "Introduction to Modern Physics", Affiliated EWast-West Press, 1989
6. R.P.Feynmann, R.B. Leighton and M.Sands , "The Feynmann Lectures on Physics", Vol III, 7th Indian reprint, Narosa Pub. Ltd, 1992

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each – No choice **20 Marks**

PART B : 2 questions from each unit of internal choice, each carrying 12 marks **60 Marks**

SIT1402	MOBILE APPLICATION DEVELOPMENT	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To develop applications for current and emerging mobile computing devices, performing tasks at all stages of the software development life-cycle.
- To learn how to utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces.
- To design, implement and deploy mobile applications using an appropriate software development environment.

UNIT 1 INTRODUCTION AND UI INTERFACE 9 Hrs.

Introduction to mobile technologies, mobile operation systems, Mobile devices-pros and cons, Introduction to Android, Versions, Features, Architecture, UI Widgets and Events handling, Layouts, Required tools-Eclipse, ADT, AVD, Application structure, AndroidManifest file, Android design philosophy, Creating Android applications.

UNIT 2 BUILDING BLOCKS AND DATABASES 9 Hrs.

Introduction to Activities and Intents-Understanding Activity life cycle, Linking Activities, Passing Data, Toast, Displaying a Dialog Window and Notifications. Content Provider, Services, Broadcast receivers, accessing databases, sample applications, debugging and deploying app, publish in Playstore.

UNIT 3 C PROGRAMMING 9 Hrs.

C- Data Types and Expressions, Decision Making and Looping, Objects and Classes, Property, Messaging, Categories and Extensions, Fast Enumeration – NSArray, NSDictionary, Methods and Selectors, Static & Dynamic objects, Exception handling, Memory management, Required Tools- Xcode, iOS Simulator, Instruments, ARC, frameworks.

UNIT 4 INTRODUCTION TO IOS 9 Hrs.

Introduction to iPhone, History, Versions, Features, MVC Architecture, View Controller - Building the UI and Event handling, Application life cycle, Tab Bars, Story Boards and Navigation Controllers, Table View, Push Notification, Database handling, Debugging and Deployment, Publishing app in Appstore, sample applications.

UNIT 5 WINDOWS MOBILE APP DEVELOPMENT 9 Hrs.

Introduction to Windows Phone 8, Application Life cycle, UI Designing and events, Building, Files and Storage, Network Communication, Push Notification, Background Agents, Maps and Locations, Data Access and storage,Introduction to silvelight and XAML, Running and Debugging the App, Deploying and Publishing.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Reto Meier, “Professional Android Application Development”, Wrox Edition.
2. http://www.tutorialspoint.com/android/index.htm
3. http://developer.android.com/training/index.html
4. Stephen G. Kochan, “Programming in COURSE OBJECTIVE C”, Addition Wesley, 4th Edition.
5. David Mark, Jack Nutting and Jeff LaMarche, “Beginning iOS 5 Development”, Apress Edition.
6. Baijian Yang, Pei Zheng, Lionel M. Ni, “Professional Microsoft Smartphone Programming”, Wrox Edition.

END SEMESTER QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No Choice **20 Marks**

PART B : 2 questions from each unit of internal choice, each carrying 12 marks **60 Marks**

SIT1606	BIG DATA	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the dominant software systems and algorithms for coping with Big Data.
- Apply appropriate analytic techniques and tools to analyze big data, create statistical models, and identify insights that can lead to actionable results
- To explore the ethical implications of big data research, and particularly as they relate to the web

UNIT 1 INTRODUCTION 9 Hrs.

Introduction to Big Data – Challenges of Conventional Systems - Nature of Data - Small data-Medium data – Big Data – Small data vs Big data - Sources of Big Data- Big Data Characteristics – Big Data Analytics – Importance of Big Data, Big Data in the Enterprise – Big Data Enterprise Model – Building a Big Data Platform -Big data in Social and Behavioral sciences.

UNIT 2 HDFS, HADOOP AND HADOOP INFRASTRUCTURE 9 Hrs.

Hadoop and Databases - Typical Datacenter Architecture - Adding Hadoop to the Mix - Key Benefit -· Flexibility: Complex Data Processing - HDFS - Hadoop Infrastructure -Architecture – Different in Data Model and Computing Model – HDFS Files and Blocks , Components of HDFS - Hadoop framework - HDFS-Map Reduce Framework-Data Loading techniques-Hadoop Cluster Architecture-Hadoop Configuration files-Hadoop Cluster modes-Single Node-Multi Node-Fully distributed node.

UNIT 3 HADOOP MAP REDUCE FRAMEWORK 9 Hrs.

Relationship between MapReduce and HDFS- Relationship between MapReduce and HDFS- Clients, Data Nodes, and HDFS Storage - MapReduce workloads.

Hadoop framework- Hadoop data types-Hadoop map reduce Paradigm-Map and Reduce Tasks-Map reduce Execution framework-Partitioners and Combiners-Input formats **(**Input Splits and Records, Text Input, Binary Input, Multiple Inputs)- Output Formats (TextOutput, BinaryOutPut, Multiple Output)- Hadoop Mapreduce programming-Advanced Map reduce concepts- Counters, Custom Writables-Unit testing framework-Error Handling-Tuning-Advanced Map reduce.

UNIT 4 HADOOP IMPLEMENTATION AND HADOOP ECO SYSTEM TOOLS 9 Hrs.

Hadoop Implementation - · Job Execution - · Hadoop Data Types - · Job Configurations - · Input and Output Formats

ECO system tools- Pig's Data Model, Pig Latin, Developing & Testing Pig Latin Scripts- Writing Evaluation, Filter, Load & Store Functions-Hive- Hive Architecture- Comparison with Traditional Database- HiveQL: Data Types, Operators and Functions- Hive Tables- Querying Data-Advance Hive, NoSQL Databases -HBase-Loading Data in Hbase-Querying Data in Hbase

UNIT 5 HADOOP PROJECT ENVIRONMENT 9 Hrs.

HBase: Introduction to HBase, Client API's and their features, Available Client, HBase Architecture, MapReduce Integration. HBase: Advanced Usage, Schema Design, Advance Indexing, Coprocessors**,** Hadoop 2.0- MRv2 –YARN-NameNode High Availability, HDFS Federation, MRv2, YARN, Running MRv1 in YARN, Upgrade your existing MRv1 code to MRv2, Programming in YARN framework-cover Apache Oozie Workflow Scheduler for Hadoop

Max. 45 Hours

TEXT / REFERENCES BOOKS

1. WA Gmob , “Big Data and Hadoop”, Kindle Edition, 2013
2. Eric Miller, “A Overview of Map Reduce and its impact on Distributed Data”, Kindle Edition, 2012.
3. Strata, “ Big Data Now”, O’Reily Media Inc., Kindle Edition, 2012.

END SEMESTER QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No Choice **20 Marks**

PART B : 2 questions from each unit of internal choice, each carrying 12 marks **60 Marks**

SIT1609	GAME PROGRAMMING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To provide introductions to event driven programming, game engine scripting, game engine class structures.
- Learning to plan and to report on a significant programming project.
- Learn to work in programming in teams, and learn to use standard game development environments, in particular the Unity3d development platform.

UNIT 1 3D GRAPHICS FOR GAME PROGRAMMING 9 Hrs.

Coordinate Systems, Ray Tracing, Modelling in Game Production, Vertex Processing, Rasterization, Fragment Processing and Output Merging, Illumination and Shaders, Parametric Curves and Surfaces, Shader Models, Image Texturing, Bump Mapping, Advanced Texturing, Character Animation, Physics-based Simulation

UNIT 2 GAME DESIGN PRINCIPLES 9 Hrs.

Character development, Story Telling, Narration, Game Balancing, Core mechanics, Principles of level design, Genres of Games, Collision Detection, Game Logic, Game AI, Path Finding.

UNIT 3 GAMING ENGINE DESIGN 9 Hrs.

Renderers, Software Rendering, Hardware Rendering, and Controller based animation, Spatial Sorting, Level of detail, collision detection, standard objects, and physics

UNIT 4 GAMING PLATFORMS AND FRAMEWORKS 9 Hrs.

Flash, DirectX, OpenGL, Java, Python, XNA with Visual Studio, Mobile Gaming for the Android, iOS, Game engines - Adventure Game Studio, DXStudio, Unity.

UNIT 5 GAME DEVELOPMENT 9 Hrs.

Developing 2D and 3D interactive games using OpenGL, DirectX – Isometric and Tile Based Games, Puzzle games, Single Player games, Multi-Player games.

Max. 45 Hours

TEXT REFERENCE BOOKS

1. David H. Eberly, “3D Game Engine Design, Second Edition: A Practical Approach to Real-Time Computer Graphics” Morgan Kaufman , 2 Edition, 2006.
2. Jung Hyun Han, “3D Graphics for Game Programming”, Chapman and Hal/CRC,1st edition, 2011 .
3. Mike McShaf rfy, “Game Coding Complete”, Third Edition, Charles River Media, 2009.
4. Jonathan S. Harbour, “Beginning Game Programming”, Course Technology PTR, 3 edition, 2009.
5. Ernest Adams and Andrew Rolings, “Fundamentals of Game Design”, Prentice Hall 1st edition, 2006.

END SEMESTER QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No Choice **20 Marks**

PART B : 2 questions from each unit of internal choice, each carrying 12 marks **60 Marks**

SIT1608	GREEN COMPUTING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To study about existing green computing strategies
- fundamental challenges in achieving green operations of computing units
- Assess enterprise-wide and personal computing and computing related energy consumption.

UNIT 1 GREEN COMPUTING FUNDAMENTALS 9 Hrs.

Green IT fundamentals: Business, IT, and the environment – Green computing: Carbon foot print - scoop on power – Green IT strategies: Drivers, Dimensions, and Goals – Environmentally responsible business: Policies, Practices and Metrics.

UNIT 2 GREEN ASSETS AND MODELING 9 Hrs.

Green Assets: Buildings, data centers, networks and devices – Green business process management: Modeling, optimization and collaboration – Green enterprise architecture – Environmental intelligence – Green supply chains – Green information systems: Design and development models.

UNIT 3 GRID FRAMEWORK 9 Hrs.

Virtualizing of IT systems – Role of electric utilities, telecommuting, teleconferencing and teleporting – Materials recycling – Best ways for green PC – Green data center – Green grid framework

UNIT 4 GREEN COMPLIANCE 9 Hrs.

Socio-cultural aspects of green IT – Green enterprise transformation roadmap – Green Compliance: protocols, standards and audits –Emergent carbon issues: technologies and future.TheWayClimate Savers Computing Initiative Do - The Climate Savers Computing Initiative - What Green Computing Impact Organization Supplies - Green Computers Initiatives - Green Computing Impact Organization Overview - Green Electronics Council - Going Green Can Be Truly Challenging - The Green Grid Framework - The CSCI Top Secrets Revealed - The EPEAT Standards - To Have a Green Computer - Green Computing Means to Save Your Money and Your Business - Finances - Green Computing Initiative Platforms.

UNIT 5 CASE STUDIES 9 Hrs.

The Environmentally Responsible Business Strategies (ERBS) – Case study scenarios for trial runs – Case studies – Applying green IT strategies and applications to a home, hospital, packaging industry and telecom sector.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Bhuvan Unhelkar, “Green IT Strategies and Applications- Using Environmental Intelligence”, CRC Press, June 2011.
2. Woody Leonhard, Katherrine Murray, “Green Home computing for dummies”, August 2009.
3. Warland & Pravin Varaiya, “High Performance Communication Networks”, Jean Harcourt Asia Pvt. Ltd., II Edition, 2001.
4. Jason Harris, “Green Computing and Green IT- Best Practices onregulations & industry”, Lulu.com, 2008.
5. Alin Gales, Michael Schaefer, Mike Ebbers, “Green Data Center:steps for the Journey”, Shoff/IBM rebook, 2011.
6. John Lamb, “The Greening of IT”, Pearson Education, 2009.

END SEMESTER QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No Choice **20 Marks**

PART B : 2 questions from each unit of internal choice, each carrying 12 marks **60 Marks**

SCS1302	COMPUTER GRAPHICS AND MULTIMEDIA SYSTEMS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To gain knowledge to develop, design and implement two and three dimensional graphical structures
- To enable students to acquire knowledge of Multimedia compression and animations.
- To learn creation, Management and Transmission of Multimedia objects.

UNIT 1 BASICS OF COMPUTER GRAPHICS 9 Hrs.

Output Primitives: Survey of computer graphics – Overview of graphics systems – Line drawing algorithm – Circle drawing algorithm – Curve drawing algorithm - Attributes of output primitives – Anti-aliasing.

UNIT 2 2D TRANSFORMATIONS AND VIEWING 8 Hrs.

Basic two dimensional transformations – Other transformations – 2D and 3D viewing – Line clipping – Polygon clipping – Logical classification – Input functions – Interactive picture construction techniques.

UNIT 3 3D CONCEPTS AND CURVES 10 Hrs.

3D object representation methods - B-REP , sweep representations, Three dimensional transformations. Curve generation - cubic splines, Beziers, blending of curves- other interpolation techniques, Displaying Curves and Surfaces, Shape description requirement, parametric function. Three dimensional concepts.Introduction- Fractals and self similarity- Successive refinement of curves, Koch curve and peano curves.

UNIT 4 METHODS AND MODELS 8 Hrs.

Visible surface detection methods – Illumination models – Halftone patterns – Dithering techniques – Polygon rendering methods – Ray tracing methods – Color models and color applications.

UNIT 5 MULTIMEDIA BASICS AND TOOLS 10 Hrs.

Introduction to multimedia - Compression & Decompression – Data & File Format standards – Digital voice and audio – Video image and animation. Introduction to Photoshop – Workplace – Tools – Navigating window – Importing and exporting images – Operations on Images – resize, crop, and rotate. Introduction to Flash – Elements of flash document – Drawing tools – Flash animations – Importing and exporting - Adding sounds – Publishing flash movies – Basic action scripts – GoTo, Play, Stop, Tell Target

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Donald Hearn, Pauline Baker M., "Computer Graphics", 2nd Edition, Prentice Hall, 1994.
2. Tay Vaughan ,"Multimedia", 5th Edition, Tata McGraw Hill, 2001.
3. Ze-Nian Li, Mark S. Drew ,"Fundamentals of Multimedia", Prentice Hall of India, 2004.
4. D. McClelland, L.U.Fuller ,"Photoshop CS2 Bible", Wiley Publishing, 2005.
5. James D. Foley, Andries van Dam, Steven K Feiner, John F. Hughes, "Computer Graphics Principles and Practice, 2nd Edition in C, Audison Wesley, ISBN – 981-235-974-5
6. William M. Newman, Roberet F. Sproull, "Principles of Interactive Computer Graphics", Second Edition, Tata McGraw-Hill Edition.

END SEMESTER QUESTION PAPER PATTERN

Max. Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No Choice **20 Marks**

PART B : 2 questions from each unit of internal choice, each carrying 12 marks **60 Marks**