PROGRAMME: B.Tech.

BIOTECHNOLOGY

CURRICULUM

SEMESTER 1										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Theory	SMTA1102	Engineering Mathematics-I (Biostatistics)	3	*	0	3	50	50	1
2	Theory	SCYA1101	Engineering Chemistry	3	1	0	4	50	50	2
3	Theory	SCSA1102	Fundamentals of Python Programming	3	*	0	3	50	50	4
4	Theory	SBTA1101	Microbiology and Cell Biology	3	*	0	3	50	50	5
5	Theory	SBTA1102	Biomechanics	3	*	0	3	50	50	6
6	Practical	SCYA2101	Engineering Chemistry Lab	0	0	2	1	25	25	7
7	Practical	SCSA2102	Fundamentals of Python Programming Lab	0	0	4	2	50	50	8
8	Practical	SBTA2101	Microbiology and Cell Biology Lab	0	0	4	2	50	50	9
9	Theory	SBTA1101	Environmental Science and Engineering	3	0	0	0	0	0	10
Total Credits for Semester 1 - 21 Total Marks for Semester 1 - 750										

SEMESTER 2										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Theory	SHSA1101	Technical English	3	0	0	3	50	50	11
2	Theory	SMTA1202	Engineering Mathematics - II	3	*	0	3	50	50	13
3	Theory	SPHA1101	Physics for Engineers	3	1	0	4	50	50	14
4	Theory	SEEA1101	Basic Electrical and Electronics Engineering	3	*	0	3	50	50	16
5	Theory	SMEA1102	Engineering Drawing	1	0	4	3	50	50	17
6	Theory	SCHA1211	Principles and calculations in Chemical Engineering	3	*	0	3	50	50	18
7	Practical	SPHA2101	Physics Lab	0	0	2	1	25	25	19
8	Practical	SMEA2201	Workshop Practice	0	0	3	2	50	50	20
Total Credits for Semester 2 - 22 Total Marks for Semester 2 - 750										

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

CAE – CONTINUOUS ASSESSMENT EXAMINATION,

ESE – END SEMESTER EXAMINATION,

SEMESTER 3

Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Theory	SMTA1303	Engineering Mathematics – III	3	*	0	3	50	50	21
2	Theory	SBTA1301	Molecular Biology and Genetics	3	*	0	3	50	50	22
3	Theory	SBTA1302	Biochemistry and Biomolecules	3	*	0	3	50	50	24
4	Theory	SBTA1303	Protein Engineering and Bioinformatics	3	0	0	3	50	50	25
5	Theory	SBTA1304	Environmental Biotechnology	3	0	0	3	50	50	26
6	Theory	SCHA1311	Heat and mass transfer for Biological systems	3	*	0	3	50	50	27
7	Practical	SBTA2301	Biochemistry and Biomolecules Lab	0	0	4	2	50	50	28
8	Practical	SBTA2302	Molecular Biology and Genetics Lab	0	0	4	2	50	50	29
Total Credits for Semester 3 - 22 Total Marks for Semester 3 - 800										

SEMESTER 4

Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Theory	SBTA1401	Enzyme Technology	3	*	0	3	50	50	30
2	Theory	SBTA1402	Immunotechnology	3	*	0	3	50	50	31
3	Theory	SCHA1411	Chemical Reaction Engineering	3	*	0	3	50	50	32
4	Theory		Open Elective – I	3	*	0	3	50	50	-
5	Theory	SAIC4001	Industry 4.0	2	0	2	2	50	50	33
6	Practical	SBTA2401	Enzymology Lab	0	0	4	2	50	50	34
7	Practical	SBTA2402	Immunology Lab	0	0	4	2	50	50	35
8	Practical	S23APT1	Professional Training - I	0	0	4	2		100	-
Total Credits for Semester 4 - 21 Total Marks for Semester 4 - 800										

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

CAE – CONTINUOUS ASSESSMENT EXAMINATION,

ESE – END SEMESTER EXAMINATION,

SEMESTER 5										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Theory	SBTA1501	Genetic Engineering	3	0	0	3	50	50	36
2	Theory	SBTA1502	Bioprocess Engineering	3	*	0	3	50	50	37
3	Theory	SBTA1503	Nanobiotechnology	3	*	0	3	50	50	38
4	Theory	SBTA1504	Pharmaceutical Biotechnology	3	*	0	3	50	50	39
5	Theory	SCHA1511	Transport Phenomena for Bioprocess	3	*	0	3	50	50	40
6	Theory		Professional Elective – I	3	0	0	3	50	50	-
7	Practical	SBTA2501	Bioprocess Engineering Lab	0	0	4	2	50	50	41
8	Practical	SBTA2502	Genetic Engineering Lab	0	0	4	2	50	50	42
Total Credits for Semester 5 - 22 Total Marks for Semester 5 – 800										

SEMESTER 6										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Theory	SBTA1601	Animal Biotechnology	3	*	0	3	50	50	43
2	Theory	SBTA1602	Biosafety, Bioethics and IPR	3	*	0	3	50	50	44
3	Theory	SBTA1603	Design and Operation of Bioreactors	3	*	0	3	50	50	45
4	Theory		Professional Elective – II	3	0	0	3	50	50	-
5	Theory		Open Elective – II	3	0	0	3	50	50	-
6	Practical	SBTA2601	Downstream Processing Lab	0	0	4	2	50	50	46
7	Practical	SBTA2602	Animal Biotechnology Lab	0	0	4	2	50	50	47
8	Project	S23AIPROJ1	Interdisciplinary Project	0	0	6	3	50	50	-
Total Credits for Semester 6 - 22 Total Marks for Semester 6 – 800										

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

CAE – CONTINUOUS ASSESSMENT EXAMINATION,

ESE – END SEMESTER EXAMINATION,

SEMESTER 7										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Theory	SBTA1701	Plant Biotechnology	3	*	0	3	50	50	48
2	Theory	SBTA1702	Cancer and Stem Cell Biology	3	*	0	3	50	50	49
3	Theory	SBAA4002	Principles of Management and Professional Ethics	3	0	0	3	50	50	50
4	Theory		Professional Elective – III	3	0	0	3	50	50	-
5	Theory		Open Elective – III	3	0	0	3	50	50	-
6	Practical	SBTA2701	Plant Biotechnology Lab	0	0	4	2	50	50	51
7	Practical	SBTA2702	Nanotechnology and Computational Biology Lab	0	0	4	2	50	50	52
8	Project	S23APROJ1	Project Work (Phase – I)	0	0	6	3	50	50	-
Total Credits for Semester 7 - 22 Total Marks for Semester 7 – 800										

SEMESTER 8										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Theory		Professional Elective – IV	3	0	0	3	50	50	-
2	Theory		Open Elective – IV	3	0	0	3	50	50	-
3	Project	S23APROJ2	Project Work (Phase – II)	0	0	14	7	50	50	-
Total Credits for Semester 8 - 13 Total Marks for Semester 8 – 300										

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

CAE – CONTINUOUS ASSESSMENT EXAMINATION,

ESE – END SEMESTER EXAMINATION,

LIST OF ELECTIVES

PROFESSIONAL ELECTIVE COURSES									
Sl. No.	Course Code	Course Title	L	T	P	C	Marks		Page No.
							CAE	ESE	
1	SBTA3001	Marine Biotechnology	3	0	0	3	50	50	53
2	SBTA3002	Aquaculture	3	0	0	3	50	50	54
3	SBTA3003	Translational Biotechnology: From IPR to Licensing	3	0	0	3	50	50	55
4	SBTA3004	Biological Process in regulatory affairs	3	0	0	3	50	50	56
5	SBTA3005	Medical Biotechnology	3	0	0	3	50	50	58
6	SBTA3006	Neurobiology	3	0	0	3	50	50	59
7	SBTA3007	Food Processing Technology	3	0	0	3	50	50	60
9	SBTA3008	PERL for Bioinformatics	3	0	0	3	50	50	61
10	SBTA3009	Molecular Modelling and Drug design	3	0	0	3	50	50	62
11	SCHA3010	Bioprocess Instrumentation and Control	3	0	0	3	50	50	63

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

CAE – CONTINUOUS ASSESSMENT EXAMINATION,

ESE – END SEMESTER EXAMINATION,

OPEN ELECTIVE COURSES									
Sl. No.	Course Code	Course Title	L	T	P	C	Marks		Page No.
							CAE	ESE	
1	SALA4001	Intellectual Property Law	3	0	0	3	50	50	A1
2	SAEA4001	Fundamentals of Aerospace Technology	3	0	0	3	50	50	A2
3	SBAA4001	Fundamentals of Management	3	0	0	3	50	50	A3
4	SBAA4002	Principles of Management and Professional Ethics	3	0	0	3	50	50	A4
5	SBTA4001	Biology for Engineers	3	0	0	3	50	50	A5
6	SBMA4001	Neurology	3	0	0	3	50	50	A6
7	SBMA4002	Modelling of Physiological Systems	3	0	0	3	50	50	A7
8	SBMA4003	Drug Delivery System	3	0	0	3	50	50	A8
9	SBMA4004	Fundamentals of Mechatronics	3	0	0	3	50	50	A9
10	SBMA4005	Virtuality and Augmented Reality	3	0	0	3	50	50	A10
11	SBMA4006	Medical Optics and Laser Applications	3	0	0	3	50	50	A11
12	SBMA4007	Forensic Science	3	0	0	3	50	50	A12
13	SBMA4008	Artificial Intelligence and Expert Systems	3	0	0	3	50	50	A13
14	SBMA4009	Human Factors in Engineering and Design	3	0	0	3	50	50	A14
15	SCHA4001	Corrosion Engineering	3	0	0	3	50	50	A15
16	SCHA4002	Energy Engineering	3	0	0	3	50	50	A16
17	SCHA4003	Environmental Impact Assessment	3	0	0	3	50	50	A17
18	SCHA4004	Environmental Pollution and Control	3	0	0	3	50	50	A18
19	SCIA4001	Disaster Management	3	0	0	3	50	50	A19
20	SCSA4001	R Programming	3	0	0	3	50	50	A20
21	SCSA4002	5 G Networks	3	0	0	3	50	50	A21
22	SECA4001	Software Tools for Engineering Applications	3	0	0	3	50	50	A22
23	SMEA4001	Resource Management Techniques	3	0	0	3	50	50	A23
24	SMEA4002	Wind and Solar Energy	3	0	0	3	50	50	A24

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

CAE – CONTINUOUS ASSESSMENT EXAMINATION,

ESE – END SEMESTER EXAMINATION

Semester	Theory courses (including elective courses)			Practical Courses (including PT and project)		
	Total no.	Total Credits	Total Marks	Total no.	Total Credits	Total Marks
1	6	16	500	3	5	250
2	6	19	600	2	3	150
3	6	18	600	2	4	200
4	5	15	500	3	6	300
5	6	18	600	2	4	200
6	5	15	500	3	7	300
7	5	15	500	3	7	300
8	2	6	200	1	7	100
Overall Total	41	122	4000	19	43	1800

Overall total credits for B.Tech. Biotechnology	165
Overall total marks for B.Tech. Biotechnology	5800

SMTA1102	ENGINEERING MATHEMATICS - I (Biostatistics) (COMMON TO BIO GROUPS)	L	T	P	Credits	Total Marks
		3	*	0	3	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 9 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 9 Hrs.

Correlation: 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 9 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 9 Hrs.

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

UNIT 5 RANDOM VARIABLES AND PROBABILITY DISTRIBUTIONS 9 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 – Normal Distribution – Mean , Variance and applications only.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Define measures of central tendency, probabilities. List the formulae of permutation and combination.
CO2 - Explain functions of random variables and their probability distributions. Derive the mean and variance of the distributions. Explain the measures of dispersion with illustrations.
CO3 - Choose appropriate probability theorem and solve the problems. Prepare the cumulative distribution for random variables. Applications of parameters of standard distributions.
CO4 - Distinguish correlation and regression, skewness and kurtosis. Categorize the regression coefficients. Point out the general term and coefficient of x^n using binomial theorem. Differentiate correlation and rank correlation.
CO5 - Evaluate the constants involved in curves by the method of least squares and the correlation coefficients
CO6 - Construct Fitting of straight line and parabola.

REFERENCE BOOKS

1. Veerarajan T., Probability, Statistics and Random Process, 4th Edition, Tata McGraw Hill, 2014.
2. Vittal P.R., Business Statistics, Margham Publications, Chennai, 2008.
3. Gupta, S.P., Business Statistics, Sultan Chand & Sons, New Delhi, 2008.
4. Beri G., Business Statistics, Tata McGraw Hill Publishing Company Limited, 2009.
5.. Vittal P.R., Allied Mathematics, Margham Publications, 3rd Edition, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SCYA1101	ENGINEERING CHEMISTRY	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVES

- To understand the basic concepts of quantum chemistry and molecular spectroscopy
- To learn the importance of functional materials for electronic devices
- To know the significance of chemistry in engineering and technology

UNIT 1 BONDS TO BANDS 12 Hrs.

Introduction to quantum chemistry – Motion of a quantum mechanical particle in one dimension (time- independent) – Schrödinger wave equation for hydrogen atom (No derivation) – Physical meaning of wave function - Angular and radial wave functions and probability densities – Quantum numbers – Principal, azimuthal, spin and magnetic quantum numbers – Wave functions and orbital shapes - s,p,d,f - LCAO-MO of H_2 – Band theory of solids: Conductors, semi-conductors and superconductors – Role of As and Ga doping on band structures.

UNIT 2 MOLECULAR SPECTROSCOPY 12 Hrs.

Electromagnetic spectrum – Interaction of radiation with matter – Energy levels in molecules – Microwave spectroscopy – Principle – Classification of molecules based on moment of Inertia – Rotational energy expression (J levels) – Calculation of J for CO molecule – Vibrational spectroscopy – Normal modes of vibrations – Vibrations of polyatomic molecules (CO_2 and H_2O) – Determination of Force constant – Electronic transitions in organic molecules – Mathematical derivation of Beer Lambert's law – Stimulated Emission – Lasers in action – Excimer laser, Diode laser and Gas laser.

UNIT 3 FUNCTIONAL MATERIALS 12 Hrs.

Introduction to conducting polymers – Charge transport carriers: Exciton formation in organic solar cells and organic light emitting diodes (principle and working) – Conduction mechanism in polymers: Soliton, polaron and bipolaron formation in polyacetylene and polyaniline – Liquid crystals: Characteristic features and phases of liquid crystals – Liquid crystal displays.

UNIT 4 CARBON MATERIALS FOR HEALTH, STEALTH AND ENERGY 12 Hrs.

Introduction to carbon materials – Fullerenes – Production, properties and applications – van der Waal's solid – Structure of graphene, graphene oxide and reduced graphene oxide – Mechanical and electrical properties of graphene – Graphene based energy storage devices for space applications – Carbon nanotubes – Single-walled and multiwalled CNTs - Synthesis of CNTs by Thermal CVD and laser ablation method – Electrical and mechanical properties of CNTs - Applications of CNTs.

UNIT 5 ENGINEERING MATERIALS 12 Hrs.

Phase equilibria: Gibbs phase rule – Terms involved in Phase rule – Phase diagram of water system – Thermal method of analysis – Construction of simple eutectic system (Lead-Silver system).

Fuels – Classification of fuels – Determination of calorific values of solid fuels by bomb calorimeter – Manufacture of synthetic petrol by Fischer-Tropsch method – Knocking in IC engines – Chemical structure – Octane and cetane rating of fuels.

Nanomaterials: Size dependent properties of nanomaterials – Synthesis of gold and silver nanoparticles by Chemical reduction method – Applications of nanoparticles in medicine.

Max.60 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand quantum chemistry and its application to band theory.
CO2 - Analyse the interaction of radiation with matter in spectroscopic techniques.
CO3 - Interpret charge transport mechanism for electronic devices.
CO4 - Illustrate the applications of carbon materials in health, stealth and energy.
CO5 - Learn basic concepts of phase diagram, nanoparticle synthesis and importance of fuel.
CO6 - Analyze and demonstrate the applications of materials in real world.

TEXT / REFERENCE BOOKS

1. Chandra A.K., Introductory Quantum Chemistry, Tata McGraw Hill, 4th Edition, 1994.
2. Ira N. Levine, Physical chemistry, 6th Edition, 2008.
3. Ira N. Levine, Quantum chemistry, 7th Edition, 2013.

4. David W. Ball and Thomas Baer, Physical Chemistry, Wadsworth Cengage Learning, 2nd Edition, 2014.
5. Donald W. Rogers, Concise Physical Chemistry, John Wiley and Sons, 2011.
6. Douglas A. Skoog and Donald M.West, Principles of Instrumental Analysis, Cengage, 6th Edition, 2014.
7. Jain P.C. and Monika Jain, Engineering Chemistry, Dhanpat Rai Publication, 2018.
8. Joel. R. Fried, Polymer Science and Technology, Prentice Hall of India Private Ltd., 3rd Edition, 2012.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SCSA1102	FUNDAMENTALS OF PYTHON PROGRAMMMING	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To understand why Python is a useful scripting language for developers.
- To learn how to use lists, tuples, and dictionaries in Python programs.
- To learn how to build and package Python modules for reusability.
- To learn how to read and write files in Python.
- To learn how to use exception handling in Python applications for error handling.
- To learn how to design and program Python applications.

UNIT 1 INTRODUCTION **9 Hrs.**

History of Python- Introduction to the IDLE interpreter (shell) - Expressions – Data Types - Built-in function - Conditional statements - Iterative statements- Input/output - Compound Data Types - Nested compound statements – Introduction to Object Oriented Concepts.

UNIT 2 FILES AND EXCEPTIONS HANDLING , MODULES, PACKAGES **9 Hrs.**

File Operations –Iterators - Exception handling - Regular Expressions- Creating Modules-Import Statement-Introduction to PIP-Installing Packages via PIP-Using Python Packages

UNIT 3 GUI PROGRAMMING **9 Hrs.**

GUI Programming in Python - Introduction to GUI library - Layout management - Events and bindings - Fonts – Colours - Canvas - Widgets (frame, label, button, check box, entry, listbox, message, radiobutton, text, spinbox).

UNIT 4 DATABASE AND NETWORK **9 Hrs.**

Database (using NoSQL):Connector Module –Cursor – Statements - Exceptions in database. Network connectivity: Socket module - Client – Server – Email – URL Access

UNIT 5 CASE STUDY **9 Hrs.**

Web Programming using Python.
Image Processing – Facebook Analysis – Twitter Analysis.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Describe the Numbers, Math functions, Strings, List, Tuples and Dictionaries in Python
CO2 - Do the decision Making and write functions in Python
CO3 - Explain how to design GUI Applications in Python and evaluate different database operations
CO4 - Design and develop Client Server network applications using Python
CO5 - Design real life situational problems and think creatively about solutions of them.
CO6 - Apply the best features of mathematics, engineering and natural sciences to program real life problems.

TEXT BOOKS/REFERENCE BOOKS

1. Daniel Liang Y., Introduction to Programming Using Python, Pearson, 2013.
2. Paul Gries, Jennifer Campbell, Jason Montojo, Practical Programming: An Introduction to Computer Science Using Python 3, Pragmatic Bookshelf, 2nd Edition, 2014.
3. Magnus Lie Hetland, Beginning Python: From Novice to Professional, Apress.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SBTA1101	MICROBIOLOGY AND CELL BIOLOGY	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVE

- The course aims to develop skills of the Students in the area of Microbiology and Cell biology particularly to identify microbes, structure, metabolism and Cell Signaling pathways

UNIT 1 CLASSIFICATION AND MULTIPLICATION 9 Hrs.

Overview of history of Microbiology- Classification of Microbes - Systems of classification, Numerical taxonomy, Identifying characters for classification, General properties and principles of classification of microorganisms Structural organization and multiplication of bacteria, viruses, algae and fungi.

UNIT 2 MICROBIAL NUTRITION, GROWTH AND METABOLISM 9 Hrs.

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

UNIT 3 CONTROL OF MICROORGANISMS 9 Hrs.

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

UNIT 4 CELL ORGANELLES 9 Hrs.

Evolution of cell; Cell as a unit of living organism, evolution and structure of prokaryotic cell, evolution of eukaryotic cell - Structural and functional features of eukaryotic cell: cell organelles; endoplasmic reticulum, golgi complex, lysosomes, vacuoles, peroxisomes, mitochondria, chloroplast, cytoskeleton, microtubules, nucleus, extracellular matrix etc.

UNIT 5 CELL CYCLE AND APOTOSIS 9 Hrs.

Cell cycle - An overview of cell cycle; Components of cell cycle control system; Intracellular and Extra-cellular control of cell division, Programmed cell death (Apoptosis), intrinsic & extrinsic pathways of cell death, Apoptosis in relation with Cancer, Viral disease (AIDS) & Organ transplant

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Familiar with overview and scope of microbiology.
CO2 - Explore the systemic classification of microbes.
CO3 - Study the methods for cultivation of organisms.
CO4 - Understand the basic principles of cellular components.
CO5 - Study the cell cycle principle.
CO6 - Understand the application of microbiology and cell biology in biotechnology.

TEXT / REFERENCE BOOKS

1. Berg, Jeremy M., John L. Tymoczko, Lubert Stryer, J.M. Berg, J.L. Tymoczko and L. Stryer, Biochemistry International version, 2002.
2. Nelson D.L., Lehninger A.L. & Cox, M.M., Lehninger principles of Biochemistry, Macmillan, 2008.
3. Moat A.G., Foster J.W. & Spector, M. P. (Eds.), Microbial Physiology, John Wiley & Sons, 2003.
4. Alberts, Bruce, Dennis Bray, Karen Hopkin, Alexander D. Johnson, Julian Lewis, Martin Raff, Keith Roberts and Peter Walter. Essential Cell Biology, Garland Science, 2015.
5. Karp G., Cell and Molecular Biology: concepts and experiments, John Wiley & Sons, 2009.
6. Robertis De., Cell and Molecular Biology, 1987.
7. Lodish H., Berk A., Darnell J.E., Kaiser C.A., Krieger M., Scott M.P., Bretscher A., Ploegh H. and Matsudaira P., Molecular Cell Biology, Macmillan, 2008.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SBTA1102	BIOMECHANICS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To gather adequate knowledge the mechanics involved in human beings.
- To understand the fundamental principles related to mechanical actions of biological tissues

UNIT 1 INTRODUCTION **9 Hrs.**

Biomechanics, History, Applications, Perspectives in Biomechanics; Rigid Body BioMechanics; Anatomical Concepts in Biomechanics., Fundamentals of Biomechanics, Anthroprometric Considerations, Newtons Laws of motions

UNIT 2 MECHANICS OF HARD TISSUES **9 Hrs.**

Whole body modeling, Structure of bones – Composition and properties of bones and relationship to structure – Elastic properties of bones, Bone fracture mechanics, Implants for bone fractures, Lubrication of joints.

UNIT 3 MECHANICS OF SOFT TISSUES **9 Hrs.**

Tissue Mechanics-Structure and functions of cartilages, tendons, ligaments,, Mechanical Properties of Tissues, Biological materials, Pseudo elasticity, nonlinear stress-strain relationship, viscoelasticity and models, structure, function and mechanical properties of skin, ligaments and tendons, Mechanical testing of Soft tissue.

UNIT 4 CARDIOVASCULAR MECHANICS **9 Hrs.**

Cardiovascular Physiology, Heart Valve Dynamics, Prosthetic Valve Dynamics. Mechanical properties of blood vessels – arteries, arterioles, capillaries, veins, blood flow: laminar and turbulent.

UNIT 5 APPLICATIONS OF BIOMECHANICS **9 Hrs.**

Mechanics of spinal distraction rods, Biomechanics of human motion and control interfaces with application to limb orthotics and prosthetics. Design of hip prosthesis, Automated driver's training programme, Sports biomechanics.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the principles and mechanics of hard tissues.
CO2 - Outline the principles of biofluid dynamics.
CO3 - Explain the fundamentals of soft tissues
CO4 - Apply the knowledge obtained in cardiovascular mechanics
CO5 - Discover mechanics related to cardiovascular system.
CO6 - Apply the knowledge gained to find solutions to various need in biomehanics

TEXT / REFERENCE BOOKS

1. Robert L.Huston, Principles of Biomechanics, CRC Press, 2005.
2. Ozkaya and Nordin, Fundamentals of Biomechanics: Equilibrium, Motion and Deformation, 2002.
3. Gardiner M. Dena, The principles of exercise therapy, CBS Publisher, 2000.
4. Fung Y.C., Bio-Mechanics - Mechanical Properties of Tissues, Springer-Verlag, 2000.
5. Subrata Pal, Textbook of Biomechanics, Viva Books Private Limited, 2009.
6. Bruce M. Koeppen and Bruce A. Stanton, Mosby, Berne & Levy Physiology, 6th Edition, 2009.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SCYA2101	ENGINEERING CHEMISTRY LAB	L	T	P	Credits	Total Marks
		0	0	2	1	50

COURSE OBJECTIVES

- To understand the basic principle involved in adsorption, kinetics and viscosity measurements.
- To acquire practical knowledge in pH metry, potentiometry and conductometry.
- To develop the skill in water analysis.

SUGGESTED LIST OF EXPERIMENTS

1. Separation and identification of organic compounds and determination of R_f values by thin layer chromatography.
2. Estimation of hardness of water by EDTA method.
3. Determination of freezing point depression of a compound.
4. Determination of pKa value of glycine by pHmetry.
5. Estimation of mixture of acids by conductometry.
6. Estimation of ferrous ion by potentiometry.
7. Determination of saponification value of oil.
8. Determination of the partition coefficient of a substance between two immiscible liquids.
9. Verification of Freundlich adsorption isotherm using adsorption of acetic acid by charcoal.
10. Determination of high molecular weight polymer using Ostwald viscometer.
11. Estimation of copper in brass.
12. Determination of alkalinity of water.
13. Estimation of Iron by photocolorimetry.
14. Determination of dissolved oxygen content of water sample by Winkler's method.
15. Estimation of sodium in water by using Flame Photometry.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Acquire knowledge about adsorption in separation of mixtures.
CO2 - Estimate the total hardness in water sample by complexometry.
CO3 - Gain the knowledge of colligative properties by Rast Method.
CO4 - Learn the principle of potentiometric and conductometric titrations.
CO5 - Understand the significance of saponification value of oil.
CO6 - Apply the concept of viscosity in determining the molecular weight of polymer.

TEXT / REFERENCE BOOKS

1. Jeffery G.H., Vogel's Textbook of Quantitative Chemical Analysis, 6th Edition. Persons Education, 2004.
2. Dara S.S., Experiments and Calculations in Engineering Chemistry, S. Chand and Co., 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 50 **Exam Duration: 2 Hrs.**

CAE	Evaluation of Regular Lab class	**15 Marks**	**25 Marks**
	Model practical exam	**10 Marks**	
ESE	University Practical exam		**25 Marks**

SCSA2102	FUNDAMENTALS OF PYTHON PROGRAMMMING LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

SUGGESTED LIST OF EXPERIMENTS

1. Program to handle Input and Output statements
2. Program using Lists, Tuples, Dictionary and Sets
3. Program using conditional statements
4. Program using looping constructs
5. Program using functions and modules
6. Program using File handling
7. Program using Exception handling
8. GUI Programming using Python - Canvas Widget
9. GUI Programming using Python - Frame, label, button, check box, entry, listbox, message, radio button, text, spinbox
10. Database Programming using Python
11. Socket Programming using Python

CASE STUDIES

- Quora : Question similarity
- Amazon :Fashion Discovery Engine

SBTA2101	MICROBIOLOGY AND CELL BIOLOGY LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVE

- To study the basic laboratory techniques of microbiology and cell biology

SUGGESTED LIST OF EXPERIMENTS

1. Microscopy– Description and operation of compound microscope, use of oil immersion objective. Micrometry
2. Staining Methods
    - Simple staining – *Bacillus* spp.
    - Differential staining – *Bacillus* and *E.coli.*
    - Special staining - Capsular staining
    - Fungal staining - Lactophenol cotton blue, staining of mold (Penicillium, Aspergillus).
3. Sterilization- Operation of autoclave, hot air oven, membrane filtration (demonstration only),
4. Culture transfer from solid to solid, solid to liquid and liquid to liquid: Checking of possible contamination.
5. Culture techniques
   Culture media preparation- Nutrient broth, nutrient agar slant, potato dextrose agar.
6. Isolation and viable cell count of bacteria by Pour plant and spread plate method
7. Isolation of pure culture by streak plate method.
8. Bacterial motility (a) Hanging drop method (b) Stabbing method.
9. Antibiotics sensitivity assay
10. Study of chromosomal abnormalities (Permanent slides)
11. Study of cancer cell lines (Permanent slides)
12. Preparation of buccal smear for identification of Barr bodies
13. Study of Mitotic stages
14. Study of Meiotic stages

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand basic principles of microscopy and microscopic examination.
CO2 - Determination of primary identification of bacteria and fungi by staining techniques.
CO3 - Differentiate bacterial species by suitable macroscopic techniques.
CO4 - Understand different sterilization techniques.
CO5 - Differentiate cell cycle stages.
CO6 - Compare normal cells from cancer cells.

SBTA1101	ENVIRONMENTAL SCIENCE AND ENGINEERING (Common to ALL Branches of B.E/ B. Tech.)	L	T	P	Credits	Total Marks
		3	2	0	0	-

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

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

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 exsitu conservation of biodiversity.

UNIT 3 ENVIRONMENTAL POLLUTION

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

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 technology in environment and human health, case studies. Visit to a local area to document environmental assets river/ forest / grassland / hill / mountain. Visit to a local polluted site-urban/rural/ industrial/agricultural-study of common plants, insects, birds-study of simple ecosystems, pond, river, hill slopes etc.

TEXT / REFERENCE BOOKS

1. Meenakshi P., Elements of Environmental Science and Engineering, 1st Edition, Prentice Hall of India, New Delhi, 2009.
2. Ravikrishnan A., Environmental Science & Engineering, 3rd Edition, Sri Krishna Publications, Chennai, 2008.
3. Wrigh R.T. & Nebel B.J., Environmental science-towards a sustainable future by Richard, 8th Edition, Prentice Hall of India, New Delhi, 2006.
4. Erach Bharucha, Text Book of Environmental Studies, 2nd Edition, University Press, Chennai, 2006.

SHSA1101	TECHNICAL ENGLISH	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To enable the students to read and respond to specialized (scientific) materials and to subject areas included for their study.
- To provide an opportunity for students to comprehend and react in oral and written forms to the specialized texts that they read in their respective courses so as to summarise and paraphrase the texts presented in the class.
- To provide opportunities for students to respond to listening and writing tasks by using digital tools
- To enhance 21st century skills like communication, collaboration, critical thinking and creativity through blended learning contexts

UNIT 1 LANGUAGE AT THE WORD LEVEL 9 Hrs.

Listening: Note Taking, Summarising the information related to resume preparation and also in flow chart templates
Speaking: Self Introduction, Talking about likes and dislikes
Reading for global understanding: The content from subject related matter or True Love by Isaac Asimov **Writing:** Formal and informal emails and letters and letter to the editor with current problems and solutions suggested.
Vocabulary: Affixes**,** technical terms, collocations, ordering words, sequence words, contextual guessing of words
Language Focus: changing one form of speech into another; present tense, signalling words for time and order
Language Lab work: Focus Digital literacy: students join Google classroom/ or class wiki: become familiar with these online tools, by introducing themselves by doing ice breaking activity

UNIT 2 LANGUAGE AT THE SENTENCE LEVEL 9 Hrs.

Listening and Predicting: Listen to the current trends about product sales; arrive at inference about technical and environmental issues
Speaking: Debate on current issues, JAM on current topics
Reading for global comprehension: Identifying topic sentences by reading Short story on Men are Different or content from the subject areas.
Writing: Writing compare/ contrast paragraphs, process descriptive paragraphs and paraphrasing passages to express meaning in own words.
Vocabulary: identifying and framing verbal phrases, prepositions and prepositional phrases form the reading materials suggested
Language focus : Recognizing Past and future tense, Conjunctions and sentence linkers with specific focus on signalling words for Comparison/similar ideas, Contrast/opposite ideas, adjectives/ adverbs for comparisons there by to use in senesces.
Identify clauses, kinds of sentences based on their functions in the passage, Transformation of sentences from one type into the other (Simple, compound, complex), impersonal passive voice.
Language Lab: Digital literacy: Respond to quiz using Google spread sheet, Prepare a quiz on Language focussed areas, sharing links in Google classroom, and collect answers/ respond to survey sheets of their classmates to write compare contrast paragraphs of responses in wikis.

UNIT 3 LANGUAGE AT THE DISCOURSE LEVEL –REPORTING 9 Hrs.

Listening: Listening for gist / to summarize and to find the attitude and tone of the speaker
Speaking: Making Group Presentations based on information gathered by eliciting responses-Preparing a questionnaire, with open ended questions to make a survey about electronic gadgets/ social media/ environmental issues using elements of reasoning to make a presentation in the class.
Reading - Skimming and Scanning to find specific information and preparing notes on Passage on 'Making Effective presentation'
Writing: Framing open ended questions using elements of reasoning. Survey Report: Preparation of and documenting to report the findings. Arranging the sentences in the right order
Vocabulary: Word classification, word associations, paired expressions
Language focus: Subject verb agreement, punctuation, Common errors in spelling, punctuation
Language Lab: Digital literacy: Use interactive power point tools like Prezi, Slideshare to make presentation on the survey report to share link in the Google classroom

UNIT 4 LANGUAGE AT THE DISCOURSE LEVEL - PRODUCT DESCRIPTION 9 Hrs.

Listening: Classifying information related products
Speaking: Group discussion on current topics to arrive at solutions to problems by using elements of reasoning
Reading: Reading to prepare notes, categorising under headings and subheadings by reading Short Extracts from User Manuals. Reading and contextual guessing by reading about products
Writing: Instructions and recommendations, Preparation of User Manual on the electronic products in current usage

Vocabulary: Classification of words, descriptive words about products, definitions, compound nouns
Language: Reported Speech, causatives and double negatives, Tag questions
Language Lab: Digital literacy: Use Padlet/ quia to develop and complete vocabulary tasks created by peers in group work

UNIT 5 LANGUAGE AT THE DISCOURSE LEVEL – CRITICAL THINKING AND CREATING 9 Hrs.

Listening and summarizing: Listening to famous speeches to identify the structure of speeches- Ted Talks/ peer presentations to fill the template
Speaking: Giving impromptu talks, Speech Writing
Reading for Global Understanding: Read technical passages and trends in social media or technological developments to summarise, Read speeches by MS Narayana Murthy ' My Life's Lessons , Dr APJ Kalam's Speech "Unity of Minds" to identify the structure of Speech
Writing: Essay writing related to the Speeches suggested for reading, besides topic areas covered in all the units, self and peer editing using rubrics
Vocabulary: Homophones/Homonyms, idioms and phrases related to technology
Language focus: Same word acting as different parts of speech
Language Lab: Digital literacy: to create their own Blogs thereby to share their creations, interactive exercises and quizzes make them visible online.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Classify technical words to use them in sentences framing, compose problem solving paragraphs in semi formal letters, use rubrics to self evaluate, listening to take linear notes, reading to infer, predict and to differentiate facts from opinions, guess contextual meaning of words, modify the verbs in present tense, use learnt language in role plays with 80% accuracy

CO2 - Categorize information based on global understanding of reading materials to prepare notes in graphic format like tables, use cohesive words related to comparing and contrasting by writing short paragraphs based on visual inputs in the form of bar diagrams, pie chart etc; describe process by composing paragraphs, recognize topic sentences and identifying verbal phrases while reading, use prepositions and prepositional phrases, modify the verbs from one form to the other in past and future tenses with 80% accuracy

CO3 - Generate specific information by using scanning and skimming reading materials, Construct questionnaire to conduct class survey by framing open ended questions to generate data on current issues to make oral presentations and report in written format by using template provided, arrange sentences in the right order by using sentence linkers as clues, revise the written materials by identifying elements of editing, edit errors related to subject verb agreement, punctuation and spelling besidescoherence with 70 % accuracy, use reported speech in spoken and written form in class room in reporting contexts, list paired words, word associations by recalling and identifying by noticing them while reading

CO4 - Paraphrase based on reading to discuss and design products thereby to create and design user manual, identify technical words related to compound nouns to expand and to paraphrase, enact role plays to present the product, discuss facts and opinions of the product in pair and team work, read current topics to summarise in note form , listen to current issues to deduct meaning from the context, choose the right option, define technical words related to the reading materials.

CO5 - Summarise reading materials, use the ideas while writing essays, take, and differentiate meaning of homonyms and homophones

CO6 - Demonstrate the ability to work cooperatively in a small group environment, in activities developed for language learning in the classroom/ online for formative assessment purposes, use and develop rubrics for self reflection, apply elements of reasoning skills for critical reading, identify facts and opinions and make judgements independently, develop intellectual courage and perseverance in pair and group work.

TEXT / REFERENCE BOOKS

1. English for Science and Technology, Department of English, Sathyabama University, 2013.
2. Bhaskaran Nair P., Radha Krishna Pillai C., Geetha Rajeevan, CLN Prakash, Nadhini Nayar Reflections - An Anthology of Prose, Poetry and Fiction, Foundation Books, Chennai, Foundation Books, 2015.
3. Leiki M., Academic Writing. CUP, 1998.
4. Seely John, Oxford Guide to Effective Writing and Speaking, OUP, 2013.
5. Sen S., Mahendra et al., Communication and Language Skills, Foundation books, Chennai, 2015.
6. Sheelagh Deller, Teaching Other Languages Through English, CUP, 2012.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SMTA1202	ENGINEERING MATHEMATICS – II (COMMON TO BIO GROUPS)	L	T	P	Credits	Total Marks
		3	*	0	3	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 **9 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 Eigen values and Eigenvectors – Cayley-Hamilton theorem (without proof) verification – Finding Inverse and Power of a matrix using Cayley-Hamilton Theorem.

UNIT 2 DIFFERENTIAL CALCULUS **9 Hrs.**

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

UNIT 3 INTEGRAL CALCULUS **9 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 **9 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 **9 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.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Identify Cayley Hamilton theorem, consistency of linear algebraic equations and derivative of standard functions. Define rank, eigen values and eigen vectors

CO2 - Explain the properties of definite integrals, Irrotational and Solenoidal of a vector, gradient and directional derivative of a function and test of hypothesis

CO3 - Uses of Cayley Hamilton theorem and its verification.

CO4 - Differentiate various types of functions. Classify test of hypothesis

CO5 - Evaluate different types of integrals

CO6 - Construct Goodness of fit and produce inverse and power of the matrix.

TEXT / REFERENCE BOOKS

1. Kreyszig E, Advanced Engineering Mathematics, 8th Edition, John Wiley & Sons, Singapore, 2001.
2. Vittal P.R., Allied Mathematics, Margham Publications, 3rd Edition, 2002.
3. Venkataraman M.K., Engineering Mathematics - First Year, 2nd Edition, National Publishing Co., Chennai, 2000.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill, New Delhi, 11th Reprint, 2010.
5. Bali N.P. and Manish Goyal, A Text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SPHA1101	PHYSICS FOR ENGINEERS	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVES

- To introduce the basic concepts of quantum mechanics.
- To realize the electronic structure of various materials via the band theory.
- To appreciate the role of quantum physics in the design and development of novel sensor devices.
- To understand the heat transfer mechanism in solids and fluids.

UNIT 1 BASIS OF QUANTUM PHYSICS 12 Hrs.

Introduction –electromagnetic waves - Photoelectric effect, Compton scattering, photons, Franck-Hertz experiment, Bohr atom, electron diffraction, wave - particle duality of radiation, de Broglie waves, wave-particle duality of matter. Physical interpretation of wave function, conditions to be satisfied for an acceptable wave function, normalized wave function, wave packets, Heisenberg uncertainty principle - statement, applications to radius of Bohr's first orbit and to energy of particle in 1D box. Operators associated with different observables, Schrodinger Equation – stationary states - Eigen value, Eigen function. Physical applications of Schrödinger's equation to (i) square well potential in one dimension: transmission and reflection coefficient at a barrier. Application of barrier penetration-α decay, field-ionization and scanning tunnelling microscope

UNIT 2 PHYSICS OF SOLIDS 12 Hrs.

Structure of solids - Bloch Theorem and Origin of energy bands, band structure of conductors, semiconductors (n-type and p-type), insulators, half metals, semi metals. Metals - Free Electron Theory of metals, Fermi level, Fermi surface, density of states. Wiede-mann Franz Law- Derivation. Semiconductors-Direct and indirect band gap, derivation of intrinsic carrier concentration in terms of energy band gap, experimental determination of energy band gap. Superconductors- Properties, BCS theory - energy gap, AC & DC Josephson effect, Superconducting Quantum Interference Device, Cryotron, Magnetic levitation.

UNIT 3 MAGNETISM, LASER FUNDAMENTALS AND OPTO ELECTRONICS 12 Hrs.

Magnetism- Bohr magneton, magnetic moments due to electron spin, Ferromagnetism- Weiss theory-Energies involved in domain formation, Hysteresis. Magnetic bubbles - formation and propagation. Nano magnets and magneto resistance,spin valve using GMR and TMR – hard disk drive storage technology. Lasers-Spontaneous and stimulated emission, condition for Laser action, Einstein Coefficients, relation between spontaneous and stimulated emission probability. Injection Laser Diode (ILD). Quantum Cascade Laser, Comparison between ILD and QCL.

UNIT 4 THERMAL PHYSICS 12 Hrs.

Laws of thermodynamics-basic concepts, closed and open systems-first law. Heat transfer-thermal expansion of solids and liquids – expansion joints-bimetallic strips, thermal conduction**,** convection and radiation. Conduction in solids – thermal conductivity- Forbe's method, Lees' disc method, conduction through compound media, formation of ice on ponds, thermal insulation, applications- heat exchangers, refrigerators, ovens and solar water heaters. Thermal Convection - properties of radiant heat, sea and land breeze. Prevost's theory of heat exchanges.Thermal Radiation – emission and absorption radiation, emissive power, black body radiation – Kirchoff's, Stefan's laws, wien's law, Newton's law of cooling.

UNIT 5 SENSORS AND DEVICES 12 Hrs.

Introduction- measurands and measurement, basic concepts, types, mechanism, examples, significance and drawbacks, applications of each of pressure sensors, temperature sensors, vibration sensors, acoustic sensors, LDR and photo diode, pressure gauge-bourdon tube, magnetic sensors – Hall sensors, strain gauge-strain sensitivity.

Max.60 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Identify the basic concepts in quantum mechanics, magnetism, lasers, superconductors, semiconductors & in thermal physics.

CO2 - Analyze the band structure of various materials.

CO3 - Apply the wave mechanical concepts to determine the radius of Bohr atom, transmission and reflection coefficient.

CO4 - Generate equation of motion of matter waves and to solve for cases related with 1D square well potential, linear harmonic oscillator and barrier penetration.

CO5 - Compare the efficiency of various memory storage devices, heat exchanger devices, opto electronic devices and sensors.

CO6 - Determine the thermal conductivity of conducting and insulting materials, convective heat transfer coefficient, emissivity, rate of cooling, etc.

TEXT / REFERENCE BOOKS

1. Griffiths, David J., Introduction to Quantum Mechanics. Pearson Prentice Hall, 2004. ISBN: 9780131118928.
2. Shankar, Ramamurti, Principles of Quantum Mechanics. Plenum Press, 1994.
3. Mahesh C Jain, Quantum Mechanics: A Textbook for Undergraduates, 2017.
4. Kittel, Charles. Introduction to Solid State Physics. 8th Edition, New York, John Wiley & Sons, 2004.
5. Ashcroft, Neil W. and N. David Mermin, Solid State Physics, New York, Holt Rinehart and Winston, 1976.
6. William D. Callister & David G. Rethwisch, Materials Science & Engineering -An Introduction, 9th Edition, 2013.
7. Asokamani R., Solid State Physics, 2nd Edition, Easwar Press, 2015 ISBN: 9781904798835.
8. Gaur R.K. & Gupta S.L., Engineering Physics, Dhanpat Rai Publication, 2007.
9. Bhattacharya P., Semiconductor Optoelectronic Devices, Prentice Hall of India, 1997.
10. Singh J., Semiconductor Optoelectronics: Physics and Technology, McGraw Hill Inc., 1995.
11. Keiser G., Optical Fiber Communications, McGraw Hill Inc., 3rd Edition, 2000.
12. Heat and Thermodynamics, D.S.Mathur, Sultan Chand, 1995.
13. Heat and Thermodynamics Brij Lal, N. Subrahmanyam, S. Chand Limited, 2001.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs.**
PART A: 10 Questions of 2 marks each - No choice	**20 Marks**
PART B: 2 Questions from each unit with internal choice, each carrying 16 marks	**80 Marks**

SEEA1101	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To impart knowledge on the analysis of DC and AC Circuits.
- To gain knowledge about the working of electrical machines.
- To impart Knowledge on the operation of the basic electronic devices.

UNIT 1 D.C. CIRCUITS **9 Hrs.**

Electrical Quantities - Ohm's law - Kirchoff's laws -Resistance in series and parallel combinations - Current and Voltage division rules - Mesh analysis and Nodal analysis.

UNIT 2 A.C. CIRCUITS **9 Hrs.**

Sinusoidal functions - R.M.S and Average values for Sinusoidal waveform - Phasor representation - Sinusoidal excitation applied to purely resistive, inductive and capacitive circuits - RL , RC and RLC series circuits - power and power factor - Introduction to three phase circuits with balanced load.

UNIT 3 INTRODUCTION TO MACHINES **9 Hrs.**

Construction and Principle of Operation of DC Generators - DC Motors - Single Phase Transformer - Single Phase Induction Motors - Stepper Motor.

UNIT 4 SEMICONDUCTOR DEVICES **9 Hrs.**

VI Characteristics of PN-junction diodes and Zener diodes, BJT and its configurations – input/output Characteristics, Junction Field Effect Transistor – Drain and Transfer Characteristics, MOSFET – Depletion type and Enhancement type, Uni Junction Transistors - Silicon Controlled Rectifiers.

UNIT 5 DIGITAL ELECTRONICS **9 Hrs.**

Number systems – Binary arithmetic - Boolean algebra, laws & theorems – Boolean Functions - Simplification of Boolean functions - Logic gates - Implementation of Boolean expressions using logic gate - Standard forms of Boolean expression.

MAX. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Analyze electrical circuits using Kirchoff's Laws.
CO2 - Compare the behaviour of R, L and C and their combinations in AC circuits.
CO3 - Describe the construction and working principle of DC and AC machines.
CO4 - Demonstrate the characteristics of various semi-conductor devices.
CO5 - Understand the concept of digital electronics.
CO6 - Recognize the importance of electronic devices.

TEXT / REFERENCE BOOKS

1. Mittle B.N. & Aravind Mittle, Basic Electrical Engineering, 2nd Edition, Tata McGraw Hill, 2011.
2. Theraja B.L., Fundamentals of Electrical Engineering and Electronics, 1st Edition, S.Chand & Co., 2009.
3. Smarajit Ghosh, Fundamentals of Electrical and Electronics Engineering, 2nd Edition, PHI Learning Pvt. Ltd, 2010.
4. Kothari D.P. and Nagarath I.J., Electrical Machines, 3rd Edition, Tata McGraw Hill Publishing Company Limited, 2006.
5. Sanjay Sharma, Electronic Devices and Circuits, 2nd Edition, S.K.Kataria & Sons, 2012.
6. John Bird, Electrical Circuit Theory and Technology, 4th Edition, Published by Taylor & Francis, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

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

PART B: 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**

SMEA1102	ENGINEERING DRAWING	L	T	P	Credits	Total Marks
		1	0	4	3	100

COURSE OBJECTIVES

- To know the basics of Engineering Graphics.
- To make the student to possess the efficient drafting skill.
- To make the students to understand the importance of sectioning and concept of development.
- To learn about the orthographic and pictorial projections.

UNIT 1 LETTERING, DIMENSIONING AND GEOMETRICAL CONSTRUCTION 9 Hrs.

BIS - Lettering - Two systems of dimensioning - Dividing a straight line into any number of equal parts - Bisecting an angle and right angled triangle - Drawing a regular pentagon and hexagon given one side - Conic sections - ellipse, parabola, hyperbola by eccentricity method.

UNIT 2 PROJECTION OF POINTS AND LINES 9 Hrs.

Projection - Types of projection - Projection of points lying in four quadrants - Projection of lines (First angle projection only) - Projection of lines parallel and inclined to one or both the planes.

UNIT 3 PROJECTION OF SOLIDS 9 Hrs.

Projection of simple solids like prisms, pyramids, cylinder, cone with its axis perpendicular to HP, axis perpendicular to VP, axis inclined to HP.

UNIT 4 SECTION OF SOLIDS 9 Hrs.

Purpose of sectioning - Sectional views - Hatching - Section plane perpendicular to one plane and parallel to other plane - Section plane inclined to HP - Section plane inclined to VP - True shape of the section.

UNIT 5 DEVELOPMENT OF SURFACES AND ORTHOGRAPHIC PROJECTION 9 Hrs.

Need for development of surfaces - Types of development of surfaces - Development of pentagonal and hexagonal prisms - Development of cylinders - Development of pentagonal and hexagonal pyramids - Development of cones. Orthographic Projection- Free hand sketch –conversion of 3D into 2D.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Identify the national standards related to the Engineering drawing based on BIS and construct conic sections and polygons.
CO2 - Draw orthographic projections of points, lines.
CO3 - Draw orthographic projections of solids
CO4 - Draw orthographic section of solids and improve the Students visualization skill to develop new products.
CO5 - Draw the development of surfaces and its applications in manufacturing industry.
CO6 - Draw the orthographic view of solids and learn to convert pictorial into orthographic projection.

TEXT / REFERENCE BOOKS

1. Engineering drawing practice for schools and colleges, SP 46 – 1988
2. Natarajan K.V., A Text Book of Engineering Graphics, Dhanalakshmi Publishers, 21st Edition, 2012.
3. Bhatt N.D., Engineering Drawing, Charotar Publishing House, 53rd Edition, 2014.
4. Venugopal K., Prabhu Raja V., Engineering Graphics, New Age International Publishers, 15th Edition, 2018.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SCHA1211	PRINCIPLES AND CALCULATIONS IN CHEMICAL ENGINEERING	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- 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.
- 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 INTRODUCTION TO CHEMICAL ENGINEERING 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. Unit operations, schematic representations of unit operations, Fermentation Process (Ethanol), Agrochemical (Urea), Pharmaceutical (Penicilin). Unit process- alkylation, aromatization, calcination, chlorination, Trans-esterification.

UNIT 2 INTRODUCTION TO PROCESS CALCULATIONS 9 Hrs.

Introduction to chemical engineering, concepts of units and conversion factors, fundamental and derived units, basic chemical calculations, mole, mass, molecular weight, introduction to dimensional analysis, dimensionless numbers, dimensional analysis.

UNIT 3 MATERIAL BALANCES WITHOUT CHEMICAL REACTIONS 9 Hrs.

Material balance without chemical reaction – Distillation, Evaporation, Crystallization, Absorption, Drying, membrane operations and Mixing.

UNIT 4 MATERIAL BALANCES WITH CHEMICAL REACTIONS 9 Hrs.

Material Balance with chemical reaction-limiting reactant, excess reactant, conversion and selectivity. Recycle, purge and bypass operations.

UNIT 5 ENERGY BALANCE AND COMBUSTION 9 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.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understanding the flow sheets of any process and symbols in unit operations and processes.
CO2 - Learn the basic definitions, units, unit systems
CO3 - Analyzing and converting the values from one-unit system to other unit system.
CO4 - Understanding the material balance calculations for with and without reaction.
CO5 - Understanding the energy balance calculations for various reactions.
CO6 - Material and Energy balance calculations for combined process equipments.

TEXT / REFERENCE BOOKS

1. Bhatt B.I., Shuchen B. Thakore, Stoichiometry, Tata McGraw Hill Education, 2010
2. David H.Himmelblau, Basic principles and calculations in chemical engineering, 8th Edition, Eastern Economy, 2011.
3. Anantharaman N., Meera Sheriffa Begum K.M., Mass Transfer Theory and Practice, 1st Edition, PHI, 2011.
4. 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: 100 **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 16 marks **80 Marks**

SPHA2101	PHYSICS LAB	L	T	P	Credits	Total Marks
		0	0	2	1	50

COURSE OBJECTIVES

- To introduce experiments in optics, semiconductors, magnetism, thermal physics and quantum mechanics in order to acquire the firsthand information and to realize the basic physics concepts.

LIST OF EXPERIMENTS (Any Eight experiments)

a. Semiconductors

1 Measurement of carrier concentration of semiconductors.-Four probe method
2 Determination of Hall coefficient -Hall Effect experiment-.
3 Determination of Energy gap of a semiconductor diodes
4 Study of I–V characteristics and variation of photocurrent voltage and intensity- by Photo Diode Characteristics.
5 Measurement of Resistivity of a semiconductor by 2-probe and 4-probe module.
6 Measurement of high resistance measurement by 2-probe module.

b. Optics

7 Measurement of wavelength of laser source using diffraction grating.
8 Measurement of fiber loss- Optical fiber
9 Diffraction Grating using spectrometer - Determination of Wavelength of Light.
10 Measurement of speed of light in water and glass medium – minimum deviation from a prism.

c. Magnetism

11 Hysteresis loop- Measurement of Hysteresis loss.
12 Magnetic susceptibility –Quinke's method

d. Thermal physics

13 Characterization of Thermocouple
14 Determination of Thermal conductivity of bad conductor-Lee's Disc method

e. Quantum Mechanics

14. Experimental Study of Photoelectric Effect.
15. Recording hydrogen atom spectrum.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Measure the band gap, electrical resistivity and carrier concentration of the given semiconductor.
CO2 - Find Hall coefficients of the given material.
CO3 - Analyse the I-V characteristics of the given photo diode.
CO4 - Determine the wavelength of the given laser light source
CO5 - Measure the Numerical aperture and the optical power loss of the given optical fiber.
CO6 - Measure the magnetic susceptibility of the given liquid sample and to identify dia, para/ferro magnetic liquid sample. To find the B-H loss from the hysteresis loop.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 50 **Exam Duration: 2 Hrs.**

CAE	Evaluation of Regular Lab class	**15 Marks**	**25 Marks**
	Model practical exam	**10 Marks**	
ESE	University Practical exam		**25 Marks**

SMEA2201	WORKSHOP PRACTICE	L	T	P	Credits	Total Marks
		0	0	4	2	100

COUSE OBJECTIVE

- To provide the students with hands on experience on different trades of engineering like Plumbing work, fitting, carpentry, Foundry, welding and sheet metal.

SUGGESTED LIST OF EXPERIMENTS

Plumbing Works

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

CARPENTRY

Handling of carpentry tools, A practice in marking, sawing planning and chiseling to size. Making simple joints such as half-lap, dove-tail and mortise and tenon joints.
Use of modern materials such as plywood, chip board, novapan, laminated sheet (Demonstration only)

FITTING

Use of fitting tools-practice in marketing, fitting to size and drilling-making of simple mating and profiles such as V, Square, Dove-tail, Half-round joints.

WELDING

i. Electric Arc Welding
   a) Study on Edge preparation techniques for Arc welding
   b) List of Welding Exercises
      1. Lap Joint 2. Butt Joint 3. Fillet Joint 4. Tee Joint 5. V Joint 6. Corner Joint
ii. Study on gas welding and gas cutting
iii. Study on TIG & MIG welding

FOUNDRY

i. Sand testing - Grain fineness - Permeability test.
ii. Study on Pattern Allowances
iii. Preparation of green sand moulding
   1. Flanges 2. Glands 3. Bush 4. Dumbbell
iv. Metal casting technique (Demonstration only)

SHEET METAL

Tools and equipment– practice.
Making rectangular tray, hopper, scoop, etc.
Mini project - Fabrication of a small cabinet, dust bin, etc.

SMTA1303	ENGINEERING MATHEMATICS - III (Common to Biotechnology and Biomedical)	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- 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 EQUATION 9 Hrs.

Formation of ODE – Solution of first order exact equations – Solution of second order linear differential equations with constant coefficients – Particular integrals for e^{ax}, sinax, cosax, x^n, $x^n e^{ax}$, e^{ax} sinbx, e^{ax} cosbx.

UNIT 2 PARTIAL DIFFERENTIAL EQUATION 9 Hrs.

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

UNIT 3 NUMERICAL MEHODS FOR SOLVING EQUATIONS AND INTERPOLATION 9 Hrs.

Numerical solution of Algebraic and Transcendental equations – Newton Raphson method – Numerical solution of a system of linear equations – Gauss Jordan method, Crout's Method, Gauss Seidel method – Interpolation – Newton's Method, Lagrange's Method.

UNIT 4 NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9 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 9 Hrs.

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

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Form ordinary and partial differential equations
CO2 - Illustrate the solution of first order exact equations
CO3 - Apply the concept of the numerical solutions to algebraic and transcendental equations.
CO4 - Categorize and implement the various numerical methods for Interpolation
CO5 - Appraise the solution of ordinary and partial differential equations by choosing the most suitable numerical method
CO6 - Produce the solution of ordinary and partial differential equations

TEXT / REFERENCE BOOKS

1. Kreyszig E., Advanced Engineering Mathematics, 8th Edition, John Wiley & Sons, Singapore, 2001.
2. Grewal B.S., Higher Engineering Mathematics, 35th Edition, Khanna Publishers, Delhi, 2000.
3. Veerarajan T., Engineering Mathematics, Tata McGraw Hill Publishing Co., New Delhi, 2005.
4. Kandasamy P., Thilagavathy K., Engineering Mathematics, Volumes II & III, 4th Revised Edition, S. Chand & Co., New Delhi, 2001.
5. Kandasamy P., Thilagavathy, K. and Gunavathy K., Applied Numerical Methods, S.Chand & Co., New Delhi, 2003.
6. Steven C.Chapra, Raymond P. Canale, Numerical Methods for Engineers, Tata McGraw Hill Publishing Co., New Delhi, 2003.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SBTA1301	MOLECULAR BIOLOGY AND GENETICS	L	T	P	Credit	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- The course aims to give an understanding on the fundamentals of conventional genetics and the intricate molecular mechanisms of heredity and variations.
- To understand storage of genetic information and its translation at molecular level in prokaryotic and eukaryotic systems.

UNIT 1 CLASSICAL GENETICS 9 Hrs.

Fundamental principles of genetics- Mendel's principles and experiments, gene interaction, multiple alleles, complementation, linkage, sex linked, sex limited and sex influenced inheritance; Chromosomes basis of heredity- extra-chromosomal inheritance; Linkage and crossing over; Hardy-Weinberg equilibrium, Extensions of Hardy- Weinberg equilibrium.

UNIT 2 STRUCTURE AND PROPERTIES OF NUCLEIC ACIDS 9 Hrs.

Introduction to nucleic acids: Evidence for DNA&RNA as a genetic material; Structure and physicochemical properties of elements in DNA and RNA, Biological significance of differences in DNA and RNA. Primary structure of DNA: Chemical and structural qualities of 3',5'-Phosphodiester bond. Secondary Structure of DNA: Watson & Crick model, Chargaff's rule; DNA replication- Overview of differences in prokaryotic and eukaryotic DNA replication, D-loop and rolling circle mode of replication, Telomere replication in eukaryotes; Okazaki fragments, Fidelity of DNA replication, Inhibitors of DNA replication, DNA repair- Mutagens, DNA mutations and various types of repair mechanisms.

UNIT 3 TRANSCRIPTION 9 Hrs.

Central Dogma in molecular biology -Structure and function of mRNA, rRNA tRNA and micro RNAs. Characteristics of promoter and enhancer sequences. RNA synthesis: Initiation, elongation and termination of RNA synthesis, Proteins of RNA synthesis, Fidelity of RNA synthesis, Inhibitors of transcription, Differences in prokaryotic and eukaryotic transcription. Basic concepts in RNA world: RNA processing: 5'-Capping, Splicing-Alternative splicing, Poly 'A' tail addition and base modification.

UNIT 4 TRANSLATION 9 Hrs.

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

UNIT 5 REGULATION OF GENE EXPRESSION 9 Hrs.

Organization of genes in prokaryotic and eukaryotic chromosomes- operon concept; Gene expression and regulation- Hierarchical levels of gene regulation, Prokaryotic gene regulation –lac and trp operon, Eukaryotic gene regulation- gene silencing.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Explain the foundations of Mendelian genetics and chromosomal theory and apply these, with appropriate terminology, to contemporary concepts in genetics.
CO2 - Emphasize the molecular mechanism of DNA replication and repair in various organisms
CO3 - Explain the properties of genetic materials and storage and processing of genetic information.
CO4 - Analyze the processes of transcription and translation in both prokaryotes and eukaryotes at molecular level.
CO5 - Understand the redundant and universal qualities of the genetic code and how it is used to determine the amino acid sequence of a polypeptide.
CO6 - Compare the mechanisms of gene regulation in prokaryotes and eukaryotes.

TEXT / REFERENCE BOOKS

1. Lewin B., Genes XI, International Edition, Jocelyn Krebs, Stephen Kilpatrick and Elliott Goldstein, Jones & Bartlett Learning, 2017, ISBN 978-1-4496-5985-1
2. Tropp, Burton E., Molecular Biology: Genes to Proteins, 3rd Edition, Jones and Bartlett, 2008.
3. Glick B.R. and Pasternak J.J., Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition. ASM, 2010.
4. Weaver, Robert F., Molecular Biology, 2nd Edition, Tata McGraw Hill, 2003.
5. Karp, Gerald, Cell and Molecular Biology: Concepts and Experiments, 4th Edition, John Wiley, 2005.

6. De Robertis E.D.P. and De Robertis, E.M.F., Cell and Molecular Biology. 8th Edition, Lippincott Williams and Wilkins, Philadelphia, 2006.
7. Watson J.D., Baker T.A., Bell S.P., Gann A., Levine M. and Losick R., Molecular Biology of the Gene, 6th Edition, Cold Spring Harbour Lab. Press, Pearson Publication, 2008.
8. Primrose S.B. and Twyman R.M., Principles of Gene Manipulation and Genomics, Blackwell Publishing, 7th Edition, 2006, ISBN 1-4051-3544-1
9. Gardner E.J., Simmons M.J. and Snustad D.P., Principles of Genetics, 8th Edition, John Wiley & Sons, Singapore, 2003.
10. Strickberger M.W., Genetics, 3rd Edition, Prentice Hall of India, New Delhi, 2008.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SBTA1302	BIOCHEMISTRY AND BIOMOLECULES	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To emphasize the role of Biochemistry in cellular organization
- To enable the ability to understand chemical aspects of biomolecules
- To equip with the knowledge on structure, classification and function of carbohydrates, lipids, proteins, nucleic acids, vitamins and minerals
- To identify the biochemical interactions and properties of biomolecules
- To expose the biological significance of biomolecules

UNIT 1 CHEMISTRY OF BIOMOLECULES 9 Hrs.

Biomolecules: Hierarchy of the molecular organization of cells, Chemistry and Properties of Amino Acids, Proteins, Carbohydrates, Lipids, Purines, Pyrimidines and Vitamins. Chemical Bonds: Covalent Bonds, Ionic Bonds, Co- Ordinate Bonds, Hydrogen Bonds, Vander Waal Forces, Hydrophobic Interactions, Diode Interactions.

UNIT 2 CARBOHYDRATES 9 Hrs.

Chemistry of Carbohydrates: Definition, classification, structure and chemical properties of: Monosaccarides; Sucrose, Lactose, Maltose; Glucosamine, Muramic Acid; Starch, Glycogen, Cellulose, Chitin, Agar, Proteoglycans; Sialic acids and blood group polysaccharides. Stereochemistry of Carbohydrates: Projection formula (Fischer, flying-wedge, Sawhorse, Newman & Howarth), Configuration, conformation, Optical isomerism (d/l, D/L and R/S nomenclature), Anomer, Epimer, Mutarotation.

UNIT 3 LIPIDS 9 Hrs.

Chemistry of Lipids: Definition, classification. Structure, Reactions and characterization of: fatty acids, Triacyl glycerols. Structure of Prostaglandins, Oil, Wax. Geometrical isomerism (cis/trans, syn/anti, E/Z) of Fatty acids. Hydrolysis, saponification value, iodine number, rancidity and Biological significance of fats. Phospholipids: Introduction and importance. Glycerophospholipids, lecithins, cephalins, phosphatidyl serine, phosphatidyl inositol, plasmalogens, sphingomyelines. Glycolipids: cerbrosides, gangliosides. Steroids and carotenoids: Introduction, and importance, cholesterol, modifications of sterols, bile acids, steroid hormones, carotenes.

UNIT 4 PROTEINS AND NUCLEIC ACIDS 9 Hrs.

Chemistry of Amino Acids, Proteins and Nucleic acids: 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. Nucleic Acids: Nitrogeneous bases - Purines and Pyrimidines - Nucleoside, Nucleotides. - Structure of nucleic acids - DNA, RNA: m-RNA, t-RNA, r-RNA - Biological importance of nucleic acids.

UNIT 5 VITAMINS AND MINERALS 9 Hrs.

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

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Analyze the basic units of living organisms and how the simple precursors give rise to large biomolecules such as proteins, carbohydrates, lipids, nucleic acids.
CO2 - Distinguish the various types of weak interactions between the biomolecules.
CO3 - Illustrate Structure, function and classification of biomolecules such as carbohydrates, proteins
CO4 - Describe the Structure, function and classification of biomolecules such as lipids and nucleoproteins.
CO5 - Summarize the structure, function and classification of biomolecules such as Vitamins and Minerals
CO6 - Understand the role of biomolecules for orderly structures of the cells/tissues.

TEXT / REFERENCE BOOKS

1. Stryer L., Biochemistry, W.H. Freeman and Company, New York, 2006.
2. Lehninger A.L., Principles of Biochemistry, Worth Publishers, New York, 2007.
3. Hames B.D. et al., Instant Notes in Biochemistry, BIOS Sci. Pub. Ltd. U.K., 2001.
4. Zubay, Biochemistry, W.C. Brown Publishers, Oxford, England, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SBTA1303	PROTEIN ENGINEERING AND BIOINFORMATICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To understand the protein structure and its applications in bioinfomatics

UNIT 1 PROTEIN STRUCTURE **9 Hrs.**

Hierarchical representation of proteins, structural classification of proteins, protein folding pathways and protein stability

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 DATABASES AND SEQUENCE ANALYSIS **9 Hrs.**

Databases for protein sequence and structure, Protein sequence analysis: sequence alignment, programs for sequence alignment, amino acid properties for sequence analysis

UNIT 4 PROTEIN STRUCTURE PREDICTION **9 Hrs.**

Overview on protein structure analysis**,** Secondary structure prediction-tools used, 3D Structure prediction-Homology modelling, threading and Ab initio methods

UNIT 5 PROTEIN ENGINEERING AND APPLICATIONS **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. Biotechnological and Biomedical Applications: Industrial, Environmental and Biomaterial applications, Applications in Nanotechnology, Biosensors, virus engineering, Engineered proteins and scaffold proteins as therapeutics

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Analyse and compare the amino acid sequence and structure of proteins, and relate this information to the function of proteins
CO2 - Understand and differentiate several biophysical techniques used for characterisation of protein structure
CO3 - Understanding protein databases that are storehouse to the latest information in protein research
CO4 - Analyse the protein sequence for their structural properties
CO5 - Use appropriate tools to predict the structure of proteins
CO6 - Appraise different protein design strategies used to design completely new proteins tailored to specific tasks

TEXT / REFERENCE BOOKS

1. Michael Gromiha M. Protein Bioinformatics: From sequence to Function, 1st Edition, Elsevier, 2010.
2. Krishna Mohan Poluri and Khushboo Gulati, Protein Engineering Techniques: Gateways to Synthetic Protein Universe, Springer, 2016
3. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press, 2002.
4. Paul R. Carey, Protein engineering and design, Academic Press, 1996.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SBTA1304	ENVIRONMENTAL BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To study about the ecology, pollution and control

UNIT 1 INTRODUCTION TO ECOLOGY 9 Hrs.,

Historical perspective, Our Environment: Atmosphere; Hydrosphere; Lithosphere; Scope of Ecology; Development and Evolution of Ecosystem; Principles and concepts of ecosystem; Structure of ecosystem; Strata of an ecosystem; Types of ecosystem; Cybernetics and Homeostasis; Biological control of chemical environment; Energy transfer in an ecosystem; Food chain, food web; Energy budget; Production and decomposition in a system; Ecological efficiencies; Trophic structure and energy pyramids; Principles pertaining to limiting factors; Biogeochemical cycles (N, C, P cycles)

UNIT 2 MICROBES AND ENVIRONMENT 9 Hrs.

Role of microorganisms in natural system and artificial system; Influence of Microbes on the Earth's Environment and Inhabitants; Ecological impacts of microbes; Symbiosis (Nitrogen fixation and ruminant symbiosis); Microbes and Nutrient cycles(Biogeochemical cycles (N, C, P cycles); Microbial communication system; Quorum sensing; Microbial fuel cells; Prebiotics and Probiotics

UNIT 3 ENVIRONMENTAL CHEMISTRY & POLLUTION 9 Hrs.

Water and water quality parameters Origin and effect of waste water on aquatic environment. Industrial water pollution ; Chemistry of waste water-DO,BOD,COD,TOC Chemistry of air and air pollutants; Sources; Sinks; Classification and effects of air pollutants on living and non-living things; Chemistry of soil: Formation; Constituents and properties of soils; Composition of types of soil; Chemical factors affecting the soil quality; Adsorption of contaminants in soil. Industrial waste; Urban waste; Chemical and metallic pollutants; Radioactive waste; Trace heavy metals; Pesticides; Fertilizers effect of modern agro-technology on quality of soil

UNIT 4 POLLUTION CONTROL & BIOPRODUCTS 9 Hrs.

Air Pollution Treatment**:** Treatment technologies, Biofilters and Bioscrubbers for treatment of industrial waste. 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. Composting- types, systems, quality- vermicomposting. Biofertilizers – Biopesticides - Biofuel production - Bioethanol – Biohydrogen and Biodiesel

UNIT 5 BIOREMEDIATION & BIODEGRADATION 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. Aerobic and Anaerobic degradation of recalcitrants - aliphatic, aromatic polyaromatic - hydrocarbons.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Bring about an insight on the basic concepts of ecology
CO2 - Describe the role of microbes in the environment
CO3 - Outline the Source and effect of pollutants in the environment
CO4 - Present an overview of important environmental technologies involved in treatment of pollutants and resource recovery.
CO5 - Explain the different bioremediation processes
CO6 - Insight into the mechanism of degradation of organic pollutants

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.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SCHA1311	HEAT AND MASS TRANSFER FOR BIOLOGICAL SYSTEMS	L	T	P	Credits	Total Marks
		3	*	0	3	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 PRINCIPLES OF MASS TRANSFER **9 Hrs.**

Introduction to Mass transfer and diffusion, Ficks law for molecular diffusion, Molecular diffusion in gases, Molecular diffusion in liquid, Molecular diffusion in solids, Miolecular diffusion in biological solutions and gels. Introduction to convective mass transfer, Convective mass transfer coefficients. Analogy between Mass, Heat and momentum transfer.

UNIT 2 BASIC SEPARATION PROCESSES – 1 **9 Hrs.**

Introduction to separation processes, Distillation, Types of distillation – Simple, Steam, Vacuum, Continuous distillation, absorption-packed and plate columns, Adsorption-chemisorption, physical adsorption, isotherms, membrane separation process – Electrodialysis, Reverse osmosis, Ion exchange, Extraction – Batch and Continuous operations.

UNIT 3 BASIC SEPARATION PROCESSES – 2 **9 Hrs.**

Drying, -Tray dryer, Vacuum dryers, rotary dryers, drum and spray dryers. Equilibrium moisture content of materials. Bound and unbound moisture. Free and equilibrium moisture, Rate of Drying curves, Freeze drying and Sterilization of Biological materials, Crystallization - theory, Equipments for crystallization, Tank, DTB Crystalliser, circulating –magma vacuum crystallizer, Swenson walker crystalliser.

UNIT 4 PRINCIPLES OF HEAT TRANSFER **9 Hrs.**

Introduction to various modes of heat transfer, Conduction- Fourier's law of heat conduction, thermal conductivity, Conduction through liquids. Convection, individual and overall heat transfer coefficient, LMTD, radiation.

UNIT 5 HEAT TRANSFER OPERATIONS **9 Hrs.**

Evaporators- natural circulation, forced-circulation and agitated-film evaporators. Methods of operation of evaporators-single-effect and multiple-effect evaporators, Evaporation of Biological materials- fruit juices, sugar solution and paper-pulp waste liquors.

Heat Exchangers - Flow patterns in Heat Exchangers, Types - Double pipe exchanger, shell-and-tube exchanger, condensers, kettle-type reboilers.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the convective mass transfer
CO2 - Understanding the principles and Operation of various separation processes
CO3 - Student will understand the mechanism of crystallization and drying
CO4 - Students will learn about the basis of heat transfer
CO5 - Operation of evaporators and design of evaporators will be clearly understood
CO6 - Operation and design of heat exchangers will be clearly understood.

TEXT / REFERENCE BOOKS

1. Treybal R.E., Mass Transfer Operations, 3rd Edition, McGraw Hill, 2009.
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. Anantharaman N., MeeraSheriffa Begum K.M., Mass Transfer Theory and Practice, 1st Edition, PHI, 2011.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SBTA2301	BIOCHEMISTRY AND BIOMOLECULES LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVE

- To understand biochemical methods in analyzing biomolecules.

SUGGESTEDLIST OF EXPERIMENTS

1. pH measurements and preparation of buffers.
2. Qualitative tests for Carbohydrates.
3. Estimation of sugars.
4. Estimation of proteins by Lowry's method / Biuret method.
5. Estimation of cholesterol by Zak's method.
6. Determination of saponification number of lipids.
7. Separation of amino acids - Thin layer chromatography.
8. Separation of sugars - Paper chromatography
9. Biochemical estimation of DNA using Spectrophotometer
10. Measurement of enzyme activity: alpha-amylase,
11. Biological Preparations: Isolation of casein, and starch

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Identify biomolecules in various sources
CO2 - Compare different biomolecules by analytical methods
CO3 - To interpret the levels of biomolecules in biological systems
CO4 - Infer the nature of biomolecules by analytical methods
CO5 - Integrate various analytical techniques to analyze biomolecules
CO6 - Understand the influence of biomolecules in biological sources

SBTA2302	MOLECULAR BIOLOGY AND GENETICS LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- The experiments provide hands-on experience in performing basic molecular biology techniques thereby developing skill in performing molecular biology experiments.
- It also helps the students to understand the theory behind in each technique and to describe common applications of each methodology in biological research.
- This will facilitate the students to take up specialized project in Molecular biology and will be a pre-requisite for research work.

SUGGESTED LIST OF EXPERIMENTS

I. Isolation of nucleic acids

1. Isolation of Plasmid DNA
2. Isolation of Plant Genomic DNA
3. Isolation of bacterial genomic DNA.
4. Isolation of RNA

II. Analysis, separation and staining of Nucleic acids

1. Estimation of DNA content in the given sample by spectrophotometer
2. Estimation of RNA content in the given sample by spectrophotometer
3. Determination of Tm of DNA.
4. Agarose gel electrophoresis
5. Poly acrylamide gel electrophoresis
6. Staining of DNA with ethidium bromide

III. Study of chromosomes

1. Isolation of polytene chromosome in Drosophila / lamp brush chromosomes from salivary glands of insects.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Demonstrate knowledge and understanding of the principles underpinning important techniques in molecular biology.
CO2 - Demonstrate knowledge and understanding of applications of these techniques.
CO3 - Demonstrate the ability to carry out laboratory experiments and interpret the results.
CO4 - Develop skill in handling macromolecules using micropipettes
CO5 - Students will be aware of the hazardous chemicals and safety precautions in case of emergency

TRXT / REFERENCE BOOKS

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

SBTA1401	ENZYME TECHNOLOGY	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVE

- To understand the working of different enzymes and applying the functions in industrial biotechnology

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. Turnover number, Enzyme inhibition -Types of enzyme inhibition, competitive inhibition, uncompetitive inhibition, non-competitive inhibition, Irreversible inhibition and inactivation kinetics. Multi substrate enzyme catalysed reaction.

UNIT 3 ENZYME IMMOBILIZATION **9 Hrs.**

Classification 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 AND EXTRACTION **9 Hrs.**

Types of specificity, Active site- Fischer hypothesis and Koshland hypothesis, Extraction of soluble enzymes, membrane bound enzymes, purification procedures, criteria of purity.

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

Application of enzymes in medicine and industry – Assay of plasma enzyme, enzyme biosensors, design of enzyme electrodes, Synzymes, Abzymes, Enzymes in genetic engineering.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - The knowledge on enzyme and enzyme reactions will be the helpful to understand various concepts in biotechnology.
CO2 - Enzyme kinetics will give inputs to use enzyme in research and industry.
CO3 - Methods of enzyme immobilization help in food, pharmaceutical and chemical industries to innovate a useful product to society.
CO4 - Concepts on Isolation, Purification and characterization of enzymes will be helpful to work technologically.
CO5 - Application of enzymes in industry.
CO6 - Identify novel applications of enzymes in bioengineering.

TEXT / REFERENCE BOOKS

1. Palmer, Enzyme, Horwood Publishing Series, 2001.
2. Price and Stevens, Fundamental of Enzymology, Oxford University Press, 2002.
1. Prasad N.K., Enzyme Technology: Pacemaker of Biotechnology Paperback, 2011.
2. Khan M.Y. and Farha Khan, Principles of Enzyme Technology, 2015.
3. Helmut Uhling, Enzyme technology, John Wiley, 1998.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SBTA1402	IMMUNOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	*	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.

UNIT 1 INTRODUCTION TO IMMUNOLOGY AND IMMUNE SYSTEM 9 Hrs.

History and Scope of Immunology, Hematopoiesis, Innate and Acquired Immunity; Cells of the immune system, Primary and Secondary lymphoid organs. Maturation, structure, activation and differentiation of T and B cells.

UNIT 2 HUMORAL IMMUNITY 11 Hrs.

Antigens: Characteristics and Types of Antigens, Factors affecting the immunogenicity, Haptens, Antigenic Determinants, Adjuvants, Immunoglobulins: Basic structures, classes and sub classes; Molecular Biology of Immunoglubulin synthesis, Antigenic determinants on Immunoglobulins. Monoclonal antibodies. Complement system **-** Alternate, Classical and Lectin pathways.

UNIT 3 CELL MEDIATED IMMUNITY 7 Hrs.

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

UNIT 4 IMMUNOTECHNIQUES 9 Hrs.

Nature of Antigen Antibody Interactions, Precipitation reactions, Agglutination reactions - Immunofluorenscence, Immunoelectroscopy, RIA, ELISA. Detection of bacterial endotoxins using immunological methods (LAL Test), Western Blot

UNIT 5 IMMUNOLOGICAL DISORDERS 9 Hrs.

Hyper-sensitivity, Autoimmunity, Immunological Tolerance, Immunodeficiency diseases: Primary and secondary diseases, Transplantation immunology, Tumor immunology.

Max.45 Hrs.

COURSE OUTCOMES

On completion of course, student will able to

CO1 - Understand overall concept of immune system.
CO2 - Acquire knowledge about different cells and organs involved in immune system.
CO3 - Recognize effectors molecules fight against infectious diseases.
CO4 - Demonstrate to produce monoclonal antibodies to diagnose and treat infectious diseases.
CO5 - Apply suitable knowledge to develop acquired immunity to maintain health.
CO6 - Implement immunotechniques to diagnose infectious diseases.

TEXT / REFERENCE BOOKS

1. Rao C.V., Text Book of Immunology, 2008.
2. Sunil Kumar Mohanty, K. Sai Leela, Text Book of Immunology, 2014.
3. Richard A.Goldsby, Thomas J. Kindt, Barsara A. Osborne, Janis Kuby, Immunology, 5th Edition, WH Freeman & Company, 1991.
4. Ivan M. Roitt, Brostoff J. and Male D., Essential Immunology, 6th Edition, Mosby Harcourt Publishers, 2001.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SCHA1411	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. Methods to determine order of a reaction- Integral & differential method of analysis of data, Half-life method & Ostwald's isolation method.

UNIT 2 IDEAL REACTORS **9 Hrs.**

Introduction to Batch reactor, semi batch reactor, Plug flow reactor, Mixed flow reactor, Packed bed reactor, Concept of ideal flow, space time and velocity, performance or design equations for batch reactor, Plug flow reactor, Mixed Flow reactor.

UNIT 3 DESIGN OF MULTIPLE REACTOR SYSTEMS **9 Hrs.**

Mixed flow reactors in series and parallel connection, Plug flow reactors in series and parallel connection, reactors of different types in series, size comparison of reactors using performance charts.

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 CATALYSIS **9 Hrs.**

Introduction to catalysis, catalytic reactions, promoters, poisons, preparation of catalyst, Physical properties of catalyst: Surface area (BET isotherm), Pore volume distribution; Steps in a catalytic reaction, rate of catalytic reaction (adsorption, surface reaction and desorption as rate limiting steps).

Max.45 Hrs.

COURSE OUTCOMES

CO1 - Develop rate laws for homogeneous reactions
CO2 - Design of ideal reactors for single and complex reactions
CO3 - Develop skills to choose the right reactor among single, multiple, recycle reactor, etc. schemes.
CO4 - Predict and design the conversion in a non-ideal reactor using tracer information
CO5 - Design reactors for fluid-solid reactions
CO6 - Understanding the principles of catalytic reactions.

TEXT / REFERENCE BOOKS

1. Levenspiel O., Chemical Reaction Engineering, 3rd Edition, John Wiley and Sons, 2006.
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. Gavhane K.A., Chemical Reaction Engineering – I &II, 5th Edition, Nirali Prakashan Publishers, 2009.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SAIC4001	INDUSTRY 4.0	L	T	P	Credits	Total Marks
		2	-	2	2	100

UNIT 1 ADVANCED TECHNOLOGY AND ADVANCED MATERIALS 7 Hrs.

Advanced electro-optical sensing technology-active, passive multi-spectral and hyper spectral imaging; electronic beam steering; vacuum technology, surface and coating technology, health care technology, Nanotechnology- Nanomechanics, Nano optoelectronics; energy storage technology-next generation Li-based Batteries, Hydrogen storage, solar photovoltaic's, Flexible electronics. Intellectual Property Rights - case studies governing/pertaining to Materials/Technology.

UNIT 2 TRANSFORMING TECHNOLOGIES IN BIOENGINEERING 7 Hrs.

Establishment of smart biotechnology factory, Artificial intelligence in Bioprocess technology, Omics – Big data analysis through automation, 3D bio printing for tissue engineering. Simulation tools, RSM and Box model. Cyber physical system based telemedicine, diagnosis and therapeutics through real time biosensors. Bionanotechnology. Intellectual Property rights (IPR): Case Studies.

UNIT 3 ADVANCEMENTS IN SUSTAINABLE BUILT ENVIRONMENT 7 Hrs.

Introduction – Technological developments in Architectural, Engineering and Construction (AEC) - Building Information Modelling (BIM) using Cloud computing technology and Internet of things (IoT) – Unmanned Aerial Vehicles, sensors – Additive manufacturing in construction – Concrete 3D printing - Materials used - Lightweight and functionally graded structures - Net Zero Energy buildings, Bioswales, Biofiltration pond, Ecosan systems- Recent developments in Waste water Management, Air pollution control, waste disposal - Integration of energy, water and environmental systems for a sustainable development- Emerging Technologies: Robot Highway- Vertical farming - Intellectual Property rights: Case studies

UNIT 4 SMART MANUFACTURING 8 Hrs.

Smart factories and interconnection, Smart Manufacturing – automation systems, Additive Manufacturing, Smart grids, Micro Electro Mechanical Systems (MEMS), Stealth technology, Metal Finishing, Self-propelled vehicles, e mobility, Green fuels, drones – unmanned aerial vehicles(UAVs), aerodynamics. Robotic Automation and Collaborative Robots – Augmented reality and haptics, engineering cybernetics and artificial intelligence (AI), Disruptive Technologies – Frugal Innovations – Emerging Technologies - Autonomous Robots, Swam Robot, Modular Robotics, Space craft, Intellectual Property Rights (IPR): Case Studies.

UNIT 5 SMART WORLD 8 Hrs.

Smart Sensors and IIOT, Smart grid, Hybrid renewable energy systems, Electronics in Smart city, Integration of Sensors in Robots and Artificial Intelligence, 5G Technology, Communication protocols, Human-Machine Interaction, Virtual Reality, Quantum Computing: Changing trends in transistor technology: Processor, Emerging Trends: Deep Space, Swarm Robots, Cyborg, Geofencing, Pervasive Computing, Intellectual Property Rights- Case Studies.

UNIT 6 CYBER PHYSICAL SYSTEMS 8 Hrs.

troduction to Cyber Physical Systems (CPS), Architecture of CPS, Data science and technology for CPS, Prototypes of CPS, Emerging applications in CPS including social space, crowd sourcing, healthcare and human computer interactions, Industrial Artificial Intelligence, Deep Learning, Gamification, Networking systems for CPS applications, Wearable cyber physical systems and applications, Domain applications of CPS: Agriculture, Infrastructure, Disaster management, Energy, Transportation, Intellectual Property Rights (IPR) : CaseStudies.

Max. 45 Hrs.

TEXT / REFERENCE BOOKS

1. William D. Callister, Materials Science and Engineering: An Introduction, John Willey and Sons Inc. Singapore, 2001.
2. Raghavan V., Physical Metallurgy: Principle and Practice, Prentice Hall India Pvt. Ltd., 2006.
3. Flavio Craveiro, Jose Pinto Duarte, Helena Bartolo and Paulo Jorge Bartolo, "Additive manufacturing as an enabling technology for digital construction: A perspective on Construction 4.0", Automation in Construction, Vol. 103, 2019.
3. Klaus Schwab, Fourth Industrial Revolution, Random House USA Inc., New York, USA, 2017.
4. Oliver Grunow, "SMART FACTORY AND INDUSTRY 4.0. The current state of Application Technologies", Studylab Publications, 2016.
5. Alasdair Gilchrist, "INDUSTRY 4.0: Industrial Internet of Things", Apress, 2016.
6. Sang C.Suh, U.John Tanik, John N Carbone, Abdullah Eroglu, "Applied Cyber-Physical Systems", Springer Publications, New York, 2013

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 11 Questions of 2 marks each-No choice **22 Marks**

PART B: 2 Questions from each unit with internal choice, each carrying 13 marks **78 Marks**

SBTA2401	ENZYMOLOGY LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVE

- To understand the role of enzymes in living systems and industry.

SUGGESTED LIST OF EXPERIMENTS

1. Standard Maltose Curve
2. Isolation of Alpha/Beta Amylase
3. Determination of enzyme activity
4. Construction of Protein standard curve by Folin's Lowry method and Determination of specific activity of enzyme.
5. Effect of substrate concentration on Enzyme kinetics and determination of K_m and V_{max}
6. Effect of temperature on Enzyme kinetics
7. Effect of enzyme concentration on Enzyme kinetics
8. Effect of pH on Enzyme kinetics

COURSE OUTCOMES

On completion of course, student will able to

CO1 - Define the role of enzymes in biological systems
CO2 - Generalize the use of enzymes in various industrial applications
CO3 - Interpret the role of enzyme in catalyzing reactions
CO4 - Chart the activity of enzymes and thereby understand its role
CO5 - Speculate the role of enzyme in different reactions
CO6 - Validate the use of enzymes in various biotechnological process.

SBTA2402	IMMUNOLOGY LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVE

- To provide knowledge on various antigen antibody interactions

SUGGESTED LIST OF EXPERIMENTS

1. ABO blood grouping
2. Identify and differentiate immune cells –Mast cell, lymphocytes, neutrophils, eosinophils, basophiles
3. Cell counting – RBC and WBC
4. Agglutination Test
    a. CRP
    b. RPR
    c. Widal Test
        i. Slide test
        ii. Tube test
    d. Pregnancy Test
5. Precipitation Test
    a. Radial Immunodiffusion (SRID)
    b. Ouchterlony Double diffusion (ODD)
        i. Antibody titration
        ii. Antigen – Antibody Pattern
    c. Rocket Immunoelectrophoresis
6. ELISA

COURSE OUTCOMES

On completion of course, student will able to

CO1 - Understand the basic principles of blood grouping.
CO2 - Understand the precipitation reactions
CO3 - Understand the agglutination reactions
CO4 - Carry out the suitable serological techniques for the diagnosis of diseases
CO5 - Determine the immunoprecipitation reactions based suitable immunodiffusion
CO6 - Apply immunosorbent assay for diagnosis of diseases

SBTA1501	GENETIC ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- Genetic Engineering course explores the manipulation of DNA using various tools and methods for its diverse application in the field of industry, medicine, plant and animal Biotechnology.

UNIT 1 MOLECULAR TOOLS IN GENETIC ENGINEERING 9 Hrs.

History, milestones and recent developments in Genetic Engineering; Steps involved in rDNA technology. DNA manipulative enzymes -Restriction enzymes: Endo & Exonucleases. Modifying enzymes- DNA & RNA polymerase, reverse transcriptase, terminal transferase; nucleases (DNases, RNases, S1) T4 polynucleotide kinase, Alkaline Phosphatase and ligase (E.coli & T4). Ligation (cohesive & blunt end ligation) – linkers, adaptor & homopolymer tailing.

UNIT 2 CLONING VECTORS 9 Hrs.

Ideal properties of a cloning vector. Plasmid vectors -pBR322 and its derivatives, phage vectors (λ & M13), Cosmid vectors, Shuttle and expression vectors; Yeast vectors-YAC & BAC (E.coli); Gene transfer methods.

UNIT 3 CLONING STRATEGIES 9 Hrs.

Screening and selection of recombinants; Hybridization methods-Southern, Northern, Western; Construction of genomic & c DNA libraries. Expression in bacteria, yeast, insects, plant & mammalian cells.

UNIT 4 TECHNIQUES IN GENETIC ENGINEERING 9 Hrs.

DNA sequencing – Maxam Gilbert & Sanger's, Nicolson sequencing methods, Pyrosequencing. PCR - Principle, types and applications; Site directed mutagenesis. Gene mapping-definition and types. Restriction mapping, FISH. Molecular markers used for gene mapping .PCR based and Hybridization based methods- RFLP, AFLP, VNTR, STS.

UNIT 5 APPLICATIONS OF GENETIC ENGINEERING 9 Hrs.

Strategies in plant and animal genetic engineering. Application of Genetically modified organisms; hazards and ethics associated with use of GMO. Production of recombinant proteins. DNA vaccines. Chromosomes engineering, targeted gene replacement, gene editing, gene silencing. Gene therapy, Human Genome Project.

Max.45 Hrs.

COURSE OUTCOMES

On completion of course, student will able to

CO1 - Explain the steps involved in rDNA technology
CO2 - Prioritize a specific cloning vector for cloning in prokaryotes and eukaryotes.
CO3 - Express specific model organisms used for recombinant protein production
CO4 - Consider the efficiency of PCR based cloning in comparison to traditional cloning strategies.
CO5 - Show the prospects of gene editing
CO6 - Evaluate the hazard and impact of genetically modified organisms

TEXT / REFERENCE BOOKS

1. Primrose, S.B. and Twyman, R.M., 2006. Principles of Gene Manipulation and Genomics - 7th Edition. Blackwell Publishing Company.
2. Dubey R.C., A Text Book of Biotechnology. S. Chand & Co Ltd, New Delhi.
3. Brown T.A., Genomes. 3rd Edition. New York: Garland Publishing Co. New York: Garland Science, 2008..
4. Satyanarayana U., Biotechnology, Books and Allied (P) Ltd., 2008.
5. Channarayappa, 2007, Molecular Biotechnology: Principle and Practices. CRC Press.

REFERENCE BOOKS:

1. Tropp, Burton E. "Molecular Biology: Genes to Proteins". 3rd Edition. Jones and Bartlett, 2008.
2. Benjamin Lewin. Gene VII. Oxford University Press, Nelson Cox.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SBTA1502	BIOPROCESS ENGINEERING	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To develop skills of the students in design operation, medium design, fermentation process and metabolic stoichiometry.
- To understand the modern industrial biotechnological process, sterilization and growth kinetics of microorganisms.

UNIT 1 CONCEPTS OF BIOPROCESS **9 Hrs.**

Historical of bioprocess technology, concept of Bioprocess, Fermentation process-types, fermentor, basic parameters of fermentation process. Basic outline of upstream and downstream process. 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 STERILIZATION KINETICS **9 Hrs.**

Medium-simple and complex media, medium requirement for fermentation process ,formulation of good medium and its optimization methods. 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 Hrs.

COURSE OUTCOMES

On completion of course, student will able to

CO1 - Summarize the overall bioprocess technology and demonstrate the upstream and downstream process
CO2 - Design of fermenter and fermentation media for the production of metabolites
CO3 - Integrate Concepts and knowledge from various sterilization methods
CO4 - Analyze the stoichiometry cell growth and evaluate Monod kinetics parameter
CO5 - Evaluate an appropriate technique for novel downstream processing and its applications.
CO6 - Determine the microbial growth rate by structure and unstructure models

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: 100 **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 16 marks **80 Marks**

SBTA1503	NANOBIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To produce and apply various types of nanostructured materials.
- To suggest methods for the characterization of nanomaterials.
- To use basic principles to solve biotechnical problems
- To assess risks of nanobiotechnology to society and environment.

UNIT 1 INTRODUCTION OF NANOTECHNOLOGY 9 Hrs.

History of nanotechnology, definitions in nanotechnology, approaches in nanotechnology, generations of nanotechnology, properties and application of nanotechnology

UNIT 2 CHARACTERIZATIONS OF NANOMATERIALS 9 Hrs.

Optical (UV-Vis/Fluorescence) –X-ray diffraction – Bragg's law, Imaging and size (Electron microscopy, light scattering, Zeta potential Surface and composition (ECSA, EDAX, AFM/STM etc) –Vibrational (FT-IR and RAMAN),

UNIT 3 PRODUCTION OF NANOPARTICLES 9 Hrs.

Production of nanomaterials by physical, chemical and biological method - Fabrication- Characterization - Biopolymer derived nanomaterials (Chitosan, PHB, polysaccharides) - applications

UNIT 4 NANOMATERIALS AND DIAGNOSTICS/DRUG DELIVERY AND THERAPEUTICS 9 Hrs.

Self-assembly of nanoparticles - Modified Nanoparticles - Peptide/DNA /Lipid Nanoparticles For Drug Delivery. Metal/Metal Oxide Nanoparticles for biological activity (antibacterial/anti-fungal/anti-viral/ anticancer), imaging and hyperthermia using nanomaterials

UNIT 5 TOXICITY EVALUATION OF NANOMATERIALS 9 Hrs.

Evaluation of genotoxicity, cytotoxicity of nanoparticles using invitro and invivo systems. Nanoparticles disposal methods and risk management.

Max.45 Hrs.

COURSE OUTCOMES

On completion of course, student will able to

CO1 - Understand the evolution of Nanotechnology and its applications
CO2 - Study the techniques used for characterization of nanomaterials
CO3 - Production of nanoparticles by different methods
CO4 - Understand the drug delivery system using nanotechnology
CO5 - Understand the toxicity evaluation methods of nanoparticles
CO6 - Understand the development of nanotechnology in biology

TEXT / REFERENCE BOOKS

1. Christof M. Niemeyer, Chad A. Mirkin, Nanobiotechnology: Concepts, Applications and Perspectives**,** Wiley, 2004
2. Arunava Goswami, Samrat Roy Choudhury, Nanobiotechnology: Basic and Applied Aspects, Anthem Press, 2017.
3. Tatsuya Okuda, Ben-Shung Chow, Nanobiotechnology: Concepts Applications and Perspectives, Scitus Academics LLC, 2018.
4. Yubing Xie, The Nanobiotechnology Handbook, CRC Press, 2012.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SBTA1504	PHARMACEUTICAL BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVE

- To understand drug metabolism pathway, thereby we able to come up with novel lead molecules.

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 Hrs.

COURSE OUTCOMES

On completion of course, student will able to

CO1 - Summarise the drug development process and pharmaceutical industry
CO2 - Discuss the mode of drug interaction and contra interaction
CO3 - Apply the chemical processes in Drug manufacturing process
CO4 - Sketch the steps involved in the manufacturing process of various formulation
CO5 - Asses the quality control and good manufacturing practices in the pharmaceutical industry
CO6 - Know the mechanism of drug action in the human body

TEXT / REFERENCE BOOKS

1. Gary Walsh, Biopharmaceuticals: Biochemistry and Biotechnology, 2nd Edition, Wiley Publication, 2004.
2. Crommelin, Daan J. A., Sindelar, Robert D., Meibohm, Pharmaceutical Biotechnology Fundamentals and Applications, Editors: Bernd (Eds.), 2013.
3. liver Kayser, Heribert Warzecha, Pharmaceutical Biotechnology: Drug Discovery and Clinical Applications, 2nd Edition, First Published,I 2012
4. Chandrakant Kokate S.S., Jalalpure Pramod H.J. Elsevier, Textbook of Pharmaceutical Biotechnology Health Sciences, 2016.
5. F. Brown, Anthony Mire-Sluis, The Design and Analysis of Potency Assays for Biotechnology Products: (Developments in Biologicals) London, 2000.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SCHA1511	TRANSPORT PHENOMENA FOR BIOPROCESSES	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- 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 INTRODUCTION TO MOMENTUM TRANSPORT 9 Hrs.

Fluids- Definition, Newton's law of viscosity, 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 2 MECHANISM OF MOMENTUM TRANSPORT 9 Hrs.

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 annulus.

UNIT 3 THERMAL CONDUCTIVITY AND THE MECHANISM OF ENERGY TRANSPORT 9 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 4 DIFFUSIVITY AND THE MECHANISM OF MASS TRANSPORT 9 Hrs.

Fick's 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, Shell mass balance and boundary conditions – Diffusion through heterogeneous and homogeneous chemical reaction, Diffusion through stagnant flim. Convective mass transport, Maxwell stefan's equation for multicomponent diffusion in gases at low density.

UNIT 5 MATHEMATICAL MODELING OF BIOLOGICAL PROCESSES 9 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. Electrokinetic phenomena, Pressure diffusion and ultracentrifuge, Centrifugation of proteins, Electro-osmosis, Transport across selectively permeable membrane, Transport in porous media.

Max.45 Hrs.

COURSE OUTCOMES

On completion of course, student will able to

CO1 - Understand the chemical and physical transport processes and their mechanism
CO2 - Do heat, mass and momentum transfer analysis
CO3 - Analyze industrial problems along with appropriate approximations and boundary conditions.
CO4 - Develop steady and time dependent solutions along with their limitations
CO5 - Understand the important physical phenomena from the problem statement
CO6 - Develop model equations for the given system.

TEXT / REFERENCE BOOKS

1. Bird R.B., Stewart W.E. and Lightfoot E.N., Transport Phenomena, 2nd Edition, J. Wiley & Sons, New York, 2002.
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, 2nd Edition, Butterworth Heinemann, 2000.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SBTA2501	BIOPROCESS ENGINEERING LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To understand the methods of microbial production and optimize the growth parameters.

SUGGESTED LIST OF EXPERIMENTS

1. Preparation of fungal biomass by solid state fermentation.
2. Design of nutritional parameters by Plackett Burman method.
3. Estimation of thermal death kinetics
4. Determination of specific growth rate by Monod model.
5. Evaluate enzyme kinetics by Michaelis Menten method.
6. Preparation of sodium alginate immobilization beads and finds the size.
7. Liquid – liquid extraction
8. Determination of sedimentation coefficient
9. Adsorption isotherm by Langmuir model.
10. Colum chromatography
11. Thin layer chromatography
12. Recovery of ethanol by distillation process.
13. Effect of pH and Temperature for an enzyme.

COURSE OUTCOMES

On completion of course, student will able to

CO1 - Analyze practical skill in solid state fermentation.
CO2 - Develop the skill in design of medium for microorganisms
CO3 - Understand the concepts of enzyme isolation and purification.
CO4 - Evaluate enzyme kinetic parameters and optimizing the specific activity on pH and Temperature.
CO5 - Improve the skill for product recovery by unit operation.
CO6 - Study and practice different recovery and purification techniques.

SBTA2502	GENETIC ENGINEERING LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVE

- To understand the engineering of genetic material and thereby utilize DNA effectively.

SUGGESTED LIST OF EXPERIMENTS

1. Isolation of genomic DNA from plant/animal source
2. Isolation of plasmid DNA from E.coli
3. Estimation of DNA by spectrophotometry
4. Agarose Gel Electrophoreis
5. Restriction digestion.
6. Ligation.
7. PCR amplification.
8. SDS PAGE -Separation and staining of proteins.

COURSE OUTCOMES

On completion of course, student will able to

CO1 - Outline fundamentals of steps in a genetic engineering procedure.
CO2 - Develop the skill in isolation of nucleic acids.
CO3 - Understand the concept of restriction enzymes.
CO4 - Improve the knowledge in PCR techniques.
CO5 - Develop the skill in protein analysis by SDS.
CO6 - Interpret the role of DNA in genetic engineering.

SBTA1601	ANIMAL BIOTECHNOLOGY	L	T	P	C	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To Provide fundamentals Of Animal Cell Culture and its application
- To Offer The Knowledge About The Micromanipulation And Transgenic Animals

UNIT 1 ANIMAL CELL CULTURE **9 Hrs.**

Introduction, importance, history of cell culture development, Basic Tissue Culture Techniques; Media for animal cell culturing – serum free Media; Primary cell cultures, secondary cell Cultures, Their Maintenance And Preservation; cell lines and cloning - Somatic Cell Fusion; Cell Cultures for production of pharma products and for Organ Culturing.

UNIT 2 GROWTH AND SCALE UP **9 Hrs.**

Cell growth and growth kinetics of animal cells, Various Types Of Cultures microcarrier attached growth, suspension Cultures, Continuous Flow Cultures, Immobilized Cultures; hollow fibre reactor.

UNIT 3 TRANSGENIC ANIMALS **9 Hrs.**

Concepts Of Transgenic Animal Technology; Strategies For The Production Of Transgenic Animals - chimeric animals generation and cloning; Pronuclear injection - generation of knockout animals and generation cloned animals. Gene editing technologies TALEN, CRISPR Cas9. Importance In transgenic animals in Biotechnology; Stem Cell Cultures in the production of Transgenic Animals.

UNIT 4 MANIPULATION OF EMBRYO'S **9 Hrs.**

What Is Micromanipulation Technology; Equipment Used In Micromanipulation; Enrichment Of X And Y Bearing Sperms From Semen Samples Of Animals; Artificial Insemination And Germ Cell Manipulations; embryo cloning- quadriparental hybrid, nuclear transplantation (Dolly), embryonic stem cells, In Vitro Fertilization And Embryo Transfer; Micromanipulation Technology And Breeding Of Farm Animals.

UNIT 5 THERAPEUTICAL APPLICATION AND SAFETY GUIDELINES **9 Hrs.**

Recombinant Cytokines And Their Use In The Treatment Of diseases; Monoclonal Antibodies – immunotoxins - Ex vivo and In vivo gene therapy, vaccines production; molecular pharming - . Containment of Safety use and release of transgenic animals- biosafety guidelines – national, Institutional and International level.

Max.45 Hrs.

COURSE OUTCOMES

On completion of course, student will able to

CO1 - Understand the cell culture techniques
CO2 - Explain the importance of aseptic techniques of cell culture
CO3 - Generalize the requirement need for cell culture
CO4 - Recommend the methods of isolation and manipulation of embryo
CO5 - Understand the importance of therapeutically applications and safety guidelines
CO6 - Understand the knowledge about the Micromanipulation and Transgenic Animals

TEXT / REFERENCE BOOKS

1. Ranga M.M., Animal Biotechnology, Agrobios India Limited, 2002.
2. Ramadass P., Meera Rani S., Text Book of Animal Biotechnology, Akshara Printers, 1997.
3. Subbaram N.R., Hand book of Indian patent law and practice, S.Viswanathan (Printers & Publishers) Pvt. Ltd. Chennai, 1998.
4. Freshney R.I., Culture of Animal Cells: A Manual of Basic Techniques and Specialized Applications, 6th Edition, John Wiley & Sons, 2010.
5. Portner R., Animal Cell Biotechnology: Methods And Protocols, 2nd Edition, Humana Press, 2007.
6. Masters J.R.W., Animal Cell Culture: Practical Approach, Oxford University Press, 2000.
7. Tzotzos G.T., Genetically modified organisms-A guide to biosafety, CAB International, Walling ford, U.K., 1995.
8. DBT, Back ground document for workshop on biosafety issues emanating from use of genetically modified organisms (GMOs), Bangalore, 1998.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SBTA1602	BIOSAFETY, BIOETHICS AND IPR	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To understand biosafety and the importance of bioethics.
- To be able to distinguish the different IPR and biotechnological patent.

UNIT 1 INTRODUCTION TO BIOSAFETY 9 Hrs.

Biosafety – definition, need, importance, applications, levels of biosafety and criteria for biosafety levels. NIH guidelines for biosafety. Regulations specific to biotechnology companies and research institutions. Biosafety guidelines in India. Role of institutional biosafety committee.

UNIT 2 IMPLICATIONS OF BIOSAFETY 9 Hrs.

Guidelines for research with transgenic organisms. Environmental impact of genetically modified organisms (beneficial and hazardous impact), Field trials with GMO, Containment levels. Biosafety protocol, Cartagena Biosafety protocol, Mechanism of implementation of biosafety guidelines. Biosafety and politics. Biosafety database.

UNIT 3 INTRODUCTION TO BIOETHICS 9 Hrs.

Bioethics – need, applications. Impact of bioethics to the environment and society. Bioethical issues pertaining to various aspects of Biotechnology. Bioengineering ethics, responsible researchers, research ethics, ethical decision making. Biowarfare and biopiracy.

UNIT 4 INTELLECTUAL PROPERTY RIGHTS 9 Hrs.

Forms of Intellectual property – patent, copyright, trademark, design, trade secret, domain name and geographical indications. WTO treaties, GATT articles, main features of TRIPS agreement, practical aspects of WIPO. IPR related legislatures in India.

UNIT 5 PATENT 9 Hrs.

History of Indian patent system and law. Patenting authority. Different types of patent. Requirements and procedure for patenting. Patentable and Non-patentable things. Patent search and patent co-operation treaty (PCT). Farmer's right and plant breeders right. Importance, social consequences and controversies on biotechnology patents.

Max.45 Hrs.

COURSE OUTCOMES

On completion of course, student will able to

CO1 - Define biosafety, bioethics and intellectual property rights.
CO2 - Discuss the different regulations pertaining to biosafety.
CO3 - Categorize the various forms of IPR.
CO4 - Appraise the importance of bioethics in biotechnology.
CO5 - Elaborate the different patents and the process of patenting.
CO6 - Interpret biotechnological novelty as patents.

TEXT / REFERENCE BOOKS

1. Sateesh M.K., Bioethics and Biosafety, I.K. International Publishing House Pvt. Ltd., 2013.
2. Fleming D.O. and Hunt D.L., Biological Safety: Principles and Practices, ASM Press, 2006.
3. Goel D. and Parashar S., IPR Biosafety and Bioethics, Pearson Education India, 2013.
4. Pandey N. and Dharni K., Intellectual Property Rights, PHI Learning, 2014.
5. Singh K.K., Biotechnology and Intellectual Property Rights: Legal and Social Implications, Springer India, 2014.
6. Young T.R., Policy I. and Group G.C., Genetically Modified Organisms and Biosafety: A Background Paper for Decision-makers and Others to Assist in Consideration of GMO Issues. IUCN, 2004.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SBTA1603	DESIGN AND OPERATION OF BIOREACTORS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To develop knowledge and technical's skills on bioreactors and its various types.
- To make understand the knowledge on growth parameters such as structure and unstructured models

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

Concept of Bioreactors, Overview of SLF and SSF. Medium optimization-Plackett Burman method. Response surface methodology, Introduction to bioreactor configuration-Basic mode of operation batch, fed-batch and continuous reactor-bioreactor lay out-Kinetics of batch and continuous culture. Criteria of scale up and scale down of bioreactor.

UNIT 2 IDEAL CONTINUOUS STIRRED TANK BIOREACTOR 9 Hrs.

Material balance-Evaluation of Monod Kinetic parameter, Alternatives to Monod equation-Blackman, Tessier, Moser, Contois equation -Comparison of batch and CSTB-Multiple CSTB connected in series-CSTB with cell recycling.

UNIT 3 GENERAL CHARACTERISTIC OF MODELS: 9 Hrs.

Basic concept of Linear model, dynamic, lumped, continuous, white or black box model. 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 Hrs.

COURSE OUTCOMES

On completion of course, student will able to

CO1 - Study of basic working principle of bioreactors and optimization of medium preparation
CO2 - Design and operation of industrial bioreactors pipeline and working process
CO3 - Evaluate the various microbial growth kinetics and comparative analysis of bioreactors
CO4 - Discuss and evaluating the microbial growth determination models
CO5 - Critique on the validity of experimental data and measurements of mass transfer rate
CO6 - Application and Operation of industrial bioreactors for various economical important products

TEXT / REFERENCE BOOKS

1. Shuler.M.L. and Kargi.F, Bioprocess Engineering Basic concepts, Pearson Education India, 1st Edition, 2003.
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: 100 **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 16 marks **80 Marks**

SBTA2601	DOWNSTREAM PROCESSING LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To understand the nature of the end product, its concentration, stability and degree of purification required
- To design processes for the recovery and subsequent purification of target biological products.

SUGGESTED LIST OF EXPERIMENTS

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

COURSE OUTCOMES

On completion of course, student will able to

CO1 - To provide hands on training in Downstream processing through simple experimentations in the laboratory.
CO2 - This will be a pre-requisite for project work.
CO3 - Acquired knowledge for the separation of whole cells and other insoluble ingredients from the culture broth.
CO4 - Learned cell disruption techniques to release intracellular products
CO5 - Learned various techniques like evaporation, extraction, precipitation, membrane separation for concentrating biological products
CO6 - Learned the basic principles and techniques of chromatography to purify the biological products and formulate the products for different end uses.

SBTA2602	ANIMAL BIOTECHNOLOGY LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVE

- To emphasis the students to get more practical knowledge about cell culturing in the invitro condition, maintenance and application oriented modules to be updated.

SUGGESTED LIST OF EXPERIMENTS

1. Preparation of Various medias in the Laboratory
2. Techniques needed to maintenance of cellines and preservation
3. Techniques involved for revival of cellines and utilized for the cytotoxicity and anticancer studies
4. Observation of cellines with different staining useful for cell differentiation.
5. To understand the application of celllines in various fields.

COURSE OUTCOMES

On completion of course, student will able to

CO1 - Learn to prepare animal cell culture.
CO2 - Develop skill in maintenance of cell lines.
CO3 - Evaluate cytotoxicity activity.
CO4 - Understand various cell differentiation.
CO5 - Interpret the growth of cell lines.
CO6 - Apply cancer cell lines in novel drug discovery studies.

SBTA1701	PLANT BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVE

- To formulate different the plant tissue culture techniques to overcome the agricultural demands

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

Structure and organization of plant genome, Chloroplast and Mitochondrial genome: 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.

Genetic Transformation methods for production of transgenic plants: Direct, Indirect methods: transgenic plant analysis: initial screens, definitive molecular characterization, phenotypic analysis.

UNIT 5 APPLICATION AND SAFETY REGULATIONS 9 Hrs.

Traits for improved crop production, improved products and food quality: 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, field testing of transgenic plants: environmental risk assessment, Current issues related to transgenic plants.

Max.45 Hrs.

COURSE OUTCOMES

On completion of course, student will able to

CO1 - Summarize and analyse the fundamentals of plant tissue culture
CO2 - Discuss the various tissue culture techniques
CO3 - Assess the importance of secondary metabolites production by plant tissue culture
CO4 - Synthesis and evaluate the importance of transgenic plants
CO5 - Evaluate the risk of GMO'S
CO6 - Devise the plant tissue culture techniques to overcome the agricultural demands

TEXT / REFERENCE BOOKS

1. Neal Stewart C. Jr., Plant biotechnology and genetics: principles, techniques and applications, Wiley John, Wiley & Sons Inc., Hoboken, New Jersey, 2008.
2. Adrian Slater, Nigel Scott, and Mark Fowler, Plant Biotechnology, Oxford University Press, New York, 2008.
3. Purohit S.S., Agricultural Biotechnology, Agrobios Indi., Jodhpur, 2002.
4. Chawla H.S., Introduction to Plant Biotechnology, 2nd Edition, Oxford and IBH Press, 2003.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SBTA1702	CANCER AND STEM CELL BIOLOGY	L	T	P	Credits	Total Marks
		3	*	0	3	100

COUSE OBJECTIVES

- To understand the molecular implications of cancer and its therapy.
- To describe the properties of various stem cells and thereby apply them in modern therapeutics.

UNIT 1 UNDERSTANDING THE SCIENCE OF CANCER 9 Hrs.

Cancer – Predisposing factors, causes of cancer, chemical carcinogenesis, interaction of chemical carcinogens with oncogenes. Tumor initiation, promotion and progression. Irradiation carcinogenesis, viral carcinogenesis, role of viruses in the causation of human cancer.

UNIT 2 BIOCHEMISTRY AND GENETICS OF CANCER 9 Hrs.

Growth characteristics of malignant cells, Cell proliferation versus differentiation, cell cycle regulation. Cancer signalling networks - central axis, cancer and cell senescence, signalling pathways that impact the central axis, signalling and systems biology. Molecular genetic alterations in cancer cells, oncogenes and characteristics of ras, myc, src, myb, bcl-2, fms, kit, trk, met genes.

UNIT 3 TUMOUR IMMUNOLOGY AND CANCER DIAGNOSIS 9 Hrs.

Mechanisms of immune response to cancer, HSP as regulators of immune response, Inflammation and cancer, Immunotherapy. Cancer diagnostic techniques – categories of tumour markers, gene expression microarrays, proteomics in cancer diagnosis, Molecular imaging. Mechanisms of gene silencing and gene therapy for cancer.

UNIT 4 STEM CELLS AS A RESOURCE 9 Hrs.

Stem cells – adult, embryonic and umbilical cord stem cells, properties. Stem cells as body repair kit, Mechanisms of stem cell self-renewal. Derivation and maintenance of human embryonic stem cells, genetic manipulation of human embryonic stem cells, genomic reprogramming, Zebrafish and stem cell research.

UNIT 5 STEM CELL THERAPY 9 Hrs.

Application of human embryonic stem cells in therapy. Umbilical cord stem cell therapy – multiple sclerosis, stroke and brain injury. Stem cells in cancer therapy. Cancer stem cells and stem cell gene therapy. Dietary considerations following stem cell therapy. Ethics and politics of stem cell therapy.

Max.45 Hrs.

COURSE OUTCOMES

On completion of course, student will able to

CO1 - Describe the induction of cancer and to describe the various stem cells in humans.
CO2 - Discuss the cancer causing agents and its impact.
CO3 - Interpret the various biochemical changes in cancer and the characteristics of oncogenes.
CO4 - Analyse stem cells as a resource for various diseases.
CO5 - Summarize various diagnostic methods for cancer.
CO6 - Understand and develop stem cells as a therapeutic solution for various diseases.

TEXT / REFERENCE BOOKS

1. Hesketh R., Introduction to Cancer Biology, Cambridge University Press, 2013.
2. Ruddon R.W., Cancer Biology, Oxford University Press, USA, 2007.
3. Lanza et al., Essentials of Stem Cell Biology. Elsevier Science, 2009.
4. Steenblock D.A. and Payne A.G., Umbilical Cord Stem Cell Therapy: The Gift of Healing from Healthy Newborns. Basic Health Publications, 2006.
5. El-Metwally T.H., Cancer Biology, An Updated Global Overview, Nova Science Publishers, 2009.
6. King R.J.B. and Robins M.W., Cancer Biology, Pearson/Prentice Hall, 2006.
7. Kleinsmith L.J., Principles of Cancer Biology, Pearson Benjamin Cummings, 2006.
8. Riordan N.H., Stem Cell Therapy: A Rising Tide: How Stem Cells Are Disrupting Medicine and Transforming Lives. Neil Riordan, 2017.
9. Al-Rubeai M. and Naciri M., Stem Cells and Cell Therapy. Springer Netherlands, 2013.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SBAA4002	PRINCIPLES OF MANAGEMENT AND PROFESSIONAL ETHICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To gain knowledge about the fundamentals of management.
- To understand the tools and techniques of the various aspects of management.
- To apply management concepts in decision making.

UNIT 1 MANAGEMENT THEORIES **9 Hrs.**

Definition of management, science or art, manager vs entrepreneur; Types of managers - managerial roles and skills; Evolution of management-scientific, human relations, system and contingency approaches; Types of Business Organizations, sole proprietorship, partnership, company, public and private enterprises; Organization culture and environment; Current trends and issues in management.

UNIT 2 PLANNING, DECISION MAKING AND ORGANISING **9 Hrs.**

Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies, Strategic Management, Planning Tools and Techniques, Decision making steps & processes. Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and Decentralization, job design,

UNIT 3 STAFFING AND LEADING **9 Hrs.**

Human resource management , HR Planning, Recruitment selection, training & development, performance management, career planning and management, Directing individual and group behavior, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, leadership, types & theories of leadership, effective communication.

UNIT 4 CONTROLLING AND REPORTING **9 Hrs.**

Controlling, system and process of controlling, budgetary and non-budget control technique, use of computer and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.

UNIT 5 VALUES AND ETHICS **9 Hrs.**

Human Values – Natural acceptance - Ethics – Definition- Objectives - Virtues – Challenges in the work place - Engineering ethics - Scope - Moral issues and judgment - Moral development theories – Engineers as responsible experimenters - Codes of ethics - Industrial standards - Global Issues: Environmental ethics- Computer ethics - Ethics and codes of business conduct in MNC.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Describe the evolution and development of management concepts.
CO2 - Understand the functions of management.
CO3 - Apply the concepts and develop key competencies for managing human resources.
CO4 - Analyze appropriate management techniques for Controlling and Reporting.
CO5 - Evaluate the various aspects of decision making and demonstrate critical thinking.
CO6 - Elaborate the importance of the ethical dimension in workplace.

TEXT / REFERENCE BOOKS

1. Robins S.P. and Couiter M, Management, Prentice Hall India, 11th Edition, 2012.
2. Harold Koontz and Heinz Weihrich, 'Essentials of Management' Tata McGraw Hill, 10th Edition, 2015.
3. Nagaraazan. R. S, 'A Text Book on Human Values and Ethics', New Age International Publishers, New Delhi, 2018.
4. Stoner James A. F., Freeman. R. E and Gilbert. R. D, 'Management', Pearson Education, 6th Edition, 2018.
5. Griffin, R. W., 'Management', South-Western College Publication 11th Edition, 2012.
6. Gregory. G. D, Gerry. M. C and Alan. E, 'Strategic Management: Text and Cases' McGraw Hill, 8th Edition, 2018.
7. Tripathy. P. C & Reddy. P. N, 'Principles of Management', Tata McGraw Hill, 5th Edition, 2012.
8. Tulsian. P.C & Pandey. V, 'Business Organisation & Management', Pearson - Education, 2011.
9. Joseph L. Massie, 'Essentials of Management', Pearson Education, 4th Edition, 2016
10. Harris Pritchard and Rabins, 'Engineering Ethics' Cengage Learning, New Delhi. 4th Edition, 2014.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: 10 Questions carrying 2 marks each – No choice **20 Marks**

Part B: 2 Questions from each unit of internal choice, each carrying 16 marks **80 Marks**

SBTA2701	PLANT BIOTECHNOLOGY LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVE

- To understand various steps involved in plant tissue culture and their application.

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

COURSE OUTCOMES

On completion of course, student will able to

CO1 - Develop skill in plant tissue culture.
CO2 - Assess the nutritional parameters of plant tissues.
CO3 - Evaluate direct and indirect regeneration.
CO4 - Learn the techniques in embryo culture.
CO5 - Apply protoplast culture techniques for protoplast fusion.
CO6 - Evaluate the possibility of secondary metabolite production by cell suspension.

SBTA2702	NANOTECHNOLOGY AND COMPUTATIONAL BIOLOGY LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVE

- To study the nanomaterial structure and synthesis process and to understand the mechanisms of computational biology.

SUGGESTED LIST OF EXPERIMENTS

NANOTECHNOLOGY

1. Study the diverse form of nanomaterials
2. Synthesis of Nanoparticles using Chemical reduction method
3. Purification of Nanoparticles
4. Primary characterization using spectroscopy methods
5. Phytogenic methods of nanoparticle synthesis
6. Synthetics of nanoparticles using microorganism (intracellular / extracellular)
7. Structural modification of nanoparticles using polymer
8. Evaluation of stability of nanomaterial

COMPUTATIONAL BIOLOGY

1. Advanced Visualization Software and 3D representations with VMD and Rasmol
2. Coordinate generations and inter-conversions.
3. Secondary Structure Prediction
4. Fold Recognition, ab initio method
5. Homology based comparative protein modeling.
6. Energy minimizations and optimization
7. Validation of models.
    1. WHATIF
    2. PROSA
    3. PROCHECK
    4. VERIFY 3D
8. Protein Structure Alignment.
9. Modeller
10. Structure based Drug Design
    1. Molecular Docking
    2. De Novo Ligand Design
    3. Virtual Screening
11. Ligand based Drug Design
    1. Pharmacophore Identification
    2. QSAR

COURSE OUTCOMES

On completion of course, student will able to

CO1 - Understand the synthesis of nanoparticle by chemical and biological methods
CO2 - Understand the purification methods of nanoparticles
CO3 - Understand the structural modification and stability of the nanoparticle
CO4 - Predict the protein modeling and to understand the validation of results
CO5 - Understand Structure based Drug Design
CO6 - Understand Ligand based Drug Design

SBTA3001	MARINE BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To know the marine organisms of interest in biotechnology, their basic functions and role in the marine ecosystems; to understand the essential elements related to aquaculture and fish genetics and to acquire knowledge on marine natural products and fishery by-products; and also, to apply biotechnological methods for the conservation and protection of marine environment

UNIT 1 INTRODUCTION TO MARINE ECOSYSTEMS AND MICROBIAL DIVERSITY 9 Hrs.

Physical and chemical properties of sea water. Zonation of sea: Euphotic zone, Bathyal zone, Abyssal zone, Benthic zone, Deep sea. Marine ecosystems and biodiversity**:** Estuary, Seagrass, Seaweed, Salt marsh, Mangroves and Coral reef. Marine microbial diversity: Marine microbial habitats, Microbial distribution in the ocean, Factors that impact marine microbial diversity. Interactions between marine microbes and other living organisms.

UNIT 2 AQUACULTURE AND FISH GENETICS 9 Hrs.

Aquaculture: Definition- Criteria of selection of aquaculture species. Culture practices of marine Fish, Shrimp, Crab, Lobster, Oyster, and Seaweed. Fish genetics: Gynogenesis, Androgenesis, Polyploidy, Artificial insemination, Eye stalk ablation and Cryopreservation of fish gametes.

UNIT 3 ECONOMIC IMPORTANCE OF MARINE ORGANISMS 9 Hrs.

Production of live-feeds in marine aquaculture: Rotifers, Artemia, Copepods and Microalgae. Biofuel production. Marine enzymes, Production of omega-3 fatty acids from marine organisms. Marine pharmacology: New and novel antibiotics from marine organisms. Secondary metabolites from marine bacteria, actinomycetes and marine endophytic fungi. Prebiotics and Probiotics for aquaculture.

UNIT 4 MARINE AND FISHERY BY-PRODUCTS 9 Hrs.

Marine algal by-products: Chitin, Chitosan, Agar, Alginates, Carrageenan and Heparin. Fishery by-products: Fish oil, Isinglass, Fish glue, Fish silage, Fin rays,

UNIT 5 MARINE ENVIRONMENT PROTECTION 9 Hrs.

Marine Pollution. 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 Hrs.

COURSE OUTCOMES

On completion of course, student will able to

CO1 - Learn the importance of marine ecosystems and microbial biodiversity
CO2 - Develop the aquaculture practices of marine fish, shrimp, crab, lobster, edible oyster, pearl oyster and seaweeds
CO3 - Device the various fish genetic techniques involved in aquaculture
CO4 - Formulate the production methodologies for economically and pharmaceutically important products from marine organisms
CO5 - Generate the production strategy of various seaweed and fishery by-products and its applications
CO6 - Evaluate the human impacted pollution in the marine environment and the usage of marine microbes to ameliorate environmental deterioration

TEXT / REFERENCE BOOKS

1. Marine Biotechnology,. Guest Editors: Song Qin, W.E.G. Muller and Edwin L. Cooper. Hindawi Publishing Corporation, 2011.
2. Grand Challenges in Marine Biotechnology, P. H. Rampelotto, A. Trincone (eds.). Springer International Publishing AG, part of Springer Nature, 2018.
3. Marine Biotechnology, Advances in Biochemical Engineering/Biotechnology, Le Gal Y., Ulber R. (Series editor: T. Scheper), Springer-Verlag Berlin Heidelberg, 2005.
4. Marine microbial diversity: The key to earth's habitability: A Report from the American academy of microbiology 2005.
5. Jennie Hunter-Cevera, David Karl and Merry Buckley, Published by American Academy of Microbiology, San Francisco, California, 2005.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SBTA3002	AQUACULTURE	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To give outline about the basics of aquaculture and various culture systems, pond management, study of monoculture, polyculture and integrated culture systems, water and soil quality in relation to fish production and to become familiar with practical aspects of aquaculture like feeds and feeding; stocking, transport, harvest and post-harvest technology; marketing and economics; disease prevention, diagnosis and treatment.

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 PRODUCTION AND GENETIC IMPROVEMENT 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, copepods and Artemia. Selection of brooder, nutrition, gonadal changes, hormonal regulation. **Genetic improvement: I**nbreeding and cross breeding. **Genetic manipulation:** Sex-reversal and sex control, role of steroids in sex reversal, **Chromosomal manipulation**: Polyploidy, Androgenesis and Gynogenesis. Production of transgenic fishes, micro injection technique.

UNIT 3 GROW-OUT PRODUCTION OF AQUATIC ORGANISMS AND POND MANAGEMENT 9 Hrs.

Culture of economically important aquatic species: Seaweed, Shrimp, Seabass, Crab, Lobster, Mussels and Oysters. Culture practices of freshwater species: Prawns, Carps, Catfish, Murrels, and Ornamental fishes. **Water quality management:** Dissolved Oxygen, CO_2, Ammonia, pH, salinity, temperature and turbidity. **Pond management:** Nursery and grow-out pond maintenance, pond fertilization. Biofloc technology

UNIT 4 POST HARVEST TECHNOLOGY 9 Hrs.

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 concept and food safety in fish industry.

UNIT 5 FISH DISEASES AND CONTROL MEASURES 9 Hrs.

Disease diagnosis: Principles of disease diagnosis in finfish and shell fish. **Microbial diseases: B**acterial disease, fungal disease, and viral disease. **Disease treatment methods**: prophylactic and therapeutic. **Parasitic diseases:** Diseases caused by Protozoa and Metazoa, and their symptoms, cure and control. **Non–infectious diseases:** Nutritional and environmental diseases, symptoms, cure and control. Treatment of Aquaculture effluents**.**

Max.45 Hrs.

COURSE OUTCOMES

On completion of course, student will able to

CO1 - Experiment the different types and methods of aquaculture methods and systems
CO2 - Construct the hatchery and learn the culture techniques of live feeds
CO3 - Demonstrate various breeding and genetic manipulation techniques for aquatic organisms
CO4 - Design and construct the aquaculture farm, analyse water quality and cultivate the aquatic plants and animals
CO5 - Learn how to do harvesting and perform post-harvest processing to improve the quality of fish
CO6 - Investigate various fish diseases and establish various methods of treatments

TEXT / REFERENCE BOOKS

1. Advances in Marine and Brackishwater Aquaculture, Santhanam Perumal, Thirunavukkarasu A.R., Perumal Pachiappan. Editors. Springer India, 2015.
2. Aquaculture, N.Arumugam. Saras Publication, 2014.
3. FAO, The state of world fisheries and aquaculture. FAO, Rome, 2018.
4. Pillay T.V.R. & Kutty M.N. Aquaculture: Principles and Practices, Wiley India Pvt Ltd; 2nd Edition 2011.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SBTA3003	TRANSLATIONAL BIOTECHNOLOGY FROM IPR TO LICENSING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To emphasize the role of Biotechnology for sustainable development
- To highlight the role of Biotechnology in product production
- To analyze the needs and success of Biotech companies
- To develop effective skills for scientific documentation and communication
- To discuss principles and significance of Intellectual Property Rights

UNIT 1 BIOTECHNOLOGY IN DEVELOPMENT 9 Hrs.

Classical and modern biotechnological concepts in products development: therapeutic, environmental, agricultural, energy utilization. Manipulation of genetic information for sustainable development.

UNIT 2 BIOTECHNOLOGY IN PRODUCT PRODUCTION 9 Hrs.

Biotechnology in multidisciplinary undertaking: entrepreneurship, economic, legal and ethical considerations in the development and scale up production of a product.

UNIT 3 VIRTUAL BIOTECH COMPANY 9 Hrs.

Creation of a virtual biotech company based on the societal needs: data collection, incubation of idea, design of business plan, funding, regulatory authority interactions, partnerships, collaborators – (Industrial visits and interactions).

UNIT 4 SCIENTIFIC COMMUNICATIONS 9 Hrs.

Communicating science: documentation, strategies to effectively communicate the scientific data to the non scientific stakeholders, plagiarism, online communication, verbal communications skills through (seminars)

UNIT 5 INTELLECTUAL PROPERTY RIGHTS 9 Hrs.

Intellectual property rights: patents, copy rights, trade marks, infringements. Guidelines involved in patent process in India.

Max.45 Hrs.

COURSE OUTCOMES

On completion of course, student will able to

CO1 - Comprehend the diverse application of biotechnological process
CO2 - Create awareness on the global scenario on various aspects in technology transfer
CO3 - Design of a model biotech company for sustained development
CO4 - Address the conceptual ideas to the diverse stakeholders
CO5 - Protection of the intellectual property
CO6 - Understand the steps involved in the conversion to licensing

TEXT / REFERENCE BOOKS

1. Montano M., Translational Biology in Medicine, Woodhead Publishing Series in Biomedicine, 2014.
2. Translational Anatomy and Cell Biology of Autism Spectrum Disorder (Advances in Anatomy, Embryology and Cell Biology), Michael J. Schmeisser (Editor), Tobias M. Boeckers, 2017.
3. Rickard T.A., A Guide to Technical Writing (Classic Reprint)
4. David Castle, The Role of Intellectual Property Rights in Biotechnology Innovation, 2015.
5. Singh, Kshitij Kumar, Biotechnology and Intellectual Property Rights Legal and Social Implications.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SBTA3004	BIOLOGICAL PROCESS IN REGULATORY AFFAIRS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To emphasize the role of biological process in regulatory affairs
- To enable the understanding of principles and operation of GMP, GLP and GCP
- To develop knowledge on Regulatory affairs, issues and implications
- To analyze the significance of Quality assurance and management
- To identify the function and scope of regulatory bodies

UNIT 1 GMP **9 Hrs.**

Good Manufacturing Practice (GMP). 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 2 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 3 GCP **9 Hrs.**

Good Clinical Practices (GCP): International regulatory requirements for pharmaceutical development regarding clinical research practices. Current issues in GCP; standards for design, conduct, performance, monitoring, auditing, recording, analysis, and reporting of clinical trials. Schedule Y of Indian Drugs and Cosmetics Act 1940, Role of Regulatory affairs in Product development, Clinical phase, Preclinical Phase, Manufacturing phase and Marketing Phase. Indian Council of Medical Research (ICMR) Guidelines for Ethics in Biomedical Research.

UNIT 4 QUALITY MANAGEMENT & INSPECTION **9 Hrs.**

Quality concept, Quality assurance, Total Quality Management-Basics, 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. ICH, ISO – regulations.

Max.45 Hrs.

COURSE OUTCOMES

On completion of course, student will able to

CO1 - Demonstrate competence in university level knowledge appropriate to the program.
CO2 - Conduct investigations of complex problems by Biological processes that include appropriate experiments, analysis and interpretation of data and synthesis of information in order to reach valid conclusions.
CO3 - Work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.
CO4 - Understand the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.
CO5 - Understand the interactions with the economic, social, health, safety, legal, and cultural aspects of society, the uncertainties in the prediction of such interactions; and the concepts of sustainable design and development and environmental stewardship.
CO6 - Identify and to address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge in Regulatory affairs.

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.
3. Sharma P.P., How to Practice GLP, Good Laboratory Practice, Vandana Publications, 2017.
4. Milton A. Anderson, GLP Essentials: A Concise Guide to Good Laboratory Practice, 2nd Edition, Informa Healthcare, 2002.

5. Josef Kolman,Good Clinical Practice: Standard Operating Procedures for Clinical Researchers, Wiley, 2000.
6. Dale H. Besterfield, Total Quality Management, Pearson Education, 3rd Edition, 2003.
7. Sharma D.D.,Total Quality Management, Principles, Implementation & Cases, Sultan Chand & Sons, New Delhi, 2000.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SBTA3005	MEDICAL BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- The course will provide students with an historical perspective in the fast emerging medical biotechnology and the innovative processes that ensures the success of such endeavors.

UNIT 1 BASIC CONCEPTS AND TOOLS **9 Hrs.**

Understanding human body, Genomics, Proteomics, Genetic disorders, Drugs, Pharmacogenomics, Pharmacokinetics.

UNIT 2 SIGNALING MECHANISMS **9 Hrs.**

Receptor mediated signal transduction – primary messenger – hormones and drugs- secondary messenger and neurotransmitters. G- Protein coupled receptors – cyclic AMP –calcium ions – Nitric oxide (NO) – prostaglandin and inositol triphosphates.

UNIT 3 DIAGNOSTICS **9 Hrs.**

Hematology, Biochemistry (Serum & Tissue), Histology (Biopsy and Autopsy) and Endocrinology. Diagnosis of Bacteria (Mycobacterium), DNA virus (HBV/H1N1), RNA virus (HIV/HCV), Parasite (Malaria).

UNIT 4 TREATMENT AND PREVENTION **9 Hrs.**

Traditional medicine (AYUSH), Chinese and Modern medicine, Antibacterial, Antiviral, Antibiotics, use of interferon, immunomodulators. Active and passive immunization, vaccines and toxoids, Food as medicine-Nutraceuticals.

UNIT 5 THERAPEUTIC DEVELOPMENTS AND DRUG DESIGNING **9 Hrs.**

Basics of Regenerative medicine, Nanomedicine, Combinatorial antibody designing, Gene therapy, Anti sense therapy-RNAi. Drug designing process, receptor–ligand interaction, ligand docking-Bioinformatics tools.

Max.45 Hrs.

COURSE OUTCOMES

On completion of course, student will able to

CO1 - Develop an ability to use appropriate knowledge to identify and analyze the molecular basis of disease & emerging technology.

CO2 - Conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data and synthesis of information in order to reach valid conclusions

CO3 - Design solutions for complex, open-ended problems that meet specified needs with appropriate attention to health and safety risks

CO4 - Create, select, apply, adapt, and extend appropriate techniques, resources, and modern tools

CO5 - Work effectively as a member and leader in teams, preferably in a multi-disciplinary setting

CO6 - Address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge in Medical & Pharmaceutical fields

TEXT / REFERENCE BOOKS

1. Judit Pongrácz and Mary Keen, Medical Biotechnology, Churchill Livingstone Elsevier, 2009.
2. Devlin T.M., Textbook of Biochemistry with Clinical correlations, John Wiley and Sons, 2010
3. Arthur C. Guyton and John Edward Hall, Textbook of medical physiology, Elsevier Saunders 2006.
4. Aparna Rajagopalan, Fundamentals of Medical Biotechnology, Ukaaz publications 2006.
5. Jogdand S.N., Medical Biotechnology, Himalaya publications, 2011.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SBTA3006	NEUROBIOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- Neuroscience is the scientific study of the brain and nervous system, whose ultimate goal is to understand higher brain function at a variety of levels.

UNIT 1 CELLULAR COMPONENTS OF THE NERVOUS SYSTEM 9 Hrs.

Neurons- Structure and Function of Neurons, components of neurons, Cytology of neurons Classification and Types Of Neurons; Glial Cells- Structure And Function Of glial cells different types of glial cells: astrocytes, Oligodendrocytes, Schwann cells, other Neuronal Cells.

UNIT 2 NEUROANATOMY 9 Hrs.

Organization of the Human Nervous System: Grass anatomy of adult brain; central nervous system, peripheral nervous system, Brainstem, spinal cord. Myelination; Blood Brain Barrier, Meninges and Cerebrospinal Fluid

UNIT 3 NEUROCHEMISTRY 9 Hrs.

Introduction to chemistry and the brain: Synaptic transmission and cellular signaling: An overview; Resting And Action Potentials; Mechanism Of Action Potential Conduction; Voltage Dependent Channels Neurotransmitters: Chemistry, synthesis, storage, release and function, Neuropeptides; Mechanism of action of drugs; Drug addiction, drug abuse and adverse drug reaction. Hormones and Their Effect on Neuronal Function

UNIT 4 NEUROBIOLOGY 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 5 PATHOLOGY OF THE NERVOUS SYSTEM 9 Hrs.

Molecular, genetic aspects and diagnostic characteristics of, Duchene Muscular dystrophy (DMD), neurodegenerative disorders Parkinson's disease, Alzheimer's disease, Huntington Disease, Multiple sclerosis: Biotechnology and Disease concern: Stem cell therapy, Transgenics,Gene therapy.

Max.45 Hrs.

COURSE OUTCOMES

On completion of course, student will able to

CO1 - A basic introduction and historical perspectives of neurobiology.
CO2 - Explores the cellular composition of the nervous system and the process of neuronal activity.
CO3 - Provides knowledge of the overall organization and functions of nervous system.
CO4 - To understand and differentiate mechanisms related to nervous system in health and disease.
CO5 - Provides knowledge of relevant methodologies and techniques in neuroscience.
CO6 - Apply and integrate their knowledge of biotechnology to diseases of nervous system.

TEXT / REFERENCE BOOKS

1. Squire, Fundamental Neuroscience, 4th Edition, Elsevier, 2013
2. Kendel, Principles of Neural Science, 5th Edition, McGraw Hill, 2013.
3. Verkhratsky, Glial Neurobiology, A Text Book, Wiley, 2007.
4. Hendelman, J., Water, Atlas.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SBTA3007	FOOD PROCESSING TECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To impart knowledge of various areas about the food safety and processing technology.

UNIT 1 PROPERTIES OF FOODS AND PROCESSING THEORY 9 Hrs.

Properties of liquids, solids and gases - Material transfer - Fluid flow - Heat transfer - Water activity - Effects of processing on sensory characteristics of foods - Effects of processing on nutritional properties - Food safety, good manufacturing practice and quality assurance : HACCP, Hurdle technology - Process control Automatic control, Computer-based systems.

UNIT 2 AMBIENT-TEMPERATURE PROCESSING 9 Hrs.

Raw material preparation : Cleaning, Sorting, Grading, Peeling - Size reduction in solid , liquid foods – mixing and forming – separation and concentration of food components – fermentation and enzyme technology – Irradiation – processing using electric fields, high hydrostatic pressure, light and ultrasound.

UNIT 3 PROCESSING BY APPLICATION OF HEAT 9 Hrs.

Heat processing using steam and water – Blanching – Pasteurization – Heat sterilization – Evaporation and distillation – Extrusion : Heat processing using hot air – Dehydration – Baking and roasting : Heat processing using hot oils – Frying : Heat processing by direct and radiated energy – Dielectric , ohmic and infrared heating.

UNIT 4 PROCESSING BY REMOVAL OF HEAT 9 Hrs.

Chilling – Controlled or modified atmosphere storage and packaging – Freezing – Freeze drying and Freeze concentration,

UNIT 5 POST – PROCESSING OPERATIONS 9 Hrs.

Coating and enrobing – Packaging – Types of packaging materials – printing – interactions between packaging and foods – environmental considerations – Filling and sealing of containers – materials handling, storage and distribution.

Max.45 Hrs.

COURSE OUTCOMES

On completion of course, student will able to

CO1 - Learning of properties of food and food safety.
CO2 - Knowledge about the food processing by using ambient temperature
CO3 - Study of processing of food by using heat
CO4 - Processing of food by removal of heat using direct and radiant energy
CO5 - Scrutinizing of Post processing of food
CO6 - Gain wide knowledge about the processing technology of food

TEXT / REFERENCE BOOKS

1. Amit K Jaiswal , Food processing Technologies – impact on product attributes , CRC Press Taylor & Francis Group, 2017.
2. Sivashakar B., Food processing preservation, Prentice Hall of India Pvt. Ltd., 2002.
3. Fellows P., Food processing and technology, Principles and Practice, 4th Edition, Woodhead Publishing Limited, Cambridge – England, 2016.
4. Da-Wen Sun, Emerging Technologies for food, 2nd Edition, Academic Press, 2014.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SBTA3008	PERL FOR BIOINFORMATICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- The student will be able to understand the basics of programming and use the Perl and its strengths for sequence manipulation and analysis.

UNIT 1 INTRODUCTION **9 Hrs.**

Biology and Computer Science - Limits to Computation - Getting Started with Perl - Perl's Benefits - Installing Perl on Your Computer - Running Perl Programs on various platforms - The Art of Programming - An Environment of Programs - Programming Strategies - The Programming Process - Sequences and Strings - Representing Sequence Data - A Program to Store a DNA Sequence - Control Flow - Comments Revisited - Command Interpretation – Statements – Variables – Strings

UNIT 2 STARTING TO CODE AND GETTING HELP **9 Hrs.**

Concatenating DNA Fragments - Transcription: DNA to RNA - Using the Perl Documentation - Calculating the Reverse Complement in Perl - Proteins, Files, and Arrays - Reading Proteins in Files – Arrays - scalar and List Context - Motifs and Loops - Flow Control - Conditional Statements - open and unless

UNIT 3 WRITING MORE CODE **9 Hrs.**

Finding Motifs - Regular Expressions - Counting Nucleotides - Exploding Strings into Arrays - Operating on Strings - Writing to Files - Subroutines and Bugs - Subroutines - Scoping and Subroutines - Command-Line Arguments and Arrays - Passing Data to Subroutines - Modules and Libraries of Subroutines - Fixing Bugs in Your Code - The Perl Debugger

UNIT 4 MANIPULATING MACROMOLECULES AND DATABASES **9 Hrs.**

Mutations and Randomization - A Program Using Randomization - A Program to Simulate DNA Mutation - Generating Random DNA - Analyzing DNA - The Genetic Code – Hashes - Data Structures and Algorithms for Biology - A Gene Expression Database - Gene Expression Data Using Unsorted Arrays - Gene Expression Data Using Hashes - Relational Databases - Translating Codons to Amino Acids - Translating DNA into Proteins - Reading DNA from Files in FASTA Format - Reading Frames - Translating Reading Frames

UNIT 5 RESTRICTION MAPS, REGULAR EXPRESSIONS AND MORE **9 Hrs.**

Regular Expressions - Restriction Enzyme Data - Logical Operators and the Range Operator - Finding the Restriction Sites - Perl Operations–GenBank - GenBank Files - Libraries - Separating Sequence and Annotation - Parsing Annotations- When to Use Regular Expressions - Protein Data Bank – Recursion - PDB Files - PDB File Format - Parsing PDB Files – BLAST - String Matching and Homology - BLAST Output Files - Parsing BLAST Output - Extracting Annotation and Alignments - Parsing BLAST Alignments - The printf Function – Bioperl - Bioperl Tutorial Script

Max. 45 Hrs.

TEXT / REFERENCE BOOKS

1. James Tisdall. Mastering Perl for Bioinformatics. O'Reilly Media, 2010.
2. Michalski, Brent, et al. Beginning Perl, John Wiley & Sons, Incorporated, 2012.
3. Dwyer, Rex A. Genomic Perl, From Bioinformatics Basics to Working Code, Cambridge University Press, 2002.
4. Holzner, Steven. Perl Black Book, Paraglyph Press, 2001.
5. Dominus, Mark Jason, Higher-Order Perl: Transforming Programs with Programs, Elsevier Science & Technology, 2005.
6. Oualline, Steve. Wicked Cool Perl Scripts: Useful Perl Scripts That Solve Difficult Problems, No Starch Press, Incorporated, 2006.
7. Krumins, Peteris. Perl One-Liners: 130 Programs That Get Things Done, No Starch Press, Incorporated, 2013.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SBTA3009	MOLECULAR MODELLING AND DRUG DESIGN	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To apply bioinformatics tools in designing novel drugs

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.**

Hard drugs, Soft drugs. Prodrugs. Drug targets - Enzymes, Receptors, Proteins, Nucleic acids, Lipids. Drug solubility, Drug Metabolism.

UNIT 4 DRUG DISCOVERY AND DESIGN **9 Hrs.**

Steps in drug Development, Computer aided drug design- structure based, Ligand based, Lead discovery, Pharmacophore. Molecular docking, QSAR

UNIT 5 COMPUTATIONAL REPRESENTATION OF MOLECULES **9 Hrs.**

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

Max.45 Hrs.

COURSE OUTCOMES

On completion of course, student will able to

CO1 - Provide an overview of the basic concepts of molecular modelling and analyse on the different types of input provided to generate 3D models along with the stability of a model based on the energy of the system

CO2 - Enumerate on the various force fields responsible for the energy of a system and assess the significance of energy minimisation for the stability of a system

CO3 - List out the different aspects of drugs like soft drugs and pro drugs and comprehend the various parameters involved in the solubility of the drugs

CO4 - Summarise the steps involved in the development of drugs and ponder on the important aspects of pharmacophore analysis and lead molecule identification in the process of drug design

CO5 - Describe the docking mechanism and analyse its importance in the development of drugs and thereby understand the nuances involved in the development of drugs

CO6 - Look into the various databases of molecules and analyse them by giving the appropriate input system like SMILES notation and analyse the three dimensional structures of molecules

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**

SCHA3010	BIOPROCESS INSTRUMENTATION AND CONTROL	L	T	P	Credits	Total Marks
		3	0	0	3	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 **9 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 **9 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 **9 Hrs.**

Introduction to Control system, open loop controller, 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 **9 Hrs.**

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

UNIT 5 INSTRUMENTATION AND CONTROL **9 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.45 Hrs.

COURSE OUTCOMES

On completion of course, student will able to

CO1. Become familiar with operation of control elements such as controllers, actuators and sensors
CO2. Formulate and solve dynamics models
CO3. Describe the behavior of dynamic processes and estimate process time constants
CO4. Describe the basic concepts of PID control
CO5. Understanding the principles and operation of controller tuning
CO6. Develop strategies for controlling chemical and bioprocess systems

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. George Stephanopolus, Chemical Process Control: An Introduction to Theory and Practice**,** 2nd Edition, Prentice Hall of India Pvt. Ltd., 2008.
4. Vyas R.P., Process control and instrumentation, 2nd Edition, Central Techno Publications, Nagpur 2005.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **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 16 marks **80 Marks**