GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE - 641 013
OFFICE OF THE CONTROLLER OF EXAMINATIONS

BRANCH : INDUSTRIAL BIOTECHNOLOGY

CURRICULUM : IV SEMESTER

S. No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
THEORY										
1.	16BBS401	PROBABILITY, STATISTICS AND RANDOM PROCESSES	BS	50	50	100	3	2	0	4
2.	16BES402	FLUID MECHANICS	ES	50	50	100	2	2	0	3
3.	16BPC403	MOLECULAR BIOLOGY	PC	50	50	100	3	0	0	3
4.	16BPC404	BIOCHEMICAL THERMODYNAMICS	PC	50	50	100	2	2	0	3
5.	16BPC405	ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY	PC	50	50	100	3	0	0	3
6.	16BPC406	IMMUNOLOGY	PC	50	50	100	3	0	0	3
PRACTICALS										
7.	16BPC407	MOLECULAR BIOLOGY LABORATORY	PC	50	50	100	0	0	4	2
8.	16BPC408	ANALYTICAL TECHNIQUES LABORATORY	PC	50	50	100	0	0	4	2
9.	16BPC409	CELL AND IMMUNOLOGY LABORATORY	PC	50	50	100	0	0	4	2
			TOTAL	450	450	900	16	6	12	25

10-11-2017

CONTROLLER OF EXAMINATIONS

16BBS401 **PROBABILITY, STATISTICS AND RANDOM PROCESSES** Category : BS

L T P C
3 2 0 4

Course Objectives:

* To gain the knowledge of probability concepts and statistical distributions both discrete and continuous cases including correlation analysis.
* To gain the knowledge of testing hypothesis for large and small samples.
* To familiarize with design of experiments.
* To be familiar with first and second order stationary, ergodic, Markov processes and also auto correlation, cross correlation, power spectral density and cross spectral density.

UNIT I	**PROBABILITY AND RANDOM VARIABLES**	**9+6 Periods**
	Axioms of probability – Conditional probability - Independent events – Total probability – Baye's theorem – Random variables – Discrete and continuous random variables – Moments – Moment generating functions and their properties.	
UNIT II	**PROBABILITY DISTRIBUTIONS**	**9+6 Periods**
	Binomial, Poisson, Geometric, Uniform, Exponential, Normal, Gamma, Weibull (Mean, Variance and Simple problems) Chebychev's inequality (Simple problems). Correlation - Regression - Multiple and Partial correlation – Partial correlation (Problems only).	
UNIT III	**TEST OF HYPOTHESIS**	**9+6 Periods**
	Large samples: Tests of means, variances and proportions. Small samples: Tests of means, variances and attributes using t, F, Chi Square distribution – Interval estimation for mean, standard deviation and proportion. Large sample test based on Normal distribution for single mean and difference means - Test based on t, Chisquare, and F distributions for testing mean and variances - Contingency table - Goodness of fit.	
UNIT IV	**DESIGN OF EXPERIMENTS**	**9+6 Periods**
	One way and two way classifications - Completely randomized block design - Latin square design - 2x2 factorial design.	
UNIT V	**RANDOM PROCESS**	**9+6 Periods**
	Classification of random process - Stationary process - Auto correlation and Cross correlation – Properties – Mean ergodic and cross ergodic process - Power spectral density – Cross spectral density – properties – Poisson process – Markov process – Markov chain – Classification of states of a Markov chain – Steady state distribution of a Markov chain.	

Contact Periods:
Lecture: 45 Periods **Tutorial: 30 Periods** **Total : 75 Periods**

TEXT BOOKS :

AUTHOR NAME	TITLE OF THE BOOK	PUBLISHER,YEAR OF PUBLICATION
Veerarajan T	*Probability and Random Processes (with Queueing Theory and Queueing Networks)*	*McGraw Hill Education(India) Pvt Ltd., New Delhi, 4th Edition 2016*

REFERENCE BOOKS:

AUTHOR NAME	TITLE OF THE BOOK	PUBLISHER,YEAR OF PUBLICATION
Gupta S.C and Kapoor V.K	*Fundamentals of Mathematical Statistics*	*Sultan Chand & Sons, New Delhi, 2015*
Gupta S.P	*Statistical Methods*	*Sultan Chand & Sons, New Delhi, 2015*
Kandasamy P, Thilagavathy K and Gunavathy K	*Probability, Statistics and Random Processes*	*S.Chand& Co, Ramnagar, New Delhi, Reprint 2013*
Yates and Goodman D.J	*Probability and Stochastic Processes*	*John Wiley and Sons, Second Edition, New Delhi, 2005*

COURSE OUTCOMES:

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

CO1: Understand probability axioms and calculate expected values through moment generating functions.

CO2: Understand probability distributions of discrete and continuous random variables and calculate coefficient of correlation, regression coefficients, multiple and partial correlation and regression plane.

CO3: Understand tests of sampling for large and small samples.

CO4: Acquire fluency in experimental design using criterion of ANOVA.

CO5: Understand stationary, ergodic, Markov processes and spectral densities.

COURSE ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	M	-	-	-	-	-	-	M	-	-	-	-
CO2	H	H	M	-	-	-	-	-	-	-	-	-	-	L
CO3	H	H	-	-	-	-	-	-	-	M	-	-	H	H
CO4	H	H	M	-	-	-	-	-	-	M	M	-	H	H
CO5	H	H	-	-	-	M	-	-	-	-	-	-	M	M
16BBS401	H	H	M	-	-	M	-	-	-	M	M	-	M	-

L- Low , M-Moderate, H- High

Controller of Examinations
Government College of Technology
COIMBATORE 641 013

16BES402 **FLUID MECHANICS** **Category : ES**

L	T	P	C
2	2	0	3

Course Objectives:

* Understand dynamics and properties of fluid flow.
* The engineering of fluid mechanics (flow measurements).
* Will learn to develop energy balance equation for flow systems determine pressure drop in fluid flow in reactors.

UNIT I	**INTRODUCTION**	**6 + 6 Periods**
	Properties of fluids, fluid statics, concept of shear stress, Newton's law of viscosity – Fluid behavior under shear, Newtonian and non-Newtonian fluids, Types of flow – Laminar, turbulent, steady, unsteady, non uniform and uniform flows – Compressible and incompressible fluids.	
UNIT II	**FLUID DYNAMICS**	**6 + 6 Periods**
	Continuity equation, Bernoulli's equation, boundary layer condition, form drag, skin drag, drag coefficient – Laminar and turbulent flow through closed conduit velocity profiles, pipes, tubes, fittings, valves, friction factor for smooth and rough pipes, head losses due to friction in pipes and fittings.	
UNIT III	**FLUID FLOW MEASURMENT AND PUMPING EQUIPMENTS**	**6 + 6 Periods**
	Orifice meter, Venturimeter, Pitot tube, Rota meter, weirs and notches, hot wire anemometer, displacement meter, current meter, magnetic flow meter, pressure measurement by manometers, U-tube, differential and inclined manometers, Pumps – Types, selection and specifications, positive displacement pumps, reciprocating pump, rotary pumps, centrifugal pumps - Characteristics curve of pumps – Fans, blowers and compressors.	
UNIT IV	**FLUIDIZATION AND PACKED BEDS**	**6 + 6 Periods**
	Mechanisms, types – Fluidized beds, properties of fluidized beds, continuous fluidization and application, packed beds – Pressure drop, flooding and loading. Mixing & agitation	
UNIT V	**MECHANICAL OPERATIONS**	**6 + 6 Periods**
	Size reduction equipments – Operations and their classification, Energy and power requirements, Laws of crushing, open and closed circuit operations - Techniques of size analysis – Different methods for storage of solids, conveyors and elevators.	

Contact Periods:
Lecture: 30 Periods **Tutorial : 30 Periods** **Total : 60 Periods**

TEXT BOOKS:

AUTHOR NAME	TITLE OF THE BOOK	PUBLISHER,YEAR OF PUBLICATION
McCabe Smith and Harriott	*Unit Operations of Chemical Engineering*	*McGraw-Hill company, 1993*
Geankoplis C.J.	*Transport Processes and Unit Operations.*	*Prentice Hall of India, 3rd edition, 2002.*
Frank M. White	*Fluid Mechanics*	*McGraw-Hill company, 2015.*

REFERENCE BOOKS:

AUTHOR NAME	TITLE OF THE BOOK	PUBLISHER,YEAR OF PUBLICATION
Coulson and Richardson 's	*Chemical Engineering. Vol I & II*	*Asian Books Pvt Ltd, 1998*
Bansal R K	*Fluid mechanics and Hydraulic machines 5th edition*	*Lakshmi publications (P)Ltd, New Delhi, 1997.*

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

CO1: Understand stress – strain relationship in fluids and analyse fluid flow problems.
CO2: To apply Bernouli principle and measure pressure drop in flow systems.
CO3: Describe the function and performance of flow metering devices.
CO4: Determine minimum fluidization velocity in fluidized bed.
CO5: Present characteristics of particulate solids, Principles of size reduction and screening, crushing and grinding equipment.

COURSE ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	H	H	M	L	-	-	-	-	-	-	H	H	L
CO2	M	M	-	H	-	-	L	L	M	L	M	H	H	L
CO3	M	M	H	L	M	M	-	-	-	-	-	M	L	H
CO4	L	H	H	M	L	-	L	M	-	-	-	H	H	M
CO5	L	H	-	-	L	-	-	-	L	L	L	H	H	M
16BES402	L	H	H	M	L	M	L	M	M	L	M	H	H	M

L- Low , M-Moderate(Medium), H- High

16BPC403 **MOLECULAR BIOLOGY** Category : PC

L T P C
3 0 0 3

Pre-Requisites:
1. 16BPC304 - Cell Biology

Course Objectives:
* To learn the fundamental aspects of nucleic acids
* To understand the principle and process of DNA replication, transcription and translation
* To study the basics of regulation of gene activity, mutation and DNA repair

UNIT I	**CLASSICAL & MOLECULAR GENETICS**	**8 Periods**
	Linkage, crossing over, classical experiments – Hershey and Chase; Avery McLeod & McCarty. Conformation of DNA and RNA, classes of RNA. Organization of eukaryotic chromosome – cot value, Bacterial conjugation, transduction and transformation - Sexduction.	
UNIT II	**DNA REPLICATION**	**10 Periods**
	Rules of replication in all nucleic acid, enzymology, replication – Continuous, discontinuous. Replication in prokaryotes - D-loop and rolling circle mode of replication, replication of linear viral DNA. Replication of telomeres in eukaryotes	
UNIT III	**TRANSCRIPTION**	**10 Periods**
	RNA polymerase, RNA replicase (Virus), Transcription in prokaryotes and eukaryotes, Inhibitors, features of promoters and enhancers, transcription factors, nuclear RNA splicing mechanisms – tRNA, rRNA, mRNA, ribozymes, RNA editing.	
UNIT IV	**TRANSLATION**	**10 Periods**
	Elucidation of genetic code, Salient features of genetic code - Wobble hypothesis, ribosomes – Prokaryotic & eukaryotic, protein synthesis, post translational processing, Protein targeting.	
UNIT V	**MUTATION – REPAIR AND REGULATION OF GENE EXPRESSION**	**7 Periods**
	Regulation of genes – Replication, transcription & translation factors, Lac and trp operon. Mutation – Transition, transversion, artificial & natural mutation, suppressor mutation. Repair of DNA.	

Contact Periods:
Lecture: 45 periods **Total: 45 periods**

TEXT BOOKS:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, EDITION, YEAR OF PUBLICATION
David Friefelder	*Molecular Biology*	*Narosa Publ. House.2nd edition, 1999*

REFERENCE BOOKS:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, EDITION, YEAR OF PUBLICATION
Benjamin Lewin	*Gene VII*	*Oxford University Press,7th edition. (2000).*
Watson JD, Hopkins WH, Roberts JW, Steitz JA, Weiner AM	*Molecular Biology of the Gene*	*McGraw Hill,2nd edition, (1986)*

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

CO1: Get familiarize with the biomolecules and their functions
CO2: Understand the fundamentals of classical & molecular genetics
CO3: Understand the regulatory mechanism of molecular biology
CO4: Solve molecular biology problems and to think analytically
CO5: Articulate applications of molecular biology in the modern world

COURSE ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	-	-	-	-	-	-	-	-	-	-	-	H	L
CO2	H	-	-	-	-	-	-	-	-	-	-	-	H	M
CO3	L	M	H	-	-	-	-	-	-	-	-	-	H	M
CO4	-	H	M	-	M	-	-	-	-	-	-	-	M	H
CO5	-	L	H	-	M	-	-	-	-	-	-	M	M	H
16BPC403	H	H	H	-	M	-	-	-	-	-	-	M	H	H

L – Low, M – Moderate, H- High

16BPC404 **BIOCHEMICAL THERMODYNAMICS** Category : PC

L	T	P	C
2	2	0	3

Pre-Requisites:

1. 16BES302 - Process Calculations

Course Objectives:

* To design & solve problem in realistic cases by applying thermodynamics concepts
* To estimate or locate necessary thermodynamic data
* To estimate thermodynamic properties of substances in gas and liquid states
* To understand about biochemical equilibrium and able to calculate the kinetics of biological systems

UNIT I	**THERMODYNAMIC LAW AND PROPERTIES OF FLUIDS**	**6 + 6 Periods**
	Review of laws of thermodynamics and their applications; thermodynamic analysis of processes. Thermodynamic properties of fluids and their interrelationship: PVT behavior of pure substances; Equation of state; Generalized correlations and acentric factor; PVT behavior of mixtures; Thermodynamics charts; Estimation of thermodynamic properties.	
UNIT II	**SOLUTION THERMODYNAMICS**	**6 + 6 Periods**
	Partial molar properties; Chemical potential; Gibbs - Duhem equation; Ideal and non-ideal solutions; Fugacity and fugacity coefficient; Activity and activity coefficient; Excess properties of mixtures.	
UNIT III	**PHASE EQUILIBRIA**	**6 + 6 Periods**
	General criterion for equilibrium and their application; Stability constraints; Gibbs phase rule and its derivation for reacting and non-reacting systems; Vapour-liquid, liquid-liquid, and vapour-solid equilibrium for ideal and non-ideal systems.	
UNIT IV	**CHEMICAL REACTION EQUILIBRIA**	**6 + 6 Periods**
	Chemical equilibrium constants; Homogeneous and heterogeneous reactions; Standard Gibbs free energy change; Equilibrium conversion in single and multiple reactions.	
UNIT V	**THERMODYNAMIC DESCRIPTION OF MICROBIAL GROWTH AND PRODUCT FORMATION**	**6 + 6 Periods**
	Thermodynamics of microbial growth stoichiometry, maintenance, Calculation of the Operational Stoichiometry of a growth process including Heat using the Herbert – Pirt Relation for Electron Donor, thermodynamics and stoichiometry of Product Formation.	

Contact Periods:
Lecture: 30 Periods **Tutorial: 30 Periods** **Total : 60 Periods**

TEXT BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, EDITION, YEAR OF PUBLICATION
Smith J.M Van Ness H.C Abbott M.M	*Introduction to Chemical Engineering Thermodynamics*	*McGraw-Hill, 7th edition,2005*
Narayanan K.V	*A Text Book of Chemical Engineering Thermodynamics*	*Prentice Hall of India, 2nd edition, 2013*
Christiana D Smolke	*The Metabolic Pathway Engineering Handbook Fundamentals*	*CRC Press Taylor & Francis 1st edition,2010*

REFERENCE BOOKS:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, EDITION, YEAR OF PUBLICATION
Hougen O.A., Watson K.M., and Ragatz R.A	*Chemical Process Principles Part II*	*John Wiley & Sons, 2nd edition, 2004*
Sandler S.I	*Chemical and Engineering Thermodynamics*	*John Wiley & Sons, 4th edition, 2006.*

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

CO1: Illustrate the application of thermodynamics in design & operation of process industries.
CO2: Design & solve problem in realistic cases by applying thermodynamics concepts.
CO3: Estimate or locate necessary thermodynamic data.
CO4: Estimate thermodynamic properties of substances in gas and liquid states
CO5: Interpret the phase equilibria concepts in multi-component systems
CO6: Understand about biochemical equilibrium and able to calculate the kinetics of biological systems.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M	-	-	-	-	L	M	L	L	-	M	H	H
CO2	H	H	H	-	H	-	-	-	M	M	-	M	H	H
CO3	L	M	-	L	M	-	-	-	-	-	-	L	L	H
CO4	M	M	M	L	-	-	-	-	L	L	-	L	L	M
CO5	M	M	M	M	M	-	-	-	L	L	-	L	L	M
CO6	-	M	L	M	H	-	-	-	-	-	-	M	M	H
16BPC404	M	M	M	M	H	-	L	M	L	L	-	M	H	H

L – Low, M – Moderate (Medium), H – High

16BPC405 **ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY** Category : PC

L	T	P	C
3	0	0	3

Pre-Requisites:

1. 16BPC306 – Biochemistry

Course Objectives:

* To analyse the research findings and interpretation can be ascertained by the knowledge gained from this course.
* To understand the structural behavior of molecule using molecular spectroscopy.
* To inculcate knowledge on the various separation and purification methods.

UNIT I	**BASICS OF MEASUREMENT**	**9 Periods**
	Classification of methods – Calibration of instrumental methods – Electrical components and circuits - Signal to noise ratio – Signal – Noise enhancement; Properties of electromagnetic radiations and their interaction with matter.	
UNIT II	**MOLECULAR SPECTROSCOPY**	**9 Periods**
	UV and visible light spectroscopy - Qualitative and Quantitative absorption Measurement, Beer-Lambert law, Spectrofluorimetry, IR spectroscopy, Raman spectroscopy, NMR spectroscopy, X-ray crystallography – Principle, instrumentation and applications; X-Ray Photoelectron Spectroscopy.	
UNIT III	**ELECTROPHORESIS**	**9 Periods**
	General principle of electrophoresis, support media (agarose and polyacrylamide gels), electrophoresis of proteins by SDS-PAGE, native PAGE, gradient gels, isoelectric focusing, two dimensional PAGE, electrophoresis of nucleic acids using agarose gel, sequencing gel, PFGE, FIGE, CHEF, capillary electrophoresis	
UNIT IV	**CHROMATOGRAPHY**	**9 Periods**
	Principles of chromatography, distribution coefficient, retention time, capacity factor, plate height and resolution, peak broadening and van Deemter plot, TLC and column chromatography, matrix materials, HPLC, ion exchange chromatography, gel exclusion chromatography and Gas chromatography	
UNIT V	**THERMAL METHODS**	**9 Periods**
	Different thermal analysis techniques. Differential scanning calorimetry - Instrumentation & application. Differential thermal analysis - Instrumentation & application, DTA curve. Thermogravimetry – Instrumentation & application, TG curve.	

Contact Periods:
Lecture: 45 periods **Total: 45 periods**

TEXT BOOKS:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, EDITION, YEAR OF PUBLICATION
Willard H.W., Merritt L.L., Dean J.A. & Settle F.A	*Instrument Methods of Analysis*	*East West Publishers 6th ed. 1988*
Skoog, D.A. F. James Holler, and Stanky, R. Crouch	*Instrumental Methods of Analysis*	*Cengage Learning, 6th edition 2007*

REFERENCE BOOKS:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, EDITION, YEAR OF PUBLICATION
Harrison ,R.G., Todd, P., Rudge, S.R. and Petrides	*Bioseparations: Science and Engineering*	*B.B. Oxford University Press (2006).*
Wilson K. and Walker J	*Principles and Techniques of Biochemistry and Molecular Biology*	*Cambridge University Press (2005) 6th ed*

COURSE OUTCOMES:

Upon completion of the course, the students will be able

CO1: Understand the Basics of Measurement in instrumental methods
CO2: Impart knowledge on spectroscopic analytical methods
CO3: Inculcate knowledge on the separation of nucleic acids and proteins in molecular biology
CO4: Study the different chromatographic separation methods and their analysis.
CO5: Analyse the thermal behaviour of the bioproducts.

COURSE ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	H	M	-	-	-	-	-	L	L	-	L	H	L
CO2	L	L	H	-	-	-	L	-	L	L	-	-	H	M
CO3	M	L	H	-	-	-	L	-	-	-	-	L	L	M
CO4	M	L	H	-	-	-	L	L	-	-	-	-	H	M
CO5	L	H	M	-	-	-	L	-	-	-	-	-	M	L
16BPC405	M	L	H	-	-	-	L	L	L	L	-	L	H	M

L – Low, M – Moderate, H- High

16BPC406 **IMMUNOLOGY** Category : PC

L	T	P	C
3	0	0	3

Pre-Requisites:

1. 16BPC304 - Cell Biology

Course Objectives:

* To articulate the role of various cells and organs involved in immune responses and associated functions
* To gain knowledge on the interaction between the immune system and pathogens
* To develop the ability to identify issues in clinical immunology

UNIT I	**CELLS AND ORGANS OF THE IMMUNE SYSTEMS**	**6 Periods**
	Innate and acquired immunity; cells of immune system, primary and secondary lymphoid organs;	
UNIT II	**ANTIGENS AND ANTIBODIES**	**12 Periods**
	Antigens: chemical and molecular nature; haptens; adjuvants; B and T-cell epitopes; antigenic determinants on antibodies; antibodies: structure and functions; antibodies: genes and generation of diversity; antigen-antibody reactions; monoclonal antibodies: principles and applications;	
UNIT III	**CELLULAR RESPONSES**	**10 Periods**
	Development, maturation, activation and differentiation of T-cells and B-cells; antigen presenting cells; major histocompatibility complex; antigen processing and presentation; regulation of T-cell and B-cell responses; cytokines;	
UNIT IV	**INFECTION AND IMMUNITY**	**8 Periods**
	Immune responses to infections: immunity to viruses, bacteria, fungi and parasites; complement; immunosuppression, tolerance; allergy and hypersensitivity; vaccines.	
UNIT V	**AUTOIMMUNITY AND TRANSPLANTATION IMMUNOLOGY**	**9 Periods**
	Autoimmunity, Auto immune diseases: systemic and organ specific autoimmune disorders, proposed mechanisms for induction of Autoimmunity, Treatment of Autoimmune diseases; Types of grafts, Basis of Graft rejection, specificity and memory of graft rejection, Mechanisms involved in Graft rejections, Tests for HLA matching, General and specific immunosuppression therapies	

Contact Periods:
Lecture: 45 periods **Total: 45 periods**

TEXT BOOKS:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, EDITION, YEAR OF PUBLICATION
Kuby J	*Immunology*	*WH Freeman & Co. 5th edition 2000.*
Roitt I, Male, Brostoff.	*Immunology*	*Mosby Publishers 6th edition 2002.*

REFERENCE BOOKS:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, EDITION, YEAR OF PUBLICATION
Chakaravarthy, A.K	*(2006) Immunology and Immunotechnology*	*1st Edition (English) 1st Edition, Oxford University Press India.*

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

CO1: Outline the basic components of immune system and their functions.
CO2: Illustrate various diagnostic methods based on antigen-antibody interaction
CO3: Describe principles and methods of various cellular immune responses
CO4: Demonstrate the state of immune system during infection
CO5: Find effective solutions for the treatment of autoimmune disorders and problem associated with organ transplantation

COURSE ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L	H	L	-	-	L	-	-	-	-	-	L	H	L
CO2	M	L	M	H	-	M	L	-	L	M	M	L	L	H
CO3	H	L	L	-	-	-	-	-	-	-	M	-	L	L
CO4	H	L	M	-	-	L	L	M	-	-	M	L	L	L
CO5	H	L	M	H	L	M	H	-	-	L	M	H	L	H
16BPC406	H	L	M	H	L	M	L	M	L	M	M	L	L	L

L – Low, M – Moderate, H- High

16BPC407 **MOLECULAR BIOLOGY LABORATORY** Category : PC

L	T	P	C
0	0	4	2

Pre-Requisites:

1. 16BPC308 – Microbiology Laboratory

Course Objectives:

* To provide hands on experience in performing basic molecular biology techniques.
* Introduce students to the theory behind in each technique and to describe common applications of each methodology in biological research.

LIST OF EXERCISES
1. Agarose gel electrophoresis for quality and quantity assessment.
2. DNA quantification by UV spectroscopy.
3. DNA Extraction from plant cells.
4. DNA Extraction from animal cells.
5. DNA Extraction from Bacterial cells.
6. Plasmid Extraction from bacterial cell.
7. DNA Extraction from Human blood.
8. Molecular weight calculation using gel electrophoresis.
9. RNA extraction.
10. Denaturing gel electrophoresis for RNA.

Contact Periods:
Practical: 60 periods **Total: 60 periods**

REFERENCE BOOKS:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, EDITION, YEAR OF PUBLICATION
Sambrook, Joseph and David W. Russell	*The Condensed Protocols: From Molecular Cloning: A Laboratory Manual*	*Cold Spring Harbor, 4th edition, 2006*

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

CO1: Understand the principles underlying in the techniques of molecular biology.
CO2: Analyze the applications of these techniques.
CO3: Carry out lab experiments and interpret the results.
CO4: Take safety precautions on usage of hazardous chemicals in case of emergency.
CO5: Trouble shoot the problems while performing an experiment.

COURSE ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L	M	H	L	H	-	-	-	L	M	-	-	H	M
CO2	L	M	H	L	M	-	-	-	L	L	-	-	H	H
CO3	L	M	H	L	H	-	-	-	L	H	-	-	H	M
CO4	M	L	L	L	-	-	-	-	L	L	-	-	H	M
CO5	-	-	H	-	-	-	-	-	-	-	H	-	M	H
16BPC407	L	M	H	L	H	-	-	-	L	H	H	-	H	M

L – Low, M – Moderate, H- High

16BPC408 **ANALYTICAL TECHNIQUES LABORATORY** Category : PC

L	T	P	C
0	0	4	2

Pre-Requisites:

1. 16BPC309 - Biochemistry Laboratory

Course Objectives:

* The students will be able to get familiar on different analytical techniques to employ their knowledge to solve the research problem.

LIST OF EXERCISES
1. Precision and Validity in an experiment.
2. Validating Lambert-Beer's law using $KMnO_4$.
3. Absorption spectrum of ferrous ions using absorption spectroscopy.
4. Finding the concentration of the Iron content present in the tablet using absorption spectrometry.
5. Finding the concentration of Na and Ca using flame photometer.
6. Finding the Concentration of Phosphate content in soft drinks.
7. Chromatography analysis using TLC.
8. Column chromatographic analysis of chlorophyll.
9. Finding the concentration of Na and Ca using atomic absorption spectrophotometer.
10. Data interpretation of FTIR spectra and X-Ray Diffraction techniques

Contact Periods:
Practical: 60 periods **Total : 60 periods**

TEXT BOOKS:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, EDITION, YEAR OF PUBLICATION
Skoog, D.A. F. James Holler, and Stanky, R. Crouch	*Instrumental Methods of Analysis*	*Cengage Learning, 6th edition, 2007*

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

CO1: Understand the Lambert-Beers law and validation of Absorption spectroscopy.
CO2: Get familiarize with the working of UV-Visible spectroscopy and to find the concentration of organic compounds using absorption spectroscopy
CO3: Understand the working of Flame photometer and Atomic Absorption Spectrophotometer.
CO4: Impart knowledge on separation methods for bioproducts.
CO5: Understand the theory in the interpretation of FTIR spectrum and XRD pattern

COURSE ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M	H	L	H	-	-	-	L	M	-	-	H	M
CO2	L	M	H	L	M	-	-	-	L	L	-	-	H	H
CO3	L	H	M	L	H	-	-	-	L	M	-	-	H	M
CO4	L	M	L	L	H	-	-	-	L	L	-	-	M	M
CO5	L	L	H	L	H	-	-	-	L	L	-	-	H	H
16BPC408	L	M	H	L	H	-	-	-	L	L	-	-	H	M

L – Low, M – Moderate, H- High

16BPC409 **CELL AND IMMUNOLOGY LABORATORY** Category :PC

L	T	P	C
0	0	4	2

Course Objectives:

* To perform different staining techniques to identify blood cells and cell division using microscope
* To perform qualitative and quantitative analyses of antigens and antibodies and interpret the data based on pathological processes
* To work as a team to perform and analyze practical methods

LIST OF EXERCISES
1. Staining for different stages of mitosis in *Allium cepa* (Onion).
2. Identification of meiosis cell division in Grass hopper testis.
3. Identification of cells in a blood smear using Leishman stain.
4. Counting of cells using haemocytometer.
5. Osmosis and Tonicity.
6. Separation and Identification of Peripheral Blood Mononuclear Cells from blood and Analysis of Cell viability using Tryphan Blue stain.
7. Separation and preservation of serum from blood.
8. Agglutination reaction to determine blood group.
9. Immunodiffusion (Double diffusion, Ouchterlony method, radial immunodiffusion).
10. Immunoelectrophoresis.
11. Enzyme Linked Immuno Sorbent Assay (ELISA).

Contact Periods:
Practical: 60 periods **Total: 60 periods**

REFERENCE BOOKS:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, EDITION, YEAR OF PUBLICATION
De Robertis, E.D.P. and De Robertis, E.M.F	*Cell and Molecular Biology*	*Lippincott Williams and Wilkins, Philadelphia, 8th edition, 2006.*
Roitt, I	*Essential Immunology*	*Blackwell Scientific, 9th edition, 1997.*

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

CO1: Identify the different specimens using microscope
CO2: Perform different staining techniques for the study of blood cells and cell division
CO3: Demonstrate various strategies of antigen-antibody interactions
CO4: Perform experiments to quantify immune molecules
CO5: Interpret the data obtained based on pathological processes

COURSE ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	-	-	-	L	-	-	-	M	-	-	-	H	M
CO2	M	-	-	-	L	-	-	-	H	-	M	-	H	M
CO3	M	H	M	-	-	-	-	-	L	H	-	L	M	H
CO4	-	M	H	-	M	-	-	M	H	-	H	-	M	H
CO5	M	-	H	-	-	-	-	-	H	L	H	H	M	H
16BPC409	M	M	H	-	L	-	-	M	H	M	H	M	M	H

L – Low, M – Moderate, H- High