3rd Semester (Second Year) – Curriculum

Contact Hours: 25

Course code	Course name	Hours per week			Marks Distribution		Total marks	Credits
		L	T	P	Internal	External		
BTBT-18301	Mathematics-III	3	1	-	40	60	100	4
BTBT-18302	Microbiology	4	-	-	40	60	100	4
BTBT-18303	Biochemistry	3	-	-	40	60	100	3
BTBT-18304	Bioanalytical Techniques	3	-	-	40	60	100	3
BTBS-18305	Biology	3	-	-	40	60	100	3
BTBT-18306	Biotech Lab – I (Microbiology Lab)	-	-	4	30	20	50	2
BTBT-18307	Biotech Lab-II (Biochemistry and Bioanalytical Techniques Lab)	-	-	4	30	20	50	2
Total		**16**	**1**	**8**	**260**	**340**	**600**	**21**

4th Semester (Second Year) – Curriculum

Contact Hours: 26

Course code	Course name	Hours per week			Marks Distribution		Total marks	Credits
		L	T	P	Internal	External		
BTBT-18401*	Biostatistics	3	1	-	40	60	100	4
BTBT-18402	Immunology and Immunotechnology	4	-	-	40	60	100	4
BTBT-18403	Animal Cell Culture and Biotechnology	3	-	-	40	60	100	3
BTBT-18404	Transport Phenomena	3	1	-	40	60	100	4
BTHS-18901	Fundamentals of Management for Engineers	3	-	-	40	60	100	3
BTBT-18405	Biotech Lab-III (Immunology Lab)	-	-	4	30	20	50	2
BTBT-18406	Biotech Lab-IV (Animal Cell Culture and Biotechnology Lab)	-	-	4	30	20	50	2
BTMC- I	Environmental Sciences	-	-	-				0
Total		**16**	**2**	**8**	**260**	**340**	**600**	**22**

***This Subject shall be taught by the faculty of Applied Sciences Department.**

5th Semester (Third Year) – Curriculum

Contact Hours: 27

Course code	Course name	Hours per week			Marks Distribution		Total marks	Credits
		L	T	P	Internal	External		
BTBT-18501	Chemical Engineering Principles	3	1	-	40	60	100	4
BTBT-18502	Genetic Engineering	3	-	-	40	60	100	3
BTBT-18503	Cell and Molecular Biology	3	-	-	40	60	100	3
BTBT-18XXX	DE-I	3	-	-	40	60	100	3
BTXX-18XXX	OE-I	3	-	-	40	60	100	3
BTHS-18902	Entrepreneurship and Project Management	3	-	-	40	60	100	3
BTBT-18504	Biotech Lab-V (Genetic Engineering Lab)	-	-	4	30	20	50	2
BTBT-18505	Biotech Lab- VI (Cell and Molecular Biology Lab)	-	-	4	30	20	50	2
BTMC-II	Constitution of India/Essence of Indian Traditional Knowledge	-	-	-				0
Total		**18**	**1**	**8**	**300**	**400**	**700**	**23**

6th Semester (Third Year) – Curriculum

Contact Hours: 25

Course code	Course name	Hours per week			Marks Distribution		Total marks	Credits
		L	T	P	Internal	External		
BTBT-18601	Fundamentals of Biochemical Engineering	3	1	-	40	60	100	4
BTBT-18602	Plant Biotechnology	4	-	-	40	60	100	4
BTBT-18603	Food and Fermentation Technology	3	-	-	40	60	100	3
BTHS-18903	Human Resource Management	3	-	-	40	60	100	3
BTXX-18XXX	OE-II	3	-	-	40	60	100	3
BTBT-18604	Biotech Lab-VII (Plant Biotechnology Lab)	-	-	4	30	20	50	2
BTBT-18605	Biotech Lab-VIII (Biochemical Engineering Lab)	-	-	4	30	20	50	2
Total		**16**	**1**	**8**	**260**	**340**	**600**	**21**

7th Semester (Fourth Year) – Curriculum

Contact Hours: 24

Course code	Course name	Hours per week			Marks Distribution		Total marks	Credits
		L	T	P	Internal	External		
BTBT-18701	Enzymology and Enzyme Technology	3	1	-	40	60	100	4
BTBT-18702	Bioinformatics	3	-	-	40	60	100	3
BTBT-18703	Biomedical Instrumentation	3	-	-	40	60	100	3
BTBT-18XXX	DE II	3	-	-	40	60	100	3
BTXX-18XXX	OE III	3	-	-	40	60	100	3
BTBT-18704	Biotech Lab-IX (Enzymology and Enzyme Technology Lab)	-	-	4	30	20	50	2
BTBT-18705	Biotech Lab-X (Bioinformatics Lab)	-	-	4	30	20	50	2
BTBT-18706	Summer Internship (6-8 weeks)*	-	-	-	40	60	100	3
Total		**15**	**1**	**8**	**300**	**400**	**700**	**23**

***This internship is during the summer break after 6th Semester (3rd Year).**

8th Semester (Fourth Year) - Curriculum

Course Code	Course Name	Marks Distribution		Total Marks	Credits
		Internal	External		
BTBT-18801	Industrial training	200	200	400	12

List of Departmental Elective (DE)

Course Code	Course Name
BTBT-18951	IPR management in Biotechnology
BTBT-18952	Stem Cell Technology
BTBT-18953	Advances in drug design and pharmacogenomics
BTBT-18954	Biological waste treatment
BTBT-18955	Introduction to Cancer Biology
BTBT-18956	Protein Engineering
BTBT-18957	Molecular Farming
BTBT-18958	Environmental Biotechnology
BTBT-18959	Pharmaceutical Biotechnology
BTBT-18960	Agricultural Biotechnology

List of Open Elective (OE)

Course Code	Course Name
BTBT-18970	Industrial Waste management
BTBT-18971	Bioinformatics
BTBT-18972	Food Safety
BTBT-18973	IPR
BTBT-18974	Biomedical Instrumentation
BTBT-18975	Human Disease and Control
BTBT-18976	Bio fertilizer Technology
BTBT-18977	Bio Nanotechnology
BTBT-18978	Biofuels
BTBT-18979	Computational Biology

Total Credits=122

From 3rd Semester to 8th Semester

Total Internal Marks: 1580

Total External Marks: 2020

Total Marks: 3600

BTBT-18301 Mathematics – III

Internal Marks: 40
External Marks: 60 **L T P**
Total Marks: 100 **3 1 0**

Objectives:
The objective of this course is to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Laplace transformations:
Laplace transforms of various standard functions, properties of Laplace transform.

(10)

Partial Differential Equations:
Formation of Partial Differential Equations, linear Partial Differential Equations, Homogeneous Partial Differential Equations with constant coefficients.

(10)

Functions of complex variables:
Limits, continuity and derivative of the function of complex variable, Analytic function, Cauchy-Riemann equations, conjugate functions, harmonic functions; Complex Integration: Line integrals in the complex plane, Cauchy's theorem, Cauchy's integral formula and derivatives of analytic function

(10)

Linear Systems and Eigen- Values:
Gauss–elimination method, gauss- Jordan method, Gauss- Seidel iteration method, Rayleigh's Power method for Eigen values and Eigenvectors.

(10)

Suggested Books:

1 Kreyszig, E., Advanced Engineering Mathematics, Eighth edition, John Wiley, New Delhi
2 Grewal, B. S., Higher Engineering Mathematics, Khanna Publishers, New Delhi
3 Ian N. Sneedon, Elements of Partial Differential Equations, McGraw- Hill, Singapore, 1957
4 Peter. V. O'Nil, Advanced Engineering Mathematics, Wadsworth Publishing Company

BTBT-18302 Microbiology

Internal Marks: 40
External Marks: 60 **L T P**
Total Marks: 100 **3 0 0**

Objective: The course imparts the knowledge of different types of microorganisms that are invisible to our naked eyes. Discovery, origin and evaluation of different forms of bacteria, fungi, protozoa and viruses constitute the basics of biotechnology. It will also give an insight of the industrial applications of microbial organisms.

Unit–I Prokaryotic Cell Organization: General account of cell size, arrangement, shape, capsule, slime, pili, spores, structure and function of gram negative & gram-positive cell wall and membrane, periplasmic space. Brief account of viruses, mycoplasma and fungi. (5)

Unit–II Bacteriological Techniques: Isolation of industrially important microbial strains, strain improvement, maintenance and preservation of industrial microbes. (5)

Unit–III Bacterial Nutrition: Physical growth requirements viz. temperature, pH, oxygen concentration, water activity, light, pressure. Chemical growth requirements viz. nutrients, nutrient uptake in bacteria: Passive and facilitated diffusion, active transport. (4)

Unit–IV Bacterial Growth Kinetics: Growth curve, growth rate and generation time. Growth kinetics, mathematical nature and expression of growth, measurement of growth by quantitating cell mass, cell number and a cell constituent, concept of geometric & arithmetic nature of growth, asynchronous and synchronous cultures, diauxic growth. (6)

Unit–V Bacterial Reproduction: Asexual reproduction, DNA replication in bacterial cell, general principles of bacterial recombination - transformation, transduction and conjugation. (6)

Unit–VI Medical Microbiology: Characteristics of major pathogens (Mycobacterium tuberculosis, Plasmodium sp., etc) their modes of transmission, mechanisms of infection and growth. Production and application of health care products(antibiotics, vitamins, amino acids, alkaloids, steroids) (4)

Unit–VII Agricultural & Environmental Microbial Biotechnology: Large-scale production of microbial inoculants for agriculture, mycorrhiza, treatment of urban (sewage) and industrial effluents. Bioplastics, Bioinstecticides, Biofertilizers, Biofuels(bioethanol, biogas, biohydrogen andbiodiesel),Biosensors. (6)

Course outcomes:

1. To be able to understand the roles and characteristics of microorganisms.
2. To understand the basic concept of replication in microorganisms.
3. To be able to understand economic significance of microorganisms and assess their impact on environment.
4. To be able to evaluate explicitly, the metabolic pathways, role of microbes in public health as well as physical and chemical control of microorganisms.

Suggested Reading and Books:

1. Microbiology 10th Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill
2. Microbiology: An Introduction (9th Ed.) by Tortora GJ, Funke BR, and Case CL, Pearson Education, 2008.
3. Prescott, Harley and Klein's Microbiology (7th Ed.) by Willey JM, Sherwood LM, and Woolverton CJ, McGraw Hill Higher Education, 2008.
4. Principles of Fermentation Technology (3rd Ed.) by Stanbury PF, Whitaker A and Hall SJ, Elsevier Science Ltd, 2006.
5. Environmental Microbiology (3rd Ed.) by R. Mitchel, Wiley-Blackwell, 2009.
6. Microbial Biotechnology: Fundamentals of Applied Microbiology (2nd Ed) by Glazer & Nikaido, W.H. Freeman and Co., New York, 1995.
7. Molecular Biotechnology (3rd Ed.) by Glick BR and Pasternak JJ, ASM Press, Washington D.C., 2003.

BTBT-18303 Biochemistry

Internal Marks: 40
External Marks: 60 **L T P**
Total Marks: 100 **3 0 0**

Objective: The course aims on understanding of the relationships between structure and function in the major classes of biopolymers. It augurs understanding on central metabolic process and the role of enzymes in modulating pathways. The theoretical background of biochemical systems helps to interpret the results of laboratory experiments.

Unit–I Biomolecules: 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. (5)

Unit–II Proteins: Primary, Secondary, Tertiary and Quaternary Structure, Proteins Analysis, Methods for Isolation and Purification of Proteins. (6)

Unit–III Fat Metabolism: Oxidation of fatty acids, synthesis of fatty acids (fatty acid synthesis complex system), and ketone bodies. Carbohydrates Metabolism: Glycolysis, glycogenolysis, glycogenesis and their regulations, citric acid cycle. (7)

Unit–IV Amino acid Metabolism: Oxidative degradation and synthesis of amino acids, estimation of amino acids. Nucleic Acid Metabolism: Biosynthesis of purines and pyrimidines, their regulation and catabolism (6)

Unit–V Mitochondria: Structure of mitochondria, organization of respiratory chain, oxidative phosphorylation and its inhibitors (6)

Unit–VI Plant & Microbial Biochemistry: Photosynthesis, differences in respiratory mechanisms and anaerobes. (4)

Unit–VII Nitrogen- Fixation: Role of Various Enzymes in Nitrogen Cycle. (3)

Course outcomes

1. Understand complex biochemical pathways within living cells
2. Understand the physiological functioning of the cells
3. Understand catabolic and anabolic metabolism
4. Determine the kinetic parameters of enzymatic reactions

Suggested Reading and Books:

1. A.L. Lehninger: Principles of Biochemistry, 7th edition, Worth Publishers, New York (2017)
2. L. Stryer: Biochemistry, W.H. Freeman and Company, 8th edition New York (2015)
3. B.D. Hames et al: Instant Notes in Biochemistry, BIOS Sci. Pub. Ltd. U.K. (2001)
4. G. Zubay: Biochemistry, W.C. Brown Publishers, Oxford, England (2002).

BTBT-18304 Bioanalytical Techniques

Internal Marks: 40
External Marks: 60 **L T P**
Total Marks: 100 **3 0 0**

Objective: Research in the field of biotechnology and its applications in development of technologies involve various kinds of unique techniques. Though these techniques are purely based on the principles of physics and chemistry yet they are specialized for biological applications. The course is aimed to impart conceptual as well as descriptive knowledge about such techniques to the bachelor students pursuing education in the field of biotechnology.

Unit–I Centrifugation: Basic principles of sedimentation, centrifugal field and relative centrifugal force, types of centrifuges, ultracentrifugation, safety aspects of centrifuges, types of rotors, differential centrifugation, density gradient centrifugation, preparative and analytical centrifugation. (4)

Unit–II Microscopy: Introduction to basic principles of microscopy, light microscopy, basic components of light microscope, compound microscope, contrast in light microscopy, advances in microscopy including confocal microscopy, fluorescent microscopy, stereomicroscope, introduction to basic principles of electron microscopy, preparation of samples, TEM, SEM and AFM. (6)

Unit–III Electrophoresis: 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, Western blot analysis, visualization of proteins in gels, electrophoresis of nucleic acids using agarose gel, sequencing gel, denaturing agarose gel, capillary electrophoresis. (5)

Unit–IV Chromatography: 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, LPLC, HPLC, normal phase and reversed phase chromatography, ion exchange chromatography, gel exclusion chromatography, affinity chromatography, GC. (6)

Unit–V Spectroscopy-I: Properties of electromagnetic radiations and their interaction with matter, UV and visible light spectroscopy, Beer-Lambert law, spectrofluorimetry, CD spectroscopy, Mass spectrometry, components of mass spectrometer, methods of ionization and mass analysis including MALDI-TOF. (6)

Unit–VI Spectroscopy-II: IR spectroscopy, Raman spectroscopy, ESR and NMR spectroscopy, X-ray crystallography. (5)

Unit–VII Radioisotope Techniques: Atomic stability and radiation, types of decay, rate of radioactive decay and half-life, units of radioactivity, specific activity, detection methods based

on ionization (GeigerMuller monitor), excitation (solid and liquid scintillation counting), Cerenkov counting, autoradiography, safety aspects of handling radioactive material and radiations, units of exposure such as gray and sievert, precautions associated with radioactivity handling. (4)

Course Outcomes:

1. To be able to use selected analytical techniques.
2. Familiarity with working principals, tools and techniques of different instruments.
3. To understand the strengths, limitations and creative use of techniques for problem-solving.
4. Able to design experiments and understand the instrumentation

Suggested Books:

1. Principles and Techniques of Biochemistry and Molecular Biology, Wilson K. And Walker J., Cambridge University Press (2010) 7th ed.
2. Biochemical Method-A Concise guide for students and researchers, Pingoud A., Urbanke C., Hoggett J. and Jeltsch A. Wiley-VCH Publishers (2002)
3. Bioseparations: Science and Engineering, Harrison, R.G., Todd, P., Rudge, S.R. and Petrides, B.B. Oxford University Press (2006).
4. Microscopy and Microtechniques. Marimuthu, R., MJP Publishers (2011).
5. Instrumental Methods of Analysis, Willard H.W., Merritt L.L., Dean J.A. & Settle F.A. 7th ed. (2011) East West Publishers.

BTBS-18305 Biology

Internal Marks: 40
External Marks: 60 **L T P**
Total Marks: 100 **3 1 0**

Objective: Students will be introduced to the basics of biology such as cell structure and functions, inheritance & evolution, basic concepts of genetics, and an introduction to microbiology. So that they can use technology for the betterment of life on this planet.

Unit–I Introduction to living world: Diversity of life, major prokaryotes- monera, eubacteria and eukaryotic kingdoms- Protista, Fungi, Plantae, and Animalia. (6L + 1T)

Unit–II Biochemistry: Metabolism (Catabolism: oxidation reactions and Anabolism: reduction reactions), ATP, Bioenergetics: cellular respiration and photosynthesis. (12L + 3T)

Unit–III Genetics: Basic principles of Mendel, molecular genetics, structure and function of genes and chromosomes, Central dogma, Replication, Transcription and Translation, introduction to recombinant DNA technology and its applications including genetically modified foods and organisms. (12L + 3T)

Unit–IV Cell Biology: Macromolecules: carbohydrates, lipids, water, aminoacids, proteins, nucleic acids, cell membrane, organelles: mitochondria, ribosomes, golgi appratus, endoplasmic reticulum, cytoskeleton, cell-signaling, cell division: mitosis, meosis, differentiation, motility. (12L + 3T)

Unit–V Microbiology: Host-microbe interactions, physiology, ecology, diversity, and virology, microbial diseases and preventions, Antibiotics production with major examples, types of vaccines and important examples. (6L +2T)

Course Outcomes:

1. Get insight into basic biology as a science
2. Outlining the diversity and evolution
3. Organization and fundamental principles of living systems
4. Principle behind recombinant technology

Suggested Books:

1. Biology Fundamental Principles by Balaji S Thorat and Sumit M Raut
2. Lehlinger's Principles of Biochemistry
3. Microbiology by Prescott

BTBT-18306

Biotech Lab –I (Microbiology Lab)

Internal Marks: 30

External Marks: 20 **L T P**

Total Marks: 50 **0 0 4**

1. Microscopic Examination of Microorganisms: - Staining methods:
   - Simple staining of bacteria
   - Gram staining of bacteria
2. Measurement of cell concentration of bacteria by counting chamber/Haemocytometer.
3. Preparation and Sterilization of Culture Media:
   - Preparation of basic liquid media (broth) for the routine cultivation of bacteria
   - Preparation of basic solid media, agar slants and agar deeps for the routine cultivation of bacteria
   - Preparation of selective and differential media.
4. Isolation and Maintenance of Microorganisms:
   - Pour plate method
   - Spread plate method
   - Streak plate method
   - Sub culturing techniques
   - Preservation of the microbial culture (preparation of glycerol stock)
5. Isolation of cellulose/protease/lipase producing bacteria and fungi from soil
6. Purification and partial characterization of the desired microbes.

BTBT-18307

Biotech Lab –II (Biochemistry and Bioanalytical Techniques Lab)

Internal Marks: 30
External Marks: 20 **L T P**
Total Marks: 50 **0 0 4**

Buffers

- Preparation of standard buffers (buffering capacity & buffering range) & determination of pH.
- Qualitative and Quantitative test for carbohydrates (anthrone method).
- Estimation of amino acid by ninhydrin method.
- Determination of saponification value and Iodine number of fats.
- To test salivary amylase activity.

Spectrophotometer

- To determine the concentration of DNA by UV – spectrophotometer.
- Estimation of proteins by Lowery & Bradford method.

Chromatography

- To analyse amino acids by 2D-Thin layer chromatography.
- To extract and separate biomolecules from plant tissue by column chromatography.

Electrophoresis

- Comparison of Coomassie brilliant blue and silver staining methods for visualizing protein bands in SDS-PAGE

Comparison of ethidium bromide and silver staining methods for visualization of small DNA fragments analyzed by native PAGE

BTBT-18401 Biostatistics

Internal Marks: 40
External Marks: 60 **L T P**
Total Marks: 100 **3 1 0**

Objective/s and Expected Outcome: The course provides students a firm foundation in statistical methods

Introduction: types of biological data (data on ratio scale, interval scale, ordinal scale, nominal scale, continuous and discrete data), frequency distribution and graphical representations (bar graph, histogram and frequency polygon), cumulative frequency distribution. (2)

Measures of central tendency and dispersion: Arithmetic mean, geometric mean, harmonic mean, median, quartiles, mode, range, variance, standard deviation. (10)

Correlation and Regression: Correlation, Karl Prearson and Spearman's Coefficient, Properties of correlation coefficient. Linear regression, Properties of regression coefficients and regression equations. (8)

Moments: Moments, Skewness and Kurtosis (5)

Probability: Permutations and Combinations, basic probability, Probability of an event, addition and multiplication of probabilities. Probability distributions: Binomial, Poisson and Normal Probability distributions (8)

Sampling and Statistical hypothesis testing: Population, sample, sampling, sample size, parameters and statistics, statistical hypothesis testing. Errors, one-tailed and two-tailed tests, t-test, F-test, chi-square test, two sample hyposthesis (testing difference between two means)

(10)

BOOKS RECOMMENDED:

1. Zar, JH, Biostatistical Analysis, Pearson-Prentice Hall (2007).

2. Rao K Visweswara, Biostatistics: A Manual of Statistical Methods for Use in Health, Nutrition & Anthropology, Jaypee Brothers Publishers (2007)

3. Pagano, M. and Gauvreau, K., Principles of Biostatistics, Thomson Learning (2005)

4. Mahajan BK, Methods in Biostatistics, Jaypee Brothers Publishers (2002)

BTBT-18402 Immunology and Immunotechnology

Internal Marks: 40
External Marks: 60 **L T P**
Total Marks: 100 **4 0 0**

Objective: The objective of this course is to provide students with a comprehensive overview of the immune system and its function as well as to introduce students to clinical situations in which the immune system plays an essential role. At the end of this course, students should be able to synthesize key concepts in immunology, understand the way in which different components of the immune system interact in a coordinated manner to fight infection and discuss the way the immune system reacts to various kinds of infectious agents.

Unit–I Introduction: Introduction to Immunology, Aims and Scope; Organization of the immune system, Structure and Functions of important immune cells & Immune organs, GALT, innate and acquired immunity, active and passive immunity. (6)

Unit–II Antigens and Antibodies: Characteristics of an antigen, haptens, epitopes, adjuvants. Structure, types, properties and functions of antibodies, VDJ rearrangements. (5)

Unit–III Immune Effector Mechanisms: Organization of MHC locus (mice & human); Structure and functions of MHC I and II molecules, Cytokines; Complement system; Leukocyte migration and inflammation. (5)

Unit–IV Generation of Immune response: T-cell receptor, B-cell receptor, Antigen processing and presentation. Primary and Secondary Immune response; Generation of Humoral Immune Response; Generation of cell mediated Immune response; Killing mechanisms by CTL and NK cells. (8)

Unit–V Immunotechnology: Antigen-antibody reactions, Immunodiffusion, Immunoelectrophoresis, ELISA, ELISPOT, Immunofluorescence, Vaccines (conventional and recombinant: subunit vaccines, conjugate vaccines, Synthetic vaccines). (5)

Unit–VI Immune system in health and disease: autoimmunity, hypersensitivity (7)

Unit–VII Applied Immunology: Tumor immunity, tissue and organ transplant, Immuno-toxins. (4)

Course Outcomes:

1. Understand innate and adaptive immune responses.
2. Understand the role of primary and secondary lymphoid organs.
3. Understand antigen and antibody interactions.
4. Understand the role of immune system in organ transplantation, autoimmune disorders and Cancer.

Suggested Books:

1. Immunology (6 th Ed.) by Thomas J. Kindt, Richard A. Goldsby, Barbara Anne Osborne, W.H. Freeman and Company,New York (2007)
2. Roitt's Essential Immunology (11 th Ed.) by Delves P, Martin S, Burton D, Roitt IM. Wiley- Blackwell Scientific Publication, Oxford (2006)
3. Immunology (6 th Ed) by Richard C, Geiffrey S. Wiley- Blackwell Scientific Publication, Oxford (2009)
4. Cellular and Molecular Immunology (6 th Ed.) by Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai. Saunders Publication, Philadelphia, (2007)

BTBT-18403 Animal Cell Culture and Biotechnology

Internal Marks: 40
External Marks: 60 **L T P**
Total Marks: 100 **3 0 0**

Objective: To develop an understanding about tissue culture as a science and advantages and disadvantages of tissue culture. To provide an exposure for the needs of different conditions required for successful experimentation with tissue culture along with its implications.

Unit–I Introduction to Animal Tissue culture: Background, Advantages, Limitations, Application, culture Environment, Cell Adhesion, Cell Proliferation, Differentiation. (3)
Unit–II Design, Layout and Equipment: Planning, Construction Layout, Essential Equipments, Aseptic Technique, Sterile Handling, Safety, Risk Assessment, biohazards (4)
Unit–III Media: Physicochemical Properties, Balanced salt Solutions, Complete Media, Serum, SerumFree Media, Disadvantages of Serum, Advantages of Serum-Free media (5)
Unit–IV Basic techniques of Mammalian Cell Culture: Isolation of the Tissue, Primary culture Subculture and Propagation. Cell line finite and continuouous cell line, Cell line designation and Routine maintenance (6)
Unit–V Scale up of Cell Culture: Principles and Procedure, Roller bottles, Reactors and Fermenters and various adaptations; Factors affecting scale up; Growth monitoring during scale up. (6)
Unit–VI Contamination: Sources of contamination, Cross contamination, Type of microbial contamination, Eradication and Cryopreservation (5)
Unit–VII Transgenic Animals: Embryonic Stem Cell method, Microinjection method, Retroviral vector method, Transgenesis; Knock- out, Knock-in, Conditional Knock out mouse, Mouse as a Model; Gene Therapy for human genetic disorders, Animal as Bioreactors. (7)

Course Outcomes:

1. Successfully maintain cultures of animal cells and established cell lines with good viability, minimal contamination and appropriate documentation.
2. Perform supportive or episodic tasks relevant to cell culture, including preparation and evaluation of media, cryopreservation and recovery, and assessment of cell growth/health.
3. Recognize and troubleshoot problems common to routine cell culture.

Suggested Books:

1. Culture of animal cells: A Manual of Basic Technique and specialised applications, by Freshney R. Ian, Willey-Liss Publisher, 7th edition (2015).
2. Mammalian Cell Biotechnology- A Practical Approach, by Butler, M, IRL Oxford University Press (1991)
3. Animal Cell Biotechnology vol 6, 6th edition(2012). R. Spire, J. Griffths, Academic press.
4. Textbook of Biotechnology by H.K. Das, Wiley India, 4 th edition, (2010).

BTBT-18404 Transport Phenomena

Internal Marks: 40
External Marks: 60 **L T P**
Total Marks: 100 **3 1 0**

Objective: The course is designed to impart knowledge of momentum, heat and mass transfer in chemical, biotechnology system and their analogous behaviour. The concept concepts will enhance the lateral thinking capabilities of the students and seamlessly integrate the concepts for their use in a multitude of processes and problems.

Unit–I Molecular Transport Phenomena: Molecular transport of momentum, heat and mass, laws of molecular transport: Newton's law of viscosity, Fourier's law of conduction and Fick's law of diffusion. Transport coefficients – viscosity, thermal conductivity and mass diffusivity and their analogous behaviour. Estimation of transport coefficients and temperature/pressure dependence. Macroscopic balance for mass, momentum and energy. (7L+3T)

Unit–II Non-Newtonian Fluids: Time Dependent, Time Dependent and Visco-elastic fluids, Consecutive Equations and Rheological Characteristics. (4 L+1T)

Unit–III Equations of Change under Laminar Flow Conditions: Equation of Continuity, Motion and Energy. Simple Shell Balance Method for Momentum, Heat and Mass Transport, Velocity Distribution in Circular Conduits and Parallel Plates. Generalized form of Equations and Simplifications. (7 L+3T)

Unit–IV Turbulence Phenomena: Basic Theory of Turbulence, Time Averaging, Intensity and Correlation Coefficients, Isotropic Turbulence. Equation of continuity, motion and energy for turbulent condition. Reynolds stresses. Phenomenological theories of turbulence, velocity profile in circular conduits. (7 L+2T)

Unit–V Diffusion Phenomena: Diffusion of gases and liquids in porous solids, Knudsen diffusion, multicomponent diffusion and effective diffusivity. (5 L+1T)

Unit–VI Convective Transport: Free and forced convective heat and mass transfer, interphase mass transport, mass transfer coefficients – individual and overall, mass transfer theories-film, penetration and surface renewal. (6 L+2T)

Course Outcomes:

1. To be able to define and explain the concepts of momentum, heat and mass transfer.
2. Apply momentum, heat and mass transfer knowledge by solving problems theoretically and practically.
3. Apply momentum, mass and heat transfer simultaneously on the biological system by solving problems theoretically**.**
4. Understand mass transfer operations absorption, distillation, extraction, drying.

Suggested Books:

1. R.B.Bird, W.E.Stewart and E.W.Lightfoot - Transport Phenomena, John Wiley & Sons.
2. Basic Concepts In Transport Phenomena, A Unified Approach". Vol.-I by Brodkey, R.S., Hershey H.C.,Brodkey Publishing (2003).
3. Nickolas J. Themelis, Transport and Chemical Rate Phenomena, Gordon Breach, New York.
4. Beek W.J. and Mutzall K.M.K., - Transport Phenomena, John Willey and Sons Ltd.

BTHS-18901 Fundamentals of Management for Engineers

Credit: 3

Internal Marks: 40
External Marks: 60 **L T P**
Total Marks: 100 **3 0 0**

Unit 1. Definition, functions, and significance of Management. Levels of management, Douglas Mc Gregor Theory X and Theory Y. Difference between management and Administration.

Unit 2. Evolution of Management, thought, approaches of management. principles of Henry Fayol and F.W Taylor.

Unit3. Planning and organization nature, objectives and significance of planning, types and steps of planning. Span of control. Methods and types of training, Various organizational structures. Formal and informal organizations.

Unit 4. Concept of motivation, theories of motivation - Maslow need hierarchy theory & Herzberg two factor theory, Concepts of leadership and styles. Steps of Controlling .

Books Recommended:-

1. General Management - C.B. Gupta Sultan Chand

2. Principal and Practice of management- L.M. Prasad Sultan Chand

3. Essential of Management -Koontz & O, Donnel Tata Mc Graw

4. Essential Of Management – Koontz and Weihrich Tata Mc Graw 5. Management : James Stoner, R Edward Freeman, Daniel R. Gilbert, Jr. Prentice Hall of India

BTBT-18405
Biotech Lab – III (Immunology Lab)

Internal Marks: 30
External Marks: 20 **L T P**
Total Marks: 50 **0 0 4**

1. Immunodiffusion (Ouchterlony)
2. Immunoelectrophoresis
3. Quantitative precipitation assay
4. Latex Agglutination test
5. Dot- ELISA
6. Hapten conjugation and quantization
7. To perform Plate ELISA
8. Western Blotting
9. RBCs, WBCs count, Hb estimation, Blood group determination.

BTBT-18406

Biotech Lab – IV (Animal Cell Culture and Biotechnology Lab)

Internal Marks: 30
External Marks: 20 **L T P**
Total Marks: 50 **0 0 4**

1. To separate serum and plasma from blood.
2. Preparation and sterilization of Media for animal cell culturing.
3. Testing of complete and incomplete media for animal cell culture.
4. Sterilization of media and instruments for animal cell culture
5. Culturing and subculturing of adherent and suspension cell.
6.To perform staining of animal cells.
7. To isolate Lymphocytes from blood sample.
8. Cell counting and viability by Trypan Blue dye exclusion test.
9. Cryo-preservation of cells.
10. Thawing of cryo-preserved cells