Department of Biochemistry, UCS, Osmania University

Approved MSc. CBCS Syllabus

(Effective for 2016 admitted batch)

SEMESTER I					
PAPERS	**TITLE**	**Teaching hrs/week**	**Credits**	**Internal marks**	**Final exam marks**
1	BI101T:Chemistry and Metabolism of Proteins and Lipids and Porphyrins (core)	4	4	20	80
2	BI102T:Chemistry and metabolism of Carbohydrat Vitamins and Nucleic acids (core)	4	4	20	80
3	BI 103T: Bio-Analytical Techniques (core)	4	4	20	80
4	BI104T:Bioenergetics and Cell Biology (core)	4	4	20	80
5	BI105P:Biomolecules	8	4	--	100
6	BI106P:Bioanalytical Techniques	8	4	--	100
Total		32	24	80	520
SEMESTER II					
PAPERS	**TITLE**	**Teaching hrs/week**	**Credits**	**Internal marks**	**Final exam marks**
1	BI201T:Enzymology (core)	4	4	20	80
2	BI202T:Molecular Biology (core)	4	4	20	80
3	BI203T:Biochemical Genetics and Model Organisms (core)	4	4	20	80
4	BI 204T: Endocrinology and Metabolic Disorders (core)	4	4	20	80
5	BI205P: Enzymology and Molecular **B**iology	8	4	--	100
6	BI206P: Molecular Biology and bioinformatics	8	4	--	100
Total		32	24	80	520
SEMESTER III					
PAPERS	**TITLE**	**Teaching hrs/week**	**Credits**	**Internal marks**	**Final exam marks**
1	BI301T:Gene Regulation and Genetic Engineering (core)	4	4	20	80
2	BI302T:Immunology and Immunotechnology (core)	4	4	20	80
3	BI303T: Nutrition, Clinical Biochemistry and Reproductive Biology (Elective)	4	4	20	80
4	BI304T: Biochemistry and Physiology (Interdisciplinary Elective)	4	4	20	80
5	BI305P:Recombinant DNA and Immunotechnology	8	4	--	100
6	BI306P: Nutrition, Clinical Biochemistry and Reproductive Biology	8	4	--	100
Total		32	24	80	520
SEMESTER IV					
PAPERS	**TITLE**	**Teaching hrs/week**	**Credits**	**Internal marks**	**Final exam marks**
1	BI401T: Biostatistics and Bioinformatics (core)	4	4	20	80
2	BI402T: Cell-Cell Junctions and Signal Transduction (core)	4	4	20	80
3	BI403T: Bacteriology and Virology (Elective)	4	4	20	80
4	BI404T: Biotechnology (Elective)	4	4	20	80
5	BI405P: Bacteriology and Virology	8	4	--	100
6	BI 406 P: Project	8	4	--	100
Total		32	24	80	520

Note: 1. Seminars should be conducted at the end of the Semester III for 25 marks which is not included in the total marks. Students must discuss on the merits and demerits of a published research paper. Evaluation can be done by the internal staff.

2. No change in examination paper format

Paper-I: BI 301T: Gene Regulation and Genetic Engineering. (4 Credits; 100 Marks) (Core)

Credit – I: Gene Regulation in Prokaryotes and Viruses

1. Operon concept for gene regulation
2. Positive (+ve) & Negative (-ve) control – Lac operon
3. Attenuation – Trp operon
4. Dual promoters – gal operon: Dual function of repressor – ara operon
5. Phase variation in Salmonella flagellar protein synthesis
6. Sporulation gene expression in Bacillus
7. Riboswitch
8. Anti – termination in lambda phage
9. Lytic / lysogenic switch in lambda phage
10. Control of plasmid copy number

Credit – II: Gene Regulation in Eukaryotes

1. Chromatin structure in active and inactive regions – DNA methylation.
2. Eu-chromatin, histone acetylation, H2AX foci, histone code
3. Transcriptional control – cell specific expression – promoters, enhancers, Transcription factors
4. Post- transcriptional control – alternative splicing RNA editing.
5. RNA transport and stability.
6. Translational feedback.
7. Gene silencing – inactivation of mammalian X chromosome.
8. Regulation by siRNA
9. Gal operon of yeast.
10. MAT locus and mating type switch in yeast, Antigenic variation in Trypanosoma

Credit–III: Recombinant DNA Technology

1. Enzymes in rDNA technology: Restriction endonucleases (discovery, properties)
2. Enzymes in rDNA technology: DNA and RNA polymerases
3. Enzymes in rDNA technology: Nucleases, Kinases, Phosphatases and Ligases
4. Prokaryotic and Eukaryotic vectors (plasmids, cosmids, phage, phagemid, BAC,YAC)
5. Shuttle vectors, Targeting vectors, Expression vectors(insect, plant and mammalian cells)
6. Construction of cDNA andgenomic DNA libraries
7. Screening library (+ve) & (-ve) selection strategies, Preparation of probes
8. Creating KO cells, Cre–Lox systems.
9. Sequencing DNA by Maxam-Gilbert and Sanger's method.
10. Sequencing DNA by Pyrosequencing, Solexa, SoLiD, Helicos, SMaRT, IonTorrent

Credit–IV: Genetic Engineering

1. Yeast 2 hybrid
2. Phage display
3. Reporter genes–GFP, b–gal, luciferase
4. Expression in heterologous systems–bacteria
5. Expression in heterologous system–yeast cells
6. Expression in heterologous system–insect cells
7. Expression in heterologous system–mammalian cells
8. Molecular markers–RFLP, AFLP
9. Random amplification of polymorphic DNA (RAPD).
10. Short tandem repeat, single-nucleotide polymorphism (SNP), Ribo-typing

References:

1. Genes VIII, Lewin, B, Publish Oxford University Press
2. Principles of Gene Manipulation: An introduction to GE – Old, R. and Primrose, S.B. Blackwell Sci. Pub
3. Molecular Biotechnology Glick, BR and Paternak, JJ. Publish ASM Press
4. Molecular Biology of the Gene by Whatson JD, …..Losick R. Pub Pearson Education

Paper-II: BI 302T: Immunology and Immunotechnology (4 Credits; 100 Marks) (Core)

Credit – I: Components of the Immune System

1. Brief history of immunology
2. Elements of Immune system - Natural & acquired immunity, Specific & non-specific immune response.
3. Cells & organs induced in immune system
4. Antigenic determinants, Epitopes, Concept of haptens. T-Cell and B-Cell epitopes, Super-antigens
5. Adjuvants – types of and their applications.
6. Classification, structure, and biological properties of immunoglobulins
7. Isotypes, allotype, idiotypes variations
8. Mucosal and neonatal immunity
9. Theories of antibody formation, Generation of antibody diversity
10. Genomic rearrangements & genes involved in antibody production

Credit – II: Immune Response

1. Humoral& cell-mediated immune response
2. T cell& B cell activation. T cell and B cell receptors
3. Antigen processing & presentation
4. MHC proteins structure & functions
5. Kinetics and regulation of immune response. Assembly and secretion of Ig. Class switching regulation
6. of immune response (brief out line)
7. Cytokines in immune response
8. Complement system – Biological consequences of complement fixation. Complement activation and types
9. (alternate, classical, Mannan-binding lectin pathway) and its regulation, Complement fixation test
10. Transplantation immunology (Types of graft rejection, mechanism of graft rejection, Graft vs host disease)Immune response to tumours

Credit – III: Immune Disorders

1. Hypersensitivity – Gell & Coombs classification. Allergen
2. Type I, II, III and V Hypersensitivity
3. Mechanism of activation
4. Tests for diagnosis of hypersensitivity, Tuberculin test
5. Auto immune diseases; classification
6. Mechanism and study of selected autoimmune diseases
7. Immuno- deficiency disorders – primary and secondary. AIDS
8. Immunosuppressive drugs/agents & their mechanism of action
9. ADA Deficiency
10. Microbial evasion of immune response

Credit – IV: Immunotechnology

1. Production of polyclonal antibodies. Experimental animals models for production of antibodies
2. Methods of antibody purification (Salt precipitation, Affinity chromatography)
3. Antigen-antibody binding analysis - Equilibrium dialysis; Affinity and Avidity of antibodies
4. Antigen-antibody interactions and visualization - gel diffusion (Ouchterlony, Mancini techniques),
5. Agglutination reaction.
6. Immune-electrophoresis (Rocket, counter-, 2-D), Immuno-fluorescence, RIA, Enzyme immune assay and their types
7. Western blotting and FACS techniques
8. Hybridoma technology – production of monoclonal antibodies and their applications; antibody engineering
9. Vaccines – Types, traditional vaccines and their applications Newer vaccine strategies (DNA, recombinant DNA, peptide and anti-idiotypic vaccines)
10. Vaccination schedules. Benefits and adverse consequences of vaccination

References:

1. Kuby Immunology – Edited Thomas J. Kindt, Richard A Goldsby, Publisher WH Freeman & Co
2. Roitt's Essential Immunology, Tenth Edition, Ivan Roitt, Peter Delves
3. Veterinary Immunology: Ian R. Tizard, I.R. Thomson press
4. The Immune System. By Peter Parham Publisher Garland publishing

Paper-III: BI 303 T: Nutrition, Clinical Biochemistry and Reproductive Biology (4 Credits; 100 Marks)(Elective)

Credit – I: Nutrition

1. Balanced diet, Macro & Micro Nutrients, Caloric values (carbohydrates, proteins, lipids, alcohol)
2. Nutritional assessment by clinical testing; Anthropometric and Biochemical testing
3. BMR, measurement of BMR, factors affecting BMR and BMI
4. Organs of digestive system; Enzymes (amylases, proteases, lipases)
5. Hormones in digestion (stomach, pancreas; gastrin, secretin, CCK); Role of bile acids
6. Absorption; Control of food intake (leptin, ghrelin, peptide YY)
7. Malnutrition (PEM, Marasmus, Kwashiorkor), Obesity (BMI and other metrics)
8. Diabetes (Type 1, 2 and 3), Jaundice, Hepatitis
9. Cholesterol, sodium, and blood pressure
10. Eating disorders; Anorexia and bulimia; Diet and longevity, ageing.

Credit – II: Clinical biochemistry

1. Sample collection, serum, plasma and anticoagulants, factors affecting the sample collection – Place, time, temperature and posture, Deproteinization, Identification, transport and storage
2. Quality control and assurance in clinical biochemistry
3. Complete Blood picture, prothrombin time, ESR and Erythrocyte metabolic disorders
4. Composition (including formed elements) and Coagulation of blood
5. Haemoglobin determination, Types and Abnormal Hbs. Hemoglobinopathies – Sickle cell Anaemia and Thalassemia, Thrombosis and Thrombolysis
6. Complete Urine Examination – Normal and abnormal constituents
7. Acid and Bases in the body; Plasma buffers and electrolytes; Mechanism of acid-base balance
8. Water and Electrolyte balance. Assessment of Na^+, K^+ and Cl^- levels in the body
9. Respiratory and renal regulation of pH, Acidosis and alkalosis (both metabolic and respiratory)
10. Oral rehydration therapy

Credit – III: Organ Function Tests and clinical enzymology

1. Tests for diagnosis of Gastrointestinal disorders
2. Liver function tests- conjugated and total bilurubin in serum, albumin: globulin ratio, hippuric acid and bromsulphthalein tests, Bile pigments in urine/faeces, carbohydrate tolerance tests, Cholesterol-cholesteryl ester ratio
3. Biochemical tests in acute and chronic kidney failure – Creatinine, Urea and Insulin clearance tests, phenol red test, Measurement of renal plasma flow
4. Biochemical tests for the diagnosis of heart diseases- HDL/LDL cholesterol, SGOT, LDH, CK, C-reactive protein, cardiac troponins.
5. Thyroid function tests
6. Pregnancy test
7. Hormone tests – Glucocorticoids including Cortisol, DHEA, Estrogen, Progesterone, FSH, Testosterone and Prostate Specific Antigen (PSA)
8. Serum enzymes in liver diseases- SGPT, GGT, alkaline phosphatase, Leucine amino peptidase
9. Prognostic and diagnostic importance of Amylase, phosphatase, cholinesterase, Aldolase Phosphohexose isomerase, lipoprotein lipase and isocitrate dehydrogenase
10. Enzymes as Tumour markers

Credit – IV: Reproductive Biology

1. Female reproductive system: anatomy and endocrinology
2. Causes of female infertility (acquired and genetic), treatments
3. Male reproductive system: anatomy and endocrinology
4. Causes of male infertility (environmental and genetic), treatments
5. Puberty, reproductive aging (menopause and andropause)
6. Gametogenesis and fertilization (natural and assisted (*in vitro*))
7. Implantation and Placenta
8. Endocrinology of pregnancy
9. Endocrinology of parturition
10. Placenta as source of stem cells, cord banking

References:

1. Nutritive value of Indian foods by C. Gopalan, B.V. Rama Sastri and S.C. Balasubramanian. National Institute of Nutrition, ICMR.
2. Essentials of Food and Nutrition –Swaminathan M. Bangalore Press
3. Manual of Nutritional Therapeutics, 2nd edition, Alpers (1991), Little Brown Publications, Washington.
4. Textbook of Medical Biochemistry by MN Chatterjea and Rana Shinde, Jaypee Brothers
5. Teitz Fundamentals of Clinical Biochemistry by Carl A. Burtis, Edward R. Ashwood and
6. David E. Bruns. Saunders, Elsevier
7. Clinical Biochemistry: An Illustrated Colour Text (Paperback) 3rd Ed. by Allan Gaw, Michael Murphy, Robert Cowan, Denis O'Reilly, Michael Stewart and James Shepherd. Churchill Livingstone.
8. Davidson's Principles and Practice of Medicine: A Textbook for Students and Doctors (Hardcover) 15th Ed by LSP Davidson, J MacLeod and CRW Edwards. Publisher: Churchill Livingstone.
9. Human Physiology by Guyton and Hall Press Pub Saunders
10. Human reproductive Biology by Jones and Lopez Pub

Paper-IV: BI 304 T: Biochemistry and Physiology(4 Credits; 100 Marks)
(Interdisciplinary Elective)

Credit – I: Biomolecules and Metabolism

1. Introduction of Biochemistry and Evolution (Outline only). Water properties, interactions, pH and Buffers
2. Amino acids – Classification, properties and importance. Peptide bond, biologically important peptides. Proteins - classification and Structural organization
3. Carbohydrates – Classification (mono, di, oligo and poly), properties and importance.
4. Lipids – Classification, properties and importance. Prostaglandins
5. Nucleic acids – Purines, Pyrimidines, Nucleosides, Nucleotides. Structure and types of DNA and RNA. Cot curves, Tm value and denaturation
6. Enzymes – Nomenclature and classification of enzymes, Enzyme assays, specific activity and enzyme units,Factors affecting enzyme activity, Michaelis-Menten Kinetics, Enzyme inhibitors, types of inhibition and Allosterism
7. Amino acid metabolism – General reactions, metabolism of glucogenic and ketogenic amino acids
8. Carbohydrate metabolism – Glycolysis, TCA cycle, Gluconeogenesis and Glycogen metabolism
9. Lipid metabolism - β-oxidation of fatty acids, de novo synthesis of fatty acids and TAG metabolism
10. Nucleic acid metabolism –Synthesis and catabolism of purines and pyrimidines

Credit – II: Endocrine and Immune systems

1. Organization of endocrine system, Classification of hormones. Mode of action of hormones (outline of hormone-receptor concept)
2. Physiological role of hormones secreted by pancreas, thyroid, pituitary and hypothalamus
3. Physiological role of hormones secreted by parathyroid, adrenals and gonads
4. Hormonal regulatory pathways (positive, negative, feedback loops)
5. Organization of Immune system. Organs and cells of immune system
6. Innate and Acquired immunity. Humoral and cell mediated immunity.
7. Types of Ig's, Antigens, immunogens and adjuvants. Nature and forces stabilizing antigen-antibody interactions
8. Immunodiagnostics – antibody as bioanalytical tool.
9. Outline of immune disorders (auto-immune and hypersensitivity)
10. Introduction to vaccines and their types

Credit – III: Clinical Biochemistry and Physiology

1. Collection, transport and storage of blood and CSF samples.
2. Composition of blood, Complete blood picture (CBP) and complete urine examination (CUE)
3. Plasma proteins in health and disease.
4. Disorders of blood coagulation (haemophilia). Types of anemias and haemoglobinopathies
5. Liver function tests- conjugated and total bilurubin in serum, albumin: globulin ratio, hippuric acid and bromsulphthaleintests, SGPT, GGT and alkaline phosphatase.
6. Renal function tests- creatinine and urea clearance tests, phenol red test.
7. Biochemical tests for the diagnosis of heart diseases- HDL/LDL cholesterol, SGOT, LDH, CK, C-reactive protein, cardiac troponins.
8. Physiology of digestion
9. Physiology of vision
10. Physiology of muscle and nerve

Credit – IV: Nutrition in Human Health

1. Balanced Diet
2. Calorific value of foods
3. Recommended dietary allowance (RDA) for children, adults and lactating women
4. Nutritional disorders – Malnutrition, - Kwashiorkar, Marasmus & PEM
5. Vitamins – Classification, dietary sources, biochemical role, deficiency disorders
6. Trace elements (Ca, Mg, Fe, I and Zn)
7. Atherosclerosis and Diabetes
8. BMR, BMI and Obesity (outline only)
9. Probiotics in human health
10. Functional foods

References:

1. LehningerPrinciplesofBiochemistry,DavidL.Nelson,MichaelM.CoxPublisher:W.H.Freeman.
2. Biochemistry-JeremyMBerg,JohnLTymoczko,andLubertStryer.:WHFreeman
3. Biochemistry,4thEdition-DonaldVoet,JudithG.Voet.–PublisherJohnWiley&Sons.
4. Kuby Immunology – Edited Thomas J. Kindt, Richard A Goldsby, Publisher WH Freeman & Co
5. Roitt's Essential Immunology, Tenth Edition, Ivan Roitt, Peter Delves

Semester III: Practicals
(Note: Each topic corresponds one Practical Session)

Paper-V: BI 305P: Recombinant DNA, Immunotechnology	**Paper-VI: BI 306P: Clinical Biochemistry, Nutrition and Reproductive Biology**
1 Isolation of plasmid DNA 2 Restriction mapping of DNA (experiment and problems) 3 Prepare competent cells 4 Transform competent cells 5 Blue-white complementation screen 6 Express heterologous protein in E. coli 7 PCR 8 Gene cloning (demonstration) 9 RFLP (experiment and problems) 10 Isolate Ig from serum (human/bovine) 11 Purify IgG by gel filtration 12 Purify IgG by affinity chromatography 13 Characterize IgG by specific antibody (Western blot) 14 SDS PAGE of Ig fractions 15 Agglutination: ABO and D Ag typing 16 RID 17 ODD 18 Rocket immunoelectrophoresis 19 ELISA, sandwich ELISA 20 Prepare and characterize carrier protein (BSA-benzidine)	1 Qualitative analysis of abnormal constituents in urine 2 Determine urinary titrable activity 3 Determine PCV, ESR, differential count 4 Determine osmotic fragility of RBC 5 Determine urinary glucose, creatinine 6 Determine blood hemoglobin (Drabkins) and glycosylated hemoglobin 7 Determine blood urea 8 Determine blood glucose (POD-DOD method, enzymatic method) 9 Determine A:G ratio 10 Assay serum alkaline phosphatase 11 Assay serum ALT (SGPT) and serum AST (SGOT) 12 Assay serum LDH 13 Serum lipid profile 14 Determine total protein content (Kjeldahl) in a food item 15 Determine total carbohydrate and lipid content in a food item 16 Detection of adulterants in Milk 17 Detection of adulterants in oils and food stuffs 18 Pregnancy test 19 Histopathology of Uterus, Ovary, Oviduct and Placenta 20 Histopathology of Testes

Project ideas:

1 Compare nutritive values of food items (example various (daals), milk from various sources, various nuts)
2 Determine your own BMI and various parameters in blood and/or urine
3 Partner with a clinic or hospital to find out prevalence of diseases such as Cardiovascular disease, diabetes
4 Test for adulterants in food items

References:

1. Molecular Cloning (Lab manual) by Maniatis T, Fritsch EF, Sambrook J, Volume –I, CSH
2. Practical Clinical Biochemistry –Varley, H. CBS Publications
3. Practical Clinical Biochemistry-Methods and Interpretations – Ranjna Chawla- Jaypee
4. Lab Manual in Biochemistry, Immunology and Biotechnology – Arti Nigam and Archana Ayyagari – Tata McGraw-Hill New Delhi

Paper-I: BI 401T: Biostatistics and Bioinformatics (4 Credits; 100 Marks) (Core)

Credit – I: Principles of Biostatistics

1. Biostatistics fundamentals (sample, population, variable); Types of variables, Measurement and measurement scales
2. Measures of central tendency (mean, median, mode)
3. Measurement of dispersion (range, variance, standard distribution)
4. Study of bivariate data: correlation and regression; Regression to calculate concentration of DNA/protein, molecular weight of DNA/protein
5. Graphical methods to depict data (histograms, bar-plots, pie charts, line graphs)
6. Probability in biology, Laws of Probability
7. Bayesian probability
8. Normal distribution.
9. Binominal distribution.
10. Poisson distribution

Credit – II: Statistical tests of significance

1. Design of experiments: factorial experiments
2. Student's t – test
3. F – test
4. Chi – square test; Contingency tests
5. CRD: Completely Randomized Design; 1-way ANOVA
6. RCBD: Randomized Complete Block Design; 2-way ANOVA
7. Non-parametric tests: sign test
8. Wilcoxon signed rank test, Mann-Whitney test
9. Kruskal-Wallis test, and Friedman tests
10. Quality control in biochemistry

Credit – III: Genomics

1. Genomics and branches of genomics
2. HGP and Strategies for sequencing genomes (shotgun and hierarchical sequencing)
3. 1st generation sequencing methods (Maxam and Gilbert Method; Sanger's method)
4. 2nd and 3rd Generation DNA sequencing methods (Next Generation Sequencing)
5. Genetic and Physical maps of the genome, EST, STS
6. DNA sequence databases, Use of databases; data mining
7. Comparing DNA sequences, pairwise local and global alignment
8. BLAST, FASTA, PAM and BLOSUM matrices
9. Multiple sequence alignments (Phylogenetic trees, Clustal-W, COBALT)
10. Epigenomics and metagenomics

Credit – IV: Proteomics

1. Relation of proteome to genome and transcriptome
2. HUPO goals and accomplishments
3. Methods for sequencing proteins: Edman degradation
4. 2D gels and peptide maps
5. MS – MALDI. LC-MS, Tandem MS (MS-MS)
6. Micro-arrays for proteins
7. Proteins motifs, sequences, and structure databases; Peptide sequence and MS profiles databases
8. Comparing protein sequences, alignment
9. Predicting secondary structure-ab initio, Homology folding, threading
10. Post-translational modification (kinome, glycosylation)

References:

1. Statistics, Basic Concepts and Methodology for the Health Sciences Daniel WW, Pub Wiley India
2. Biostatistics – Arora & Malhan, Himalaya Publishing House
3. Introduction to Bioinformatics- Attwood T K and parry –smith, D.J. Pearson Education
4. Bioinformatics (Sequence and Genome Analysis) Mount David W, Press CSH
5. Discovering Genomics, Proteomics and Bioinformatics – Campell & Heyer, Benjamin / Cummings pub

Paper-II: BI 402T: Cell-Cell Junctions and Signal Transduction (4 Credits; 100 Marks)(Core)

Credit–I: Extra Cellular Matrix(ECM) and cytoskeleton

1. Molecules in ECM of animal tissue.
2. Cell-Cell junctions and cadherin's
3. Functions and origin of cytoskeleton
4. Actin and actin binding proteins
5. Myosin and actin
6. Microtubules, Intermediate filaments and septins
7. Cell polarization and cell migration
8. Transport across cell membrane, Ficks Law.
9. Types of transport-simple, passive, facilitated. Active transport, primary and secondary active Transport system.
10. Ionophores, gated channels (Voltage and Ligand).

Credit–II: Cell Signaling and second messengers

1. Cell communication and type of signaling molecules.
2. Types of receptors and their structure.
3. Signal cascades their importance
4. GPCR, mechanism of signal transduction; inhibitory and stimulatory G alpha (one eg each)
5. GPCR signal termination
6. Tyrosine kinase receptors mediated signaling (eg Insulin, growth factors EGF, VEGF)
7. MAPK pathway, role in signaling
8. Second messengers–Ca and calmodulin
9. Phosphoinositides
10. NO, cAMP, cGMP

Credit – III: Signal Transduction and Cancer

1. Regulation of Cell cycle
2. Discovery of oncogenes, proto-oncogenes
3. Modes of action of oncogenes– monomeric G-proteins, Ras, p53
4. c-Myc and leukemia
5. RB and retinoblastoma
6. BRCA and breast cancer
7. Discovery of tumor suppressor genes
8. Important signaling enzymes and their regulation: PKC, CAM-kinases
9. PI3-kinase, phospholipases
10. Phosphatases

Credit–IV: Signal Transduction in Bacteria and Plants

1. Introduction of signaling components in bacteria
2. Chemotaxis, Protein kinases in bacteria
3. His-kinases: structure and role
4. Plant signaling system : an overview
5. Stress signaling in plants (biotic)
6. Stress signaling in plants (abiotic)
7. Signaling in yeast
8. STAT pathway in yeast
9. Protein-Protein interactions in signaling
10. Drugs targeting signaling molecules

References:

1. The Biochemistry of Cell Signaling, Helmreich JM, Oxford Press
2. Cell signaling – John T Hancock, Oxford University press
3. Cell biology. Second edition: Edited by C A Smith and E J Wood. Chapman & Hall publ
4. Molecular Cell Biology, 4th edition. Harvey Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore, and James Darnell. New York: W. H Freeman

Paper-III:BI 403T: Bacteriology and Virology (4 Credits; 100Marks) (Elective)

Credit – I : General Microbiology and Microbial Diversity

1. Introduction and History of Microbiology
2. Classification of Microorganisms – Prokaryotic and eukaryotic microorganisms
3. General Characters of Bacteria, Fungi, Viruses and Algae
4. Type of media – Selective and Enriched media
5. Methods of sterilization - Physical and chemical methods
6. Isolation of pure cultures
7. Bacterial growth curve and kinetics of growth. Batch, Continuous and synchronous cultures
8. Microbial metabolism – Autotrophs and Heterotrophs
9. Bacterial Photosynthesis
10. Industrial Uses of microorganisms

Credit – II: Bacteriology

1. Introduction to medical bacteriology. Infections – Types and transmission
2. Gram positive pathogens – *Staphylococcus*
3. Gram negative pathogens – *E.coli* and *Salmonella*
4. *Mycobacterium tuberculosis*
5. Analysis of air, water and milk borne bacteria
6. Probiotic bacteria and their relevance to health
7. Domestic, municipal and industrial wastes Disposal. Microorganisms in the recycling process
8. Biodegradation of lignocellulosic waste, phenolic compounds and hydrocarbons.
9. Biotransformation of antibiotics and steroids.
10. Bioremediation of pollutants, metals and metallothioneins

Credit – III: Prokaryotic Viruses

1. Discovery of bacteriophages, Structure and composition of bacteriophages, Classification system of Baltimore& ICTV
2. Phage biodiversity, Genome diversity and host- specific interactions
3. Isolation and purification by filtration, ultracentrifugation and affinity chromatography
4. Plaque assays
5. One step growth, single burst and eclipse experiments
6. Life cycle of model bacteriophages infecting *E coli* – λ (lytic lysogenic)
7. Life cycle of model bacteriophages: ϕ X 174, M13
8. Life cycle of model bacteriophages: T4, T7
9. Life cycle of model bacteriophages: Qß, Mu
10. Applications of phages - therapy; Concern over phage contamination in industry (dairy)

Credit – IV: Eukaryotic Viruses

1. Discovery and classification of plant and animal viruses, structure of viruses, viroids, virusoids
2. Classification of viruses – ICTV and Baltimore classifications
3. Host – viruses interactions, permissive/non – permissive hosts; Cytopathic effects
4. Isolation and purification of viruses, Cultivation and propagation
   Assay methods – pock assay, hemagglutination assay, transformation assay.
5. Structure, Life cycle and Pathogenicity of Gemini virus
6. Structure, Life cycle and Pathogenicity of TMV
7. Structure, Life cycle and Pathogenicity of Adenovirus
8. Structure, Life cycle and Pathogenicity of Rotavirus
9. Structure, Life cycle and Pathogenicity of Rubella, Influenza and Measles viruses
10. Structure, Life cycle and Pathogenicity of HIV and Hepatitis B Virus

References:

1. Microbiology by Pelczar M.J., Ried, RD and Chan, ECS.
2. Microbiology by Gerard J. Tortora, Berdell Ra. Funke and Christine L. Case. Publ: Pearson Education Inc
3. Medical Microbiology-David Green wood
4. Jawetz-Medical Microbiology-Geo F.Brooks,Janet S Butel.
5. Principles of Virology, (Vol I & II) Flint SJ, Enquist LW, Racaniello VR, Skalka AM Pub ASN Press
6. Introduction to Modern Virology – Dimmock

7. Basic Virology – Wagner
8. Virology – Saravanan
9. Virology – Maharajan
10. Molecular Virology – A. J. Cann
11. An introduction to Viruses – Biswas

Paper-IV: BI 404T: Biotechnology. (4 Credits; 100 Marks) (Elective)

Credit – I: Microbial Biotechnology

1. Large scale cultivation of microbes; Fermenter design and control of growth
2. Downstream processing, Production of biomass, single cell protein
3. Production of low molecular weight primary and secondary metabolites, Microbial insecticides
4. Production of enzymes for research (restriction enzymes)
5. Production of enzymes for industry (high fructose corn syrup, cheese, food processing)
6. Microbial polysaccharides-Xanthan gum, Dextran, Pullulan, Mannan, Curdlan, Alginate
7. Microbial mining (heavy metal mining, mineral leaching, Sulfur cycle)
8. Microbial production of human insulin, human growth hormone
9. Microbial production of interferon, tissue plasminogen activator
10. Superbug and microbial degradation of oil (bioremediation)

Credit – II: Plant Biotechnology

1. Plant cell culture: callus, protoplast fusion, differentiation into plantlets
2. Plant vectors, Ti plasmids
3. GM plants, GM foods
4. Terminator technology
5. Anti sense RNA and DNA
6. Plantibodies (example dental caries)
7. Case studies (genes involved, commercial value, problems) of StarLink corn, Bt cotton
8. Case studies of Zeneca tomato paste, FlavrSavr tomato
9. Case studies of Golden rice, Herbicide resistant plants (Roundup Ready)
10. Virus resistant plants (papaya)

Credit – III: Animal Biotechnology

1. Development, maintenance and growth of animal cell lines
2. Cloning of mammalian and non-mammalian species (Polly, Molly, and Dolly)
3. Production of viral vaccines
4. Production high value therapeutics, interferon
5. Plaminogen activator, urokinase
6. Chimeric antibodies and antibody engineering
7. Immunotoxins as therapeutic agents
8. Gene knockouts
9. Human gene therapy
10. "Humanized" animals as organ farms

Credit – IV: Protein Engineering

1. Methods and applications of immobilized cells
2. Methods and applications of immobilized enzymes
3. Large-scale and site-directed mutagenesis, high throughput screening tools in protein engineering
4. Rational protein design, Engineering a new fold: case study of Top7
5. Natural and recombinant fusion proteins, tags for protein purification
6. Altering kinetic properties and pH dependence of enzymes
7. Increasing stability, enhancing specific activity of enzymes
8. Directed enzyme evolution
9. PEGylated interferon
10. Methods of drug design and delivery

References:

1. Introduction to Biotechnology, William J. Thieman, Michael A. Palladino, Benjamin Cummings Publ
2. Biotechnology- Arora, Himalaya pub. House
3. Principles of Gene Manipulation, by R.W. Old, S.B. Primrose, Wiley-Blackwell Publications

Semester IV: Practicals
(Note: Each topic corresponds one Practical Session)

Paper-V: BI 405P: Bacteriology and Virology	Paper-VI: BI 406P: Project Work
1Preparation of culture media and sterilization methods. 2 Isolation of pure cultures: Streak plate method and Serial dilution method. 3 Gram Staining 4 Differential staining: Acid fast staining, Giemsa staining, Leishmann staining. 5 Methods of isolation and identification of gram+ve and gram -ve bacteria 6Methods of isolation and identification of Fungi (Soil fungi) 7Bacterial growth curve 8Widal test, VDRL test 9 Antibiotic sensitivity by Disc diffusion and Broth dilution Methods 10Assay of pencillin and streptomycin as secondary metabolites 11Biotransformation of Antibiotics and Steroids 12Biodegradation of lignocellulosic waste 13 Biodegradation of phenolic compounds 14 Biodegradation of hydrocarbons 15Dye decolourization by microorganisms 16Isolation of bacteriophages from sewage / waste water 17Reactivation of lysogenic viruses 18 Plaque assay 19 One-step growth assay 20 Plaque reduction neutralization test	**Duration: Not more than 12 weeks** Suitable project work to be carried out by the student under the mentorship of departmental staff, within the department or in recognized institutions. The distribution of marks for the project is as follows. Dissertation – 50 Marks Project presentation – 25 Marks Response to queries – 25 Marks

Project ideas:

1 Isolate and characterize phages from natural sources
2 Partner with a clinic or hospital to find out prevalence of various diseases, culture methods and diagnosis
3 Collect various industrial effluents for analysis of microbial degradation

References:

1 Practical Medical Microbiology by R Panjarathinam. Jaypee Brothers Medical Publishers (P) Ltd.
2 Practical Medical Microbiology by Mackie & Mc Cartney. Elsevier
3 Microbiology – A Laboratory Manual by Cappuccino and Sherman. Pearson Education India.
3 Practical Medical Microbiology by Chandra Prakash Bhatt. A.K. Books and Educational Enterprises
4 A Practical guide to Clinical Virology by L. R. Haaheem, John R. Pattison and Richard J. Whitley
5 Virology Methods Manual by Brian WJ Mahy and Hillar O Kangro. Elsevier

Model paper: Theory

Duration 3 hours Max. Marks 80

Section - A (Short Answer Type)
Answer all Questions 8 x 4 = 32 Marks

1.

2.

3.

4.

5.

6.

7.

8.

Section - B (Essay Answer Type)

Answer all Questions 4 x 12 = 48 Marks

9. (A).

(OR)

(B)

10. (A)

(OR)

(B)

11. (A)

(OR)

(B)

12. (A)

(OR)

(B)

Model Paper Practicals (End of semester)

Time: 10.00 AM to 4.00 PM **Max. Marks 100**

1. Write the Principles for the following experiments 20 Marks
2. Major Experiment 40 Marks
3. Minor Experiment 20 Marks
4. Viva-Voce 10 Marks
5. Record 10 Marks