SEMESTER III

Paper I
MBCR4301

Part A: Enzymology (60 marks)

Unit I: Enzyme kinetics: principle of transition state stabilization; classification and nomenclature of enzymes; cofactors – metal ions and coenzyme; steady state kinetics – Michaelis-Menten equation, Lineweaver-Burke plot, enzyme inhibition; effect of pH and temperature on enzyme rates (qualitative); multisubstrate systems – bisubstrate reactions – sequential and ping pong; isotope effects – its application to decipher mechanisms of bisubstrate reactions; Integration of kinetic, chemical and structural data towards enzyme mechanisms – lysozyme and triose phosphate isomerase. (24 lectures)

Unit II: Structural enzymology: Structural basis of Enzyme function: catalytic triad in serine proteases; Active site characterization - methods of active group assignment, chemical modifications and site directed mutagenesis; Integration of chemical and structural data towards enzyme mechanisms – cysteine proteases, aspartyl proteases, metalloenzyme (carbonic anhydrase), restriction endonucleases; Regulatory enzymes (e.g. ATCase); Immobilization techniques and methods, influence of immobilization on enzyme activity; Ribozymes and Catalytic Antibodies. (12 Lectures)

Teachers involved:
Dr. U. Siddhanta (Unit I)
Dr. J. Dasgupta (Unit II)

Recommended texts:
Lehninger Principles of Biochemistry. Cox & Nelson (5th ed.). Chapter 6 (Unit I)
Biochemistry. Voet & Voet (4th ed.). Chapters 14, 15 (lysozyme) (Reference)
Biochemistry - Berg, Tymoczko & Stryer
Structural enzymology: Biochemistry by Lubert Stryer (6th edition). Chapter 9 and 10

Part B: Microbial Genetics (40 marks)

Unit I: Mutation and Mutagenesis: types of mutations, the molecular basis of mutations, spontaneous mutations, the Streisinger model, Ames test for mutagenesis, induced mutations; analysis of biochemical mutations using the one gene one enzyme concept and biosynthetic pathways. (6 lectures)

Unit II: Methods of genetic analysis: the rII locus and Benzer's experiments, deletion mapping, complementation in phage T4. (2 lectures)

Unit III: Bacterial Gene Transfer: transformation (process of transformation, competence, cotransformation and genetic mapping), conjugation (process of conjugation, F plasmid; mapping the bacterial genome by the gradient of transfer, time of transfer and recombinant frequency; deriving gene order by reciprocal crosses), transduction: (generalized and specialized transduction; cotransduction and genetic mapping). (8 lectures)

Unit IV: Transposable Elements In Prokaryotes And Eukaryotes: Transposable elements in prokaryotes: IS elements in bacteria, transposons, Phage mu, mechanism of transposition in prokaryotes (replicative and conservative transposition), retrotransposons. Transposable elements in

eukaryotes: transposable elements in maize, Ty elements in yeast, transposable elements in *Drosophila* with reference to P elements (outline only). (4 lectures)
Unit V: Recombination: Four strand crossing over, chiasma formation, cytological basis of crossing over, mechanism of crossing over (outline only) (4 lectures)
Unit VI: Plasmids: Types of plasmids, bacteriocin (outline only) (3 lectures)

Teachers involved:
Dr. R. Nag Chaudhuri

Recommended texts:
1) Principles of Genetics- Gardner et al. Chapters 7-11
2) An Introduction to genetic analysis- David Suzuki – Chapters 5, 14, 15
3) Genetics- Strickberger-Chapters 16, 19, 25

Paper II
MBCR4302

Part A: Cell Biology II (50 marks)

Unit I: Eukaryotic Cell cycle: An overview; Cell cycle experiments; Cell cycle control: Cyclin dependent kinases, cyclical proteases, transcriptional regulation; Entry and exit of G1, S and M phases; Checkpoints: Spindle and DNA damage checkpoints, metaphase-anaphase transition antimitotic drugs (12 lectures)
Unit II: Cell Signaling I: General characteristics – specificity, amplification, desensitization or adaptation and integration; non-receptor mediated cell signaling - gaseous messengers (NO and CO); receptor mediated cell signaling – ligands (membrane diffusible, eg. steroid hormones and non-diffusible, e.g. peptide hormones and other peptide or protein ligands) and receptors (intracellular, e.g. steroid hormone receptors and cell surface); ion-channel-linked receptors – neurotransmitters; G protein coupled receptors - heterotrimeric G proteins and its effectors (second messengers like cAMP, DAG, Ca^{2+}); desensitization process; bacterial toxins as tools in study of receptor signaling; calcium signaling. (24 lectures)

Teachers involved:
Dr. C. Barat (Unit I)
Dr. U. Siddhanta (Unit II)

Recommended texts:
Molecular Biology of the Cell. Alberts, Johnson, Lewis, Raff, Roberts & Walter (4^{th} ed.). Chapters 17 (Unit I Cell Cycle), 15 (Unit II)
Lehninger Principles of Biochemistry. Cox & Nelson (5^{th} ed.). Chapter 12 (Unit II)

Part B: Human Physiology I (50 marks)

Unit I: The Skeleto-Muscular System: Overview of the axial and appendicular skeleton, types of joints, types of muscles and their role in contraction, pathophysiological aspects. (9 lectures)

Unit II: The Digestive System: Overview of the digestive tract, regulation of various secretions of the digestive tract and associated glands (salivary gland, stomach, liver, exocrine pancreas, intestine), phases of nutrition (ingestion, digestion, absorption, assimilation and egestion), pathophysiological aspects. (8 lectures)

Unit III: The Heart and the Circulatory System: The heart, the cardiac cycle, myogenic stimulation of heart rate, mechanism of heart rhythmicity and its control. The normal electrocardiogram and cardiac arrhythmias (sinoatrial and atrioventricular block, ventricular and atrial fibrillation, Stokes-Adams syndrome, circus movements). Blood and its components, blood clotting, ABO and Rh blood groups. Blood circulation, blood pressure and its regulation. Lymph, its circulation and the reticuloendothelial system. (9 lectures)

Unit IV: The Respiratory System: The respiratory tract and mechanism of respiration, lung volumes, gaseous exchange in the lungs, oxygen and carbon dioxide transport in blood, oxygen dissociation curves, regulation of respiration. (3 lectures)

Unit V: The Excretory System: Overview of the excretory system, structure of kidney and nephron, mechanism of urine formation, micturition, pathophysiological aspects. (8 lectures)

Teachers involved:
Dr. A. Banerji (Unit III, IV)
Dr. P. De (Unit I, II, V)

Recommended texts:
1) Textbook of Medical Physiology. A.C. Guyton, J.E. Hall (11^{th} ed.). Chapters 9–11, 13, 14, 16, 18, 32, 33, 35, 36 (Unit III), 19, 26–28, 31 (Unit V), 37, 39-41 (Unit IV), 62–66, 70 (Unit II).
2) Berne and Levy Physiology. B.M. Koeppen, B.A. Stanton (6^{th} ed.). Chapters 26–36 (Unit II).
3) Atlas of Human Anatomy - Frank H. Netter (6th Ed) -Ch 1-7 (Unit I)

Paper III
MBCR4303
Plant Biology I (50 marks)

Unit I: Plant Kingdom: Cyanobacteria general account, Algae and Algal biotechnology, Fungi, Bryophytes, Pteridophytes and Gymnosperm general introduction with reference to life cycle patterns, alternation of generations and economic importance. (14 lectures)

Unit II: Angiosperm Morphology: Root system – Modifications; Shoot system - branching, Modifications - Aerial, sub-aerial and underground; Leaf - simple and compound, Phyllotaxy, Modifications - Phyllode, pitcher, tendrils, stipules; Inflorescences- Definition and types- Racemose, Cymose, Mixed and special types; Flower is a modified shoot, Forms of corolla, Types of stamen and carpel, Types of fruits. (10 lectures)

Unit III: Angiosperm Taxonomy: Taxonomy and its Importance, Herbarium techniques; Concept of a taxon – Genus and Species; Citation of authors, binomial nomenclature, I.C.B.N. and Taxonomic hierarchy. Categories of Classification - Artificial (Linnaeus), Natural (Bentham & Hooker) & Modern (Cronquist) only outline classification with merits and demerits; study of the range of characters and the economic importance in these families: Dicotyledons – Ranunculaceae, Leguminosae, Cucurbitaceae, Solanaceae, Malvaceae, Labiateae, Asclepiadaceae, Apocyanaceae, Acanthaceae, Euphorbiaceae, Rubiaceae and Compositae; Monocotyledons – Orchidaceae, Poaceae and Cyperaceae; Introduction to Numerical and Molecular taxonomy. (6 lectures)

Unit IV: Anatomy: Tissues – Definition; Types - Simple permanent - Parenchyma, collenchyma, sclerenchyma; Fibres and Sclereids - Structure and functions; Complex permanent tissues - Xylem and Phloem, development, arrangement; Meristems - Classifications. Tissue systems - Dermal tissue system - Fundamental or ground tissue system; Vascular tissue system, Types of vascular bundles; The stem - Primary and Secondary structure; Anatomy of Dicotyledonous and monocotyledonous-stems; Secondary growth in dicotyledonous and monocotyledonous stems; Anomalous secondary growths- different examples. (12 lectures)

Teachers involved:
Dr. D. Chakraborti

Recommended texts:
Unit I: Phycology. Robert Edward Lee, Chapter 2
College Botany. Vol II. Ganguly and Kar, Chapter 2, 11, 16, 27, 28, 29, 31, 33, 36, 44,
A Text Book of Botany. Vol I. Bhattacharya, Hait and Ghosh. Chapter 7
A Text Book of Botany. Vol II. Bhattacharya, Hait and Ghosh. Chapter 1
Review papers
Unit II: A Text Book of Botany. Vol II. Bhattacharya, Hait and Ghosh. Chapter 2
Unit III: Studies in Botany. Vol I. Mitra, Mitra, Chowdhuri. Chapter Taxonomy
Unit IV: Plant Anatomy. Pijush Roy. Chapter 2, 5, 6, 7, 8, 13, 14, 17, 19, 20, 21

MBCR4353

Plant Biology Practical (50 marks)

Microscopic observation, drawing, description and identification of following cryptogams: *Nostoc, Oedogonium, Chara*
Identification with reasons: *Rhizopus, Penicillium, Agaricus, Riccia, Marchantia, Pogonatum, Anthoceros, Lycopodium, Selaginella, Equisetum*, Microsprophyll and megasporophyll of *Cycas* (macroscopic), male and female cone of *Pinus* (macroscopic), LS of ovule of *Gnetum* (microscopic), Anatomical slides (root, stem and leaves)
Anatomical studies following double staining method: Stem: Sunflower, **Root:** *Cicer*, **Leaf:** Mango
Anatomical studies of ecological adaptation: *Nerium, Eichhornia*
Anomalous structures: Stem of *Mirabilis* and *Bauhinia*
Cytology: Staining (aceto orcein) and squash preparation of root tips, study of mitotic stages and determination of mitotic index
Study of different stages of meiosis from permanent slides
Ecological adaptations in hydrophytes, xerophytes, mesophytes, halophytes and epiphytes (theoretical outline)

Teachers involved:
Dr. D. Chakraborti
Dr. A. Roy Choudhury

Paper IV

MBCH4304

Chemistry III (50 marks)

Unit I: Molecular Spectroscopy-I: General introduction of spectroscopy, UV-visible absorption spectroscopy- Beer Lambert's law, Deviations of Beer Lambert's law; Electronic transitions; Concept of chromophore, auxochrome; Red shift (bathochromic shift); Blue shift (hypsochromic shift); hyperchromic shift; hypochrromic shift; Relative positions of λmax considering conjugative effect, steric effect, solvent effect; Applications of UV-visible spectroscopy; UV-visible spectroscopy of proteins and nucleic acids; Fluorescence and Phosphorescenc; Fluorescence spectroscopy of proteins. (10 lectures)

Unit II: Chemical Bonding-I: Introduction to chemical bonding, Types of chemical bonds, Ionic bonding – Properties of ionic compounds, Lattice energy, Born-Lande equation and its applications, Born-Haber cycle and its applications, Solvation energy, Polarizing power and polarizability, Ionic potential, Fajan's rules. Covalent bonding- Valence Bond theory (VBT), Directional nature of covalent bond, Hybridization involving s, p and d orbitals, Equivalent and non-equivalent hybrid orbitals, Bent's rule, Valence Shell Electron Pair Repulsion (VSEPR) Theory, Shapes of molecules, Bond moment and dipole moment, Resonance structures and resonance energy, Hydrogen bonding and van der Waals forces. Molecular Orbital concept (elementary pictorial approach)- Sigma and pi bonds, bonding and antibonding orbital, bond order, MO diagrams of some homonuclear diatomic molecules. (14 lectures)

Unit III: Bonding Features in Organic Molecules: Nomenclature of organic Compounds (trivial and IUPAC); Formation of σ- and π-bonds; Bond length (distance); Bond angles; Strains in organic molecules; Inductive effect, Electromeric effect, Steric effect, Resonance, Resonance energy, Steric inhibition of resonance, Hyperconjugation and their applications; π-MO diagrams of ethylene, butadiene; HOMO and LUMO in ground and excited states; Intermolecular and intramolecular forces- Dipole-dipole interaction, Induced-dipole interaction, London force, Hydrogen bonding force; Physical properties related to molecular structures; Solute solvent interaction. (12 lectures)

Teacher involved:
Dr. S. Saha

Recommended texts:

1. Spectroscopy of Organic Compounds. P. S. Kalsi (6^{th} Edition), Chapter 1, 2 (UnitI).
2. Organic Spectroscopy. William Kemp (3^{rd} Edition), Chapter 4 (UnitI).
3. General and Inorganic Chemistry (Part-I). R. P. Sarkar (3^{rd} Edition), Chapter 5-7 (UnitII).
4. Concise Inorganic Chemistry. J. D. Lee (5^{th} Edition), Chapter 2, 4 (UnitII).
5. Advanced General Organic Chemistry- A Modern Approach (Part-I). Sachin Kr. Ghosh (3^{rd} Edition), Chapter 3, 4, 7, 8 (UnitIII).
6. A Guide Book to Mechanism in Organic Chemistry. Peter Sykes (5^{th} Edition), Chapter 3 (UnitIII).

MBCH4354

Chemistry Practical I (50 marks)

Qualitative inorganic analysis of mixtures containing not more than 3 radicals from the following:

Basic radicals: Pb^{+2}, Cu^{+2}, Fe^{+3}, Al^{+3}, Cr^{+3}, Co^{+2}, Ni^{+2}, Mn^{+2}, Zn^{+2} , Ca^{+2}, Sr^{+2}, Ba^{+2}, Mg^{+2}, Na^{+}, K^{+} and NH_4^{+}.

Acid Radicals: F^{-}, Cl^{-}, Br^{-}, I^{-}, BrO_3^{-}, NO_3^{-}, NO_2^{-}, SCN^{-}, S^{2-}, $S_2O_3^{2-}$, SO_4^{2-}, PO_4^{3-}, BO_3^{3-}/ H_3BO_3, CrO_4^{2-}/ $Cr_2O_7^{2-}$, $Fe(CN)_6^{3-}$, $Fe(CN)_6^{4-}$.

Experiment A: Preliminary tests for acid and basic radicals in given samples.
Experiment B: Wet tests for Acid and Basic radicals in given samples.
Experiment C: Confirmatory tests.

Teachers involved:
Dr. S. Saha
Prof. S. Roy

Recommended text:
An Advanced Course in Practical Chemistry- A.K.Nad, B.Mahapatra and A.Ghoshal

Paper V

MBBM4305

Mathematics III (50 marks)

Biostatistics and Biometry

Unit I: Elements of Probability theory; Random experiment, sample space, events, Laplace's definition, Theorems of Total and Compound Probability, Bayes's theorem, Independence of events, Random variable, Probability function, Distribution function, Mathematical Expectation, Moment generating function, Theoretical distributions- Binomial, Poisson, normal, uniform, exponential, and hypergeometric. (14 lectures)

Unit II: Elements of Statistics: Population, Sample, Methods of sampling, Sampling distributions, Measures of central tendency, dispersion, Moments ,Skewness and Kurtosis. Correlation and regression, Curve-fitting – linear, quadratic and exponential, Least-square method. (16 lectures)

Unit III: Biometry; Hypothesis testing, Parametric and nonparametric tests, z, t and χ^2-tests. (6 lectures)

Teachers involved:
Ms. S. Ray

Recommended texts:
Statistical Methods By N.G Das [Combined Edition Vol. I & II; Chapter 4,5,6,7,8,9,11,12,13,14]

MBCO4305

Computer I (Theory - 25 marks)

Unit I: Introduction to Computer and Problem Solving: Information and Data. Hardware: CPU, Primary and Secondary storage, I/O devices, Bus structure Software: Systems & Application. Generation of Computers: Super, Mainframe, Mini & Personal Computer. (8 lectures)
Unit II: Programming Languages: Machine Language, Assembly Language, High Level Language. Problem solving: Flow charts, Decision tables & Pseudo codes. (5 lectures)
Unit III: Basic Computer Organization: Arithmetic and Logic Unit, Control Unit, Registers. System Bus. Instruction Cycle. Memory: Types of Memory, RAM, ROM, EPROM, DRAM, SRAM, Associative memory. (4 lectures)
Unit IV: Introduction to Data Structures: Arrays, Linked Lists, Stacks, Queues. (5 lectures)
Unit V: Operating Systems: What is OS? OS Functions. Multiprogramming OS. Concepts of processes, Files, Shell, System Calls. (3 lectures)
Unit VI: Internet Technologies: Intranet and Internet; Servers and Clients; Ports; Domain Name Server (DNS); Accounts, Internet Service Providers; Connections Dial up, ISDN, ADSN; Cable, Modem; E-mail : Account, Sending, Receiving, Mailing List, IRC, Voice and Video Conferencing, WWW, Browsers. (4 lectures)

Teachers involved:
Prof. Siladitya Mukherjee

Recommended texts:
1) Reema Thareja – Computer Fundamentals and C Programming
2) Morris Mano. - Computer Fundamentals
3) E. Balaguruswami. – C Language

MBCO4355

Computer I (Practical – 25 marks)

Introduction to C Programming
Introduction: Basic structure. Character sets, Keywords, Identifiers, Constants, Variables, Data types, Program structure.
Operators: Arithmetic, Relational, Logical and Assignment; Increment, Decrement and Conditional, Expression evaluation and type conversion. Formatted input and output.
Statements: Assignment, Initialization, String handling functions. Functions - Arguments passing. Return values and their types, recursion.
Pointers: Declaration and initialization. Accessing variables through pointer arithmetic.

Teachers involved:
Prof. Siladitya Mukherjee
Prof. Kaushik Goswami