

DEPARTMENT OF BIOCHEMISTRY

PATNA UNIVERSITY, PATNA-800005

Ref.....2011.....

Date.....10.5.18.....

To

The Academic Section,
Patna University

Subject: - Submission of two copies of M.Sc. (CBCS) syllabus of
biochemistry with CD

Sir,

Herewith, I am submitting two copies of M.Sc. (CBCS) of Biochemistry
syllabus with CD

With due respect.

Head



(Vivekanand Mishra)

Head,
Dept. of Bio-Chemistry
Patna University

**UNIVERSITIES OF BIHAR
&
PATNA UNIVERSITY**



**FACULTY OF SCIENCE
SYLLABUS
OF
M. Sc. BIOCHEMISTRY**

2 Year (Four Semester)

**Choice Based Credit System (CBCS)
With effect from 2018**

DEPARTMENT OF BIOCHEMISTRY

**Biology Block II
(Patna Science College Campus)**

PATNA UNIVERSITY

PATNA 800005

PATNA UNIVERSITY, PATNA

DEPARTMENT OF BIOCHEMISTRY

A meeting of board of courses and studies of Biochemistry was held in the P. G. Department of Bio-chemistry, Patna University, Patna, on 7th of May 2018 to recommend to the Faculty Science syllabi of studies for M.Sc. Biochemistry Choice Based Credit System (CBCS).

The following members were present:-

1. Dr. Vivekanand Mishra

Chairman

2. Prof. R. K. Prasad

Member

3. Prof. M. P. Trivedi

Member

4. Sri Pasupati Nath

Member

5. Dr. Birendra Prasad

Member

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Head
Dept. of Bio-Chemistry
Patna University

Head

(Vivekanand Mishra)

FIRST YEAR						
Semester	Course/paper Code	Title	Credit	Marks		
				CIA	ESE	Total
SEMESTER I	CC-1	Organic and Biophysical Chemistry	5	30	70	100
	CC-2	Cell and Molecular Biology	5	30	70	100
	CC-3	Biophysical & Biochemical Techniques, Biostatistics, Basic Computer skill & Research Methodologies	5	30	70	100
	CC-4	Practical – General Biochemistry	5	30	70	100
	AECC-1	Environmental Sustainability & Swachhha Bharat Abhiyan Activities	5	50	50	100
		Total	25	170	330	500
SEMESTER II	CC-5	Nutritional Biochemistry	5	30	70	100
	CC-6	Bioenergetics & Biomolecules	5	30	70	100
	CC-7	Enzymology	5	30	70	100
	CC-8	Plant Biochemistry	5	30	70	100
	CC-9	Practical-Enzymology & Analytical Biochemistry	5	30	70	100
	AEC-1	Solid waste Management	5	50	50	100
		Mushroom Culture				
		Bio-fertilizer production				
		Total	30	200	400	600

SECOND YEAR						
Semester	Course/Paper Code	Title	Credits	Marks		
				CIA	ESE	Total
SEMESTER III	CC-10	Dissertation / Project	5	30	70	100
	CC-11	Human Physiology	5	30	70	100
	CC-12	Immunology & Immunochemistry	5	30	70	100
	CC-13	Biotechnology & Bioinformatics	5	30	70	100
	CC-14	Practical-Haematology, ImmunoChemistry and Biotechnology	5	30	70	100
	AECC-2	Human Values & Professional Ethics & Gender Sensitization	5	50	50	100
		Total	30	200	400	600
SEMESTER IV	EC-1	Theory- Microbial Biochemistry/ Clinical Biochemistry	5	30	70	100
	EC-2	Practical- Microbial Biochemistry/ Clinical Biochemistry	5	30	70	100
	DSE-1		5	30	70	100
		Total	15	90	210	300

CIA- Continuous Internal Assessment
CC – Core Course

AEC – Ability Enhancement Course
(1 Credit = 10Hrs.)

ESE- End of Semester Examination
AECC - Ability Enhancement Compulsory Course : (Qualifying and Non-CGPA course)
DSE – Discipline Specific Elective course

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SEMESTER I

PAPER- CC-1

ORGANIC AND BIOPHYSICAL CHEMISTRY

Total Credit-5

The question paper will be divided in three parts A, B, & C.

PART A: Ten Questions, two questions from each unit (No choice)

: 10x2 = 20 marks

PART B: Five Questions, one question from each group (Four to be answered)

: 5x4 = 20 marks

PART C: Five Questions, one question from each group (Three to be answered)

: 3x10 = 30 marks

UNIT I (ORGANIC CHEMISTRY I):

1 Credit

Electronic Theory of valency: Valence Bond theory, Tetravalency of Carbon, Hybridization & Shapes of Molecules, Molecular orbital theory, Ionisation Potential, Electron affinity, Electronegativity, Dipole moments, Resonance, Hydrogen Bond, Vander waal's force, Electronic displacements in a molecule: Inductive effect, Mesomeric effect, Electronic effect, Inductomeric effect, Hyperconjugation, Steric effect.

UNIT II (ORGANIC CHEMISTRY II):

1 Credit

Types of Organic Reactions: Substitution, addition, elimination, rearrangement, condensation and polymerization.

~~Mechanism of substitution in the Benzene Ring: o-, p- and m-directing groups, The concept of resonance with reference to Benzene derivatives, Direct influence of substituents-electronic interpretation.~~

Isomerism: Structural Isomerism, Stereoisomerism: Geometrical isomerism (E&Z nomenclature), Optical isomerism: Optical activity, specific rotation, chirality, chiral centre, enantiomers, diastereomers, meso-compounds, DL & RS Nomenclature, Configuration and Conformation, dihedral angles, Conformational analysis of ethane, n-butane, cyclohexane, mono & di-substituted cyclohexane, boat and chair forms, eclipsed, gauche and staggered conformations, axial and equatorial bonds. Monosaccharides, Anomers, mutarotation, glycoside, epimers, glucopyranose, fructopyranose, periodic acid oxidation of sugars.

Heterocyclic Systems occurring in living system: Numbering of the ring and properties of pyran, furan, thiazole, indole, pyridine, pyrimidine, quinone, purine, piperidine.

UNIT III THERMODYNAMICS IN BIOLOGICAL SYSTEMS:

1 Credit

Open, closed and isolated system; First law of thermodynamics, Enthalpy, Hess Law, Internal Energy; second law of thermodynamics, entropy, Helmholtz and Gibbs free energy, Criteria of Spontaneity; Third law of thermodynamics and calculation of entropy; application of first and second law of thermodynamics in understanding energies in living cells.

UNIT IV IONIC EQUILIBRIUM IN BIOLOGICAL SYSTEMS:

1 Credit

Physical properties and structure of water, ionization of water, pH scale, acid & bases, buffer, Henderson equation, titration curve, buffer solution and their action.

UNIT V (COORDINATION CHEMISTRY & RADIOCHEMICAL ISOTOPE IN MODERN BIOLOGY):

1 Credit

Co-ordination Chemistry:- VBT, CFT, MOT, Magnetism, Colour and Co-ordination Compounds such as Hemoglobin and Chlorophyll.

Nature of radio- activity, properties of α , β , and γ rays, measurement of radioactivity, use of radioactivity in research.

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PAPER- CC-2

CELL AND MOLECULAR BIOLOGY

Total Credit-5

The question paper will be divided in three parts A, B, & C.

PART A : Ten Questions, two questions from each unit (No choice):

10x2 = 20 marks

PART B : Five Questions, one question from each group (Four to be answered):

5x4 = 20 marks

PART C : Five Questions, one question from each group (Three to be answered):

3x10= 30 marks

UNIT I CELL:

1 Credit

Cell wall, nucleus, mitochondria, ribosome, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility. Eukaryotic and prokaryotic cells

UNIT II CELL CYCLE AND CANCER:

1 Credit

Cell Cycle: Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle.

Cancer: Biochemistry of cancer, concept of proto-oncogenes and tumour suppressor genes. Microenvironment of a cancer cell, cancer as a multistep process. Role of carcinogens, Treatment of cancer, Apoptosis

UNIT III: - MEMBRANE BIOLOGY:-

1 Credit

Membrane structure and function: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes (membrane potential), transport of macromolecules across plasma membrane.

Cell communication: general principles of cell communication, cell adhesion and roles of different adhesion molecules, cell junction/gap junctions, extracellular matrix, integrins.

Signal transduction: Cell surface receptor, G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component systems, bacterial chemotaxis and quorum sensing.

UNIT IV MOLECULAR BIOLOGY I:

1 Credit

Genetic material in eukaryotes and prokaryotes, a brief account of Mendelian genetics, population Genetics and Mutation.

DNA replication: Semi conservative nature of replication, Replication fork and the origin of replication. DNA polymerases and other enzymes involved in replication. Mechanism, regulation and inhibitors of replication

DNA Repair: Mechanisms of DNA repair.

Transcription: - Transcription in prokaryotes and eukaryotes. RNA polymerase, promoters, initiation, elongation and termination of RNA synthesis, inhibitors of transcription, post transcriptional processing of RNA in eukaryotes, RNA editing, RNA interference

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UNIT V MOLECULAR BIOLOGY II:

1 Credit

Genetic code: Basic features, biological significance of degeneracy, Wobble hypothesis and overlapping genes.

Translation: Ribosome structure, A and P sites, charged tRNA, f-met-tRNA, initiator codon, Shine-Dalgarno sequence, Formation of 70S initiation complex. Role of initiation factors, elongation factors and termination factors, Inhibitors of protein synthesis.

Regulation of gene expression in prokaryotes and eukaryotes: Operon concept, Lac operon, Trp operon, transcriptional level control, translational level control and post-translational level control of gene expression. Role of chromatin modifications in gene regulation

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PAPER- CC-3

BIOPHYSICAL & BIOCHEMICAL TECHNIQUES, BASIC COMPUTER SKILL & BIOSTATISTICS

Total Credit-5

The question paper will be divided in three parts A, B, & C.

PART A: Ten Questions, two questions from each unit (No choice):

10x2 = 20 marks

PART B: Five Questions, one question from each group (Four to be answered):

5x4 = 20 marks

PART C: Five Questions, one question from each group (Three to be answered):

3x10= 30 marks

UNIT I TOOLS, BIOCHEMICAL TECHNIQUES (PART I): 1 Credit

Centrifugation: Principles of centrifugation, concepts of RCF, Sedimentation of macromolecules, different types of instruments and rotors, preparative, differential and density gradient centrifugation, analytical ultra-centrifugation, determination of molecular weights of biomolecules and other applications, Sub cellular-fractionation.

Electrophoretic techniques: Principles of electrophoretic separation, Continuous, zonal and capillary electrophoresis, different types of electrophoresis including paper, cellulose and gel (Polyacrylamide and agarose), pulse field gel electrophoresis and isoelectric focusing

Chromatography: Principles of partition chromatography, Paper, Thin layer, Ion-exchange, Adsorption, Reverse phase, Gel Filtration & Affinity chromatography, Gas liquid chromatography, HPLC (High performance liquid chromatography) and FPLC (Fast protein liquid chromatography)

UNIT II TOOLS, BIOCHEMICAL TECHNIQUES (PART II):

1 Credit

Spectroscopy: Concepts of spectroscopy, Laws of photometry, Beer-Lambert's law, Principles and applications of colorimetry, applications of X-ray diffraction, NMR, ESR, Visible, UV, IR, Fluorescence, Raman, Mass spectroscopy in structure determination of organic and Biomolecules, CD and ORD.

Microscopy: Light, Electron (scanning and transmission), Phase contrast, Fluorescence microscopy (FRET, FLAP, FRAP, FISH techniques) & specific staining of cells and cell organelles.

Fluorimetry: Phenomena of fluorescence, intrinsic and extrinsic fluorescence, instrumentation and application.

UNIT III:-BIOSTATISTICS

1 Credit

Definition, Scope and Limitation; Frequency Distribution-Discrete and Continuous; Measures of Central Tendency – A.M., Median and Mode; Measures of Dispersion- Range, Quartile Deviation, Mean deviation, Standard deviation, Co-efficient of variation; Simple Correlation – Scatter diagram, Computation of r , properties of r ; Simple Regression – Regressive lines of y on x and x on y . Properties of regression co-efficient; Probability – Definitions of probability and terms used in probability theory; Addition and Multiplication theorem and problems based on them; Probability distribution – Binomial and Poisson, Normal probability curve and its properties; Tests of Significance – Large sample tests of Population mean, Equality of two population means, Population proportion, Difference of two population proportion. ; Tests based on chi-square statistics and t statistics; Analysis of variance (One way).

UNIT IV: - BASIC COMPUTER SKILL

1 Credit

Computer peripherals with application: Introduction, MS Windows basics, MS-office including MS-Word, MS-Excel, and MS-PowerPoint, Internet and E-mail.

Logic development: Generations of programming languages, emulation of common DOS commands using C and C++, data structures in C, objects and classes, pointers, arrays (One & two dimensional) normal string and file handling in C++

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UNIT V: - RESEARCH METHODOLOGIES

1 Credit

Collection and review of research literature, source of literature and their evaluation, Designing research methodologies, General strategies for preparation of research proposals, Data representation in technical reports, posters presentation in scientific conference and workshops, Preparation of manuscripts for publication in national and international journals, Yardsticks employed in evaluation of manuscripts for publications.

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Total Credit-5

UNIT I INTRODUCTION TO INSTRUMENTATION:

1 Credit

Introduction to laboratory safety precautions: personal hygiene, Glass wares, Instruments etc. (Centrifuge, pH meter, Colorimeter, Spectrophotometer, UV & VIS Spectrophotometer, Flame Photometer, Ultra Centrifuge, Electronic Balance, Chemical Analyzer & Elisa Reader etc.

Verification of Beer-Lambert's Law.

UNIT II GENERAL CHEMISTRY:

1 Credit

pH, Buffer Solutions and Titration

- Preparation of Standard Solution and Buffer Solution
- Determination of pH of the given sample.
- Titration of a mixture of a strong and weak acid
- Titration of a strong acid with a strong base
- Titration of a weak acid with a strong base
- Titration of a polybasic acid with a strong base
- Titration of a Amino acid (Neutral) with a strong base and acid

Unit III QUALITATIVE TEST OF BIOMOLECULES:

1 Credit

- Qualitative test for carbohydrate**
Molisch's test, Benedict's test, Barfoed's test / Bradford's method etc
- Qualitative test for Unknown Protein:-**
Biuret test, Ninhydrin test, Heller's Nitric Acid test etc.
- Qualitative test for Unknown Lipid:-**
Salkowski's test, Emulsification, Saponification, etc.

Unit IV EXAMINATION OF URINE AND STOOL:

1 Credit

- Study of Urine Examination (Urinalysis):-**
 - Physical examination
 - Chemical examination:
 - Normal constituents
 - Abnormal constituents
 - Microscopic examination
- Study of Faecal Material (Stool Examination):-** Physical, Chemical & Microscopic

Unit V BIOTECHNIQUES:

1 Credit

- Chromatography:-** Separation of sugars and amino acids using Paper chromatography
- DNA Isolation.**

P. C. Srivastava
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PAPER- AECC-1

ENVIRONMENTAL SUSTAINABILITY & SWACHCHHA BHARAT ABHIYAN
ACTIVITIES

Total Credit-5

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SEMESTER II

PAPER- CC-5

NUTRITIONAL BIOCHEMISTRY (DSE)

Total Credit-5

The question paper will be divided in three parts A, B, & C.

PART A: Ten Questions, two questions from each unit (No choice)

: 10x2 = 20 marks

PART B: Five Questions, one question from each group (Four to be answered)

: 5x4 = 20 marks

PART C: Five Questions, one question from each group (Three to be answered)

: 3x10 = 30 marks

Unit I :

1 Credit

Basic concepts – Function of nutrients. Measurement of the fuel values of foods. Direct and indirect calorimetry. Basal metabolic rate: factors affecting BMR, measurement and calculation of BMR. Measurement of energy requirements. Specific dynamic action of proteins.

Unit II :

1 Credit

Elements of nutrition – Dietary requirement of carbohydrates, lipids and proteins. Biological value of proteins. Concept of protein quality. Protein sparing action of carbohydrates and fats. Essential amino acids, essential fatty acids and their physiological functions.

Unit III :

1 Credit

Minerals & Vitamins – Nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper. Dietary sources, biochemical functions, requirements and deficiency diseases associated with vitamin B complex, C and A, D, E & K vitamins.

Unit IV :

1 Credit

Malnutrition – Prevention of malnutrition, improvement of diets. Recommended dietary allowances, nutritive value of common foods. Protein-calorie malnutrition. Requirement of proteins and calories under different physiological states- infancy, childhood, adolescence, pregnancy, lactation and ageing.

Unit V :

1 Credit

a) **Starvation** – Techniques for the study of starvation. Protein metabolism in prolonged fasting.

b) **Obesity** – Definition, Genetic and environmental factors leading to obesity.

PAPER- CC-6

BIOENERGETICS & BIOMOLECULES

Total Credit-5

The question paper will be divided in three parts A, B, & C.

PART A : Ten Questions ,two questions from each unit (No choice):

10x2 = 20 marks

PART B : Five Questions, one question from each group(Four to be answered):

5x4 = 20 marks

PART C : Five Questions, one question from each group(Three to be answered):

3x10= 30 marks

UNIT I: - BIOENERGETICS

1 Credit

A:- Introduction- Energy transformation, Biological oxidations, Oxygenases, hydroxylases, dehydrogenases, free energy on hydrolysis of ATP, standard free energy change of ATP hydrolysis, electrochemical potential, photons energy inter conversions, ionophores and shuttle systems.

B:- The mitochondrial respiratory chain- order and organization of carriers. The Q cycle, chemiosmotic theory and oxidative phosphorylation, P/O and H/P ratios, respiratory quotient, uncouplers and inhibitors of electron transport chain. Fractionation and reconstitution of respiratory chain complexes and ATP – synthase complex.

UNIT II: BIOMOLECULE: STRUCTURE & METABOLISM (PART I)

1 Credit

Carbohydrate:- Classification, Structure, General Properties and function of Monosaccharides, Polysaccharides and complex carbohydrate (Amino sugar, proteoglycans and glycoprotein), Stereoisomerism and optical isomerism of sugar, reactions of aldehyde and ketone groups, ring structure and anomeric forms, mutarotation, reaction of sugar due to hydroxyl group.

Glycolysis, TCA cycle, Alternate pathways of carbohydrate metabolism (Gluconeogenesis, Glyoxalate cycle, pentose phosphate pathway, biosynthesis of starch and cellulose, glycogen metabolism); Regulation of Blood glucose, Homeostasis, hormonal regulation of carbohydrate metabolism.

UNIT III:- BIOMOLECULE: STRUCTURE & METABOLISM (PART II)

1 Credit

Lipid:-Introduction, Classification, Nomenclature, Structure and Properties of Saturated and Unsaturated fatty acids Triacyl glycerol: Nomenclature and properties Characterization of fat hydrolysis, saponification value, rancidity of fats, Reichert-Meissel number and reaction of glycerol. Properties and Functions of Glycerophospholipids (lecithins, lysolecithins, cephalins, phosphatidyl serine, phosphatidyl inositol, plasmalogens), Sphingomyelins, Glycolipids (cerebrosides and Gangliosides), Phospholipid, Isoprenoids and Sterols.

Fatty acid Biosynthesis: Acetyl CoA carboxylase, Fatty acid synthase, desaturase and elongase. Fatty acid oxidation: α , β , ω oxidation and lipo-oxidation. Lipid Biosynthesis: Biosynthesis of triacylglycerols, phosphoglycerides and sphingolipids, Biosynthetic pathways for terpenes, steroids and prostaglandins. Ketone bodies: Formation and utilization. Metabolism of circulating lipids: chylomicrons, LDL, HDL and VLDL. Free fatty acids. Lipid levels in pathological conditions.

UNIT IV:- BIOMOLECULE: STRUCTURE & METABOLISM (PART III):-

1 Credit

Protein and Amino acids:-Polypeptide chain. Primary (Peptide confirmation, N- and C- terminal, Peptide cleavage), Secondary (α helix, β pleated sheet, random coil, Ramachandran plot), Tertiary and Quaternary structures of Proteins, stability of protein structure, Biosynthesis, degradation and regulation of important amino acids. Protein sequencing, Urea cycle and its regulation.

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UNIT V:- BIOMOLECULE: STRUCTURE & METABOLISM (PART IV)

1 Credit

Nucleic Acids:- DNA: Structure, physical and chemical properties, DNA topology (Supercoil forms of DNA, Linking number), Types of DNA -A, B, Z, forms of DNA, Satellite DNA, Centromeric DNA,.

RNA: Structure, physical and chemical properties of RNA and types (mRNA, tRNA, rRNA, hnRNA, snRNA). Biosynthesis, Degradation and Regulation of Purines and Pyrimidines.

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PAPER- CC-7

ENZYMOLOGY

Total Credit-5

The question paper will be divided in three parts A, B, & C.

PART A : Ten Questions ,two questions from each unit (No choice):

10x2 = 20 marks

PART B : Five Questions, one question from each group (Four to be answered):

5x4 = 20 marks

PART C : Five Questions, one question from each group (Three to be answered):

3x10= 30 marks

UNIT I: - ENZYMES: GENERAL ACCOUNT:

1 Credit

Nomenclature and Classification of Enzymes
Characteristics of Enzymes
Three dimensional structure of Enzymes- RNase
Biological role of Enzymes

UNIT II: - MULTI ENZYME SYSTEM: STRUCTURE AND DYNAMICS:

1 Credit

Occurrence, Isolation and their properties
Polygenic nature of multienzyme system
Mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthase complex
Immobilized multi enzyme system and their application

UNIT III: - ENZYME KINETICS:

1 Credit

Concept of ES complex, Active site, Derivation of Michaelis-Menten equation for uni substrate reaction, Different plots for the determination K_m and V_{max} and their significance, Significance and evaluation of energy of activation, Collision state theories and transition
Kinetics of zero and first order reaction, methods for measuring Kinetic and rate constants of enzymic reactions & their magnitude
Factors affecting the rate of enzyme -catalyzed reaction
Kinetics of multi substrate reactions, Derivation of the rate of expression for ping pong, random and ordered bi-bi mechanism, use of initial velocity, inhibition and exchange studies to differentiate between multi substrate reaction mechanism.

UNIT IV: - MECHANISM OF ENZYME ACTION:

1 Credit

Acid Base catalysis, Covalent catalysis, proximity, orientation effect, Strain and Distortion theory
Chemical modification of active site groups
Mechanism of enzymatic action of Lysozyme, Glyceraldehydes, 3 Phosphate dehydrogenase, aldolase, triose phosphate isomerase & Alcohol dehydrogenase.
Water soluble vitamins and their coenzymes, Mechanism of catalysis of serine, proteases, Ribonuclease.

UNIT V: - ENZYME REGULATION:

1 Credit

General mechanism of enzyme regulation
Reversible and irreversible covalent modification of enzymes
Monocyclic and Multicyclic cascade system with specific examples
Feedback inhibition and feed forward stimulation, Enzyme repression, induction and degradation
Allosteric enzymes, concerted/symmetric and sequential model for their action and significance
Competitive, non competitive, uncompetitive, linear mixed type inhibition and their kinetics, Suicide inhibitor

P. K. Srivastava
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Protein-ligand binding measurement, analysis of binding isotherm, Co-operativity phenomenon with special reference to aspartate transcarbamoylase & phosphofructo kinase, Hill & scatchard plot

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PAPER- CC-8

PLANT BIOCHEMISTRY

Total Credit-5

The question paper will be divided in three parts A, B, & C.

PART A : Ten Questions ,two questions from each unit (No choice):

10x2 = 20 marks

PART B : Five Questions, one question from each group(Four to be answered): 5x4 = 20 marks

PART C : Five Questions, one question from each group(Three to be answered): 3x10= 30 marks

Unit I SOLUTE TRANSPORT AND PHOTOASSIMILATE TRANSLOCATION –

1 Credit

uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.

Unit II PHOTOSYNTHESIS:

1 Credit

Light harvesting complexes, CO₂ fixation C₃, C₄ and CAM pathways. Citric acid cycle, plant mitochondrial electron transport and ATP synthesis; photorespiration.

UNIT III: BIOLOGICAL NITROGEN FIXATION AND AMMONIA ASSIMILATION:

1 Credit

Nitrate and ammonium assimilation; amino acid biosynthesis.

UNIT IV: PLANT HORMONES & SECONDARY METABOLISM AND METABOLITES –

1 Credit

Biosynthesis of terpenes, phenols, nitrogenous compounds and their roles. Isolation, Characterization, Classification and Commercialization.

Hormones: Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action.

UNIT V: ENVIRONMENTAL BIOCHEMISTRY:

1 Credit

Air pollution – Particulate matter, compounds of carbon, sulphur, nitrogen and their interactions, methods of their estimation, their effect on atmosphere.

Water pollution – Types of water bodies and their general characteristics, major pollutants in domestic, agricultural and industrial wastes, methods of their estimation effects of pollutants on plants and animals, brief account on treatment and management of domestic waste, industrial wastes and solid wastes .

PRACTICAL

Total Credit-5

ENZYMOLGY AND ANALYTICAL BIOCHEMISTRY

UNIT I: Quantitative Estimation of Biomolecules (manual method/ Colorimetric method): 1 Credit

1. Glucose (Sugar),
2. Blood Urea,
3. Creatinine,
4. Cholesterol,
5. Uric acid,
6. Bilirubin
7. Total Protein, Albumin & A/G ratio
8. Iodine value, acid value and saponification value in oil or fat

UNIT II ENZYMOLOGY: 1 Credit

1. Calculation of Km value of Enzyme and its Lineweaver burk plot
2. Quantitative Study of Biocatalyst (Assay of Enzymes):- SGPT, SGOT, Alkaline phosphatase, Amylase etc.

UNIT III 1 Credit

1. Identification of Food Adulterants':
 - a) Test for dilution of milk with water
 - b) Test for starch in milk or milk products
 - c) Test for Argemone oil in Mustard oil
 - d) Test for common sugar in honey
 - e) Test for khesari Dal in Besan of other Dal
 - f) Test for coloured saw in turmeric powder
2. Detection of vitamin C in fruit juices.
3. Chemical Analysis of milk

UNIT IV Qualitative and Quantitative test for Secondary metabolites in plants: 1 Credit

- a. Alkaloids
- b. Total Phenol
- c. Flavonoids
- d. Tannins etc.

UNIT V Water Analysis: 1 Credit

- a) Estimation of dissolved oxygen in water.
- b) Chemical oxygen demand
- c) Biological oxygen demand

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- d) Estimation of nitrate, pH, temperature, TDS, TSS, Total Hardness.
- e) Bacterial and Chemical Analysis of domestic and industrial effluents

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*Dr. Srinivas
14.6.18*

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*Dr. Prakash
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PAPER- AEC-1

SOLID WASTE MANAGEMENT / MUSHROOM CULTURE / BIO-
FERTILIZER PRODUCTION

Total Credit-5

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SEMESTER III

PAPER- CC-10

DISSERTATION / PROJECT

Total Credit-5

(ON TOPICS RELATED TO SYLLABUS)

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PAPER- CC-11

HUMAN PHYSIOLOGY

Total Credit-5

The question paper will be divided in three parts A, B, & C.

PART A : Ten Questions ,two questions from each unit (No choice):

10x2 = 20 marks

PART B : Five Questions, one question from each group(Four to be answered): 5x4 = 20 marks

PART C : Five Questions, one question from each group(Three to be answered): $3 \times 10 = 30$ marks

UNIT I:

1 Credit

Nutritional Biochemistry: Nutrition & Dietary habits, Balanced diet, Recommended dietary allowances for average Indians, Role of WHO, Nutritive and Caloric value of food. minerals and vitamins.

Digestive system: Composition, functions and regulation of saliva, Gastric, pancreatic, intestinal and bile secretions – digestion and absorption of carbohydrates, lipids, proteins, nucleic acids.

UNIT II:

1 Credit

Muscle System – Type of muscles-skeletal, cardiac and smooth muscles, Ultrastructure and molecular mechanism of contraction of skeletal muscles and its regulation, Role of energy rich compounds, skeletal muscle diseases, and Muscle hypertrophy and hyperplasia.

Circulatory system – Cardiovascular and lymphatic vascular system. Blood vessels, Heart, Route of blood, lymphatic vessels, Blood composition and function of Plasma, formed elements – Erythrocytes, Leukocytes, Platelets, including Hb, Plasma proteins in health diseases.

UNIT III:

1 Credit

Blood Homeostasis: - Blood coagulation, Hydrogen ion homeostasis – Factors regulating blood pH – buffers, respiratory and renal regulation, Acid-bases balance, metabolic and respiratory acidosis and alkalosis. transfer of blood gases – oxygen and carbon dioxide, Role of 2, 3 DPG, Bohr effect and chloride shift.

UNIT IV:

1 Credit

Endocrine system – Brief outline of various endocrine glands and their physiological roles; storage and secretion of hormones; Feedback regulation of hormone secretion, hormone-receptors and their activation, mechanism and extracellular and intracellular hormone action.

Nervous system – Organization of the system, nerve cells, ^{glial cells} nerve impulses, and ^{neurotransmission} neurotransmission, synapses, Chemical and electrical synapses, functional properties of nerve fiber, action potential, the reflex action and reflex arc.

UNIT V:

1 Credit

Excretory System – Structure and its organization, Functions of glomerular membrane and glomerular filtration rate (GFR), ~~structural and functional characteristics of tables~~, selective reabsorption and secretion, active and passive transport of various substances (Sugars, amino acids, urea and creatinine), antiport capabilities of various tubule segments, role of aldosterone and anti diuretic hormones and mechanisms of urine formation.

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PAPER- CC-12

IMMUNOLOGY AND IMMUNOCHEMISTRY

Total Credit-5

The question paper will be divided in three parts A, B, & C.

PART A : Ten Questions ,two questions from each unit (No choice):

10x2 = 20 marks

PART B : Five Questions, one question from each group (Four to be answered):

5x4 = 20 marks

PART C : Five Questions, one question from each group (Three to be answered):

3x10= 30 marks

Unit I : CONCEPT OF IMMUNE SYSTEM:

1 Credit

Concept of innate and acquired immunity.

Structure and function of primary and secondary lymphoid organs.

Cells involved in the immune system- Hematopoiesis; mononuclear phagocytic cells, granulocytes, mast cells, dendritic cells, Natural killer cells, lymphoid cells B lymphocytes and T lymphocytes.

Lymphocyte trafficking

Mechanism of innate immune system (phagocytosis and inflammation)

Mechanism of humoral and cell mediated immunity

Unit II: ANTIGEN AND ANTIBODY: CHEMICAL NATURE AND FUNCTION:

1 Credit

Antigenicity vs Immunogenicity

Chemical nature of antigen, epitopes adjuvants, haptens, mitogens and super antigens.

Cross and fine structures of immunoglobulin, types and sub types.

Antibody mediated effectors functions

Unit III: IMMUNE EFFECTORS MECHANISM:

1 Credit

Kinetics of primary and secondary immune response

Complement activation and its biological significance

Cytokines

Antigen Processing and Presentation

Hypersensitivity (Type I, II, III, IV)

Assembly of antigen antibody interactions-agglutination, precipitation, opsonization, immune diffusion, immunoblotting, RIA, ELISA, ELISPOT

Immune tolerance and immune suppression

Hybridoma technology

Unit IV: GENETIC DIVERSITY OF IMMUNE SYSTEM:

1 Credit

Clonal selection theory

Concept of antigen specific receptor

Organization of immunoglobulin gene and generation of antibody diversity

T cell receptor diversity

Polymorphism of MHC gene and role of MHC antigen in immune responses.

Unit V: IMMUNOLOGICAL DISORDERS: PROPHYLAXIS AND THERAPY:

1 Credit

Autoimmune diseases

Immunological Basis of Cancer

Host immune response to protozoan and metazoan parasites, bacterial and viral diseases

Passive and Active Immunization and role of Vaccination in the prevention of diseases.

PAPER- CC-13

BIOTECHNOLOGY & BIOINFORMATICS

Total Credit-5

The question paper will be divided in three parts A, B, & C.

PART A : Ten Questions ,two questions from each unit (No choice):

10x2 = 20 marks

PART B : Five Questions, one question from each group(Four to be answered):

5x4 = 20 marks

PART C : Five Questions, one question from each group(Three to be answered):

3x10= 30 marks

UNIT I: RECOMBINANT DNA TECHNOLOGY (PART I):

1 Credit

History and Scope: Core Technique and essential enzymes, Restriction enzymes-types and cleavage pattern, DNA ligase- types and ligation of DNA molecule in vitro

Cloning vectors; Plasmids (pBR322, Ti plasmid vectors), cosmid, artificial chromosome vector

Passenger DNA: Different strategies used for isolation/synthesis of gene: Organo-chemical synthesis of gene; Construction of genomic and cDNA libraries.

UNIT II : RECOMBINANT DNA TECHNOLOGY(PART II):

1 Credit

Construction of rDNA: Different strategies for construction of rDNA (use of restriction enzymes, linkers, adaptors, homopolymer tailing)

Method of DNA transfer in suitable host: Transformation, electroporation, micro-injection, particle gun method

Selection Strategies: Different methods for selection of clones (antibiotic resistant markers, colony hybridization, plaque hybridization, immune-screening)

Application of rDNA technology in medicine, agriculture, forensic and environment protection.

Various methods of DNA Sequencing.

UNIT III: FERMENTATION TECHNOLOGY:

1 Credit

Primary & secondary metabolites in biotechnology, continuous & batch type culture techniques, principle type of fermentors, general design of fermentor, fermentation process – brewing, manufacture of Penicillin, production of single cell proteins, production strategies for other antibiotics and other organic compounds.

UNIT IV: PLANT AND ANIMAL CELL CULTURE:

1 Credit

Micropropagation, somatic cell culture, somaclonal variations, somatic cell hybridization, protoplast isolation protoplast fusion, protoplast culture, genetic transformation, production of transgenic plants and animals, production of secondary metabolites, primary & transferred cell-culture, differentiated cells in culture, applications.

UNIT V: BIOINFORMATICS:

1 Credit

Introduction: definition & scope of bioinformatics. Terminologies, types of format, motifs, patterns.

Databases: types of databases; sequence databases, structural databases) Protein data bank, Swiss-prot, NCBI, examples and applications.

Sequence analysis: nucleic acid sequence, protein sequence

Similarity search Tools: BLAST and FASTA

Pair wise sequence comparison, Multiple sequence alignments sequence queries., multifunctional tools for sequence analysis;

Phylogenetic analysis

PRACTICAL

Total Credit-5

HAEMATOLOGY, IMMUNOBIOCHEMISTRY AND BIOTECHNOLOGY

A. HAEMATOLOGY

2 Credits

1. Complete Blood Count (C.B.C) / Hemogram

Study of blood: -

- a) Total count of WBC
 - b) Total count of RBC
 - c) Differential count of WBC
 - d) Estimation of Hemoglobin percentage
 - e) ESR, BT & CT
 - g) Platelets Count
2. Laboratory Diagnosis of Kala-azar
 3. Screening for sickle-cell anemia

B. IMMUNOLOGY & IMMUNOCHEMISTRY

1 Credit

1. Serological Tests :- ABO grouping and Rh typing, VDRL/RPR, ASO Titer, CRP test, RA test, Widal test and Pregnancy test etc.
2. ELISA for any Hormone (TSH etc.)

C. BIOTECHNOLOGY

2 Credits

1. Column Chromatography
2. Gel Electrophoresis
3. Isolation of DNA from bacteria
4. Fermentation test through bacterial strain (ethanol production)

PAPER- AECC-2

HUMAN VALUES & PROFESSIONAL ETHICS & GENDER SENSITIZATION
Total Credit-5

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SEMESTER IV

PAPER- EC-1

ELECTIVE I (THEORY)

Total Credit-5

ANY ONE FROM FOLLOWING OPTION

CLINICAL BIOCHEMISTRY

The question paper will be divided in three parts A, B, & C.

PART A: Ten Questions, two questions from each unit (No choice): 10x2 = 20 marks

PART B: Five Questions, one question from each group (Four to be answered): 5x4 = 20 marks

PART C: Five Questions, one question from each group (Three to be answered): 3x10 = 30 marks

UNIT I: PRE-REQUISITES:

1 Credit

Introduction to laboratory principles and instrumentation in clinical biochemistry
Instrument concepts, Chemical reaction Phase, Measurement approaches
Selection of Instruments

UNIT II: QUALITY ASSURANCE:

1 Credit

Control of pre analytical variable
Control of analytical variable
External and Internal Quality control mechanism

UNIT III: DIAGNOSTIC ENZYMES & ORGAN FUNCTION TEST:

1 Credit

Principles of diagnostic enzymology
Clinical significance of Aspartate aminotransferase, Alanine aminotransferase, creatinine kinase, Aldolase and Lactate dehydrogenase
Assessment and clinical manifestation of renal and hepatic disease LFT and KFT
Evaluation of Gastric, intestinal and pancreatic functions, Bilirubin metabolism
Enzymatical determination of myocardial infarction.

UNIT IV: DISORDERS OF METABOLISM- PART I:

1 Credit

Disorder of Carbohydrate metabolism- Diabetes mellitus, Hypoglycemia, Glycogen storage disease, Galactosemia, Glucose tolerance test
Disorder of Amino acid metabolism – Phenylketoneuria (PKU), homocysteinuria, tryosinemia, aminoaciduria
Disorder of Lipid and related metabolism
Clinical interrelation between lipids (sphingolipidosis, multiple sclerosis), lipidosis, lipoproteins and apolipoproteins, diagnostic tests for apolipoproteins, HDL & LDL cholesterol & triglyceride related disorder
Hormonal disorder – Anterior and Posterior pituitary hormonal related diseases, thyroid function, Andrenocortical steroids and gonadal steroids
Disorder of Vitamins and Trace elements.

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UNIT V: DISORDERS OF METABOLISM- PART II :

1 Credit

Haematological disorders – Disorder of erythrocyte metabolism, haemoglobinopathies, thalassemias & Anaemias, Homeostasis and thrombosis, Extrinsic and intrinsic pathways of blood clotting, laboratory test to assess coagulation and thrombolysis

Electrolyte and blood gases related disorders, respiratory and renal mechanism of acid base disorders

Disorder of Mineral metabolism- Hypercalcemia, Hypocalcemia, Normocalcemia, Hypophosphatemia, Hyperphosphatemia,

Disorder of Nucleic Acid Metabolism - Purine metabolism and Pyrimidine metabolism

Detoxification strategies – Enzymes related to detoxification, Polymorphism in drug metabolizing enzymes, Detection of toxic substances and their elimination strategy.

MICROBIAL BIOCHEMISTRY

The question paper will be divided in three parts A, B, & C.

PART A: Ten Questions, two questions from each unit (No choice):

10x2 = 20 marks

PART B: Five Questions, one question from each group (Four to be answered):

5x4 = 20 marks

PART C: Five Questions, one question from each group (Three to be answered):

3x10 = 30 marks

UNIT: GENERAL INTRODUCTION:

1 Credit

History and development of Microbiology

Nutrition, culture and metabolism of microorganisms; microbial growth: bacterial cell division, growth of bacterial populations, measurement of growth and microbial growth control

UNIT II: BACTERIOLOGY AND VIROLOGY:

1 Credit

Cell structure and function in bacteria and archaea: cell shape and size, the cytoplasmic membrane and transport, cell walls of prokaryotes, other cell surface structures and inclusions, microbial locomotion

Virus structure and growth, viral replication, viruses of bacteria, archaea and eukaryotes, subviral entities

UNIT III: MICROBIAL GENETICS AND REGULATION OF GENE EXPRESSION:

1 Credit

Bacterial genetics: Bacterial chromosomes and plasmids, genetic exchanges in prokaryotes (genetic recombination, transformation, transduction, conjugation, complementation, mobile DNA)

Regulation of gene expression: Sensing and signal transduction (two component systems, quorum sensing, regulation of chemotaxis, the stringent response); regulation of development (sporulation in *Bacillus*, *Caulobacter* differentiation); RNA based regulation (RNA regulation and antisense RNA, Riboswitches, attenuation)

UNIT IV: APPLIED MICROBIOLOGY:

1 Credit

Food Microbiology: Spoilage of common foods (Fruits, Vegetables, milk, sea foods meat and canned food); food preservation methods; Microbial production of Common foods (bread, cheese, vinegar, beer, wine)

Medical Microbiology: Common microbial diseases of human (Tuberculosis, Cholera, Malaria, Kala azar, Syphilis and AIDS)

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UNIT V: MICROBIAL ECOLOGY:

1 Credit

Metabolic diversity: Phototrophy, autotrophy, chemolithotrophy and nitrogen fixation, fermentation, anaerobic respiration and aerobic chemoorganotrophic processes

Methods in Microbial Ecology: Culture dependent and culture independent analyses of microbial communities

Microbial Ecosystems: Principles of microbial ecology, the microbial habitat, freshwater, soil and plant microbial ecosystems, marine microbial ecosystems

Bioremediation: microbial leaching of ores, mercury and heavy metal contamination, petroleum degradation, biodegradation of xenobiotic

Symbioses: Animal-microbial symbioses and plant-microbial symbioses

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ELECTIVE II(PRACTICAL)

Total Credit-5

ANY ONE FROM FOLLOWING OPTION

CLINICAL BIOCHEMISTRY

1. Thin Layer Chromatography
2. Electrophoresis
3. ELISA (HIV, TSH, HBSAg, Tuberculosis and Kala-azar etc)
4. PCR, RIA
5. Test for Diabetic Profile:- Blood Glucose, G.T.T and Glycosylated Hemoglobin (HBA1C)
6. Organ function test (by Kit Method):-
 - a) Liver Function Test (LFT):- Bilirubin, SGPT, SGOT, Total Protein, Albumin, A/G ratio and Alkaline Phosphatase etc.
 - b) Kidney Function Test (KFT):- Urea, Uric Acid and Creatinine etc.
 - c) Pancreatic Function test:- Serum Amylase, Serum Lipase etc.
 - d) Cardiac Profile:- Lipid Profile etc.
7. Electrolyte test:- Na^+ , K^+ , Cl , HCO_3
8. Anaemia Profile:- Fe in blood , Iron binding capacity and detection of sickle cell anemia
9. Aldehyde test:- Screening test for Kala-azar
10. Detection of Minerals – Ca, P, Mg and copper etc.
11. Detection of toxic substances – Hg, Selenium, Cobalt, Alcohol (Methanol & Ethanol) etc.
12. Blotting Techniques

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MICROBIAL BIOCHEMISTRY

1. Good laboratory practices and aseptic techniques in microbial laboratory.
2. Sterilization techniques: Moist heat, dry heat, filtration, LAF etc.
3. Preparation of culture media: Solid and liquid
4. Isolation and enumeration of microorganisms (bacteria & fungi) from air, water and soil.
5. Purification of microorganism by streak plate technique.
6. Preparation of slants and sub-culturing.
7. Simple and differential staining of bacteria (Gram's staining, AFB stain, Capsule, spore and flagella staining).
8. Urine Culture and Sensitivity test:- Plating, Inoculation and putting Antibiotic Disc
9. Determination of growth phases of *E.coli* by measurement of absorbance
10. Determination of growth phases of *Aspergillus niger* by dry weight method.
11. Determination of total vs viable count of *Aspergillus niger*.
12. Reductase test for milk quality.
13. Isolation of microorganisms from common food items such as curd, bread, Pan massalas.
14. Drug sensitivity test of bacteria.

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15. Determination of MIC of antibiotic against bacteria.
16. Isolation of antibiotic resistant mutant bacteria by auxanography techniques.
17. Biochemical characterization of bacteria (Amylase, Catalase, Phosphatase test; Sugar Fermentation /utilization.
18. Isolation of genomic DNA from bacteria.
19. Separation of genomic DNA by agarose gel electrophoresis.
20. Testing of water quality.

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PAPER-DSE-1

DISCIPLINE SPECIFIC ELECTIVE COURSE

Total Credit-5

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