

M.Sc., Degree Course in Biochemistry

I Semester

Core Paper-I-Biomolecules

UNIT-I

Carbohydrates- classification, structure, function and properties of monosaccharides (glucose, galactose, fructose), Disaccharides (lactose, cellobiose, sucrose, maltose). Homopolysaccharides (starch, glycogen, cellulose, inulin, dextrin, agar, pectin, dextran) Glycosaminoglycans– source, structure, functions of hyaluronic acid, chondroitin sulphates, heparin, keratan sulphate, proteoglycans. O- Linked and N-linked glycoproteins. Bacterial cell wall (peptidoglycans, teichoic acid) and plant cell wall carbohydrates.

UNIT-II

Lipids – classification of lipids, structure, properties and functions of fatty acids, triglycerides, phospholipids, glycolipids, sphingolipids and steroids. Eicosanoids- classification, structure and functions of prostaglandins, thromboxanes, leukotrienes. Lipoproteins – structure, function and mechanism of transport.

UNIT-III

Amino acids – classification, structure and properties of amino acids. Proteins – classification based on composition, structure and functions. Primary, secondary, super secondary and quaternary structure of proteins. Determination of amino acid sequence. Forces involved in stabilization of protein structure. Ramachandran plot. Folding of proteins. Structural characteristics of collagen and hemoglobin.

UNIT-IV

Nucleic acids – types and forms (A, B, C and Z) of DNA. Watson-Crick model- Primary, secondary and tertiary structures of DNA. Triple helix and quadruplex DNA Mitochondrial and chloroplast DNA. DNA supercoiling. Determination of nucleic acid sequences by Maxam Gilbert and Sanger's methods. Forces stabilizing nucleic acid structure. Properties of DNA and RNA. C-value, C-value paradox, Cot curve. Structure and role of nucleotides in cellular communications. Major and minor classes of RNA and their structure.

UNIT-V

An overview of vitamins – source, structure and functions of water soluble and fat-soluble vitamins – vitamin preparation, enrichment and fortification – overload and criteria of food sources. Antioxidants and oxidative stress. Phytochemicals – structure and functions of carotenoids, flavonoids, triterpenoids, polyphenols and lipoic acid

Books Recommended:

1. David L.Nelson and Michael M.Cox (2012) Lehninger Principles of Biochemistry (6th ed) W.H. Freeman.
2. Voet.D&Voet. J.G (2010) Biochemistry, (4th ed), John Wiley & Sons, Inc.
3. Metzler D.E (2003). The chemical reactions of living cells (2nd ed), Academic Press.
4. Zubay G.L (1999) Biochemistry, (4th ed), Mc Grew-Hill.
5. LubertStryer (2010) Biochemistry, (7th ed), W.H.Freeman
6. Satyanarayan,U (2014) Biochemistry (4th ed), Arunabha Sen Books & Allied (P) Ltd, Kolkata.

Core Paper-II-Biochemical Techniques

UNIT-I

General approaches to biochemical investigation. Organ and tissue slice technique, cell distribution and homogenization techniques, cell sorting, and cell counting, tissue culture techniques. Cryopreservation, and manometric techniques. Electrochemical techniques: Basic principles. The pH electrode. Ion-selective, gas-sensing and oxygen electrodes. Biosensors-principle and applications.

UNIT-II

Basic principles of chromatography- adsorption and partition techniques. Chiral Chromatography and counter current Chromatography. Adsorption Chromatography - Hydroxy apatite chromatography and hydrophobic interaction Chromatography. Affinity chromatography. Gas liquid chromatography- principle, instrumentation, column development, detectors-flame ionisation detectors (FID), nitrogen phosphorus detectors (NPD), electron capture detector (ECD), Flame photometric detector. Rapid scanning fourier transform infrared detector, Mass spectrometer detector and applications. Low pressure column chromatography - principle, instrumentation, column packing, detection, quantitation and column efficiency, High pressure liquid chromatography- principle, instrumentation, delivery pump, sample injection unit, column packing, development, detection and application. Reverse HPLC, capillary electro chromatography and perfusion chromatography

UNIT-III

General principles of electrophoresis, supporting medium, factors affecting electrophoresis, Isoelectric focusing-principle, ampholyte, development of pH gradient and application. PAGE-gel casting-horizontal, vertical, slab gels, sample application, detection-staining using CBB, silver, fluorescent stains. SDS PAGE-principle and application in

molecular weight determination principle of disc gel electrophoresis ,2D PAGE. Electrophoresis of nucleic acids-agarose gel electrophoresis of DNA, DNA sequencing gels, pulsed field gel electrophoresis- principle, apparatus, application. Field inversion gel electrophoresis. Electrophoresis of RNA, capillary electrophoresis-principle, instrumentation and calibration curve. Microchip electrophoresis. Immuno electrophoresis-qualitative, rocket, 2D electrophoresis.

UNIT-IV

Basic laws of light absorption- principle, instrumentation and applications of UV-Visible, IR, ESR, NMR, Mass spectroscopy, Turbidimetry and Nephelometry. Luminometry (Luciferase system, chemiluminescence). Atomic flame and flameless spectrophotometry. Principle, working and uses of x-ray diffraction, optical rotatory dispersion (ORD) and circular dichroism.

UNIT-V

Principle, working and applications of light microscope, dark field, phase contrast and fluorescent microscope. Electron microscope- Principle, instrumentation of TEM and SEM, Specimen preparation and applications-shadow casting, negative staining and freeze fracturing. Nature of radioactivity-detection and measurement of radioactivity, methods based upon ionization (GM counter) and excitation (scintillation counter), autoradiography and applications of radioactive isotopes, Biological hazards of radiation and safety measures in handling radioactive isotopes.

Books Recommended

1. Keith Wilson, John Walker (2010) Principles and Techniques of Biochemistry and Molecular Biology (7th ed) Cambridge University Press
2. David Sheehan (2009), Physical Biochemistry: Principles and Applications (2nd ed), Wiley-Blackwell
3. David M. Freifelder (1982) Physical Biochemistry: Applications to Biochemistry and Molecular Biology, W.H. Freeman
4. Rodney F. Boyer (2012), Biochemistry Laboratory: Modern Theory and techniques, (2nd ed), Prentice Hall
5. KalochRajan (2011), Analytical techniques in Biochemistry and Molecular Biology, Springer
6. Segel I.H (1976) Biochemical Calculations (2nd ed), John Wiley and Sons
7. Robyt JF (2015) Biochemical techniques: Theory and Practice (1st ed), CBS Publishers & Distributors.

Core Paper-III-Physiology and Cell Biology

UNIT-I

Major classes of cell junctions- anchoring, tight and gap junctions. Major families of cell adhesion molecules (CAMs)- cadherins, integrins. Types of tissues. Epithelium- organization and types. The basement membrane. Connective tissue and extracellular matrix- proteoglycans, glycoproteins and glycosaminoglycans.

UNIT-II

Composition of membranes- the lipid bilayer, peripheral and integral proteins. The fluid mosaic model. Brief account of membrane rafts. Endocytosis and exocytosis. Membrane transport: types. Diffusion- passive and facilitated. General classes of transport systems- uniport, symport, antiport. Active transport- primary and secondary. The P-type ATPases (Na⁺K⁺-ATPase), F-type ATPases (ATP synthases), ABC transporters, ionophores, aquaporins, ion channels (ligand-gated and voltage-gated).

UNIT-III

Digestive system- structure and functions of different components of digestive system, digestion and absorption of carbohydrates, lipids and proteins, role of bile salts in digestion and absorption, mechanism of HCl formation in stomach, role of various enzymes and hormones involved in digestive system. Composition of blood, lymph and CSF. Blood cells - WBC, RBC and energy metabolism of RBC, Blood clotting mechanism and blood groups- ABO and Rhesus system.

UNIT- IV

Respiratory system-Gaseous transport and acid-base homeostasis. Mechanism of the movement of O₂ and CO₂ through lungs, arterial and venous circulation. Bohr effect, oxygen and carbon dioxide binding hemoglobin. pH maintenance by cellular and intracellular proteins. Phosphate and bicarbonate buffers, Metabolic acidosis and alkalosis. Respiratory acidosis and alkalosis. Regulation of fluid and electrolyte balance.

UNIT-V

Sensory transduction, Nerve impulse transmission- nerve cells, synapses, reflex arc structure, resting membrane potential, Nernst equation, action potential, voltage gated ion-channels, impulse transmission, neurotransmission, neurotransmitter receptors, synaptosomes, synaptotagmin, rod and cone cells in the retina, changes in the visual cycle, photochemical reaction and regulation of rhodopsin, odour receptors, learning and memory. Chemistry of muscle contraction – actin and myosin filaments, theories involved in muscle contraction, mechanism of muscle contraction, energy sources for muscle contraction.

Books Recommended

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments (6th ed). John Wiley & Sons. Inc.
2. Bruce Alberts and Dennis Bray (2013), Essential Cell Biology, (4th ed), Garland Science.
3. De Robertis, E.D.P. and De Robertis, E.M.F. (2010). Cell and Molecular Biology. (8th ed). Lippincott Williams and Wilkins, Philadelphia.
4. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. (5th ed). Sunderland, Mass. Sinauer Associates, Inc.
5. Wayne M. Baker (2008) the World of the Cell. (7th ed). Pearson Benjamin Cummings Publishing, San Francisco. Cell Biology
6. P.S.Verma and V.K.Agarwal. (2004) Cell Biology, Genetics, Molecular Biology, Evolution and Ecology (14th ed), S.Chand and Company Ltd
7. John E. Hall (2010). Guyton and Hall Textbook of Medical Physiology (12th ed), Saunders
8. Best an Taylor (1990), Medical Physiology (12th ed), Lippincott Williams and Wilkins
9. Walter F. Boron, Emile L. Boulpaep (2012) Medical Physiology (2nd ed), Saunders
10. Anne Waugh (2010) Ross and Wilson Anatomy and Physiology in Health and Illness. Elsevier

Elective Paper-I-Microbiology

UNIT-I

Molecular taxonomy- bacteria, viruses (DNA, RNA), algae, fungi and protozoa. Lytic cycle and lysogeny. Distribution and role of microorganisms in soil, water and air. Types of culture media, isolation of pure culture, growth curve and the measurement of microbial growth.

UNIT-II

Contamination and spoilage of foods – cereals, cereal products, fruits, vegetables, meat, fish, poultry, eggs, milk and milk products. General principles of food preservation- low temperature, drying, radiation, canning. Food fermentation- cheese, yoghurt, pickles and bread.

UNIT-III

Food poisoning- bacterial food poisoning, *Salmonella*, *Clostridium botulinum*(botulism), *Staphylococcus aureus*, fungal food poisoning – aflatoxin, food infection – *Clostridium*, *Staphylococcus* and *Salmonella*. Pathogenic microorganisms, *E. coli*, *Pseudomonas*, *Klebsilla*, *Streptococcus*, *Haemophilus* , & *Mycobacterium*, causes, control, prevention and cure.

UNIT-IV

Antimicrobial chemotherapy, General characteristics of antimicrobial agents. Mechanism of action – sulfonamides, sulphones and PAS. Penicillin, streptomycin-spectra of activity, mode of administration, mode of action, adverse effects and sensitivity test. Antiviral, and antiretroviral agents.

UNIT-V

Isolation, screening and maintenance of isolates of microbial strains, strain improvement through mutant selection. Downstream processing and *in situ* recovery of products. Industrial production of alcohol and α -amylase. Industrial production of antibiotics- streptomycin. Organic acids- citric acid. Biofertilizers- Example, *Rhizobium* species and blue green algae. Single cell protein and biomass production.

Books Recommended:

1. Michael J.Pelczar Jr.(2001) Microbiology (5th ed), McGraw Hill Education (India) Private Limited
2. Frazier WC, Westhoff DC, Vanitha NM (2010) Food Microbiology (5th ed), McGraw Hill Education (India) Private Limited
3. Willey J and Sherwood L (2011) ,Prescott's Microbiology (8th ed) McGraw Hill Education (India)
4. Ananthanarayanan, Paniker and Arti Kapil (2013) Textbook of Microbiology (9th ed) Orient Black Swan
5. Brooks GF and Carroll KC (2013) JawetzMelnick&Adelbergs Medical Microbiology, (26th ed) McGraw Hill Education
6. Greenwood D (2012), Medical Microbiology Elsevier Health

II Semester

Major Paper-IV-Enzymes and Enzyme Technology

UNIT-I

Enzyme techniques- Isolation and purification of enzymes. Criteria of purity of enzymes, Enzyme activity units. Katal and International units. Enzyme assay- Different types - coupled enzyme assay. Applications of stopped flow techniques. Isoenzymes and their separation by electrophoresis with special reference to LDH. Significance of LDH and CK isoenzymes.

UNIT-II

Enzyme kinetics – Rate of enzymatic reaction, effect of substrate and enzyme concentration, pH, temperature on enzyme activity. M-M equation, L-B plot, Eadie Hofsee Plot. Determination of K_m . Catalytic efficiency, Sigmoidal kinetics, Allosteric enzymes = significance, structure and regulatory functions with special reference to aspartate transcarbomylase. Role of covalent modification in regulation of enzymes-regulation of glutamine synthetase, glycogen synthase and glycogen phosphorylase.

UNIT-III

Coenzymes – cofactors and prosthetic groups. Structures and functions of coenzymes- reactions involving CoA, TPP, NAD⁺, NADP, biotin, folic acid, FMN, FAD, tetrahydrofolate and cobamide. Multienzyme complexes. Functions of pyruvate dehydrogenase and fatty acid synthase complexes. Methanogenesis, coenzymes involved in methanogenesis. Significance of Vitamin K- dependent carboxylation in blood clotting process.

UNIT-IV

Mechanism of enzyme action- Enzyme active site, mapping of active site, identification of amino acids like lysine, cysteine, serine and histidine in the active site. Enzyme specificity. Mechanism of enzyme action. Mechanisms of enzyme catalysis-covalent catalysis, proximity and orientation effect, acid-base catalysis

UNIT-V

Enzyme technology – production and industrial uses of enzymes like amylase, protease, pectinase, lipases and cellulase. Designer enzymes, abzymes, biosensors and ribozyme, Methods of Immobilization of enzymes and their applications. Enzymes as therapeutic agents.

Books Recommended:

1. David L.Nelson and Michael M.Cox (2012) Lehninger Principles of Biochemistry (6th ed), W.H.Freeman.
2. Voet.D and Voet. J.G (2010) Biochemistry, (4th ed), John Wiley & Sons, Inc.
3. Robert K. Murray, Darryl K. Granner, Peter A. Mayes, and Victor W. Rodwell (2012), Harper's Illustrated Biochemistry, (29th ed), McGraw-Hill Medical.
4. Trevor Palmer (1995), Understanding Enzymes (4th ed), Ellis Horwood Ltd
5. Metzler D.E (2003). The chemical reactions of living cells (2nd ed), Academic Press.
6. Zubay G.L (1999) Biochemistry, (4th ed), Mc Grew-Hill.
7. Marangoni AG. (2002), Enzyme Kinetics:A Modern Approach, Wiley-Blackwell.

Major Paper-V-Intermediary Metabolism I

UNIT-I

Glycolysis – aerobic and anaerobic, inhibitors, and regulation. Feeder pathway-entry of hexoses into glycolysis, Pyruvate dehydrogenase complex-mechanism and regulation. Citric acid cycle- regulation. ATP/ADP cycle. Glyoxalate cycle and its regulation. Gluconeogenesis- source, key enzymes, reaction sequence and its regulation. Synthesis and degradation of starch.

UNIT-II

Pentose phosphate pathway- significance and its regulation. Metabolism of glycogen and its regulation. Uronic acid pathway. Biosynthesis of N-linked and O-linked glycoproteins, mucopolysaccharides- Chondroitin sulphate, bacterial cell wall polysaccharide.

UNIT-III

Metabolism of nucleotides-*De novo* synthesis and salvage pathways of purine and pyrimidine nucleotides. Regulation and inhibitors of nucleotide biosynthesis. Role of ribonucleotide reductase and its regulation. Degradation of purine and pyrimidine nucleotides.

UNIT-IV

Versatile role of PLP as coenzyme. -transamination, deamination and decarboxylation. Trans methylation and one carbon transfer. Regulation of urea cycle, Inherited disorders of urea cycle enzymes. Conversion of amino acids to specialized products- Serotonin, GABA, epinephrine, nor-epinephrine, melanin, creatinine and NAD.

UNIT-V

Biosynthesis and degradation of heme. Oxidation and reduction of inorganic sulphur compounds by microbes and plants. Sulphotransferases and their biological role-rhodanases, sulphatases, 3-mercapto pyruvate sulphur transferases. Oxidation of cysteine to sulphate and inter conversion of sulphur compounds.

Books Recommended

1. David L.Nelson and Michael M.Cox (2012) Lehninger Principles of Biochemistry (6th ed), W.H.Freeman
2. Voet.D and Voet. J.G (2010) Biochemistry, (4th ed), John Wiley & Sons, Inc.
3. Robert K. Murray, Darryl K. Granner, Peter A. Mayes, and Victor W. Rodwell (2012), Harper's Illustrated Biochemistry, (29th ed), McGraw-Hill Medical
4. Metzler D.E (2003). The chemical reactions of living cells (2nd ed), Academic Press.
5. Zubay G.L (1999) Biochemistry, (4th ed), Mc Grew-Hill.
5. Ferrier DR (2013), Lippincott's Illustrated Reviews Biochemistry, (6th ed), Ippincott Williams & Wilkins

Major Paper-VI-Intermediary Metabolism II

UNIT-I

Oxidation of fatty acids-oxidation of saturated and unsaturated fattyacids (α , β & ω oxidation) Oxidation of fatty acids with odd and even numbered carbon atoms. Regulation of β oxidation. Ketogenesis and its regulation. Biosynthesis of fatty acid – saturated and unsaturated, chain elongation, regulation.

UNIT-II

Biosynthesis and degradation of triacylglycerol, phosphoglycero lipids-lecithin, cephalin, plasmalogens and phosphatidyl inositol, Sphingolipid-sphingomyelin, cerebroside, sulfatides, and gangliosides. Biosynthesis of prostaglandins, thromboxanes and leukotrienes and hydroxyl eicosanoic acids. Cholesterol biosynthesis and its regulation. Biosynthesis of bile acids. Lipoprotein metabolism-chylomicrons, VLDL, HDL and LDL.

UNIT-III

Biosynthesis of essential amino acids. - Role and biological significance of glutamate dehydrogenase, glutamine and asparagine synthetase, lysine, proline and phenylalanine hydroxylase. Interconversion of amino acids - proline to glutamate, methionine to cysteine, serine to glycine. Biosynthesis of spermine and spermidine.

UNIT IV

Degradation of aminoacids –glucogenic and ketogenic aminoacids. Formation of acetate from leucine and aromatic aminoacid, pyruvate from cysteine, threonine and hydroxy proline, α -keto glutarate from histidine and proline, succinate from methionine, threonine, valine and isoleucine, Oxaloacetate from aspartate, glycine and serine.

UNIT V

Integration of Metabolism-Interrelationship of carbohydrate, protein and fat metabolism-role of acetyl CoA and TCA cycle. Interconversion of major food stuffs. Metabolic profile of the principal organs and their relationships.

Books Recommended

1. David L.Nelson and Michael M.Cox (2012) Lehninger Principles of Biochemistry (6th ed), W.H.Freeman.
2. Voet.D and Voet. J.G (2010) Biochemistry, (4th ed), John Wiley & Sons, Inc.
3. Robert K. Murray, Darryl K. Granner, Peter A. Mayes, and Victor W. Rodwell (2012), Harper's Illustrated Biochemistry, (29th ed), McGraw-Hill Medical
4. Metzler D.E (2003). The chemical reactions of living cells (2nd ed), Academic Press.
5. Zubay G.L (1999) Biochemistry, (4th ed), Mc Grew-Hill.
5. Ferrier DR (2013), Lippincott's Illustrated Reviews Biochemistry, (6th ed), Ippincott Williams & Wilkins

Core Paper VII-Practical-I

I. Biochemical studies and estimation of macromolecules

1. Isolation and estimation of glycogen from liver.
2. Isolation and estimation of DNA from animal tissue.
3. Isolation and estimation of RNA from yeast.
4. Separation of starch from plant source and assessment of its purity.
5. Denaturation of DNA and absorption studies at 260nm.
6. Denaturation of Protein and absorption studies at 280nm.

II. Colorimetric estimations

1. Estimation of lactate.
2. Estimation of pyruvate.
3. Estimation of tryptophan.
4. Estimation of protein by Lowry's method.

III. Estimation of minerals and vitamins

1. Estimation of calcium and iron.
2. Estimation of vitamins – Thiamine, Riboflavin.

IV. Group experiment

Subcellular Organelles - Separation of Mitochondria and Nucleus and identification of the subcellular organelles using marker enzymes.

Books Recommended

1. David Plummer (2001) An Introduction to Practical Biochemistry (3rd ed) McGraw Hill Education (India) Private Ltd
2. Jayaraman, J (2011), laboratory Manual in Biochemistry, New age publishers
3. Varley H (2006) Practical Clinical Biochemistry (6th ed) , CBS Publishers

Core Paper VIII-Practical-II

Credits: 3

Isolation, purification and assay of alkaline phosphatase from kidney.

1. Assay of amylase.
2. Assay of superoxide dismutase.
3. Assay of ATPase.
4. Assay of catalase.
5. Assay of acid phosphatase.
6. Effect of pH, temperature substrate concentration and inhibitors on activity of alkaline phosphatase
7. Test for blood grouping (Haemagglutination).
8. Culture and inoculum preparation.
9. Separation of lipids by TLC.
10. Separation of proteins by SDS-PAGE.

Books Recommended

1. David Plummer (2001) An Introduction to Practical Biochemistry (3rd ed) McGraw Hill Education (India) Private Ltd
2. Jayaraman, J (2011), laboratory Manual in Biochemistry, New age publishers
3. Varley H (2006) Practical Clinical Biochemistry (6th ed) , CBS Publishers

Elective Paper-II-Energy and Drug Metabolism

UNIT-I

Thermodynamic- principles in biology- Concept of entropy, enthalpy and free energy change. Redox systems. Redox potential and calculation of free energy. Biological oxidation – Oxidases, dehydrogenases, hydroperoxidases, oxygenases. Energy rich compounds – phosphorylated and non-phosphorylated. High energy linkages.

UNIT-II

Electron transport chain-various complexes of ETC, Q-cycle. Inhibitors of ETC. Oxidative phosphorylation-P/O ratio, chemiosmotic theory. Mechanism of ATP synthesis - role of F₀-F₁ ATPase, ATP-ADP cycle. Inhibitors of oxidative phosphorylation ionophores, protonophores. Regulation of oxidative phosphorylation.

UNIT-III

Light reaction-Hill's reaction, absorption of light, photochemical event. Photo ETC- cyclic and non-cyclic electron flow. Photophosphorylation-role of CF₀-CF₁ ATPase. Dark reaction- Calvin cycle, control of C₃ pathway, and Hatch-Slack pathway (C₄ pathway), Photorespiration.

UNIT-IV

Energy sources of brain, muscle, liver, kidney and adipose tissue. Amphibolic nature of Citric acid cycle. Anaplerotic reaction. Inhibitors and regulation of TCA cycle. Transport of extra mitochondrial NADH – Glycerophosphate shuttle, malate aspartate shuttle. Energetics of metabolic pathways – glycolysis, (aerobic and anaerobic), citric acid cycle, beta oxidation.

UNIT-V

Activation of sulphate ions – PAPS, APS, SAM and their biological role. Metabolism of xenobiotics – Phase I reactions – hydroxylation, oxidation and reduction. Phase II reactions – glucuronidation, sulphation, glutathione conjugation, acetylation and methylation. Mode of action and factors affecting the activities of xenobiotic enzymes.

Books Recommended

1. David L.Nelson and Michael M.Cox (2012) Lehninger Principles of Biochemistry (6th ed), W.H.Freeman
2. Voet.D and Voet. J.G (2010) Biochemistry, (4th ed), John Wiley & Sons, Inc.
3. Robert K. Murray, Darryl K. Granner, Peter A. Mayes, and Victor W. Rodwell (2012), Harper's Illustrated Biochemistry, (29th ed), McGraw-Hill Medical
4. Metzler D.E (2003). The chemical reactions of living cells (2nd ed), Academic Press.

5. Zubay G.L (1999) Biochemistry, (4th ed), Mc Graw-Hill.
6. Ferrier DR (2013), Lippincott's Illustrated Reviews Biochemistry, (6th ed), Lippincott Williams & Wilkins
7. Devlin RM (1983) Plant Physiology (4th ed), PWS publishers
8. Taiz L , Zeiger E (2010), Plant Physiology (5th ed), Sinauer Associates, Inc

Extra Disciplinary Paper-I
Plant Research Methodology

UNIT - I

Introduction – Light –Lens –Compound Microscope –Principle –Instrumentation – Types of Light microscope –Electron Microscopes – Scanning Probe Microscopes – Microtomy – Killing and fixation – Fixatives – Dehydration – Paraffin sectioning – Types of rotary microtome – Ultra microtome – Stain – Methods of staining.

UNIT –II

Centrifugation – pH and pH meter – Chromatography –Paper Chromatography – Thin layer Chromatography – Column Chromatography Gas chromatography – Liquid Chromatography. Electrophoresis – Types of electrophoresis and their applications – polyacrylamide gel electrophoresis – Agarose electrophoresis – Isoelectrophoresis –

UNIT –III

Principles of photometry – Principle of colorimeter and spectrophotometer – Applications. Photography – Digital photography –Microphotography.

UNIT-IV

Laboratory safety – Introduction – Bio hazardous agents – Risk groups and Biosafety levels – Laboratory acquired infections – Safety measures – Additional hazardous – Electrical Hazards – Safety in Genetic engineering – Safety of Laboratory animals.

UNIT – V

Writing the research report – The components a research report – Title – Authors and address – Abstract – Summary – Synopsis – Key words –introduction – materials and methods –results –discussion – acknowledgements General introduction and General discussion-

References:

1. Anderson, J.B.H. Durston and M.Poole, Thesis and Assignment Writing, Wiley Eastern Private limited, New Delhi, 1970.

2. Cromwell, L.F.J. Weibell, and E.A. Pfeiffer, Biomedical Instrumentation and Measurements (Second Edition), Prentice –Hall of India Pvt, New Delhi,1980.
3. Day, R.A. How to write and publish a scientific paper, 3rd edition, Oryx press, Phoenix, Anzona, 1988.
4. Gurumani, N.An introduction of Biostatistics (Second edition). MJP publishers, Chennai 2005.
5. Jayaraman, J Laboratory manual of Biochemistry, Wiley Eastern limited, New Delhi 110 002, 2000.
6. Johansen. D.A. Plant Microtechnique Tata McGrawPunlishingCompantynew Delhi.
7. Johansen.D.A Tertiary butyl alcohol methods.El Palo Alto News 1:1-2
8. Prescott, L.M.J.P. Harley, and D.A.Klein, Microbiology (Sixth edition) McGraw-Hill, New York.2005.
9. Ray,K.And the dispute goes on... Deccan Herald, Tuesday,January 13, DH News Service, New Delhi,2004.
10. Sharma, K.R.Research methodology. National publishing house, Jaipur and NewDelhi, 2002.
11. Webster, J.G. Bioinstrumentation, John Wiley & Sons (Asia) Pvt Ltd. Singapore 2004.

III Semester

Core Paper-IX-Biotechnology

UNIT I

Basic techniques: Cutting DNA molecules, Restriction digestion, isoschizomers, joining DNA molecules – DNA ligase, double linkers, adaptors, homopolymer tailing, selection of recombinants and screening – genetic methods, immuno chemical methods, South-Western screening, Nucleic acid hybridization methods, synthesis of probes, radioactive and non-radioactive labelling of probes, analysing DNA sequences methods: Automated sequencing, Next Generation Sequencing Analysis (NGS), *in silico* sequence analysis,

UNIT II

Cloning strategies: Cloning vectors – plasmids (pBR 322, pUC 18), phage and M 13, cosmids, phasmids, expression vectors, ; pMal; GST; pET-based vectors, Protein purification, His-tag; GST-tag; MBP-tag, Inclusion bodies- Methodologies to reduce formation of inclusion bodies, yeast vectors – YEP, YIP, YRP, YCP and YAC, shuttle vectors. Genomic

DNA libraries, chromosome walking, cDNA cloning, RACE, RAPD. Site directed mutagenesis of cloned genes.

UNIT III

Animal cell culture- media, primary culture, contamination, disaggregation, subculturing. Introduction of genes into animal cells: Reporter genes, selectable markers, viral vectors – SV 40, Retroviruses and Baculovirus, Adenoviruses, Transferring genes into animal cells in culture, oocytes, eggs, embryos and specific tissues, transgenic animals, Creation of knockout mice. Hazards and safety aspects of biotechnology. Patents and IPR.

UNIT IV

Plant tissue culture- media, callus and protoplast cultures. Production of biochemicals from plant cell culture. Micropropagation Agro bacterium – mediated gene transfer to plant cells, Plant based vectors, Ti and Ri as vectors microprojectiles, transgenic plant technology – for pest resistance, herbicide tolerance, delay of fruit ripening and use of plants to produce commercially important proteins.

UNIT V

Applications of recombinant DNA technology: production of insulin and growth hormone in *E. coli*. Genome mapping, types of gene map, molecular markers. The Human Genome Project- goals, results, potential benefits and risks. DNA microarrays. Techniques for separation and identification of proteins, 2D-gel electrophoresis, mass spectrometry, MALDI-TOF. Protein arrays. Applications of proteomics. Bioinformatics- introduction, biological databases, database similarity searches- FASTA, BLAST. Multiple sequences alignment, construction of a phylogenetic tree.

Books Recommended

1. David Freifelder (1992) Essentials of Molecular Biology (2nd ed) Jones& Bartlett Pub
2. Click B.R. and Pasternark J.J (2010). Molecular Biotechnology: Principles and Applications of Recombinant DNA. (4th ed) American Society for Microbiology
3. James D. Watson, Amy A. Caudy , Richard M. Myers , Jan Witkowski (2006) , Recombinant DNA: Genes and Genomes - a Short Course (3rd ed),W.H.Freeman& Co
4. Satyanarayana U (2008), Biotechnology, Books & Allied (P) Ltd.
5. Brown TA, (2010) Gene Cloning and DNA Analysis (6th ed), Wiley-Blackwell
6. Green MR and Sambrook J (2012) Molecular Cloning: A Lab Manual (4th ed) Cold Spring Harbor Laboratory Press

7. Sandy B. Primrose and Richard M. Twyman (2002), Principles of Gene Manipulation (6th ed) Wiley-Blackwell

Core Paper-X-Clinical Biochemistry-I

UNIT-I

Biochemical investigations in diagnosis, prognosis, monitoring, screening. Specimen collection- blood and urine. Factors influencing biochemical variables. Sample analysis and reporting- precision, accuracy, specificity, sensitivity. Sources of error. Interpretation of results- normal reference ranges. Good laboratory practices.

UNIT-II

Applications of Clinical Biochemistry-Biological specimens used for the diagnosis. Preservation of biological specimens -blood, urine, CSF and amniotic fluid. Diabetes mellitus-causes, pathology, types, Metabolic complications- acute and long-term, Diagnosis-by GTT, Glycated Haemoglobin. Management- diet and life-style modifications and anti-diabetic drugs. Hypoglycaemia.

UNIT-III

Disorders of blood cells- Hemolytic, iron deficiency and aplastic anemia and diagnosis. Porphyrias, Thrombocytopenia, Causes of leucopenia, leukemia and leucocytosis. Disorders of blood clotting mechanism - Von willebrand's disease, Hemophilia A, B and C, diagnostic test for clotting disorders.

UNIT-IV

Disorders of lipid metabolism -Normal levels of blood lipids and their functions. Hyperlipidemia –Atherosclerosis -causes and symptoms-diagnosis. Hypolipidemic agents, Hyper and Hypolipoproteinemia- Types and pathology.

UNIT-V

Disorders of calcium and phosphorous metabolism. Factors affecting blood phosphorous and calcium levels..Biological functions of calcium and phosphorous. Role in bone formation. Blood calcium homeostasis. Role of PTH and calcitonin. Hypo and Hypercalcemia).

Books Recommended

1. Thomas M.Devlin (2014) Textbook of Biochemistry with Clinical Correlations (7th ed). John Wiley & Sons
2. Montgomery R, Conway TW, Spector AA (1996), Biochemistry: A Case-Oriented Approach (6th ed), Mosby Publishers, USA.

3. Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics (2014) (7th ed), Saunders
4. Dinesh Puri, (2002), Text book of Biochemistry: A clinically oriented approach - Churchill Livingstone Inc., India.
5. M.N.Chatterjee and Rana Shinde (2007).Textbook of Medical Biochemistry (7th ed)

Core Paper-XI-Molecular Biology

UNIT-I

Genetics-Mendel laws of inheritance-dominance-complete, incomplete and co dominance, multiple alleles-gene mapping in haploids and diploids, recombination mapping-restriction mapping- mode of gene information transfer in bacterial-conjugation, transformation and transduction.

UNIT-II

The bacterial chromosome and plasmids. Organization of eukaryotic chromatin-nucleosomes, 30 nm fiber, higher order structure. Organization of organelle genomes. Enzymes and mechanism of prokaryotic and eukaryotic replication. Telomeres, telomerase and end replication. Regulation of replication.

UNIT-III

Mutation, spontaneous and induced mutation, molecular mechanisms of mutation. DNA repair mechanisms-Direct repair, excision repair, mismatch repair, recombination repair, SOS response, eukaryotic repair system. Recombination and mobile genetic elements-the Holliday model, the general recombination in *E. coli*, site specific recombinations, transposons and retroposons.

UNIT-IV

Transcription- Prokaryotic and Eukaryotic transcription, Subunits of RNA polymerase, eukaryotic RNA polymerases, E.coli and eukaryotic promoters and enhancers. Transcription factors. mechanism of prokaryotic and eukaryotic transcription. Post Transcriptional modifications- mRNA 5' capping and 3' polyadenylation, splice, spliceosomes assembly, alternative splicing, Regulation of Transcription- Trp and Lac operon. Gene regulation, levels of gene expression, methylation.

UNIT-V

Ribosomes, Genetic code, nature of genetic code, wobble hypothesis, activation, initiation, elongation, termination of translation in prokaryotes, inhibitors of protein synthesis. Protein synthesis in eukaryotes and its regulation. Post translational modification.

Protein sorting- signal peptides, targeting of mitochondria, secretor and lysosomal proteins.

Protein degradation- the ubiquitin pathway.

Books Recommended:

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments (6th ed).
John Wiley & Sons. Inc.
2. Bruce Alberts and Dennis Bray (2013), Essential Cell Biology, (4th ed), Garland Science.
3. De Robertis, E.D.P. and De Robertis, E.M.F. (2010). Cell and Molecular Biology. (8th ed). Lippincott Williams and Wilkins, Philadelphia.
4. James.D.Watson (2013) Molecular Biology of the Gene (7th ed), Benjamin Cummings
5. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. (5th ed). Sunderland, Mass. Sinauer Associates, Inc.
6. David Freifelder (1992) Essentials of Molecular Biology (2nd ed) Jones & Bartlett Pub

Elective Paper-III-Biostatistics

UNIT – I

Nature of biological and clinical experiments – Collection of data in experiment- Primary and secondary data. Methods of data collection. Classification and tabulation. Different forms of diagrams and graphs related to biological studies. Measures of Averages- Mean, Median, and mode. Use of these measures in biological studies.

UNIT- II

Measures of Dispersion for biological characters – Quartile deviation, Mean deviation, Standard deviation and coefficient of variation. Measures of skewness and kurtosis. Correlation and regression – Rank correlation – Regression equation. Simple problems based on biochemical data.

UNIT-III

Basic concepts of sampling- Simple random sample stratified sample and systemic sampling. Sampling distribution and standard error. Test of significance based on large samples. Test for mean, difference of means, proportions and equality of proportions.

UNIT-IV

Small sample tests – Students T^o test for mean, difference of two way means, tests for

correlation and regression coefficients. Chi-square test for goodness of a non-independence of attributes. F test for equality of variances. ANOVA- one way and two ways. Basic concept related to biological studies.

UNIT-V

Operating systems and application programmes, MS excel and Statistical package for social sciences (SPSS) for basic statistical functions, Regression, correlation, ANOVA, Chi square test with specific biological examples.

Books Recommended:

1. Zar, J.H. (1984) "Bio Statistical Methods", Prentice Hall, International Edition
2. Sundar Rao P. S.S., Jesudian G. & Richard J. (1987), "An Introduction to Biostatistics", 2nd edition, Prestographik, Vellore, India,
3. Warren, J; Gregory, E; Grant, R (2004), "Statistical Methods in Bioinformatics", 1st edition, Springer
4. Milton, J.S. (1992), "Statistical methods in the Biological and Health Sciences", 2nd edition, Mc Graw Hill,
5. Rosner, B (2005), "Fundamentals of Biostatistics", Duxbury Press
6. SPSS for you by A.Rajathi and P.Chandran, MJP publishers
7. An introduction to Biostatistics- Second revised edition by N.Gurumani
8. Statistical methods for biologists by S.Palinichamy & M.Manoharan

Extra Disciplinary Paper-II

Environmental Biotechnology

UNIT-I

Biofilm – Occurrence causes and effects – control measures, Biofilm reactor – Soluble microbial products and inert biomass – principles and applications.

UNIT – II

Bioreactors – Principles and designing. Reactor types – batch, continuous – flow, stirred – tank reactor, Plug – flow reactors. Effluent recycles- reactors with recycle of settled cells- alternative rate models – Reactors.

UNIT – III

Denitrification – physiology, types and microbes involved – Sludge denitrification. Waste water treatment systems – anaerobic and aerobic – special factors for the design of digesters. Drinking – Water treatment – Principles – anaerobic treatment by methanogens.

UNIT – IV

Detoxification of Hazardous chemicals – factors causing molecular recalcitrance. Synthetic organic chemicals – Energy metabolism versus co-metabolism – Electron donor versus Electron acceptor – Biodegradation of environmental contaminants.

UNIT-V

Bioremediation Strategies for bioremediation – pollution monitoring, control and Remediation (Petroleum industry, Paper industry, chemical industry etc). Biomass from the wastes.

Books Recommended:

1. Introduction to Environmental Biotechnology by A.K.Chatterji
2. Textbook of Environmental Biotechnology by Pradipta Kumar Mohapatra
3. Environmental Microbial Biotechnology by Lala Behari Sukla

IV Semester

Core Paper-XII-Hormones

UNIT I

Hormones – Classification, Biosynthesis, circulation in blood, modification and degradation. Mechanism of hormone action, Target cell concept – Feedback control and regulation. Hormones of Hypothalamus and pituitary – Vasopressin and oxytocin, Hypothalamic releasing factors. Anterior pituitary hormones – actions and feedback regulation of synthesis. Growth promoting, Lactogenic hormones. Glycoprotein hormones, the POMC family, Endorphins.

UNIT II

Pancreatic hormones – cell types of the islets of Langerhans. Insulin – structure, Biosynthesis, regulation of secretion, Biological actions and mechanism of action. Glucagon, somatostatin and pancreatic polypeptide. Insulin like growth factors – structure, biological action. Gastrointestinal hormones – secretin, gastrin, cholecystokinin – biological action, regulation of secretion.

UNIT III

Thyroid hormones – synthesis, secretion, transport, biological action, metabolic fate and mechanism of action, regulation. Parathyroid hormone – biological action, regulation of calcium and phosphorus metabolism and the role of calcitonin. Calcitriol – Biosynthesis, transport, functions, mechanism of action.

UNIT IV:

Adrenal hormones – Glucocorticoids, mineralocorticoids, synthesis, secretion, transport, metabolism and excretion. Biological effects. Mechanisms of action, adrenal androgens, metabolic effects and functions. Adrenal medulla – Catecholamines, biosynthesis, storage, metabolism, regulate of synthesis. Chemical nature and biological action of prostaglandins.

UNIT V:

Gonadal Hormones – Chemical Nature. Biosynthesis, metabolism and metabolism of action of androgen, estrogen and progesterone. Factors involved in the regulation of gonadal hormone activities. Ovarian cycle. Pregnancy, biochemical changes in pregnancy.

Books Recommended:

1. Larsen PR (2002) Williams Text Book of Endocrinology (10th ed) Saunders
2. Wilson JD and Foster DW (1998) Williams Textbook of Endocrinology, (9th ed) Saunders

Core Paper-XIII-Clinical Biochemistry-II

UNIT-I

Clinical enzymology, functional and non- functional serum enzymes –Normal levels. Clinical significance of AST, ALT, ALP, ACP, CK, γ -GT, amylase, pseudocholesterase. Enzyme pattern in diseases- myocardial infarction and liver diseases. Isoenzymes –LD, CK and ALP. Enzymes as therapeutic agents.

UNIT-II

Inborn errors of metabolism- Inborn errors of carbohydrate metabolism- Galactosemia, fructosuria, Glycogen storage diseases -causes and symptoms Inborn errors of lipid metabolism -Taysach's disease, Gaucher's and Niemannpick's disease-causes and symptoms. Inborn errors of aminoacid metabolism-phenyl ketonuria, Tyrosinemia, Maple syrup urine disease and alkaptonuria- causes and symptoms. Amniocentesis, prenatal detection of inborn errors of metabolism in developing fetus-Autosomal recessive mode of inheritance- cystic fibrosis, X linked recessive inheritance-Duchenne muscular dystrophy.

UNIT-III

Liver function tests based on synthesis, excretion and detoxification. Jaundice-classification, pathology and Differential diagnosis. Plasma protein changes in liver diseases. Hepatitis A,B and C. Cirrhosis and fibrosis. Portal hypertension and hepatic coma. Acute phase proteins -CRP, Haptoglobins, α -fetoprotein, ferritin and transferrin-their clinical significance.

UNIT-IV

Renal function tests -tests for glomerular and tubular function-Acute and chronic renal failure-Glomerulonephritis, Nephrotic syndrome, uraemia-urinary calculi-Nephrocalcinosis and Nephrolithiasis-causes, pathology and symptoms. Dialysis-Hemodialysis and peritoneal dialysis.

UNIT-V

Hormonal disorders-causes and the pathology of thyroid disorders-Hypothyroidism and Hyperthyroidism-Diagnostic methods – disorders associated with adrenal, pituitary and sex hormones- Addison's disease, Cushing's syndrome, pituitary tumour, Hypopituitarism, Hypogonadism-Causes, pathology, symptoms and diagnosis.

Books Recommended:

1. Thomas M.Devlin (2014) Textbook of Biochemistry with Clinical Correlations (7th ed). John Wiley & Sons
2. Montgomery R, Conway TW, Spector AA (1996), Biochemistry: A Case-Oriented Approach (6th ed), Mosby Publishers, USA.
3. Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics (2014) (7th ed), Saunders
4. Dinesh Puri, (2002), Text book of Biochemistry: A clinically oriented approach - Churchill Livingstone Inc., India.
5. M.N.Chatterjee and Rana Shinde (2007).Textbook of Medical Biochemistry (7th ed)

Core Paper XIV-Practical-III

1. Antioxidant status: Estimation of super oxide dismutase and catalase. Estimation of vitamine E and C.
2. Haematology: RBC count, WBC count – total and differential count, ESR, PCV, MCV. Estimation of hemoglobin.
3. LPO, Nitrite, glutathione and GPX.
4. Estimation of Sodium, Potassium and Calcium
5. Estimation of ALT, AST, CPK by kit method.
6. Liver function test: Estimation of bilirubin – direct and indirect. Estimation of plasma protein, A/G ratio, Thymol turbidity test, Assay of serum glutamate oxaloacetate transaminase, alkaline phosphatase, isoenzyme separation of LDH by electrophoresis.
7. Renal function test: Qualitative tests for normal and pathological components of urine. Estimation of blood and urine urea, creatinine, creatine and uric acid. Urea

Clearance tests. Chemical analysis of kidney and gall stones.

8. Estimation of blood glucose by orthotoluidine and glucose oxidase method. Determination of glycosylated Hb. Glucose tolerance test.
9. Lipid profile: Estimation of cholesterol by Zak's method, lipoprotein profile, estimation of ketone bodies, estimation of triglycerides, free fatty acids and phospholipids.

Elective Paper-IV-Signal Transduction

UNIT I:

General functions and structure of signaling pathways, Mechanism of intracellular and intercellular signal transduction, Hormone and hormone analogues; Recognition and interaction of hormones with receptors, Signal amplification, regulation of inter and intracellular signaling; Receptor superfamilies and subtypes., intra cellular signaling molecules-secondary messengers; Divergence, convergence and cross talk

UNIT II:

Protein kinases and protein phosphatases: Classification, structure protein kinases, ser/ thr protein kinases, Regulation of PKA, PKB, PKC, Ca²⁺/ calmodulin-dependent protein kinases, Structure and regulation of phosphatases, I,2A,2B, PP2A; subcellular localization.

UNIT III:

G-Protein coupled signal transduction pathways: Transmembrane Receptors– Structure, Major classes of trimeric G proteins based on Gs unit, mechanism of signal transmission, toxins as tools in characterization of G- protein, GTPase switches, G proteins that regulate ion channels; G-protein and gene control

UNIT IV:

Signaling and Gene control: TGF receptors; Cytokine receptors and JAK – STAT; Receptor Tyrosine Kinases (RTK), activation of ras, genetic analysis – drosophila eye development; MAPK; Phosphoinositide cascade, NF-kB; signal induced protein cleavage, Down modulation of receptor signaling.

UNIT V:

Nuclear receptors, Principles of signaling by nuclear receptors, Classification and structure of nuclear receptors, Mechanism of transcriptional regulation by nuclear receptors, transactivation. Steroid hormone signaling

Books Recommended:

1. John Hancock (2010), Cell signalling(3rd ed) Oxford University Press

2. Wendell Lim, Bruce Mayer (2014) Cell Signalling (Garland Science) 3. Lewin B: Genes 8; Prentice Hall; International Ed edition (2004)
3. Watson JD, Baker TA, Bell S, Gann A, Levine M, Losick R: Molecular Biology of the Gene; Addison Wesley; (2004)
4. Alberts B, Bray D, Hopkin K, Johnson A, Lewis J, Raff M, Roberts K, Walter P: Essential Cell Biology; Garland Science (2003)
5. Lodish H, Darnell JE: Molecular Cell Biology; W.H.Freeman& Co Ltd; (2003)

Elective Paper-V-Immunochemistry

UNIT-I

Scope and advances in immunology. Achievements in the field of immunology
Immunity – innate & acquired immunity– factors contributing for innate immunity – role of lymphokines in acquired immunity. Vaccines – different types – Attenuated vaccines- Preventive vaccines-DNA vaccines-. Antigenic competition. Contradictions in vaccinotherapy and Production of vaccines.

UNIT-II

Antibodies – classification, structure, properties & biological functions – abnormal immunoglobulins – isohemeagglutinins. Monoclonal antibodies – commercial production by hybridoma technique & applications. Cooper Antigens – nature & different types, classification based on epitope. Iso and neo antigens. MHC gene arrangement and functions of Class I and Class II antigens in human and mice. Factors affecting antigenicity and immunogenicity of antigens. Complement system- activation by direct and alternate pathways. Biological functions of complements.

UNIT-III

Antigen – Antibody reactions- General mechanism – Qualitative and quantitative determination of antigen-antibody reactions. Diagnostic tests based on antigen-antibody reactions – with special reference to typhoid, syphilis, HIV & Retro virus infection. ELISA, RIA and immuno fluorescence techniques. Cross reaction with examples.

UNIT-IV

Immune response – humoral & cell mediated immune response – ontogeny of T & B cells – clonal selection theory of antibody formation. Primary & secondary immune response. Immune response against bacterial, viral and fungal antigens. Immune surveillance.

UNIT-V

Pathology of immune system – Autoimmune disorders – causes and effects – systemic

& localized types. Hypersensitivity reactions – causes & effects – different types of hypersensitivity reactions (eg) allergy, atopy, anaphylatoxis, serum sickness. Disorders associated with complements. Transplantation and transfusion immune reactions. Graft rejection and adverse reactions of mismatched blood transfusion.

Books Recommended:

1. Judy Owen, Jenni Punt Kuby (2013), Immunology (Kindt, Kuby Immunology) (7th ed) W. H. Freeman & Co
2. Janis Kuby (1997), Immunology (3rd ed), W. H. Freeman & Co
3. David Male (2012), Immunology, (Immunology (Roitt) (8th ed), Saunders
4. Ivan Roitt and Peter Delves (2001), Roitts Essential Immunology (10th ed)
5. Donald M. Weir (1998), Immunology (8th ed), Churchill Livingstone

Programme Outcomes:

Program Outcomes for B.Sc., Biochemistry:

- After completion of Biochemistry program students will be able to get exposed to strong theoretical and practical background in fundamental concepts.
- To get insights of multiple important technical areas of Biochemistry.
- To apply contextual knowledge and modern tools of biochemical research for solving problems.
- To make them able to express ideas persuasively in written and oral form to develop their leadership qualities.
- To demonstrate professional and ethical attitude with enormous responsibility to serve the society.
- Comprehending fundamental concepts in modern biology to meet the emerging trends.
- Handling biochemical microbial systems.
- Procuring hands-on real-time experience in industries.

Program Outcomes for M.Sc., Biochemistry:

- The M.Sc. Biochemistry program offered by SRM Arts and Science College is a Two Years full time program. In order to make students more career oriented and nurturing their scientific temperaments students will get exposure to the depth of core understanding of various dimensions of Biochemistry during these two years of the study.
- The training provided will give students to breadth and depth of scientific knowledge.

- A strong understanding of fundamentals of biochemical process at an advanced level.
- Better understanding of major thrust areas of the discipline.
- Know how on current developments in the biochemical research.
- Capacity to identify, analyze and design safe experimental process to provide efficient solutions by fair interpretation of data.
- Perfect gain insight into biochemical research ethics for production of quality research and publication.
- An ability to get engages them in lifelong learning to foster their growth as a successful researcher and established as an entrepreneur in the field of biochemistry.