

Shiksha Mandal's
Bajaj College of Science, Wardha
(Autonomous)
B. Sc. Semester Pattern Syllabus
B. Sc. Part II
BIOTECHNOLOGY
(With effect from academic session 2024-25)

B.Sc. Part II- Semester III

Sr. No.	Unit	Total Theories Required
1	Unit I	10
2	Unit II	10
3	Unit III	10
4	Unit IV	12
5	Unit V	10
6	Unit VI	12

B.Sc. Part II- Semester IV

Sr. No.	Unit	Total Theories Required
1	Unit I	12
2	Unit II	12
3	Unit III	10
4	Unit IV	12
5	Unit V	12
6	Unit VI	12

B. Sc. Part II – Semester III

METABOLISM AND BIOPHYSICAL TECHNIQUES- I

Course Objectives:

1. To study the concept of bioenergetics and major pathways of carbohydrates metabolism.
2. To study the lipid metabolism and physiological and pathological disorder of lipid metabolism.
3. To study the major pathway of metabolism of nitrogenous compound and physiologically important chemical reactions.
4. To study the spectrophotometry.
5. To study principle, instrumentation and application of IR and Mass Spectrometry and Spectrofluorometry.
6. To study the various type of chromatography techniques.

Course Outcomes:

1. Students will be able to discuss concept of bioenergetics and illustrate major pathways of carbohydrates metabolism and their regulations.
2. Students will be able to describe major pathways of lipids metabolism and explain disorder related to lipid metabolism.
3. Students will be able to explain major pathways of metabolism of nitrogenous compound, discuss disorder associated with metabolic pathway and will discuss physiologically important product of transmethylation and decarboxylation.
4. Students will be able to discuss concept of electromagnetic radiation, absorption spectrum, Beer's law and describe difference between spectrophotometer and colorimeter, double beam spectrometer and dual wavelength spectrometer.
5. Students will be able to discuss principle, instrumentation and application of IR, Mass and Spectrofluorometry.
6. Students will be able to demonstrate and explain principle and application of paper, thin layer, gel filtration, affinity, ion exchange and high pressure liquid chromatography.

B.Sc. –II Semester –III	METABOLISM AND BIOPHYSICAL TECHNIQUES- I	
Unit Nos.	Topic	Total Theories Required
I	<p>Bioenergetics and carbohydrate metabolism</p> <p>A) Concept of free energy, Entropy, Enthalpy & Redox Potential. Concept of high energy bonds as related to the structure of ATP, Phosphoenolpyruvate.</p> <p>B) Glycolysis (pathway, entry of other monosachharides and disaccharides, regulation, inhibitors), Gluconeogenesis: Bypass reactions.</p> <p>C) TCA cycle: Detailed account, regulation, amphibolic nature and anaplerosis. Electron Transport Chain: Components of the chain, sites of ATP synthesis.</p>	10
II	<p>Lipid Metabolism</p> <p>A) β -oxidation of fatty acids, role of Carnitine, oxidation of unsaturated fatty acids and odd carbon fatty acids. Regulation. Ketogenesis, Ketosis and ketoacidosis in physiology and pathology.</p> <p>B) Biosynthesis of fatty acids, fatty acid synthase complex, regulation, Microsomal and Mitochondrial system of chain elongation and synthesis of unsaturated fatty acids.</p>	10
III	<p>Metabolism of Nitrogenous Compounds</p> <p>A) Transamination (mechanism) Oxidative and Non-oxidative deamination. Urea cycle: Detail account, linkage of urea and TCA cycle, compartmentation of urea cycle, regulation and metabolic disorders of urea cycle.</p> <p>B) Transmethylation and decarboxylation, physiologically important products of decarboxylation. Biosynthesis of purines and pyrimidines: Salvage pathways.</p>	10
IV	<p>A) Spectrophotometry: Concept of electromagnetic radiation, spectrum of light, absorption of electromagnetic radiations, Concept of chromophores and auxochromes, Absorption spectrum and its uses, Beer's law - derivation and deviations, extinction coefficient.</p> <p>B) Difference between spectrophotometer and colorimeter. Instrumentation and Applications of UV and visible spectrophotometry, Double beam spectrometer; dual-wavelength spectrometer.</p>	12
V	<p>A) Principle , instrumentation and application of IR and Mass spectrometry</p> <p>B) Spectrofluorometry: Principle, instrumentation and applications. Absorption & emission flame photometry: principle, instrumentation and application.</p>	10
VI	<p>A) Chromatography: Partition principle, partition coefficient, nature of partition forces, brief account of paper chromatography. Thin layer chromatography and column chromatography. Gel filtration: Concept of distribution coefficient, types of gels and glass beads, applications.</p> <p>B) Ion-exchange chromatography: Principle, types of resins, choice of buffers, applications including amino acid analyzer. Affinity chromatography: Principle, selection of ligand, brief idea of ligand attachment, specific and non-specific elution, applications. Brief note on high pressure liquid chromatography.</p>	12

Sr. No.	Practicals	Minor/Major
1	Spectrophotometric analysis of DNA denaturation	Minor
2	Determination of absorption spectrum of oxy- and deoxyhemoglobin and methemoglobin.	Major
3	Protein estimation by E280/E260 method	Major
4	Paper chromatography of amino acids/sugars/lipids.	Major
5	TLC of sugars/amino acids.	Major
6	Cellular fractionation and separation of cell organelles using centrifuge.	Major
7	Isolation of mitochondria and assay of marker enzyme.	Minor
8	Estimation of Urea by diacetylenonoxime method	Major
9	Estimation of Sugars by Folin Wu method.	Major
10	Validity of Beer's law for colorimetric estimation of creatinine.	Major
11	Absorption spectrum of NAD & NADH/ Determination of pKa of Amino Acid	Minor
12	Preparation of standard buffers and determination of pH of a solution.	Minor
13	Titration of a mixture of strong & weak acid.	Major
14	Performance of affinity chromatography.	Major
15	Performance of gel filtration chromatography	Major

Recommended readings:

- Biochemistry, 4th edition, (2013), Satynarayana U, Chakrapani U., Elsevier.
- Essentials of Physical Chemistry, 24th edition, (2000), B. S. Bahl, G. D. Tuli, Arun Bahl, S. Chand Limited, India
- Lehninger's Principles of Biochemistry, 5th edition, (2008), Nelson D. L. and Cox M. M., CBS Publications,
- Principles of Biochemistry, 4th edition, (1997), Jeffery Zubey., McGraw-Hill College, USA.
- Fundamentals of Biochemistry, 3rd edition, (2008), Donald Voet & Judith Voet , John Wiley and Sons, Inc. USA
- Textbook of Biochemistry for medical student, 6th edition, (2011), Vasudewan M. D., Sreekumari S and Vaidynathan K., Jaypee Brother medical publishers.
- Laboratory manual in Biochemistry, (1981), Jayaram T., Wiley Estern Ltd. New Delhi.
- An Introduction to Practical Biochemistry. 3rd edition, (1988), Plummer D., Tata McGraw Hill, New Delhi.
- Practical Biochemistry in Clinical Medicine, (1990), Nath R L., Academic Pub.
- Biochemical Methods. 2nd edition. (1996), Sadasivam S. and Manickam A., New Age International (P) Ltd. Publisher, New Delhi.
- Biochemical Methods, 1st edition, (1995), S. Sadashivam, A. Manickam, New Age International Publishers, India
- Biophysical Chemistry, 4th edition, (2016), Upadhyay A, Upadhyay K and Nath N., Himalaya publication house.
- Biophysical chemistry 1st edition, (2008), Allen J. P., Wiley Blackwell publication.

B. Sc. Part II – Semester IV
IMMUNOLOGY AND BIOPHYSICAL TECHNIQUES- II

Course Objectives:

1. To study the components of immune system, antigen and vaccination.
2. To study the humoral, cell mediated immunity and hypersensitivity.
3. To study the various type of immunological techniques and hybridoma technology.
4. To study the electrophoresis and its various types.
5. To study principle, procedure and application of SDS Page, pulse-field electrophoresis and centrifugations.
6. To study the isotopic tracer techniques.

Course Outcomes:

1. Students will be able to discuss cell and organs of immunity, types of immunity, concept of antigen, complement systems and explain principle and significance of vaccination.
2. Students will be able to explain components of humoral and cell mediated immunity and describe various type of hypersensitivity.
3. Students will be able to demonstrate immunological techniques and discuss application of hybridoma technology.
4. Student will be able to discuss and demonstrate paper electrophoresis, high voltage electrophoresis and gel electrophoresis.
5. Students will be able to describe principle, procedure and application of SDS Page, pulse-field electrophoresis and centrifugations.
6. Student will be able to explain isotopic tracer techniques and its application.

B.Sc. –II Semester – IV	IMMUNOLOGY AND BIOPHYSICAL TECHNIQUES- II	
Unit No.	Topic	Total Theories Required
I	A) Immune system, Organs and cells of immune system, Immunity, innate immune mechanism, Acquired immune mechanism, Antigen, Antigenicity (factors affecting antigenicity), Humoral immunity and main pathways of complement system. B) Vaccination: Discovery, principles and significance.	12
II	A) General structure of Antibody and different classes. Cell mediated immunity: TC mediated immunity, NK cell mediated immunity, ADCC, cytokines and brief idea of MHC molecules and different classes, Concept of autoimmunity. B) Hypersensitivity: General features and various types of hypersensitivity.	12
III	A) Immunological Techniques: Antigen-antibody reactions: Precipitation, agglutination, complement fixation, immunodiffusion, ELISA. B) Hybridoma technology: Monoclonal antibodies and their applications in immunodiagnosis.	10
IV	A) Electrophoresis: Definition, Migration of ions in electric field and Factors affecting electrophoretic mobility. B) Paper electrophoresis: - Electrophoretic run, Detection techniques. C) High Voltage Electrophoresis. D) Gel electrophoresis: - Types of gels, Solubilizers, Procedure, Column & slab gels, Detection, Recovery and Techniques used for estimation of macromolecules.	12
V	A) SDS-PAGE Electrophoresis: principle, procedure and application. B) Pulsed-field gel electrophoresis: principle, procedure and application. Isoelectric focussing: principle, procedures and applications. . C) Centrifugation: Basic principles, concept of RCF, types of centrifuges (clinical, high speed and ultracentrifuges). Preparative centrifugation: Differential and density gradient centrifugation, applications Analytical centrifugation: Sedimentation coefficient, determination of molecular weight by sedimentation velocity and sedimentation equilibrium methods.	12
VI	Isotopic tracer technique: - A) Radioactive & stable isotopes, rate of radioactive decay. Units of radioactivity. B) Measurement of radioactivity: - Ionization chambers, proportional counters, Geiger- Muller counter, Solid and liquid scintillation counters (basic principle, instrumentation and technique). C) Principles of tracer technique, advantages and limitations. Applications of isotopes in biological science.	12

Sr. No.	Practical's	Minor/Major
1	Antigen –antibody reaction – determination of Blood group	Minor
2	Pregnancy test.	Minor
3	Widal test.	Minor
4	Ouchterloney immunodiffusion.	Major
5	Radial immunodiffusion.	Major
6	ELISA (Enzyme Linked Immunosorbent Assay)	Major
7	Isolation of casein by isoelectric precipitation.	Major
8	Immuno-electrophoresis	Major
9	VDRL (Venereal Disease Research Laboratory Test)	Minor
10	One step test for Qualitative detection of HBs.	Minor
11	Separation of different components from clinical specimen (Blood or Urine) using centrifugation.	Major
12	TRUST [Toluidine Red Unheated Serum Test]/Rapid test for Malaria detection	Major
13	Paper electrophoresis of proteins.	Major
14	Gel electrophoresis of Nucleic acids (DNA/RNA).	Major
15	SDS-PAGE of an Oligomeric protein.	Major

Recommended readings:

1. Essential Immunology, 10th edition, (2001), Roitt I.M., Delves P.J. Oxford Blackwell Science
2. Essential Immunology, 1st edition, (2012), Gupta S.K., Aray Publication New Delhi.
3. Kuby Immunology, 7th edition, (2013), Punt, Stranford, Jones, Owen. W. H. Freeman & company.
4. Textbook of Basic and Clinical Immunology, 1st edition, (2013), Gangal S., Sontakke S., University Press, India
5. Textbook of Immunology, 2nd edition, (2012), Basir F., Prentice Hall India Learning private limited.
6. Fundamental of Medical Immunology, 1st edition, (2007), Jaypal V., Jaypee Brother medical publisher (P) LTD, India
7. Textbook of Microbiology, (2006), Ananthanarayan R. and Paniker's CK., University Press Publication.
8. Laboratory Manual in Biochemistry, (1981), Jayaram T., Wiley Estern Ltd. New Delhi.
9. An Introduction to Practical Biochemistry. 3rd edition, (1988), Plummer D., Tata McGraw Hill, New Delhi.
10. Practical Biochemistry in Clinical Medicine, (1990), Nath R. L., Academic Pub.
11. Biochemical Methods. 2nd edition, (1996), Sadasivam S. and Manickam A., New Age International (P) Ltd. Publisher, New Delhi.
12. Biochemical Methods, 1st edition, (1995), S. Sadashivam, A. Manickam, New Age International Publishers, India
13. Biophysical Chemistry, 4th edition, (2016), Upadhyay A., Upadhyay K. and Nath N., Himalaya publication house.
14. Biophysical chemistry 1st edition, (2008), Allen J. P., Wiley Blackwell publication.