

**Shiksha Mandal's**  
**Bajaj College of Science, Wardha (Autonomous)**  
**BIOTECHNOLOGY**  
(With effect from academic session 2025-26)  
**B. Sc. Semester Pattern Syllabus**  
**B. Sc. Part II- Semester III**  
**DSC III [Credits 4T+2P=6]**

**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 (DSC III)	<b>METABOLISM AND BIOPHYSICAL TECHNIQUES- I</b>	Course Code: <b>UBT230T</b>
Unit Nos.	Topic	Total Theories Required
<b>I</b>	<b>Bioenergetics and carbohydrate metabolism</b> <ul style="list-style-type: none"> <li>• Concept of free energy, Entropy, Enthalpy &amp; Redox Potential. Concept of high energy bonds as related to the structure of ATP, Phosphoenolpyruvate.</li> <li>• Glycolysis (pathway, entry of other monosachharides and disaccharides, regulation, inhibitors)</li> <li>• Gluconeogenesis: Bypass reactions.</li> <li>• TCA cycle: Detailed account, regulation, amphibolic nature and anaplerosis.</li> <li>• Electron Transport Chain: Components of the chain, sites of ATP synthesis.</li> </ul>	<b>10</b>
<b>II</b>	<b>Lipid Metabolism</b> <ul style="list-style-type: none"> <li>• <math>\beta</math> -oxidation of fatty acids, role of Carnitine, oxidation of unsaturated fatty acids and odd carbon fatty acids.</li> <li>• Regulation. Ketogenesis, Ketosis and ketoacidosis in physiology and pathology.</li> <li>• Biosynthesis of fatty acids, fatty acid synthase complex, regulation, Microsomal and Mitochondrial system of chain elongation and synthesis of unsaturated fatty acids.</li> </ul>	<b>10</b>
<b>III</b>	<b>Metabolism of Nitrogenous Compounds</b> <ul style="list-style-type: none"> <li>• Transamination (mechanism) Oxidative and Non-oxidative deamination.</li> <li>• Urea cycle: Detail account, linkage of urea and TCA cycle, compartmentation of urea cycle, regulation and metabolic disorders of urea cycle.</li> <li>• Transmethylation and decarboxylation, physiologically important products of decarboxylation. Biosynthesis of purines and pyrimidines: Salvage pathways.</li> </ul>	<b>10</b>
<b>IV</b>	<b>Spectrophotometry Technique I</b> <ul style="list-style-type: none"> <li>• 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.</li> <li>• Difference between spectrophotometer and colorimeter. Instrumentation and Applications of UV and visible spectrophotometry, Double beam spectrometer; dual-wavelength spectrometer.</li> </ul>	<b>12</b>
<b>V</b>	<b>Spectrophotometry Technique II</b> <ul style="list-style-type: none"> <li>• Principle , instrumentation and application of IR and Mass spectrometry</li> <li>• Spectrofluorometry: Principle, instrumentation and applications. Absorption &amp; emission flame photometry: principle, instrumentation and application.</li> </ul>	<b>10</b>

<b>VI</b>	<b>Chromatography Techniques</b> <ul style="list-style-type: none"> <li>• Partition principle, partition coefficient, nature of partition forces</li> <li>• Brief account of Paper chromatography</li> <li>• Thin layer chromatography</li> <li>• Column chromatography: Gel filtration, Ion-exchange chromatography, Affinity chromatography, High pressure liquid chromatography.</li> </ul>	<b>12</b>
-----------	--	-----------

Sr. No.	Practicals Course Code: UBT230P
1	Spectrophotometric analysis of DNA denaturation
2	Determination of absorption spectrum of oxy- and deoxyhemoglobin and methemoglobin.
3	Protein estimation by E280/E260 method
4	Paper chromatography of amino acids/sugars/lipids.
5	TLC of sugars/amino acids.
6	Cellular fractionation and separation of cell organelles using centrifuge.
7	Isolation of mitochondria and assay of marker enzyme.
8	Estimation of Urea by diacetylenoxime method
9	Estimation of Sugars by Folin Wu method.
10	Validity of Beer's law for colorimetric estimation of creatinine.
11	Absorption spectrum of NAD & NADH/ Determination of pKa of Amino Acid
12	Preparation of standard buffers and determination of pH of a solution.
13	Titration of a mixture of strong & weak acid.
14	Performance of affinity chromatography.
15	Performance of gel filtration chromatography

## Recommended readings:

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

**Shiksha Mandal's**  
**Bajaj College of Science, Wardha (Autonomous)**  
**BIOTECHNOLOGY**  
(With effect from academic session 2024-25)  
**B. Sc. Semester Pattern Syllabus**  
**B. Sc. Part II- Semester III**  
**Minor III [Credits 4T+2P=6]**

**METABOLISM AND BIOPHYSICAL TECHNIQUES- I**

**Course Objectives:**

7. To study the concept of bioenergetics and major pathways of carbohydrates metabolism.
8. To study the lipid metabolism and physiological and pathological disorder of lipid metabolism.
9. To study the major pathway of metabolism of nitrogenous compound and physiologically important chemical reactions.
10. To study the spectrophotometry.
11. To study principle, instrumentation and application of IR and Mass Spectrometry and Spectrofluorometry.
12. To study the various type of chromatography techniques.

**Course Outcomes:**

7. Students will be able to discuss concept of bioenergetics and illustrate major pathways of carbohydrates metabolism and their regulations.
8. Students will be able to describe major pathways of lipids metabolism and explain disorder related to lipid metabolism.
9. 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.
10. 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.
11. Students will be able to discuss principle, instrumentation and application of IR, Mass and Spectrofluorometry.
12. 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 (Minor III)	<b>METABOLISM AND BIOPHYSICAL TECHNIQUES- I</b>	Course Code: <b>UBT231T</b>
Unit Nos.	Topic	Total Theories Required
<b>I</b>	<b>Bioenergetics and carbohydrate metabolism</b> <ul style="list-style-type: none"> <li>• Concept of free energy, Entropy, Enthalpy &amp; Redox Potential. Concept of high energy bonds as related to the structure of ATP, Phosphoenolpyruvate.</li> <li>• Glycolysis (pathway, entry of other monosachharides and disaccharides, regulation, inhibitors)</li> <li>• Gluconeogenesis: Bypass reactions.</li> <li>• TCA cycle: Detailed account, regulation, amphibolic nature and anaplerosis.</li> <li>• Electron Transport Chain: Components of the chain, sites of ATP synthesis.</li> </ul>	<b>10</b>
<b>II</b>	<b>Lipid Metabolism</b> <ul style="list-style-type: none"> <li>• <math>\beta</math> -oxidation of fatty acids, role of Carnitine, oxidation of unsaturated fatty acids and odd carbon fatty acids.</li> <li>• Regulation. Ketogenesis, Ketosis and ketoacidosis in physiology and pathology.</li> <li>• Biosynthesis of fatty acids, fatty acid synthase complex, regulation, Microsomal and Mitochondrial system of chain elongation and synthesis of unsaturated fatty acids.</li> </ul>	<b>10</b>
<b>III</b>	<b>Metabolism of Nitrogenous Compounds</b> <ul style="list-style-type: none"> <li>• Transamination (mechanism) Oxidative and Non-oxidative deamination.</li> <li>• Urea cycle: Detail account, linkage of urea and TCA cycle, compartmentation of urea cycle, regulation and metabolic disorders of urea cycle.</li> <li>• Transmethylation and decarboxylation, physiologically important products of decarboxylation. Biosynthesis of purines and pyrimidines: Salvage pathways.</li> </ul>	<b>10</b>
<b>IV</b>	<b>Spectrophotometry Technique I</b> <ul style="list-style-type: none"> <li>• 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.</li> <li>• Difference between spectrophotometer and colorimeter. Instrumentation and Applications of UV and visible spectrophotometry, Double beam spectrometer; dual-wavelength spectrometer.</li> </ul>	<b>12</b>
<b>V</b>	<b>Spectrophotometry Technique II</b> <ul style="list-style-type: none"> <li>• Principle , instrumentation and application of IR and Mass spectrometry</li> <li>• Spectrofluorometry: Principle, instrumentation and applications. Absorption &amp; emission flame photometry: principle, instrumentation and application.</li> </ul>	<b>10</b>

<b>VI</b>	<b>Chromatography Techniques</b> <ul style="list-style-type: none"> <li>• Partition principle, partition coefficient, nature of partition forces</li> <li>• Brief account of Paper chromatography</li> <li>• Thin layer chromatography</li> <li>• Column chromatography: Gel filtration, Ion-exchange chromatography, Affinity chromatography, High pressure liquid chromatography.</li> </ul>	<b>12</b>
-----------	--	-----------

Sr. No.	Practicals
	<b>Course Code: UBT231P</b>
1	Spectrophotometric analysis of DNA denaturation
2	Determination of absorption spectrum of oxy- and deoxyhemoglobin and methemoglobin.
3	Protein estimation by E280/E260 method
4	Paper chromatography of amino acids/sugars/lipids.
5	TLC of sugars/amino acids.
6	Cellular fractionation and separation of cell organelles using centrifuge.
7	Isolation of mitochondria and assay of marker enzyme.
8	Estimation of Urea by diacetylenoxime method
9	Estimation of Sugars by Folin Wu method.
10	Validity of Beer's law for colorimetric estimation of creatinine.
11	Absorption spectrum of NAD & NADH/ Determination of pKa of Amino Acid
12	Preparation of standard buffers and determination of pH of a solution.
13	Titration of a mixture of strong & weak acid.
14	Performance of affinity chromatography.
15	Performance of gel filtration chromatography

## Recommended readings:

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

**Shiksha Mandal's**  
**Bajaj College of Science, Wardha (Autonomous)**  
**Department of Biotechnology**  
**B.Sc. Part II- Semester III**  
**VSC**  
**PRODUCTION OF VALUABLE PLANT PRODUCTS**

**Course Objective**

1. To provide students with an understanding of the methods and principals involved in the extraction and production of valuable plant-based products, such as essential oils, pigments, and phytochemicals.
2. To give hands-on experience in the laboratory techniques required for the extraction and production of natural dyes, bio-pesticides, and biofuels from plant materials.
3. To aware student about sustainable practices in utilizing plant resources for the production of eco-friendly and economically viable products.

**Course Outcomes**

1. Students will gain the ability to perform essential oil extraction, pigment extraction, and phytochemical production with a strong understanding of the underlying processes.
2. Students will develop skills in creating natural dyes, bio-pesticides, and biofuels, emphasizing environmentally friendly methods and sustainability.
3. Students will enhance their analytical skills by understanding the composition and utility of plant-based products, preparing them for further research or industry roles in the field of bioproducts.

<b>List of Practical</b>	<b>PRODUCTION OF VALUABLE PLANT PRODUCTS</b> <b>Course Code: UBT232P</b>	<b>Time in Hours</b>
1	Essential Oil Extraction from Plants	12
2	Extraction of Plant Pigments	8
3	Production of Plant-Based Phytochemicals	12
4	Production of Natural Dyes	8
5	Bio-pesticide Preparation	10
6	Biofuel Production from Plant Materials	10

**References:**

1. Smith, A. R. J. (2020). *Essential oils: Extraction, bioactivity, and therapeutic properties*. CRC Press. ISBN 9780367338010
2. Sheehan, S. R. K. (2019). *Plant pigments and their manipulation*. Springer. ISBN 9783030022772
3. Kelly, J. G. (2016). *Phytochemicals: Extraction, isolation, and identification*. Wiley. ISBN 9781118922635
4. Lawrence, C. A. (2018). *Natural dyes: Sources, tradition, technology, and science*. AATCC Press. ISBN 9780892520776
5. Patel, D. G. (2021). *Bio-pesticides: Production, characterization, and application*. CRC Press. ISBN 9780367339871
6. Thompson, M. C. R. (2019). *Biofuels: Biotechnology and renewable resources*. Elsevier. ISBN 9780128124980

**Shiksha Mandal's**  
**Bajaj College of Science, Wardha (Autonomous)**  
**Department of Biotechnology**  
**B.Sc. Part II- Semester III**  
**SEC**  
**BASIC TECHNIQUE IN MOLECULAR BIOTECHNOLOGY**

**Course Objective:**

1. To equip students with the practical skills necessary to isolate and manipulate nucleic acids, including genomic DNA, plasmid DNA, and RNA from various biological sources.
2. To provide hands-on experience with essential molecular techniques such as restriction digestion, ligation and Estimation of protein by Bradford method, allowing students to understand and apply these methods in genetic engineering and research.
3. To develop the ability to apply molecular Biotechnology techniques in real-world research and Biotechnology contexts, fostering a deeper understanding of how these methods contribute to advancements in the life sciences.

**Course Outcomes:**

1. Students will be able to independently isolate genomic DNA, plasmid DNA, and RNA from bacterial, animal, and plant cells.
2. Students will demonstrate proficiency in performing restriction digestion and ligation of DNA.
3. Students will be able to estimate protein by Bradford method

<b>List of Practical</b>	<b>BASIC TECHNIQUE IN MOLECULAR BIOTECHNOLOGY</b> <b>Course Code:UBT243P</b>	<b>Times in Hours</b>
1	Isolation of genomic DNA from Bacterial/ Animal/ Plant cell.	10
2	Isolation of Plasmid DNA.	10
3	Isolation of RNA from Bacteria /Plant cells.	10
4	Restriction Digestion of DNA.	10
5	Ligation of DNA.	10
6	Estimation of Protein by Bradford Method	10

**References:**

1. Sambrook, J., & Russell, D. W. (2001). *Molecular Cloning: A Laboratory Manual* (3rd ed.). Cold Spring Harbor Laboratory Press.
2. Ausubel, F. M., Brent, R., Kingston, R. E., Moore, D. D., Seidman, J. G., Smith, J. A., & Struhl, K. (1994). *Current Protocols in Molecular Biology*. John Wiley & Sons.
3. Green, M. R., & Sambrook, J. (2012). *Molecular Cloning: A Laboratory Manual* (4th ed.). Cold Spring Harbor Laboratory Press.
4. Brown, T. A. (2010). *Gene Cloning and DNA Analysis: An Introduction* (6th ed.). Wiley-Blackwell.
5. Freifelder, D. (1983). *Molecular Biology: A Comprehensive Introduction to Prokaryotes and Eukaryotes*. Jones & Bartlett Learning.

**Shiksha Mandal's**  
**Bajaj College of Science, Wardha (Autonomous)**  
**Department of Biotechnology**  
**B.Sc. Semester- III**  
**Generic Elective Course (GE/OE)**  
**WILD VEGETABLE DIVERSITY OF WARDHA DISTRICT**  
**[30 Hrs- 2 Credit]**

General elective in “Wild vegetable diversity of Wardha district” for students wants to pursue knowledge of wild vegetable and their nutritional and medicinal properties. The important feature of the elective course is to identification and conservation of indigenous Wild vegetable diversity of Wardha district.

**Course Objectives:**

1. To explore the diversity of wild vegetables in the Wardha district.
2. To establish a seed bank for wild vegetable genotypes from Wardha.
3. To implement diverse strategies for conserving the wild vegetable genotypes within the Wardha district.

**Course Outcomes:**

1. Students will attain expertise in identifying various wild vegetables.
2. Students will gain the skills necessary to maintain a seed bank containing wild vegetable genotypes.
3. Students will acquire the ability to apply a range of conservation strategies to preserve wild vegetable genotypes.

Sr. No.	Unit Number	Wild Vegetable Diversity of Wardha District (GE/OE) Course Code:- UBTG231	Times in Hrs.
1	I	Concept of edible wild plants, medicinal properties of wild vegetables, Diversity of wild vegetable. Nutritional value of wild vegetable, Commercial uses of wild vegetables.	8
2	II	Important and easily available wild vegetable and their uses –Tarota ( <i>Cassia tora</i> ), Patli Musli ( <i>Chlorophytum borivillianum</i> )Tavakila ( <i>Curcuma angustifolia</i> ), Baboo shut/ Bans ( <i>Dendrocalamus strictus</i> ) Matadu ( <i>Dioscorea bulbifera</i> ), Awla ( <i>Emblica officinalis</i> ), Umbari ( <i>Ficus racemosa</i> ) Karvand ( <i>Flacourtia indica</i> ), etc.	12
3	III	Important threats for wild vegetable diversity, conservation strategies of wild vegetable genotypes, Collection, identification, conservation of wild vegetable. Re-habitation of wild vegetable with help of seed ball.	10

**References**

- 1) Ambasta S.P. (2000). The useful plants of India, Publication and information Directorate, CSIR, New Delhi.
- 2) Chopra R.M.; Chopra S.L.; Handa K.L.; Kapur L.D.( 1982). Indigenous Drugs of India (Second Edi.- Repr.) Academic Publishers, New Delhi
- 3) Sharma, B.D., Karthikeyan, S., Singh, N.P., & Lakshminarasimhan, P. (1996). Flora of Maharashtra State.
- 4) Badhe, P.D and Pande, V.K. (1999) Medicinal Plants of Nagpur and Wardha Forest Divisions, Maharashtra. Central Council for Research in Ayurveda and Siddha (India).
- 5) Dhale D.A (2022). Medicinal Plants of Maharashtra.

**Shiksha Mandal's**  
**Bajaj College of Science, Wardha (Autonomous)**  
**BIOTECHNOLOGY (Major)**  
**(With effect from academic session 2025-26)**  
**B. Sc. Part II – Semester IV**  
**DSC IV [Credits 4T+2P=6]**

**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 (DSC IV)	IMMUNOLOGY AND BIOPHYSICAL TECHNIQUES- II	Course Code: UBT240T
Unit No.	Topic	Total Theories Required
I	<b>Introduction to Immunology</b> <ul style="list-style-type: none"> <li>• 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.</li> <li>• Vaccination: Discovery, principles and significance.</li> </ul>	12
II	<b>Antibody Dependent and Cellular Immunity</b> <ul style="list-style-type: none"> <li>• 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.</li> <li>• Hypersensitivity: General features and various types of hypersensitivity.</li> </ul>	12
III	<b>Immunological Techniques</b> <ul style="list-style-type: none"> <li>• Antigen-antibody reactions: Precipitation, agglutination, complement fixation, immunodiffusion, ELISA.</li> <li>• Hybridoma technology: Monoclonal antibodies and their applications in immunodiagnosis.</li> </ul>	10
IV	<b>Electrophoresis Technique</b> <ul style="list-style-type: none"> <li>• Definition, Migration of ions in electric field and Factors affecting electrophoretic mobility.</li> <li>• Paper electrophoresis: - Electrophoretic run, Detection techniques.</li> <li>• High Voltage Electrophoresis.</li> <li>• Gel electrophoresis: - Types of gels, Solubilizers, Procedure, Column &amp; slab gels, Detection, Recovery and Techniques used for estimation of macromolecules.</li> </ul>	12
V	<b>Electrophoresis Technique II and Centrifugation</b> <ul style="list-style-type: none"> <li>• SDS-PAGE Electrophoresis: principle, procedure and application.</li> <li>• Pulsed-field gel electrophoresis: principle, procedure and application. Isoelectric focussing: principle, procedures and applications. .</li> <li>• 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.</li> </ul>	12
VI	<b>Isotopic Tracer Technique</b> <ul style="list-style-type: none"> <li>• Radioactive &amp; stable isotopes, rate of radioactive decay. Units of radioactivity.</li> <li>• Measurement of radioactivity: - Ionization chambers, proportional counters, Geiger- Muller counter, Solid and liquid scintillation counters (basic principle, instrumentation and technique).</li> </ul>	12

	<ul style="list-style-type: none"> <li>Principles of tracer technique, advantages and limitations. Applications of isotopes in biological science.</li> </ul>	
--	---	--

Sr. No.	Practical's Course Code:UBT240P
1	Antigen –antibody reaction – determination of Blood group
2	Pregnancy test.
3	Widal test.
4	Ouchterloney immunodiffusion.
5	Radial Immunodiffusion.
6	ELISA (Enzyme Linked Immunosorbent Assay)
7	Isolation of casein by isoelectric precipitation.
8	Immuno-electrophoresis
9	VDRL (Venereal Disease Research Laboratory Test)
10	One step test for Qualitative detection of HBs.
11	Separation of different components from clinical specimen (Blood or Urine) using centrifugation.
12	TRUST [Toluidine Red Unheated Serum Test]/Rapid test for Malaria detection
13	Paper electrophoresis of proteins.
14	Gel electrophoresis of Nucleic acids (DNA/RNA).
15	SDS-PAGE of an Oligomeric protein.

### Recommended readings:

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

**BIOTECHNOLOGY**  
**(With effect from academic session 2024-25)**  
**B. Sc. Part II – Semester IV**  
**Minor IV [Credits 4T+2P=6]**

**IMMUNOLOGY AND BIOPHYSICAL TECHNIQUES- II**

**Course Objectives:**

7. To study the components of immune system, antigen and vaccination.
8. To study the humoral, cell mediated immunity and hypersensitivity.
9. To study the various type of immunological techniques and hybridoma technology.
10. To study the electrophoresis and its various types.
11. To study principle, procedure and application of SDS Page, pulse-field electrophoresis and centrifugations.
12. To study the isotopic tracer techniques.

**Course Outcomes:**

7. 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.
8. Students will be able to explain components of humoral and cell mediated immunity and describe various type of hypersensitivity.
9. Students will be able to demonstrate immunological techniques and discuss application of hybridoma technology.
10. Student will be able to discuss and demonstrate paper electrophoresis, high voltage electrophoresis and gel electrophoresis.
11. Students will be able to describe principle, procedure and application of SDS Page, pulse-field electrophoresis and centrifugations.
12. Student will be able to explain isotopic tracer techniques and its application.

B.Sc. –II Semester – IV (Minor IV)	IMMUNOLOGY AND BIOPHYSICAL TECHNIQUES- II	Course Code: UBT241T
Unit No.	Topic	Total Theories Required
<b>I</b>	<b>Introduction to Immunology</b> <ul style="list-style-type: none"> <li>• 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.</li> <li>• Vaccination: Discovery, principles and significance.</li> </ul>	<b>12</b>
<b>II</b>	<b>Antibody Dependent and Cellular Immunity</b> <ul style="list-style-type: none"> <li>• 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.</li> <li>• Hypersensitivity: General features and various types of hypersensitivity.</li> </ul>	<b>12</b>
<b>III</b>	<b>Immunological Techniques</b> <ul style="list-style-type: none"> <li>• Antigen-antibody reactions: Precipitation, agglutination, complement fixation, immunodiffusion, ELISA.</li> <li>• Hybridoma technology: Monoclonal antibodies and their applications in immunodiagnosis.</li> </ul>	<b>10</b>
<b>IV</b>	<b>Electrophoresis Technique</b> <ul style="list-style-type: none"> <li>• Definition, Migration of ions in electric field and Factors affecting electrophoretic mobility.</li> <li>• Paper electrophoresis: - Electrophoretic run, Detection techniques.</li> <li>• High Voltage Electrophoresis.</li> <li>• Gel electrophoresis: - Types of gels, Solubilizers, Procedure, Column &amp; slab gels, Detection, Recovery and Techniques used for estimation of macromolecules.</li> </ul>	<b>12</b>
<b>V</b>	<b>Electrophoresis Technique II and Centrifugation</b> <ul style="list-style-type: none"> <li>• SDS-PAGE Electrophoresis: principle, procedure and application.</li> <li>• Pulsed-field gel electrophoresis: principle, procedure and application. Isoelectric focussing: principle, procedures and applications. .</li> <li>• 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.</li> </ul>	<b>12</b>
<b>VI</b>	<b>Isotopic Tracer Technique</b> <ul style="list-style-type: none"> <li>• Radioactive &amp; stable isotopes, rate of radioactive decay. Units of radioactivity.</li> <li>• Measurement of radioactivity: - Ionization chambers, proportional counters, Geiger- Muller counter, Solid and liquid scintillation counters (basic principle, instrumentation and technique).</li> <li>• Principles of tracer technique, advantages and limitations. Applications of isotopes in biological science.</li> </ul>	<b>12</b>

Sr. No.	Practical's Course Code: UBT241P
1	Antigen –antibody reaction – determination of Blood group
2	Pregnancy test.
3	Widal test.
4	Ouchterloney immunodiffusion.
5	Radial Immunodiffusion.
6	ELISA (Enzyme Linked Immunosorbent Assay)
7	Isolation of casein by isoelectric precipitation.
8	Immuno-electrophoresis
9	VDRL (Venereal Disease Research Laboratory Test)
10	One step test for Qualitative detection of HBs.
11	Separation of different components from clinical specimen (Blood or Urine) using centrifugation.
12	TRUST [Toluidine Red Unheated Serum Test]/Rapid test for Malaria detection
13	Paper electrophoresis of proteins.
14	Gel electrophoresis of Nucleic acids (DNA/RNA).
15	SDS-PAGE of an Oligomeric protein.

### Recommended readings:

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

**Shiksha Mandal's**  
**Bajaj College of Science, Wardha (Autonomous)**  
**Department of Biotechnology**  
**B.Sc. Part II- Semester IV**  
**SEC**  
**MICROBIAL FOOD QUALITY TESTING**

**Course Objectives:**

1. To provide students with a thorough understanding of microbial contamination in food, focusing on the detection and quantification of pathogenic microorganisms such as fecal coliforms using techniques like MPN (Most Probable Number) and Membrane Filtration (MF).
2. To equip students with the skills needed to perform microbiological quality assurance tests on commercially available foods and sterile products, ensuring safety and compliance with health standards.
3. To impart practical knowledge on the role of beneficial microorganisms in food fermentation and the application of microbial testing techniques such as the IMViC test and Microbial quality test of milk in food quality assessment.

**Course Outcomes:**

1. Students will be able to accurately detect and quantify fecal coliforms in food samples using MPN and MF techniques, ensuring the microbiological safety of food products.
2. Students will develop the ability to conduct comprehensive microbiological quality assurance of commercially available foods and perform sterility testing of pack drinking beverages/Soft drink/ Drinking Water, ensuring products meet safety standards.
3. Students will gain hands-on experience in conducting the IMViC test, Microbial quality test of milk and producing fermented food products, applying these skills in real-world food quality testing scenarios.

List of Practical	MICROBIAL FOOD QUALITY TESTING Course Code:UBT243P	Times in Hours
1	Determination of fecal coliforms by MPN technique/MF technique.	12
2	IMViC test.	8
3	Microbiological quality assurance of the commercially available pack foods.	10
4	Sterility testing of pack drinking beverages/Soft drink/ Drinking Water	10
5	Microbial quality test of milk	6
6	Production of fermented food product	14

**References:**

1. APHA. (2017). *Standard Methods for the Examination of Water and Wastewater* (23rd ed.). American Public Health Association.
2. Cappuccino, J. G., & Welsh, C. T. (2019). *Microbiology: A Laboratory Manual* (12th ed.). Pearson.
3. Downes, F. P., & Ito, K. (Eds.). (2001). *Compendium of Methods for the Microbiological Examination of Foods* (4th ed.). American Public Health Association.
4. United States Pharmacopeia (USP). (2021). *USP 43-NF 38: The United States Pharmacopeia and National Formulary*. United States Pharmacopeial Convention.
5. Madigan, M. T., Bender, K. S., Buckley, D. H., Sattley, W. M., & Stahl, D. A. (2018). *Brock Biology of Microorganisms* (15th ed.). Pearson.
6. Holzapfel, W. H. (Ed.). (2014). *Advances in Fermented Foods and Beverages: Improving Quality, Technologies and Health Benefits*. Woodhead Publishing.