

 Estd. 1962 "A++" Accredited by NAAC (2021) With CGPA 3.52	SHIVAJI UNIVERSITY, KOLHAPUR - 416004, MAHARASHTRA PHONE:EPABX-2609000, www.unishivaji.ac.in, bos@unishivaji.ac.in शिवाजी विद्यापीठ, कोल्हापूर - ४१६००४, महाराष्ट्र दूरध्वनी-ईपीएबीएक्स - २६०९०००, अभ्यासमंडळे विभाग दुरध्वनी ०२३१-२६०९०९४ ०२३१-२६०९४८७	 
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Ref.No.SU/BOS/Science/148

Date: 26/05/2026

The Principal,
 All Concerned Affiliated Colleges/Institutions
 Shivaji University, Kolhapur.

Subject: Regarding revised syllabi of B.Sc. Part-III (Sem.V & VI) degree programme under the Faculty of Science and Technology as per NEP-2020 (2.0)

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the syllabi, nature of question paper of B.Sc. Part-III (Sem.V & VI) degree programme under the Faculty of Science and Technology as per NEP-2020 (2.0).

B.Sc. Part-III (Sem. V & VI) as per NEP-2020 (2.0)			
1.	Botany	9.	Geology
2.	Physics	10.	Zoology
3.	Statistics	11.	Chemistry
4.	Mathematics	12.	Electronics
5.	Microbiology	13.	Drug Chemistry
6.	Industrial Microbiology	14.	Pollution
7.	Biochemistry	15.	Food Science and Quality Control
8.	Computer Science (Optional)	16.	Biotechnology (Optional/Vocational)

This syllabus, nature of question and equivalence shall be implemented from the academic year 2026-2027 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in>Syllabus>Syllabus as per NEP2020.

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2026 & March/April 2027. These chances are available for repeater students, if any.

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,



Dy Registrar

Encl: as above

for information and necessary action

Copy to:

1	Dean, Faculty of Science & Technology	6	Appointment Section A & B
2	Director, Board of Examinations and Evaluation	7	I.T.Cell /Computer Centre
3	Chairman, Respective Board of Studies	8	Eligibility Section
4	B.Sc.-M.Sc. Exam Section	9	Affiliation Section (T.1) (T.2)
5	Internal Quality Assurance Cell (IQAC Cell)	10	P.G. Seminar Section

Shivaji University, Kolhapur

**B.Sc. III Biochemistry Syllabus
As Per NEP 2.0**

STRUCTURE AND SYLLABUS

**B.Sc.- III Biochemistry
as
[w.e.f.AcademicYear:2026-27]**

SEMESTER-V

T.Y. B.Sc. Biochemistry (Major-IX) Semester-V
Advanced Cell Biology

Total Hours: 30

Credits: 2

Course Objectives	- To study the structural and functional organization of the cell and its organelles. - To comprehend the phases of cell cycle and cell division. - To acquire knowledge about the components of microscopes and the principles and applications of different microscopy techniques	
Course Outcomes	After successful completion of this course, students are expected to: - Understand the structure and functions of the basic components of prokaryotic and eukaryotic cells, and also gain insights about various types of membrane transport - Comprehend the structure and functions of chromosomes and learn to independently prepare stained specimens and identify the phases of cell division. - Independently gain practical hands-on expertise in basic microscopy, simple staining and temporary mount preparation	
Unit	Contents	Hours
Unit I	INTRODUCTION TO CELL BIOLOGY Historical aspects: cell theory, protoplasm theory and organizational theory. Broad classification of cell types: prokaryotic cell and eukaryotic cells, and their characteristics. Compartments and division of labour within organelles. Ultrastructure of virus, bacterial, plant and animal cells.	04
Unit II	CELL COMMUNICATION AND CELL SIGNALLING Hormones and their receptors, cell surface receptors, signaling through G-protein coupled receptors, Signal transduction pathways, second messengers, regulation of signaling pathways; General principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, and integrin. Transport mechanisms: simple diffusion, osmosis, facilitated diffusion, uniport, antiport, symport and bulk transport (ion channels, exocytosis, endocytosis, pinocytosis and phagocytosis).	09
Unit III	Protein Sorting and Secretory Pathway Transport of proteins across nuclear envelopes. Overview of the endomembrane system; Targeting, modification and sorting of proteins from and into Endoplasmic Reticulum; Mechanism of Vesicular Transport; Coat Proteins and Vesicle Budding; Vesicle Fusion; Targeting of Proteins.	09

Unit IV	MICROSCOPY Principles and applications: refraction, magnification, resolution, resolution limit and Ernst Abbe's equation. Types of microscopy, with principles and application: light microscopy, dark field microscopy, phase contrast microscopy, differential interference contrast microscopy, fluorescence microscopy, confocal microscopy, electron microscopy (transmission electron microscopy, scanning electron microscopy, scanning tunneling microscopy) and atomic force microscopy. ○	08
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Study Resources	<i>REFERENCE BOOKS:</i> 1. Cooper GM, <i>The cell: a molecular approach</i> (8th ed.), London: Sinauer, 2018. 2. Alberts B, Johnson A, Lewis J, <i>et al.</i>, <i>Molecular biology of the cell</i> (6th ed.), New York: Garland Science, Inc., 2014. <i>SUGGESTED READING</i> 1. De Robertis EDP and De Robertis EMF, <i>Cell and molecular biology</i> (8th ed.), New York: Lippincott Wilkins & Williams, 2011. •	
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T.Y. B.Sc. Biochemistry (Major-X) Semester-V

Microbiology

Total Hours: 30

Credits: 2

Course Objectives	- To trace the history of development of the discipline of Microbiology. - To emphasize the existence of immense diversity in the microbial world and maintenance of microbes under laboratory conditions. - Make aware of both pathogenic as well as beneficial microbes to prepare students for higher education in microbiology-related disciplines	
Course Outcomes	After successful completion of this course, students are expected to: - Identify different microbes - Perform routine microbiological practices including sterilization, media preparation, maintenance of microbial culture, staining etc. - Carry out research using microbes. - Test microbial culture for antibiotic resistance.	
Unit	Contents	Hours
Unit I	History of Microbiology History of development of microbiology as a discipline, Spontaneous generation versus biogenesis, contributions of Anton von Leeuwenhoek, Joseph Lister, Paul Ehrlich, Richard Petri, Charles Chamberland, Edward Jenner, Louis Pasteur, Robert Koch, Martinus W. Beijerinck, Sergei Winogradsky, Alexander Fleming, Elie Metchnikoff and Emil von Behring	04
Unit II	Diversity of Microbial world and Microbial Cell organization General characteristics of different groups: Acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Archaea, Algae, Fungi and Protozoa) with emphasis on distribution, occurrence and morphology. Cell-wall: Composition and detailed structure of Gram positive and Gram-negative cell walls, mechanism of Gram's staining.	07
Unit III	Microbial Nutrition and Growth Nutritional types of microorganisms, growth factors, culture media- synthetic and complex, types of media; isolation of pure cultures, growth curves, mean growth rate constant, generation time; influence of environmental factors on growth of microbes: effect of pH, temperature, solute, oxygen concentration, pressure and radiation. Sterilization, disinfection and antiseptics. Use of physical methods (heat, low temperature, filtration, radiation) and chemical agents (phenolics, halogens, heavy metals, sterilizing gases) in microbial control.	09

Unit IV	Pathogenicity of Microorganisms and Antimicrobial Chemotherapy Introduction to pathogenic microbes; Bacteria, Viruses, Algae, protozoa and fungi. General Characteristics of antimicrobial drugs, determining the level of microbial activity: dilution susceptibility test and disc diffusion test. Range of activity and mechanism of action of penicillin, vancomycin and tetracycline.	05
Unit V	Food and Industrial Microbiology Importance of microbiology in food and industries; Basic design of fermenter, continuous and discontinuous culture. Preparation of fermented food products such as yoghurt, curd and cheese. Preparation of alcoholic beverages like wine and beer. Single cell proteins. Treatment of wastewater (Municipal treatment plant) and sewage. Bioremediation and biodegradation	05
Study Resources	REFERENCE BOOKS: 1. Prescott LM, Harley JP and Klein DA <i>Microbiology</i> (7th edition) McGraw Hill, New York, 2006. 2. Pelczar MJ, Chan ECS and Kreig NR, <i>Microbiology</i>, 5th Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 1993. 3. Dube RC and Maheswari DK, <i>General Microbiology</i>, S Chand, New Delhi, Edition, Himalaya Publishing House, Mumbai, 2000. 4. Power CB and Dagainawala HF, <i>General Microbiology Vol I & II</i>, (1986). SUGGESTED READING: 1. Reddy SM, and Reddy SR, <i>Microbiology, Practical Manual</i>, 3 rd Edition, Sri Padmavathi Publications, Hyderabad. (1998). 2. Jaya Babu, <i>Practical Manual on Microbial Metabolisms and General Microbiology</i>. Kalyani Publishers, New Delhi, (2006). 3. Gopal Reddy et al., <i>Laboratory Experiments</i> •	

T.Y. B.Sc. Biochemistry (Major)
Semester-V
Major Practical P V (a)

Total Hours: 60

Credits: 2

After successful completion of this course students are expected to:

Course Objectives	- To accustom students to techniques in Cell Biology. - To accustom students to microbiological methods.	
Course Outcomes	After successful completion of this course, students are expected to: - Understand the basic microbial structure and also. - Understand the structural similarities and differences among various physiological groups of bacteria. - Learn basic concepts and their applications as technology	
Sr. No.	Contents	Hours
1	Study of parts of compound microscope	4
2	Micrometry	4
3	Examination of prokaryotic and eukaryotic cell	4
4	Study of salivary gland chromosomes	4
5	Staining of nuclei in cheek epithelium	4
6	Examination of Barr body	4
7	Study of mitosis in onion root tip squash preparation	4
8	Techniques of Plant /Animal Tissue Culture	4
9	Study of pinocytosis by paramecium under microscopy	4
10	Calculating viability of bacterial cells after exposure of the bacterial culture to UV rays	4

T.Y. B.Sc. Biochemistry (Major)
Semester-V
Major Practical P V (b)

Total Hours: 60

Credits: 2

After successful completion of this course students are expected to:

Course Objectives	- To accustom students to techniques in Cell Biology. - To accustom students to microbiological methods.	
Course Outcomes	After successful completion of this course, students are expected to: - Understand the basic microbial structure and also. - Understand the structural similarities and differences among various physiological groups of bacteria. - Learn basic concepts and their applications as technology	
Sr. No.	Contents	Hours
1	Preparing temporary mount of nerve cell from mammalian spinal cord	4
2	Differential centrifugation of cell and validation of separated organelles by enzyme markers	4
3	Study of cell- cell agglutination by lectin and calculation of haem-agglutination titre.	4
4	Demonstration of phagocytosis/apoptosis	4
5	To prepare and sterilize the culture media for the growth of microorganisms	4
6	To perform various culture transfer techniques: Solid to solid (streaking), liquid to solid (spreading), liquid to liquid, solid to liquid and determine CFU/ml	4
7	To stain bacteria using methylene blue.	4
8	To perform gram staining	4
9	To prepare temporary mount of algae (spirogyra)	4
10	To prepare temporary mount of fungi (Penicillium)	4
11	Study of different shapes of bacteria, fungi, algae, protozoa using permanent slides/pictographs	4
Study Resources	- Chan, M. J., Krieg E. C. S., Pelczar, N. R. (2004) <i>Microbiology</i> (5th ed.). McGraw Hill International. ISBN 13: 9780094623206. - Willey, J., Sherwood, L., Woolverton, C. (2017). <i>Prescott's Microbiology</i> (10th ed.). McGraw Hill international. ISBN 13: 9781259657573. Additional Resources: - Cappuccino J. G., and Sherman N., <i>Microbiology: A Laboratory manual</i> (10th ed.). Benajamin/ Cummings. ISBN 13: 9780321840226.	

T.Y. B.Sc. Biochemistry Major 1 (Elective) Semester-V
Biochemical Applications in Forensic

Total Hours: 30

Credits: 2

Course Objectives	- To understand the applications of biochemistry in forensic sciences through analysis of evidence. - The course will keep abreast with all recent developments and emerging trends in forensic science	
Course Outcomes	After successful completion of this course, students are expected to: - Students will learn the fundamental concepts and principles of forensic science and their significance. - Students will understand how a forensic investigation is initiated through preservation of evidences, as well as chemical, physical and biological methods of their analysis including analysis of DNA and other bodily fluids. - Students will learn how to establish identity of an individual by document evaluation, fingerprints, footprints and DNA analysis. - Students will obtain hands-on-experience in some of the basic biochemical processes involved in forensic investigation	
Unit	Contents	Hours
Unit I	Introduction to Forensic Science Basic Principles and Significance; History and Development of Forensic Science; Defining the scene of investigation; Collection, Packaging, Labelling and Forwarding of biological exhibits to forensic laboratories; Preservation of biological evidence; Importance of Health and Safety Protocols in sample collection and analysis.	05
Unit II	Biological science and its application in investigation Biochemical analysis of various biological evidence-like blood, semen & other biological fluids, viscera, bite marks, hair (animal and human), fibers & fabrics, pollen and soil; Establishment of identity of individuals - fingerprints, footprints, blood and DNA analysis.	10
Unit III	Chemical science and its application in investigation Detection of drugs of abuse and narcotics in biological samples; Toxicological examination of viscera, detection of petroleum products, food adulteration; Analysis of inks and their use in questioned document identification, blood splatter analysis, stain analysis, case studies.	08

Unit IV	Recent advances in forensics <i>Narco analysis</i>: theory, forensic significance, future prospect; <i>Brain mapping</i>: introduction, EEG, P-3000 wave, forensic applications, limitation of technique; <i>Polygraph</i>: Principle and technique, polygraph as forensic investigative tool, use of psychoactive drugs in forensic analysis. NHRC guidelines for polygraph test; <i>Facial reconstruction</i>: Method and technique, facial reconstruction in forensic identification; DNA Finger Printing; Techniques of DNA fingerprinting- RFLP, STR.	07
Study Resources	• James, S. H., Nordby, J. J. & Bell, S. (2014). <i>Forensic Science: An Introduction to Scientific and Investigative Techniques, Fourth Edition</i>: Taylor & Francis. ISBN 9781439853832 • Jones, P., & Williams, R. E. (2009). <i>Crime Scene Processing and Laboratory Workbook First Edition</i>: CRC Press. ISBN 9780429249976 • Lee, H., Palmbach, T. & Miller, M. (2001). <i>Henry Lee's crime scene handbook, First Edition</i>: Academic Press ISBN 9780080507989 • Parikh, C. K. (2016). <i>Parikh's textbook of medical jurisprudence, forensic medicine and toxicology : for classrooms and courtrooms, Seventh Edition</i>: CBS Publishers and Distributors. ISBN 9788123926469 • Saferstein, R. (2018). <i>Criminalistics: An Introduction to Forensic Science, Twelveth edition</i>: Pearson Education. ISBN 10:0134477596, ISBN 13: 9780134477596 • Tewari, R. K., Sastry P. K., Ravikumar, K. V. (2002). <i>Computer Crime and Computer Forensic, First Edition</i>: Selective & Scientific Books • Veeraraghavan, V. (2009). <i>Handbook of Forensic Psychology, First Edition</i>: Selective & Scientific Books	

T.Y. B.Sc. Biochemistry (Major)
Semester-V
Major P-I Practical (ELEC)

Total Hours: 60

Credits: 2

Course Objectives	- The course aims to provide an understanding of the applications of biochemistry in forensic. - To accustom students to biochemical methods in forensic investigation.	
Course Outcomes	After successful completion of this course, students are expected to: - Understand the basic forensic biology and chemistry. - Learn basic concepts and their applications in forensics.	
Sr. No.	Contents	Hours
1	TLC method for differentiation of ink/drugs	4
2	Fingerprint development from various surfaces	4
3	Handwriting identification based on class characteristics and individual characteristics	4
4	Microscopic examination of hair/fiber/pollen/diatom	4
5	Examination of blood samples: Blood grouping, DNA finger printing, Blood splatter analysis.	4
6	Examination of urine samples: Identification of drugs.	4
7	Examination of liquor/ alcoholic drinks and alcohol	4
8	MICROSCOPIC Examination of human SCALP HAIR	4
9	Study the Morphology of Animal Hair	4
10	Examine the Microscopic Characteristics of Soil	4
11	Determine Densities of Glass and Plastic Specimens	4
12	Dusting and Lifting Latent Fingerprints	4
13	Physical and Chemical Tests of Fibers	4
14	Perforation and Tear Analysis	4
15	Field trip to a forensic laboratory.	4
Study Resources	- James, S. H., Nordby, J. J. & Bell, S. (2014). <i>Forensic Science: An Introduction to Scientific and Investigative Techniques, Fourth Edition</i>: Taylor & Francis. ISBN 9781439853832 - Jones, P., & Williams, R. E. (2009). <i>Crime Scene Processing and Laboratory Workbook First Edition</i>: CRC Press. ISBN 9780429249976 - Lee, H., Palmbach, T. & Miller, M. (2001). <i>Henry Lee's crime scene handbook, First Edition</i>: Academic Press ISBN 9780080507989 - Parikh, C. K. (2016). <i>Parikh's textbook of medical jurisprudence, forensic medicine and toxicology : for classrooms and</i>	

	<i>courtrooms, Seventh Edition: CBS Publishers and Distributors. ISBN 9788123926469</i> • Saferstein, R. (2018). <i>Criminalistics: An Introduction to Forensic Science, Twelveth edition: Pearson Education. ISBN 10:0134477596, ISBN 13: 9780134477596</i> • Tewari, R. K., Sastry P. K., Ravikumar, K. V. (2002). <i>Computer Crime and Computer Forensic, First Edition: Selective & Scientific Books</i> Veeraraghavan, V. (2009). <i>Handbook of Forensic Psychology, First Edition: Selective & Scientific Books</i>	
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Biochemistry OE-5 Nutritional Biochemistry

Course Objectives	• This course is an introduction to the importance of nutrition in human health. • It includes the requirements and roles of macro- and micronutrients in the body, and the biochemical bases of deficiency diseases. • The course also provides practical, hands-on training in the biochemical methods and analyses used in nutritional research	
Course Outcomes	After successful completion of this course, students are expected to: • Describe the biochemical roles of macro- and micronutrients in human health and diseases. • Calculate the recommended metabolic requirements in normal humans, athletes and pregnant women. • Capable of independently estimating the vitamin and nutrition content in various food stuff in a laboratory	
Unit	Contents	Hours
Unit I	NUTRITION AND ENERGY METABOLISM Nutrition and the role of nutrition in maintaining health. Energy, unit of energy and measurements of energy. Energy requirement for different categories of people, body mass index (BMI) and basic metabolism. Basal metabolic rate (BMR): determination. factors affecting BMR, SDA, RQ	08
Unit II	UNIT II: MACRONUTRIENTS Role of food and classification of foods. Macronutrients: functions, and dietary sources of carbohydrates, fats, proteins and dietary fibre. Caloric value and recommended daily allowances (RDA). Malnutrition: deficiencies and over-consumption.	08

Unit III	UNIT III: MICRONUTRIENTS Vitamins, classification of vitamins, dietary sources, RDA and deficiency of vitamins A, D, E, K, C and B-complex. Hypervitaminosis, and the biochemical bases of deficiency symptoms. Minerals, classification of minerals. Distribution in the body, dietary sources, RDA, digestion, mechanism of absorption, utilization, transport, storage, excretion, balance, deficiency and toxicity of calcium, iron and phosphorus. Distribution in the body, dietary sources, physiological function, deficiency and toxicity of iodine, fluoride, magnesium, copper, zinc, selenium and manganese.	08
Unit IV	UNIT IV: DIFFERENT DIMENSIONS FOR FITNESS Balanced diet, Different criteria for health and well-being: physical, intellectual, emotional, social, spiritual, environmental and occupational. Special nutritional concerns: pregnancy, lactation and aging. Special nutritional requirements of working women, female athletes and post-pregnancy weight management. Eating disorders: anorexia, bulimia, binge-eating and obesity	06
Study Resources	REFERENCE BOOKS: 1. Mahan LK and Raymond J, Krause's food and nutrition care process (14th ed.), St. Louis: Elsevier, 2017. 2. Gibson R, Principles of nutritional assessment, London: Oxford University Press, 2005. 3. Coombs GF and McClung JP, The vitamins: fundamental aspects in nutrition and health (5th ed.), London: Academic Press, 2017. SUGGESTED READING: 1. Brody T, Nutritional biochemistry (2nd ed.), San Diego: Academic Press, 1999. 2. Devlin TM, Textbook of biochemistry with clinical correlations (7th ed.), New York: John Wiley & Sons, 2010.	

T.Y. B.Sc. Biochemistry (Vocational)
Semester-V
VSC II: Practical Fermentation Technology

Total Hours: 60

Credits: 2

Course Objectives	- To accustom students with preservation methods of microorganisms - To develop inoculum and produce various products by fermentation technique - To recover and estimate product produced by fermentation technique	
Course Outcomes	After successful completion of this course, students are expected to: - Preserve important microorganisms required for fermentation - Develop inoculum and carry out fermentation successfully - Recover and estimate product produced by fermentation technique	
Sr. No.	Contents	Hours
1	Study of various parts of Bioreactor	4
2	Preservation of industrially important microorganisms	4
3	Inoculum development for ethanol production	4
4	Production of ethanol by submerged/batch fermentation method	4
5	Recovery of ethanol by distillation method	4
6	Estimation of ethanol by dichromate method	4
7	Estimation of ethanol by specific gravity	4
8	Inoculum development for amylase production	4
9	Production of amylase by submerged/batch fermentation method	4
10	Determination of amylase activity by DNSA method	4
11	Inoculum development for citric acid production	4
12	Production of Citric acid by solid state fermentation	4
13	Production of citric acid by submerged/batch fermentation method	4
14	Recovery of citric acid	4
15	Estimation of citric acid by volumetric method	4
Study Resources	- Sadasivam S., Manikam A. (2018), Biochemical Methods, 3rd edition, New Age International Pvt. Ltd. - Aneja K. R. (2003), Experiments in Microbiology, Plant Pathology and Biotechnology, New Age International Pvt. Ltd. - Sawhney S.K., Singh R. (2001), Introductory Practical Biochemistry, Narosa Publishing House, New Delhi - Plummer D. (2017), An Introduction to Practical Biochemistry, Indian Edition, McGraw Hill Education. - Jayaraman J. (1996), Laboratory manual in Biochemistry, Wiley Eastern Ltd. - Aneja K. R. (2003), Experiments in Microbiology, Plant Pathology and Biotechnology, New Age International Pvt. Ltd.	

T.Y. B.Sc. Biochemistry (On Job Training)
Semester-V
BIC: On Job Training/Internship

Total Hours: 120

Credits:4

Course objectives	• To provide the students with actual work experience • To make aware prescribe standards and guidelines at work • To develop the employability of participating students • To avail an opportunity to eventually acquire job experiences
Course outcomes	After successful completion of this course, students are expected to: • Get actual work experience with office and virtual exposure to various management styles, technical, industrial, and procedural systems • Acquaint the knowledge related to working hours, work protocols and guidelines • Understand the roles and responsibilities of employee as well as team work • Justify job experiences that match their potentials, skills, and competencies
Internship An internship is a professional learning experience that offers meaningful, practical work related to a student's field of study or career interest. An internship gives a student the opportunity for career exploration and development, and to learn new skills. On the job training On the job training is a form of training provided at the workplace. During the training, employees are familiarized with the working environment they will become part of. Employees also get a hands-on experience using machinery, equipment, tools, materials, etc.	

Internship / OJT Process:

1. **Pre-Approval:** Students should seek approval from the college before starting the Internship / OJT. This ensures that the Internship / OJT aligns with the curriculum and meets the necessary criteria.
2. **Mentor and Supervisor:** Each student should have an assigned mentor at the organization/industry where they are interning. Additionally, an Internship / OJT supervisor from the college will be appointed to guide and monitor the progress.
3. **Regular Reporting:** Students should maintain regular communication with their supervisor and mentor, providing progress reports and seeking feedback.
4. **Professional Conduct:** Students must adhere to professional conduct throughout the Internship / OJT, including punctuality, respect for colleagues, and adherence to the organization's/industry's policies and guidelines.
5. **Student Diary:** Students should maintain a diary to document their experiences, challenges faced, and lessons learned during the Internship / OJT.
6. **Final Report:** At the end of the Internship / OJT, students should submit a comprehensive final report, summarizing their accomplishments, contributions, and key takeaways.
7. **Evaluation:** The Internship / OJT is worth 4 credits (equivalent to 100 marks), and the evaluation will be divided into two categories: one by the mentor and the other by the Internship / OJT supervisor. The mentor's evaluation (internal examination) will carry 40 marks, and it will be based on the student's performance during the Internship / OJT. External examination will be conducted by mentor and supervisor which will be based on the student's diary, the final report prepared by the student, and their performance in the final viva voce, and will carry 60 marks. The total marks obtained by the students in both evaluations will be added together for the purpose of final evaluation. The evaluation of the students will be conducted by the mentor using the evaluation sheet provided by the college.

Internal Evaluation Criteria for Students by the Mentor:

1. **Quality of Work** (10 marks): How well did the student perform their assigned tasks during the Internship / OJT? Evaluate the accuracy, thoroughness, and attention to detail in their work.
2. **Initiative and Proactiveness**(10 marks): Did the student show initiative in taking on additional responsibilities or tasks beyond their assigned role? Did they demonstrate a proactive attitude towards problem-solving?
3. **Communication Skills** (10 marks): Assess the student's ability to communicate effectively with colleagues, superiors, and clients (if applicable). Consider both written and verbal communication.
4. **Problem-Solving Skills and Time Management** (10 marks): Evaluate the student's ability to analyze problems, propose solutions, and implement effective strategies to overcome challenges. How well did the student manage their time during the Internship / OJT? Were they able to meet project deadlines and handle multiple tasks efficiently?

External Evaluation Criteria for Students by the Supervisor and Mentor:

1. **Student Diary** (15 marks): Review the student's diary to understand their reflections, insights gained, and self-assessment of their performance during the Internship / OJT.
2. **Final Report** (15 marks): Evaluate the quality and comprehensiveness of the student's final report, including the clarity of their achievements and contributions.
3. **Presentation of Student in Viva Voce** (30 marks): Evaluate the responses given by the student to the questions asked by the faculty in the Viva Voce.

Evaluation Criteria for Final Viva Voce:

1. Presentation Skills
2. Knowledge of the Internship / OJT Project
3. Practical Application and Work Experience
4. Problem-Solving and Critical Thinking
5. Communication and Professionalism

SEMESTER-VI

T.Y. B.Sc. Biochemistry (Major-XI)
Semester-VI
BIC-Immunology & Virology

Total Hours: 30

Credits: 2

Course Objectives	- To compare the innate and the adaptive immune systems, as well as humoral and cell-mediated immune responses. - To distinguish various cell types, antibody isotypes, and cytokines involved in immune responses and associated functions. - To understand the significance of the Major Histocompatibility Complexes in immune surveillance and transplantation	
Course Outcomes	After successful completion of this course, students are expected to: - Understand the components of different cells and organs involved in humoral and cell-mediated immunity. - Comprehend the role of over-activation of immune system in hypersensitivity and its consequences. - Gain knowledge about autoimmunity, graft rejection and therapeutic modalities for immunosuppression during transplantation.	
Unit	Contents	Hours
Unit I	OVERVIEW AND HISTORICAL PERSPECTIVE Immunity and types of immunity: innate and adaptive, active and passive, natural and acquired immunity. Overview of immune system, cells of the immune system and their functions. Organs of the immune systems and their functions: primary and secondary lymphoid organs	05
Unit II	ANTIGEN AND ANTIBODY Nature and types of antigens, specificity, epitope, haptens, adjuvants. Immunoglobulins: structure, classes and functions. Antigen–antibody reactions: agglutination, precipitation, flocculation, complement fixation, neutralization.	08
Unit III	HUMORAL AND CELL-MEDIATED IMMUNITY IMMUNODIAGNOSTIC TECHNIQUES Functions of T_H, T_C, T_S and B lymphocytes. Primary and secondary immune responses and the role of memory cells. Polyclonal and monoclonal antibody generation and their applications.	11

	Single immunodiffusion: one dimension and radial, double immunodiffusion: one dimension and radial. Immunoelectrophoresis, immunofluorescence, rocket electrophoresis, haemagglutination assay, CFT, ELISA, RIA.	
Unit IV	VIROLOGY Immune response to infectious diseases Concept of immunotherapy; viruses: MARS, SARS, Nipah, Dengue, Zika, Vaccines (Recombinant, DNA, live and attenuated, subunit); Herd immunity; Success stories in vaccinology e.g. smallpox, polio, Hepatitis, DPT. ○	06
Study Resources	REFERENCE BOOKS: 1. Punt J, Stranford S, Jones P and Owen J, <i>Kuby immunology</i> (8th ed.), New York: W.H. Freeman, 2018. 2. Murphy K, Mowat A, Weaver CT, <i>Janeway's Immunobiology</i> (8th ed), Garland Science, London & New York, 2012. 3. Gordon JR, <i>A practical guide to cellular and molecular research methods in immunology</i> (4th ed.), Saskatoon: University of Saskatchewan, 2002. 4. Plummer DT, <i>Introduction to practical Biochemistry</i>. Tata McGraw-Hill, New Delhi Education, 2001. SUGGESTED READING: 1. Delves PJ, Martin, SJ, Burton RD and Roitt IM, <i>Roitt's essential immunology</i> (13th ed.), London: Wiley-Blackwell, 2017.	

T.Y. B.Sc. Biochemistry (Major-XI)
Semester-VI
BIC-Genetic Engineering

Total Hours: 30

Credits: 2

Course Objectives	- The course outlines how molecular manipulation of DNA provides complete control of the Central Dogma of molecular biology, and the principles of the techniques used in gene identification, isolation and analysis. - It also lists applications of genetic engineering, such as the production of recombinant therapeutic proteins, vaccines, molecular farming and organ farming. - It provides hands-on, practical training in isolation and manipulation of DNA, which form the basis of molecular cloning	
Course Outcomes	After successful completion of this course, students are expected to: - Understanding the isolation of DNA using restriction enzymes, and its incorporation into suitable cloning and expression vectors. - Comprehend the methods and techniques used in the construction and analysis of genomic and cDNA libraries, and their applications. - Gain expertise in practical hands-on isolation of genomic DNA from mammalian tissue including its estimation, manipulation as required in gene cloning.	
Unit	Contents	Hours
Unit I	INTRODUCTION TO GENETIC ENGINEERING Basic steps of gene cloning, Enzymes used in genetic engineering, Restriction enzymes - types, target sites, nomenclature, DNA polymerase, ribonuclease, ligases, alkaline phosphatases, reverse transcriptase.	05
Unit II	CLONING VECTORS Plasmid vectors, bacteriophage, phagemid, cosmids, yeast vectors and plant vectors; Gene transfer techniques - microinjection, electroporation and gene gun bombardment.	08
Unit III	GENOMIC AND DNA LIBRARIES Selection and screening of recombinants; Isolation and purification of cellular and plasmid DNA, methods for labeling nucleic acids and probes, somatic cell hybrids, in situ hybridization. Amplification of DNA by PCR: Technique and applications, analysis of DNA, RNA and proteins by blotting techniques.	11

Unit IV	PLANT AND ANIMAL GENETIC ENGINEERING Transgenic plants - Agrobacterium mediated gene transfer and protoplast fusion - somaclonal variation - Applications of transgenic plants. Transgenic animals: Production of recombinant insulin, and vaccines. RAPD, RFLP and its applications, DNA fingerprinting, foot printing, gene therapy. ○	06
Study Resources	REFERENCE BOOKS: 1. Primrose SB and Twyman RM, <i>Principles of gene manipulation and genomics</i> (7th ed.), Malden: Wiley Blackwell, 2014. 2. Brown TA, <i>Gene cloning and DNA analysis: an introduction</i> (7th ed.), Hoboken: Wiley- Blackwell, 2016. 3. Green MR and Sambrook J, <i>Molecular cloning: a laboratory manual</i> (4th ed.), Cold Spring Harbor: Cold Spring Harbor Laboratory Press, 2012. SUGGESTED READING: 1. Nicholl DST, <i>An Introduction to Genetic Engineering</i>, Cambridge University Press, United Kingdom, 2010. 2. Glick BR, Pasternak JJ, Patten CL, <i>Molecular Biotechnology: Principles and Applications of recombinant DNA</i>, ASM Press, Washington DC, 2012. 3. Sambrook J and Russell DW, <i>Molecular Cloning: A Laboratory Manual</i> –a set of 3 volumes, CSHL Press, New York, 2012.	

T.Y. B.Sc. Biochemistry (Major)
Semester-VI
Major Practical P VI (a)

Total Hours: 60

Credits: 2

After successful completion of this course students are expected to:

Course Objectives	- To accustom students to techniques in Immunology. - To accustom students to r-DNA methods.	
Course Outcomes	After successful completion of this course, students are expected to: - Understand the components of different cells and organs involved in humoral and cell-mediated immunity. - Comprehend the role of over-activation of immune system in hypersensitivity and its consequences. - Understanding the isolation of DNA using restriction enzymes, and its incorporation into suitable cloning and expression vectors. - Comprehend the methods and techniques used in the construction and analysis of genomic and cDNA libraries, and their applications. - Gain expertise in practical hands-on isolation of genomic DNA from mammalian tissue including its estimation, manipulation as required in gene cloning.	
Sr. No.	Contents	Hours
1	Blood grouping	4
2	Identification of immune cells in blood smears	4
3	Single and double immunodiffusion	4
4	Radial immunoassay	4
5	Dot ELISA	4
6	Widal's test	4
7	Complement Fixation Test	4
8	Isolation of plasmid DNA from bacterial culture	4
9	Restriction digestion analysis of DNA	4
10	Ligation of DNA fragments and bacterial transformation	4
11	Immobilization of cells	4
Study Resources	REFERENCE BOOKS: - Punt J, Stranford S, Jones P and Owen J, <i>Kuby immunology</i> (8th ed.), New York: W.H. Freeman, 2018. - Murphy K, Mowat A, Weaver CT, <i>Janeway's Immunobiology</i> (8th ed), Garland Science, London & New York, 2012. - Gordon JR, <i>A practical guide to cellular and molecular research methods in immunology</i> (4th ed.), Saskatoon: University of Saskatchewan, 2002.	

	4. Plummer DT, <i>Introduction to practical Biochemistry</i>. Tata McGraw-Hill, New Delhi Education, 2001. SUGGESTED READING: 2. Delves PJ, Martin, SJ, Burton RD and Roitt IM, <i>Roitt's essential immunology</i> (13th ed.), London: Wiley-Blackwell, 2017. REFERENCE BOOKS: 4. Primrose SB and Twyman RM, <i>Principles of gene manipulation and genomics</i> (7th ed.), Malden: Wiley Blackwell, 2014. 5. Brown TA, <i>Gene cloning and DNA analysis: an introduction</i> (7th ed.), Hoboken: Wiley- Blackwell, 2016. 6. Green MR and Sambrook J, <i>Molecular cloning: a laboratory manual</i> (4th ed.), Cold Spring Harbor: Cold Spring Harbor Laboratory Press, 2012. SUGGESTED READING: 4. Nicholl DST, <i>An Introduction to Genetic Engineering</i>, Cambridge University Press, United Kingdom, 2010. 5. Glick BR, Pasternak JJ, Patten CL, <i>Molecular Biotechnology: Principles and Applications of recombinant DNA</i>, ASM Press, Washington DC, 2012. 6. Sambrook J and Russell DW, <i>Molecular Cloning: A Laboratory Manual</i> –a set of 3 volumes, CSHL Press, New York, 2012. •	
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T.Y. B.Sc. Biochemistry (Major)
Semester-VI
Major Practical P VI (b)

Total Hours: 60

Credits: 2

After successful completion of this course students are expected to:

Course Objectives	- To accustom students to techniques in Immunology. - To accustom students to r-DNA methods.	
Course Outcomes	After successful completion of this course, students are expected to: - Understand the components of different cells and organs involved in humoral and cell-mediated immunity. - Comprehend the role of over-activation of immune system in hypersensitivity and its consequences. - Understanding the isolation of DNA using restriction enzymes, and its incorporation into suitable cloning and expression vectors. - Comprehend the methods and techniques used in the construction and analysis of genomic and cDNA libraries, and their applications. - Gain expertise in practical hands-on isolation of genomic DNA from mammalian tissue including its estimation, manipulation as required in gene cloning.	
Sr. No.	Contents	Hours
1	Isolation of genomic DNA from animal tissue (liver, fish tissue, etc.).	4
2	DNA quantification using the Diphenylamine (DPA) method.	4
3	Assessment of DNA purity using UV spectrophotometry.	4
4	Visualization of DNA using agarose gel electrophoresis.	4
5	Study of restriction endonuclease digestion using virtual or demonstration data.	4
6	Study of alkaline phosphatase activity in molecular cloning.	4
7	Demonstration of reverse transcription for cDNA synthesis.	4
8	Virtual PCR using online simulation tools	4
9	Interpretation of PCR results in disease diagnosis.	4
10	Preparation of competent bacterial cells.	4
11	Transformation of bacteria with plasmid DNA.	4
12	Blue-white colony screening of transformants (demonstration).	4
13	Retrieval of DNA and protein sequences from National Center for Biotechnology Information.	4
Study Resources	REFERENCE BOOKS: - Punt J, Stranford S, Jones P and Owen J, <i>Kuby immunology</i> (8th ed.), New York: W.H. Freeman, 2018. - Murphy K, Mowat A, Weaver CT, <i>Janeway's Immunobiology</i> (8th ed), Garland Science,	

	London & New York, 2012. 7. Gordon JR, <i>A practical guide to cellular and molecular research methods in immunology</i> (4th ed.), Saskatoon: University of Saskatchewan, 2002. 8. Plummer DT, <i>Introduction to practical Biochemistry</i>. Tata McGraw-Hill, New Delhi Education, 2001. SUGGESTED READING: 3. Delves PJ, Martin, SJ, Burton RD and Roitt IM, <i>Roitt's essential immunology</i> (13th ed.), London: Wiley-Blackwell, 2017. REFERENCE BOOKS: 7. Primrose SB and Twyman RM, <i>Principles of gene manipulation and genomics</i> (7th ed.), Malden: Wiley Blackwell, 2014. 8. Brown TA, <i>Gene cloning and DNA analysis: an introduction</i> (7th ed.), Hoboken: Wiley-Blackwell, 2016. 9. Green MR and Sambrook J, <i>Molecular cloning: a laboratory manual</i> (4th ed.), Cold Spring Harbor: Cold Spring Harbor Laboratory Press, 2012. SUGGESTED READING: 7. Nicholl DST, <i>An Introduction to Genetic Engineering</i>, Cambridge University Press, United Kingdom, 2010. 8. Glick BR, Pasternak JJ, Patten CL, <i>Molecular Biotechnology: Principles and Applications of recombinant DNA</i>, ASM Press, Washington DC, 2012. 9. Sambrook J and Russell DW, <i>Molecular Cloning: A Laboratory Manual</i> –a set of 3 volumes, CSHL Press, New York, 2012. •	
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T.Y. B.Sc. Biochemistry (Major-2 ELEC)**Semester-VI****BIC-: Cell Culture Technology****Total Hours: 30****Credits: 2**

Course Objectives	• Objective of this course is to familiarize the student with concepts of cell and tissue culture technology in both animals and plants. • The course objective of Cell Culture Technology typically focuses on providing students with a comprehensive understanding of the principles, techniques, and applications of cell culture in both academic and industrial settings.	
Course Outcomes	After successful completion of this course, students are expected to: • Understand the basics of plant and animal cell culture. • Get in-depth knowledge about growing the animal cells in vitro to get cell mass, tissues, and their applicability examples. • learn the mass propagate the plants in vitro and how to raise viruses free, pest resistance, new variety of plants etc. • Understand application of cell culture in industries and research labs.	
Unit	Contents	Hours
Unit I	ANIMAL CELL CULTURE History, biology of cultured cells, culture media-composition, preparation and development, cell isolation, establishment and evaluation of cell culture, sterilization techniques for ATC lab. Animal cell lines: Establishment, properties and use of cell lines, cultures of tumor cells; Cryopreservation of animal cells. Culture and scale up: Monolayer culture-surface requirements, gas phase requirements, capillary culture units, suspension culture scale up. Somatic cell fusion: Methods of somatic cell fusion, selection, properties of cell hybrids and their applications.	07
Unit II	ANIMAL CLONING AND EMBRYO TRANSFER Superovulation, in vitro fertilization, embryo transfer technology in animals; Concepts and techniques of cloning. Applications: Industrial applications of animal cell culture; Stem cell culture and its applications. ○	08

Unit III	PLANT TISSUE CULTURE History of plant cell culture, culture media-composition, preparation and development, cellular totipotency, cryopreservation. Callus and cell culture: Isolation of cells, growth of single isolated cells. Suspension culture: Regeneration and maintenance of callus, organogenesis and embryogenesis.	07
Unit IV	APPLICATIONS & ASSAYS Cell-Based Assays- Proliferation assays, Apoptosis assays Reporter gene assays. Clinical Applications- Stem cell culture and regenerative medicine. Cell therapy and personalized medicine. Current Trends and Emerging Technologies- 3D cell culture, Organoids and microfluidics, Ethical and Regulatory Considerations- Ethical guidelines in cell culture research, Regulatory requirements for cell-based products	08
Study Resources	• Culture of Animal Cells(2005) 5th Edition, FreshneyWiley-Liss, • Animal Cell Culture - Practical Approach (2000), 3rd Edition, Ed. John R.W. Masters Oxford University Press Animal Cell Culture Techniques. (1998). Ed. Martin ClynesSpringer • Gupta P. K. (2005), Elements of Biotechnology, Rastogi Publication Meerut. • Ignacimuthu S. (1997), Applied plant biotechnology, Science Publishers, U.S. • Ramavat K. G. (2008), Plant biotechnology, S. Chand and Co., New Delhi. • Satyanarayana U. (2008), Biotechnology, Books and Allied (P) Ltd, Kolkata. • Chawla H.S. (2009), Introduction to Plant Biotechnology, 3rd edition, CRC press. • Jogdand S.N. (2012), Advances in Biotechnology, Himalaya Publishing House, Mumbai.	

T.Y. B.Sc. Biochemistry (Elective)
Semester-VI
PRACTICAL BIC- Tissue Culture Techniques

Total Hours: 60

Credits: 2

Course Objectives	- To accustom students with Techniques in Genetic engineering - To make students competent in PTC techniques - To introduce students to animal cell culturing	
Course Outcomes	After successful completion of this course, students are expected to: - Perform skillfully various plant tissue culture techniques - Separate DNA fragments by agarose gel electrophoresis - Perform restriction digestion and PCR - Culture animal cells successfully	
Sr. No.	Contents	Hours
1	Isolation of cells from suitable animal tissue	4
2	Primary culturing of suitable animal cells	4
3	Quantification of cell viability and cell counting	4
4	Preparation of MS media for PTC	4
5	Development of seedling by aseptic germination of available seed	4
6	Initiation of shoots by shoot tip culture method	4
7	Multiplication of shoots by shoot tips	4
8	Elongation and rooting of multiplied shoots	4
9	Development of callus from suitable tissue	4
10	Development of somatic embryo from suitable tissue	4
11	Isolation of protoplast	4
Study Resources	- Sadasivam S., Manickam A. (2018), Biochemical Methods, 3rd edition, New Age International Pvt. Ltd. - Aneja K. R. (2003), Experiments in Microbiology, Plant Pathology and Biotechnology, New Age International Pvt. Ltd. - Sawhney S. K., Singh R. (2001), Introductory Practical Biochemistry, Narosa Publishing House, New Delhi - Rao B. S., Deshpande V. (2005), Experimental Biochemistry A student companion, I.K. International Pvt. Ltd., Mumbai - Jayaraman J. (1996), Laboratory manual in Biochemistry, Wiley Eastern Ltd.	

T.Y. B.Sc. Biochemistry VSC-III
Semester-VI
BIC-: FOOD PROCESSING TECHNIQUES

Total Hours: 60

Credits: 2

Course Objectives	- Understand methods of processing and analysis of important parameters related to food science. - Perform proximate analysis to know components of food,	
Course Outcomes	After successful completion of this course, students are expected to: - Demonstrate various principles applied to food processing. - Understand the importance of processing techniques.	
Sr. No.	Contents	Hours
1	Introduction to food laboratory practices,	4
2	Proximate analysis (protein, carbohydrate, fat) of food	4
3	Estimate the moisture content of food.	4
4	Determination of ash content in food.	4
5	Determination of fiber content.	4
6	Precipitation of casein protein from milk with vinegar and to test the effectiveness of casein as a bonding agent to make casein glue.	4
7	To demonstrate how changes in air pressure can affect food products and the principle behind applying a vacuum in meat processing.	4
8	Jelly preparation and effect of sugar content on the quality of Jelly.	4
9	Effect of Temperature on Taste	4
10	Estimation of microbial load in food materials by aerobic plate count	4
11	Estimation of protein by lowry's method	4
12	To study the osmotic dehydration of foods	4
13	Determination of rehydration ratio of dehydrated food	4
14	To detect the adulterants, present in the food.	4
15	Food preservation Techniques.	4
Study Resources	- Food – The Chemistry of Its Components by T P Coultate, Royal Society of Chemistry, 2016 6TH , edition , - Food Processing and Preservation by B. Sivasanker, Prentic Hall of India, 2014 - Food Microbiology by W C Frazier and D C Westhoff, McGraw-Hill Book Company - Modern Food Microbiology by J M Jay, Springer US, Language:English, Author:James M. Jay, Martin J.	

	Loessner, David A. Golden2005, Food Processing: Principles and Applications by J Scott Smith and Y H Hui 6.Principles of Food Processing by Sathya Prakash Sinha	
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T.Y. B.Sc. Biochemistry (Major with IKS)
Semester-VI
BIC- Ayurved: Ancient Indian Medicinal System

Total Hours: 30

Credits: 2

Course Objectives	- To introduce students to great Ancient Indian Medicinal System : Ayurved - To make students aware about ayurvedic diagnosis of some common diseases - To make students aware about ayurvedic treatment of some common diseases	
Course Outcomes	After successful completion of this course, students are expected to: - Recognize the importance of Ayurved in medical field - Understand base of Ayurvedic treatment - Explore home remedies for common diseases	
Unit	Contents	Hours
Unit I	Ayurveda- Traditional medicinal system - Ayurveda: Definition, Scope, History and origin - Father of Indian ancient medicine - Charaka: Biography and contribution. - Father of Indian ancient surgery: - Sushruta: Biography and contribution. - PanchaMahabhutas : Akasha, Vayu, Agni, Ap (Jal), Prithvi - Saptadhatu: Rasa, Rakta, Mansa, Meda, Asthi, Majja, Shukra - Tridosha: Vata, Kapha, and Pitta and their subtypes - Rasayana: Definition, types (KamyaRasayanas and NaimittikaRasayanas), formulations.	08
Unit II	Ajirna(Indigestion) and Amlapita(Hyperacidity) Ajirna (Indigestion) - Definition, clinical description - History and epidemiology - Etiology - Pathogenesis and pathology - Clinical diagnosis - Classification of indigestion - Clinical course and prognosis - Management: Ayurvedic therapy and management, clinical experiences - Life style changes Amlapita (Hyperacidity) - Definition, clinical description - History and epidemiology - Etiology - Pathogenesis and pathology - Clinical diagnosis - Classification - Clinical features of GERD - Therapy - Lifestyle changes - Home remedies for hyperacidity	07

Unit III	Medoroga (Obesity) and Madhumeha (Diabetes Mellitus) Medoroga (Obesity)	08
	• Definition, Agni and srotas, Adipose tissue • Measurement of obesity • Features of obesity • Symptoms and signs • Obesity and affect disorders • Body mass index • Prevention of obesity • Management of obesity Madhumeha (Diabetes Mellitus) • Introduction • Clinical description • Pathogenesis • Clinical course and prognosis • Clinical examination and diagnosis • Therapy	
Unit IV	Shvasa (Bronchial Asthma) and Kaphaja Disease (Allergy) Shvasa (Bronchial Asthma) • Definition • Etiology • Pathology and Pathogenesis • Clinical Features • Clinical Course and Prognosis • Management • Ayurvedic Approach ○ Precautions ○ Diet ○ Lifestyle ○ Breathing ○ Meditation Kaphaja Disease (Allergy) • Definition and clinical description • Etiology • Pathogenesis • Diagnosis and prognosis • Therapy	07
Study Resources	▪ Scientific Basis for Ayurvedic Therapies, CRC PRESS ▪ Indication of vedic plants available in the present era, International Journal of Ayurveda and Pharma Research ▪ Sherwin, R.S., Diabetes mellitus, in Cecil Textbook of Medicine, Goldman, L. and Bennett, J.C., Eds., W.B. Saunders, New York, 2000. ▪ Swoboda, R.E. (translator), Prakriti: Your Ayurvedic Constitution, 1st ed., Motilal Banarasisdas, New Delhi, 1994. ▪ deShazo, R.D., Allergic rhinitis, in Cecil Text Book of Medicine, Goldman, L. and Bennett, J.C., Eds., W.B. Saunders, Philadelphia, 2000.	

T.Y. B.Sc. Biochemistry SEC-III
Semester-VI
BIC-: Practical on Clinical Biochemistry

Total Hours: 60

Credits: 2

Course Objectives	- To accustom students with various pathological tests - To generate awareness about clinical significance of the tests - To develop skill full hand on pathological tests	
Course Outcomes	After successful completion of this course, students are expected to: - Estimate various clinically important components and understand their clinical significance - Estimate various clinically important enzymes and understand their clinical significance - Correlate results obtained clinically	
Sr. No.	Contents	Hours
1	Estimation of blood glucose by suitable method	4
2	Estimation of reducing sugar in urine	4
3	Estimation of haemoglobin by using haematometer and its significance	4
4	Estimation of serum bilirubin.	4
5	Estimation of SGOT by 2, 4 DNPH method	4
6	Estimation of SGPT by 2, 4 DNPH method	4
7	Estimation of serum alkaline phosphatase by colorimetric method	4
8	Estimation of serum acid phosphatase by colorimetric method	4
9	Estimation of serum cholesterol by colorimetric method	4
10	Estimation of serum uric acid from the given sample	4
11	Estimation of serum urea from the given sample	4
12	Estimation of serum creatinine from the given sample	4
13	Detection of abnormal constituents of urine: Sugar, protein, ketone bodies and bile Pigments	4
14	Estimation of proteins by Biuret method	4
15	Estimation of serum calcium from given sample	4

Study Resources	• Sharma S., Sharma R. (2016), Practical manual of Biochemistry, Scientific International Publisher and Distributor, New Delhi. • Maheshwari N. (2008), Clinical Biochemistry, Jaypee Brothers, Medical Publishers. • Godkar P. B., Godkar D. P., Textbook of medical laboratory technology, 2nd edition, Bhalani Publishing House, Mumbai • Sadasivam S., Manickam A. (2018), Biochemical Methods, 3rd edition, New Age International Pvt. Ltd. • Sawhney S. K., Singh R. (2001), Introductory Practical Biochemistry, Narosa Publishing House, New Delhi	
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Skills acquired and Job prospects for Biochemistry students

Biochemistry is the molecular basis of life. Degree program in Biochemistry teaches students the way several lifeless chemicals combine to produce a functional living organism. A significant attraction of the course is the ability to combine in-depth scientific knowledge with practical laboratory skills and the career opportunities in all sectors.

After successful completion of three years degree course in Biochemistry, student will be well versed with laboratory skills and transferable skills.

Laboratory Skills:

- Laboratory safety practices as well as aseptic techniques
- Accurate weighing and reagent preparation
- Skillful handling of basic and advanced instruments
- Calibration of basic instruments like pH meter, micropipettes etc
 - Advanced techniques like; Chromatography, Electrophoresis
 - Spectrometry, Polymerase Chain Reaction (PCR)
 - Plant Tissue Culture, Animal Tissue Culture
- Collection, organization and presentation of data
- Analysis, Logical thinking and, interpretation of results

Transferable Skills:

During the course student will develop skills other than laboratory skills that are transferable across the number of career areas which include;

- Analytical skill, Observational skill
- Planning and Time management
- Mathematical and IT skills
- Creative thinking, Problem solving
- Report writing skill, Presentation skill

Job Opportunities:

After successful completion of B.Sc. in Biochemistry, student may continue further studies like M.Sc. in Biochemistry and then Ph.D. in Biochemistry and make career in research field. Students have opportunities in private as well as public (Government) sectors.

Private Sector:

Biochemist can work in quality control, quality assurance and R & D divisions of companies like-Biotech companies, Pharmaceutical companies, Chemical manufacturing companies, Food and Drink (includes brewing), Health and Beauty Care, Medical Instrument companies, Agricultural companies, Research Companies and Laboratories etc.

Public Sectors:

Blood Service, Cancer research institutes, Environmental Pollution Control, Forensic Science, Hospitals, National Blood Services, Overseas Development, Public Health Entities, Public Health Laboratories, Agriculture and fisheries etc.

Job profiles:

Biochemist, Biologist, Biomedical Scientist, Biotechnologist, Chemical Examiners, Chemist, Clinical Scientist, Food Scientist, Forensic Scientist, Laboratory Technician, Microbiologist, Research Associates, Research Officers, Research Scientist etc.

Opportunities in higher studies

After successful completion of B.Sc. in Biochemistry, student may continue further studies like M.Sc. in Biotechnology / Biochemistry and pursue higher studies. Even students can pursue other courses where graduation is essential.

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