



K.M.G. COLLEGE OF ARTS AND SCIENCE **(AUTONOMOUS)**

Approved by the Government of Tamil Nadu
Permanently Affiliated to Thiruvalluvar University, Vellore.
Recognized under Section 2(f) and 12(B) of the UGC Act 1956
Accredited by NAAC (2nd Cycle) with (CGPA of 3.24/4) 'A' Grade

P.G. AND RESEARCH DEPARTMENT OF BIOCHEMISTRY

B.Sc., BIOCHEMISTRY

SYLLABUS
(CHOICE BASED CREDIT SYSTEM)

Under

LEARNING OUTCOMES-BASED CURRICULUM
FRAMEWORK (LOCF)

(Effective for the Batch of Students Admitted from 2024-2025)

PREFACE

The curriculum of undergraduate Biochemistry has been designed to explain the concepts in various branches of Biochemistry such as Clinical biochemistry, Nutritional biochemistry, etc. The purpose of the outcome-based education is meant to provide an exposure to the fundamental aspects in different branches of Biochemistry and its applications, keeping in mind the growing needs for higher education, employability, entrepreneurship and social responsibility. The periodical restructuring of the syllabi is carried out to fulfill the requirements of graduate attributes, qualification descriptors, programme learning outcomes and course outcomes. The outcome-based education enriches the curriculum to deliver the basic principles, synthetic strategies, mechanisms and application-oriented learning for the benefit of students. It also includes self-learning module, minor projects and industrial internship to enable students to get equipped for higher studies and employment. The programme also includes training to students for seminar presentation, preparation of internship reports, hands-on training in lab courses, skills to handle instruments, synthesis and its analysis, developing leadership qualities, organization and participation in the interdepartmental academic competitions. The allied papers provide a platform to strengthen the understanding of the core subjects. The non-major elective courses offer chances to learn and augment interest in other related fields. The outcome-based curriculum is intended to enrich the learning pedagogy to global standards. ICT enabled teaching-learning platforms are provided to students along with the interaction of international scientists. The seminars periodically delivered by industrialists, subject experts and former professors would certainly help the students to update with latest technology/trends in different fields of Biochemistry. The exposure to the industrial internship and MOUs with industries can open an avenue for a start-up and its progress would be followed regularly. The OBE based evaluation methods will reflect the true cognitive levels of the students as the curriculum is designed with course outcomes and cognitive level correlations as per BLOOM's Taxonomy.

In pursuit of the Higher Education Department Policy Note 2022-23 Demand 20, Section 1.4, Tamil Nādu State Council for Higher Education took initiative to revamp the curriculum. On 27 July 2022, a meeting was convened by the Member-Secretary Dr. S. Krishnasamy enlightening the need of the hour to restructure the curriculum of both Undergraduate and Post-graduate programmes based on the speeches at the Tamil Nādu Legislative Assembly Budget meeting by the Honorable Higher Education Minister Dr K. Ponmudy and Honorable Finance Minister Dr. P. Thiagarajan. At present there are three different modes of imparting education in most of the educational institutions throughout the globe. Outcome Based Education, Problem Based Education, and Project Based Education.

Now our Honorable Higher Education Minister announced Industry Aligned Education. During discussion, Member Secretary announced the importance of question papers and evaluation as envisaged by the Honorable Chief Secretary to Government Dr. V. Irai Anbu. This is very well imbedded in Revised Bloom's Taxonomy forms three learning domains: the cognitive (knowledge), affective (attitude), and psychomotor (skill). This classification enables to estimate the learning capabilities of students.

Briefly, it is aimed to restructure the curriculum as student-oriented, skill-based, and institution industry- interaction curriculum with the various courses under "Outcome Based Education with Problem Based Courses, Project Based Courses, and Industry Aligned Programmes" having revised Bloom's Taxonomy for evaluating students skills. Three domains:

(i)Cognitive Domain

(Lower levels: K1: Remembering; K2: Understanding; K3: Applying; Higher levels: K4: Analyzing; K5: Evaluating; K6: Creating)

(ii) Affective Domain

(iii) Psychomotor Domain

ABOUT THE COLLEGE

The College was founded in the new millennium 2000 by the vision of late Shri.K.M.Govindarajan fondly known as Iyah, with a mission to offer higher education in the fields of Arts and Science to the needy and the poor middle class students of this area and make them fully employable and economically self-reliant. With a humble beginning of launching an elementary school named Thiruvalluvar Elementary School in the year 1952, Iyah groomed it into a Higher Secondary School and later into a college. Education was his soul and breath. The college has grown into a full-fledged educational hub offering 12 under graduate programmes, 8 post graduate programmes, 5 M.Phil research programmes and 4 Ph.D programmes. The college has been accredited with ‘A’ grade by NAAC in 2nd cycle and recognized under section 2(f) & 12(B) of the UGC act 1956. The College is permanently affiliated to Thiruvalluvar University. The College is also acquired the status of Autonomous from the academic year 2024-2025. The College is an associate member of ICT Academy and registered member of NPTEL and Spoken Tutorials of IIT Bombay. The college is also a member of INFLIBNET and NDL.

VISION OF THE COLLEGE

- Empower young men and women by educating them in the pursuit of excellence, character building and responsible citizen.

MISSION OF THE COLLEGE

- Offer higher education in the fields of Arts, Science & Management to the needy and make them fully self-dependent.

QUALITY POLICY OF THE COLLEGE

KMG Students achieve the best learning results and personal growth with modern education that equip them for working life and a changing society to become deserving citizens.

ABOUT THE DEPARTMENT

The knowledge of basic science is essential for the sustainable development of the society. To get the basic knowledge in Biochemistry to young students the Department of Biochemistry initiated in the academic year 2000-2003. The objective of our department is to motivate students to excel in Biochemistry at the global level, which is necessary for Biochemists getting placement as well as becoming an entrepreneur in future. The department was uplifted as the post graduate department in the year 2004-2006. The department has been recognized as a research department since 2008 to offer M.Phil., Followed that the Thiruvalluvar University accorded recognition to the Department as a centre for Doctoral research in Biochemistry from 2019-2020. The focus of the department is the holistic development of the students and involves them in curricular and co-curricular activities. The Bio Chemistry Department pledges itself to serve in the broadest, innovative and most liberal manner towards the advancement of Biochemistry in all of its branches through academics, research and service missions upholding the values and entrepreneurial skills. The job potential to the biochemist is very high now and opportunities to provoke research in biochemistry are ample. Needless to say that for a developing country likes ours, “BIOCHEMISTRY IS OUR LIFE AND FUTURE”.

VISION OF THE DEPARTMENT

- Produce World class academicians, Scientist, Industrialist and entrepreneurs in the field of Biochemistry.

MISSION OF THE DEPARTMENT

- To educate and inspire the young minds from the basics to the latest innovations in science.
- Inculcate strong theoretical, practical, research and analytical skills in the subject domains and thereby prepare the students for both employability and entrepreneurship.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

- 1. Professional Excellence:** Graduates will demonstrate competency and excellence in their chosen fields of study, applying theoretical knowledge to practical situations effectively.
- 2. Character Development:** Graduates will exhibit strong moral and ethical character, upholding values of integrity, honesty, and respect for others in both personal and professional endeavors.
- 3. Leadership and Citizenship:** Graduates will emerge as responsible leaders and active citizens, contributing positively to their communities and society at large through their actions and initiatives.
- 4. Continuous Learning:** Graduates will engage in lifelong learning and professional development activities, adapting to evolving technologies, methodologies, and societal needs.
- 5. Self-Dependency and Entrepreneurship:** Graduates will possess the skills and mindset necessary to be self-reliant and entrepreneurial, capable of creating opportunities for themselves and others through innovation and initiative.
- 6. Effective Communication and Collaboration:** Graduates will demonstrate proficiency in communication skills, both verbal and written, and exhibit the ability to collaborate effectively with diverse teams and stakeholders.
- 7. Global Perspective:** Graduates will have a broad understanding of global issues and perspectives, demonstrating cultural sensitivity and adaptability in multicultural environments.

PROGRAM OUTCOMES (POs)

On successful completion of the Programme, the students will be able to:

| POs | Graduate Attributes | Statements |
|------|---|---|
| PO1 | Disciplinary Knowledge | Acquire detailed knowledge and expertise in all the disciplines of the subject. |
| PO2 | Communication Skills | Ability to express thoughts and ideas effectively in writing, listening and confidently Communicate with others using appropriate media |
| PO3 | Critical Thinking | Students will develop aptitude Integrate skills of analysis, critiquing, application and creativity. |
| PO4 | Analytical Reasoning | Familiarize to evaluate the reliability and relevance of evidence, collect, analyze and interpret data. |
| PO5 | Problem Solving | Capacity to extrapolate the learned competencies to solve different kinds of non-familiar problems. |
| PO6 | Employability and Entrepreneurial Skill | Equip the skills in current trends and future expectations for placements and be efficient entrepreneurs by accelerating qualities to facilitate startups in the competitive environment. |
| PO7 | Individual and Team Leadership Skill | Capability to lead themselves and the team to achieve organizational goals and contribute significantly to society. |
| PO8 | Multicultural Competence | Possess knowledge of the values and beliefs of multiple cultures and a global perspective. |
| PO 9 | Moral and Ethical awareness/reasoning | Ability to embrace moral/ethical values in conducting one’s life. |
| PO10 | Lifelong Learning | Identify the need for skills necessary to be successful in future at personal development and demands of work place. |

PROGRAM SPECIFIC OUTCOMES (PSOs)

On successful completion of the B.Sc., Biochemistry, the students will be able to:

| PSOs | Statements |
|------|---|
| PSO1 | Comprehend the knowledge in the biochemical, analytical, biostatistical and computational areas. |
| PSO2 | Ability to understand the technical aspects of existing technologies that help in addressing the biological and medical challenges faced by human kind. |
| PSO3 | Acquiring analytical and hands on skills to perform research in multidisciplinary environments. |

Correlation Rubrics:

| High | Moderate | Low | No Correlation |
|------|----------|-----|----------------|
| 3 | 2 | 1 | - |

Mapping of PSOs with POs:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| PSO1 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 2 |
| PSO2 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 2 |
| PSO3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |

K.M.G. COLLEGE OF ARTS AND SCIENCE (AUTONOMOUS)

Subject and Credit System- B.Sc., Biochemistry

(Effective for the Batch of Students Admitted from 2024-2025)

| Semester | Part | Category | Course Code | Course Title | Ins.Hrs / Week | Credit | Maximum Marks | | |
|-----------------------|------|--------------------|------------------|--|----------------|-----------|---------------|----------|-------|
| | | | | | | | Internal | External | Total |
| SEMESTER - I | I | Language | AULT10 / AULU 10 | General Tamil – I / Urdu - I | 6 | 3 | 25 | 75 | 100 |
| | II | English | AULE10 | English – I | 6 | 3 | 25 | 75 | 100 |
| | III | Core – 1 | AUCBC11 | Nutritional Biochemistry | 6 | 5 | 25 | 75 | 100 |
| | III | Core – 2 | AUCPBC 12 | Practical I - Nutritional Biochemistry | 3 | 3 | 25 | 75 | 100 |
| | III | Elective-I | AUECH13 | Chemistry I | 3 | 3 | 25 | 75 | 100 |
| | III | Elective Practical | AUEPCH23 | Practical - Chemistry | 2 | - | - | - | - |
| | IV | Skill Enhancement | AUSBC14 | Health and Nutrition | 2 | 2 | 25 | 75 | 100 |
| | IV | Skill Enhancement | AUFBC15 | Foundation Course (Basics of Biochemistry) | 2 | 2 | 25 | 75 | 100 |
| Semester Total | | | | | 30 | 21 | | | |
| SEMESTER - II | I | Language | AULT20 / AULU20 | General Tamil – II / Urdu - II | 6 | 3 | 25 | 75 | 100 |
| | II | English | AULE20 | English – II | 6 | 3 | 25 | 75 | 100 |
| | III | Core - 3 | AUCBC21 | Cell Biology | 5 | 5 | 25 | 75 | 100 |
| | III | Core – 4 | AUCPBC22 | Practical II - Cell Biology | 3 | 3 | 25 | 75 | 100 |
| | III | Elective-II | AUECH23 | Chemistry II | 3 | 3 | 25 | 75 | 100 |
| | III | Elective Practical | AUEPCH23 | Practical - Chemistry | 3 | 3 | 25 | 75 | 100 |
| | IV | Skill Enhancement | AUSBC24 | Medicinal Diet | 2 | 2 | 25 | 75 | 100 |
| | IV | Skill Enhancement | AUSBC25 | First Aid | 2 | 2 | 25 | 75 | 100 |
| Semester Total | | | | | 30 | 24 | | | |

| Semester | Part | Category | Course Code | Course Title | Ins.Hrs / Week | Credit | Maximum Marks | | |
|-----------------------|-----------------------|--------------------------|------------------|---|----------------|-----------|---------------|----------|-------|
| | | | | | | | Internal | External | Total |
| SEMESTER - III | I | Language | AULT30 / AULU 30 | General Tamil – III / Urdu - III | 6 | 3 | 25 | 75 | 100 |
| | II | English | AULE30 | English – III | 6 | 3 | 25 | 75 | 100 |
| | III | Core - 5 | AUCBC31 | Biomolecules | 4 | 4 | 25 | 75 | 100 |
| | III | Core – 6 | AUCPBC32 | Practical III- Biomolecules | 3 | 3 | 25 | 75 | 100 |
| | III | Elective-III | AUAEMB33 | Microbiology-I | 3 | 3 | 25 | 75 | 100 |
| | III | Elective Practical | AUAEPMB43 | Practical - Microbiology | 2 | -- | - | - | - |
| | IV | Skill Enhancement | AUSBC34 | Tissue Culture | 2 | 2 | 25 | 75 | 100 |
| | IV | Skill Enhancement | AUSBC35 | Plant Biochemistry & Plant therapeutics | 2 | 2 | 25 | 75 | 100 |
| | IV | Compulsory | AUES30 | Environmental Studies | 2 | 2 | 25 | 75 | 100 |
| | Semester Total | | | | | 30 | 22 | | |
| SEMESTER - IV | I | Language | AULT40 / AULU 40 | General Tamil – IV / Urdu - IV | 6 | 3 | 25 | 75 | 100 |
| | II | English | AULE40 | English – IV | 6 | 3 | 25 | 75 | 100 |
| | III | Core - 7 | AUCBC41 | Biochemical Techniques | 5 | 5 | 25 | 75 | 100 |
| | III | Core-8 | AUCPBC42 | Practical IV - Biochemical Techniques | 3 | 3 | 25 | 75 | 100 |
| | III | Elective-IV | AUAEMB43 | Microbiology - II | 3 | 3 | 25 | 75 | 100 |
| | III | Elective Practical | AUAEPMB43 | Practical - Microbiology | 3 | 3 | 25 | 75 | 100 |
| | IV | Skill Enhancement Course | AUSBC44 | Bioinformatics | 2 | 2 | 25 | 75 | 100 |
| | IV | Skill Enhancement | AUSBC45 | Biochemical Pharmacology | 2 | 2 | 25 | 75 | 100 |
| | Semester Total | | | | | 30 | 24 | | |

| Semester | Part | Category | Course Code | Course Title | Ins.Hrs / Week | Credit | Maximum Marks | | |
|-----------------------|------|----------------------------------|-------------|--|----------------|-----------|---------------|----------|-------|
| | | | | | | | Internal | External | Total |
| SEMESTER - V | III | Core – 9 | AUCBC51 | Enzymes | 6 | 4 | 25 | 75 | 100 |
| | III | Core – 10 | AUCBC52 | Intermediary Metabolism | 5 | 4 | 25 | 75 | 100 |
| | III | Core – 11 | AUCBC53 | Medical Lab Technology | 5 | 4 | 25 | 75 | 100 |
| | III | Core – 12 | AUPBC56 | Project with Viva-voce | 5 | 4 | 25 | 75 | 100 |
| | III | Elective-V (Choose any one) | AUEBC54A | Research Methodology | 4 | 3 | 25 | 75 | 100 |
| | | | AUEBC54B | Bioentrepreneurship | | | | | |
| | III | Elective Practical | AUEPBC55 | Practical V- Medical Lab Technology | 3 | 3 | 25 | 75 | 100 |
| | IV | Compulsory | AUVE50 | Value Education | 2 | 2 | 25 | 75 | 100 |
| | IV | Compulsory | AUIBC57 | Internship/Industrial Training (Carried out in II-Year Summer vacation) (30hours) | . | 2 | 100 | - | 100 |
| Semester Total | | | | | 30 | 26 | | | |
| SEMESTER - VI | III | Core – 13 | AUCBC61 | Molecular Biology | 6 | 4 | 25 | 75 | 100 |
| | III | Core – 14 | AUCBC62 | Biotechnology | 5 | 4 | 25 | 75 | 100 |
| | III | Core – 15 | AUCBC63 | Clinical Biochemistry | 4 | 3 | 25 | 75 | 100 |
| | III | Core-16 | AUCPBC64 | Practical-VI-Clinical Biochemistry | 3 | 3 | 25 | 75 | 100 |
| | III | Elective-VI | AUEBC65 | Human Physiology | 5 | 3 | 25 | 75 | 100 |
| | III | Elective-VII (Choose any one) | AUEBC66A | Immunology | 5 | 3 | 25 | 75 | 100 |
| | | | AUEBC66B | Basics of Forensic Science | | | | | |
| | IV | Compulsory | AUEA60 | Extension Activity | - | 1 | 100 | - | 100 |
| | V | Compulsory | AUPCBC67 | Professional Competency Skill – Medical Coding | 2 | 2 | 25 | 75 | 100 |
| Semester Total | | | | | 30 | 23 | | | |

Consolidated Semester wise and Component wise Credit distribution

| Parts | Semester-I | Semester-II | Semester-III | Semester-IV | Semester-V | Semester-VI | Total Credits |
|-----------------|------------|-------------|--------------|-------------|------------|-------------|---------------|
| Part-I | 03 | 03 | 03 | 03 | - | - | 12 |
| Part-II | 03 | 03 | 03 | 03 | - | - | 12 |
| Part-III | 11 | 14 | 10 | 14 | 22 | 20 | 91 |
| Part-IV | 04 | 04 | 06 | 04 | 04 | 01 | 23 |
| Part-V | - | - | - | - | - | 02 | 02 |
| Total | 21 | 24 | 22 | 24 | 26 | 23 | 140 |

*Part I, II, and Part III components will be separately taken into account for CGPA calculation and classification for the under graduate programme and the other components. IV, V has to be completed during the duration of the programme as per the norms, to be eligible for obtaining the UG degree.

COURSE DESCRIPTORS

| | | | |
|----------------------------|--|----------------------------|-------|
| Title of the Course | Nutritional Biochemistry | Hours/Week | 06 |
| Course Code | AUCBC11 | Credits | 05 |
| Category | Core-1 | Year & Semester | I & I |
| Prerequisites | Higher secondary Chemistry/Biology/Mathematics/Botany/ Zoology/Physics | Regulation | 2024 |

Objectives of the course:

The objectives of this course are to

- Create awareness about the role of nutrients in maintaining proper health.
- Understand the nutritional significance of carbohydrates, lipids and proteins.
- Understand the importance of a balanced diet.
- Study the effect of additives, emulsifiers, and flavor enhancing substances in food.
- Study the significance of nutraceuticals.

| UNIT S | Contents | COs | Cognitive Levels |
|---------|--|-------------------|----------------------|
| UNIT-I | Concepts of food and nutrition. Basic food groups-energy yielding, bodybuilding and functional foods. Modules of energy. Calorific and nutritive value of foods. Measurement of Calories by bomb calorimeter. Basal metabolic rate (BMR) - definition, determination of BMR and factors affecting BMR. Respiratory quotient (RQ) of nutrients and factors affecting the RQ. SDA- definition and determination- Anthropometric measurement and indices – Height, Weight, chest and waist circumference BMI. | CO1 CO3 | K1 K2 K3 |
| UNIT-II | Physiological role and nutritional significance of carbohydrates, lipids and protein. Evaluation of proteins by nitrogen balance method- Biological value of proteins- Digestibility coefficient, Protein Energy Ratio and Net Protein Utilization. Protein energy malnutrition –Kwashiorkor and Marasmus, Obesity-Types and preventive measures. | CO1 CO2 CO3 | K1 K2 K3 K4 |

| | | | |
|-----------------|--|--------------------------|----------------|
| UNIT-III | Balanced diet, example of low and high cost balanced diet- for infants, children, adolescents, adults and elderly people. ICMR classification of five food groups and its significance. Food pyramid. Junk foods- definition and its adverse effects. | CO3 CO4 | K1 K2 K3 |
| UNIT-IV | Food additives: Structure, chemistry, function and application of preservatives, emulsifying agents, buffering agents, stabilizing agents, natural and artificial sweeteners, bleaching, starch modifiers, antimicrobials, food emulsions, fat replacers, viscosity agents, gelling agents and maturing agents. Food colors, flavours, anti-caking agent, antioxidants. Safety assessment of food additives. | CO2 CO3 CO4 CO5 | K1 K2 K3 |
| UNIT-V | Nutraceuticals and Functional Foods: Definition, properties and function of Nutraceuticals, food Supplements, dietary supplements prebiotics, probiotics, and functional Foods. Food as medicine. Natural pigments from plants– carotenoids, anthocyanins and its benefits. | CO2 CO3 CO4 CO5 | K1 K2 K3 |

Recommended Text Books

1. Gaile Moe, Danita Kelley, Jacqueline Berning and Carol Byrd-Bred benner. 2013. Wardlaw's Perspectives in Nutrition: A Functional Approach. McGraw-Hill, Inc., NY, USA.
2. M.Swaminadhan (1995) Principles of Nutrition and Dietetics. Bappco.
3. Tom Brody (1998). Nutritional Biochemistry (2nd ed), Academic press, USA.
4. Garrow, JS. James WPT and Ralph A (2000). Human nutrition and dietetics (10th ed) Churchill Livingstone.
5. Andreas M.Papas (1998). Antioxidant Status, Diet, Nutrition, and Health (1st ed) CRC.

Reference Books

1. Branen, A.L., Davidson PM & Salminen S. 2001. Food Additives. 2nd Ed. Marcel Dekker.
2. George, A.B. 1996. Encyclopedia of Food and Colour Additives. Vol. III. CRC Press.
3. Advances in food biochemistry, Fatih Yildiz (Editor), CRC Press, Boca Raton, USA, 2010
4. Food biochemistry & food processing, Y.H. Hui (Editor), Blackwell Publishing, Oxford, UK, 2006.
5. Geoffrey Campbell-Platt. 2009. Food Science and Technology. Wiley-Blackwell, UK.

Website and e-learning source

1. <http://old.noise.ac.in/SecHmscicour/english/LESSON O3.pdf>
2. <https://study.com/academy/lesson/energy-yielding-nutrients-carbohydratesfat-protein.html>.<https://www.nhsinform.scot/healthy-living/food-and-nutrition/eatingwell/vitamins-and-minerals>

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

| COs | CO Description | Cognitive Level |
|-----|---|-----------------|
| CO1 | Cognizance of basic food groups viz. Carbohydrates, proteins and lipids and their nutritional aspects as well as calorific value. | K1,K2,k3 |
| CO2 | Identify and explain nutrients in foods and the specific functions in maintaining health. | K1,K2,K3 |
| CO3 | Classify the food groups and its significance | K1,K2,K3 |
| CO4 | Understand the effect of food additives | K1,K2,K3 |
| CO5 | Describe the importance of nutraceuticals and pigments | K1,K2,K3 |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 | 3 | 2 | 1 | 1 | 2 | 1 | - | - | - | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | - | 3 | 3 | 3 | 3 |
| CO3 | 3 | 2 | 2 | 2 | 1 | 1 | - | 2 | - | 3 | 1 | 3 | 3 |
| CO4 | 3 | 2 | 2 | 3 | 2 | 1 | 1 | - | 2 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 2 | 2 | 2 | 2 | - | 1 | 1 | 3 | 3 | 3 | 3 |

COURSE DESCRIPTORS

| | | | |
|----------------------------|---|----------------------------|-------|
| Title of the Course | Practical I-Nutritional Biochemistry | Hours/Week | 03 |
| Course Code | AUCPBC12 | Credits | 03 |
| Category | Core-II | Year & Semester | I & I |
| Prerequisites | Higher secondary chemistry/Biology/Mathematics/Botany/Zoology/Physics | Regulation | 2024 |

Objectives of the course:

The objectives of this course are to

- Impart hands-on training in the estimation of various constituents by titrimetric method
- Prepare Biochemical preparations.
- Determine the ash content and extraction of lipid.

| UNITS | Contents | COs | Cognitive Levels |
|----------|---|---------------------|------------------|
| UNIT-I | TITRIMETRY 1. Estimation of ascorbic acid in a citrus fruit. 2. Estimation of calcium in milk. 3. Estimation of glucose by Benedict's method in honey. 4. Estimation of phosphorous (Plant source) | CO1,CO3 | K5,K4,K3 |
| UNIT-II | BIOCHEMICAL PREPARATIONS 1. Preparation of the following substances and its qualitative tests. 2. Lecithin from egg yolk. | CO1, CO2, CO3 | K1,K2, K3,K5 |
| UNIT-III | 1. Starch from potato. 2. Casein and Lactalbumin from milk. | CO3 CO4 | K1,K2 K5 |
| UNIT-IV | GROUP EXPERIMENT 1. Determination of ash content and moisture content in food sample | CO1,CO2 CO3 | K1,K2 K5 |
| UNIT-V | 1. Extraction of lipid by Soxhlet's method. | CO1,CO2 CO4 | K1,K2 K5 |

Recommended Text Books

1. Laboratory manual in Biochemistry, J. Jayaraman, 2nd edition, New Age International Publishers,2011,
2. An Introduction to Practical Biochemistry, David T. Plummer, 3rd edition, Tata McGraw-Hill Publishing Company Limited, 2001.

Reference Books

1. Biochemical Methods, Sadasivam S and Manickam A, 4h edition, New Age International Publishers,2016.
2. Essentials of Food and Nutrition, Vol. I & II, M.S. Swami Nathan.
3. Bowman and Robert M. 2006. Present Knowledge in Nutrition. 9th edition, International Life Sciences Publishers.
4. Indrani TK. 2003. Nursing Manual of Nutrition and Therapeutic Diet, 1st edition Jaypee Brothersmedical publishers.
5. Martha H. and Marie A. 2012. Biochemical, Physiological, and Molecular Aspects of HumanNutrition. 3rd edition. Chand Publishers

Website and e-learning source

- 1.<https://www.elsevier.com/journals/clinical-biochemistry/0009-9120/guide-for-authors>
- 2.<http://rajswashya.nic.in/RHSDP%20Training%20Modules/Lab.%20Tech/Biochemistry/Dr.%20Jagarti%20Jha/Techniques%20In%20Biochemistry%20Lab.pdf>
- 3.https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical_biochemistrypdf.pdf?sequence=1&isAllowed=y
- 4.https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical_biochemistry.pdf.pdf

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

| COs | CO Description | Cognitive Level |
|-----|--|-----------------|
| CO1 | Estimate the important biochemical constituents in the food samples. | K1,K2 |
| CO2 | Prepare the macronutrients from the rich sources. | K1,K2,K4 |
| CO3 | Determine the ash and moisture content of the food samples | K1,K2,K3 |
| CO4 | Extract oil from its sources | K1,K2,K3 |
| CO5 | Determine Prophase, Anaphase, Metaphase, Telophase of the Cell | K1,K2,K3 |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 | 3 | 2 | 3 | 2 | 1 | 2 | - | - | - | - | 3 | 3 | 3 |
| CO2 | 3 | 2 | 3 | 2 | 2 | 2 | 1 | 1 | - | 1 | 3 | 3 | 3 |
| CO3 | 3 | 2 | 3 | 2 | 1 | 2 | 1 | 2 | - | 1 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 2 | 1 | 2 | - | - | 1 | - | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 1 | 2 | - | - | 1 | 1 | 3 | 3 | 3 |

COURSE DESCRIPTORS

| | | | |
|----------------------------|---|----------------------------|-------|
| Title of the Course | Health and Nutrition | Hours/Week | 02 |
| Course Code | AUSBC14 | Credits | 02 |
| Category | Skill enhancement Course –SEC-1 | Year & Semester | I & I |
| Prerequisites | Higher secondary chemistry/Biology/Mathematics/Botany/Zoology/Physics | Regulation | 2024 |

Objectives of the course:

The objectives of this course are to

- Gain basic knowledge about health.
- Understand about vitamins.
- Learn about functions of fat on health.
- Understand the types of minerals and its functions
- Know about the importance of carbohydrates and proteins on health

| UNITS | Contents | COs | Cognitive Levels |
|----------|--|--------------------------|----------------------|
| UNIT-I | Health – definition, Factors affecting human health. Importance of health care of children, adults and elderly people. Balanced diet and calorific value. | CO1 CO3 | K1 K2 K3 |
| UNIT-II | Vitamins-definition, classification, sources, properties, Functions and deficiency symptoms. Recommended daily allowances. | CO1 CO2 CO3 | K1 K2 K3 K4 |
| UNIT-III | Sources and functions of dietary fats Role of fats in health and diseases (LDL, HDL, VLDL and Cholesterol). | CO3 CO4 | K1 K2 K3 |
| UNIT-IV | Minerals- Role of minerals on human health Sources biological functions, deficiency disorders with special reference to Calcium, Phosphorus, Potassium, Copper, Iron, Zinc and Selenium. Minerals in biological systems and their importance –Iron, Calcium, Phosphorus, Iodine, Copper, Zinc. | CO2 CO3 CO4 | K1 K2 K3 |
| UNIT-V | Role of proteins and carbohydrates in health. Functions of protein and carbohydrate and their calorific value. Dietary sources and deficiency disorders – Kwashiorkor and Marasmus – supplementation programs in India and their implications. | CO2 CO3 CO4 CO5 | K1 K2 K3 |

Recommended Text Books

1. Davidson and J.R.Passmore (1986) Human Nutrition and Dietetics, (8th ed), Churchill Livingstone.
2. J. S. Garrow, W. Philip T. James, A. Ralph (2000), Human Nutrition and Dietetics (10th ed), Churchill Livingstone.
3. M.Swaminathan (1995) Principles of Nutrition and Dietetics, Bappco.

Reference Books

1. Margaret Mc Williams (2012). Food Fundamentals (10th ed), Prentice Hall

Website and e-learning source

1. <https://www.universalclass.com/articles/health/nutrition/nutritional-needs-for-differentages>.
2. [nhp.gov.in/healthy living/healthy diet](http://nhp.gov.in/healthy_living/healthy_diet)
3. www.anme.com.mx/libros/PrinciplesofNutrition.pdf

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

| COs | CO Description | Cognitive Level |
|-----|--|-----------------|
| CO1 | Understand about the importance of health and diet. | K1,K2 |
| CO2 | Discuss about the classification, properties and deficiencies of vitamins. | K1,K2,K4 |
| CO3 | Understand about sources and functions of fats and lipids onhealth. | K1,K2,K3 |
| CO4 | Detail about the different typed of minerals and its role in health. | K1,K2,K3 |
| CO5 | Relate the role of proteins and carbohydrates on health. | K1,K2,K3 |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 | 3 | 2 | 3 | 3 | 1 | 3 | - | - | - | - | 3 | 3 | 2 |
| CO2 | 3 | 2 | 3 | 3 | 2 | 3 | 1 | 1 | - | 1 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 3 | - | 2 | - | 1 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 3 | - | - | 1 | - | 3 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 2 | 2 | 3 | - | - | 1 | 1 | 3 | 3 | 3 |

COURSE DESCRIPTORS

| | | | |
|----------------------------|--|----------------------------|-------|
| Title of the Course | Basics of Biochemistry | Hours/Week | 02 |
| Course Code | AUFBC15 | Credits | 02 |
| Category | Foundation course (Bridge course) | Year & Semester | I & I |
| Prerequisites | Higher secondary Chemistry/Biology/Mathematics/Botany/Zoology/Physics | Regulation | 2024 |

Objectives of the course:

The objectives of this course are to

- Create awareness about the role of nutrients in maintaining proper health.
- Understand the nutritional significance of carbohydrates, lipids and proteins.
- Understand the importance of a balanced diet.
- Study the effect of additives, emulsifiers, and flavor enhancing substances in food.
- Study the significance of nutraceuticals.

| UNITS | Contents | COs | Cognitive Levels |
|----------|---|-------------------|----------------------|
| UNIT-I | Definition, Important Functional & structural features of biomolecules in biological system Outline the classification of carbohydrates-Mono, Di, and Polysaccharide Proteins classification-Simple. Conjugated Proteins- Keratin, Collagen, Silk fibroin, Hemoglobin. Lipids Classification - simple, complex, and derived lipids. Role of lipids-DNA is genetic material. | CO1 CO3 | K1 K2 K3 |
| UNIT-II | Nucleic acids- Central dogma, Watson Crick model of DNA, Mode of Replication, RNA - Structure and type's m-RNA, t-RNA, r-RNA with function – Genetic code. | CO1 CO2 CO3 | K1 K2 K3 K4 |
| UNIT-III | Enzymes-structure, and function in a biological system Vitamins classification and its deficiency symptoms. | CO3 CO4 | K1 K2 K3 |
| UNIT-IV | Classification of microbes .Role of Microbes in fermentation and infections. Immune system- Definition of Immunity, Role of immune cells in infections. | CO2 CO3 CO4 | K1 K2 K3 |

| | | | |
|---------------|---|-----|----|
| UNIT-V | Role of Medical lab in the diagnosis of Clinical disorder Applications of Medical Coding. | CO2 | K1 |
| | | CO3 | K2 |
| | | CO4 | K3 |
| | | CO5 | |

Recommended Text Books

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

Reference Books

1. Voet.D. et al., 2012. Fundamentals of Biochemistry: Life at the Molecular level, 4th Edition John Wiley and Sons.
2. Zubay,G.L. 1998. Biochemistry, Wm. C. Brown Publishers.
3. Sinden, S.R.DNA structure and function, First Edition, Academic Press, 1994.
4. Carl Branden and John Tooze, Introduction to Protein Structure, Second Edition, Garland Publishing, 1999.
5. Garrett, R. and Grisham C, 2010 .Biochemistry, 4th Edition, Saunders.
6. Chemistry of Biomolecules by RJ Simond.
7. Biomolecules: Chemistry of Living System by VK Ahluwalia.
8. Cell Biology (Cytology, Biomolecules and Molecular Biology) by Verma PS and Agarwal V
9. Textbook of Biochemistry with clinical correlations by Thomas. M. Devlin, John Wiley liss Hoboken NJ Publishers 2006.
10. Biochemistry and Molecular Biology of Antimicrobial Drug Action, 6th Edition Paperback– 2005. by franklin.j. et.al (Author).

Website and e-learning source

1. <http://old.noise.ac.in/SecHmscicour/english/LESSON O3.pdf>
2. <https://study.com/academy/lesson/energy-yielding-nutrients-carbohydratesfat->
3. <https://www.nhsinform.scot/healthy-living/food-and-nutrition/eatingwell/vitamins-and-minerals>

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

| COs | CO Description | Cognitive Level |
|-----|--|-----------------|
| CO1 | Students will be introduced to the structure of biomolecules. | K1,K2 |
| CO2 | The significance of carbohydrates in biological processes will be understood. | K1,K2,K4 |
| CO3 | The structure, properties and biological significance of lipids in the biological system will be studied | K1,K2,K3 |
| CO4 | Students will learn about the concepts of protein structure and their significance in biological processes and creatively comprehend the role of membrane components with their biological Significance. | K1,K2,K3 |
| CO5 | Students will gain knowledge about the structures and functional roles of nucleic acids in the Biological system | K1,K2,K3 |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 | 3 | 2 | 2 | 2 | 1 | - | - | - | - | - | 3 | 3 | 2 |
| CO2 | 3 | 2 | 2 | 2 | 1 | - | 1 | 1 | - | 1 | 3 | 3 | 1 |
| CO3 | 3 | 2 | 2 | 2 | 1 | - | - | 2 | - | 1 | 3 | 3 | 1 |
| CO4 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | - | - | - | 3 | 3 | 2 |
| CO5 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | - | 1 | 1 | 3 | 3 | 2 |

COURSE DESCRIPTORS

| | | | |
|----------------------------|---|----------------------------|-------|
| Title of the Course | BIOCHEMISTRY I | Hours/Week | 04 |
| Course Code | AUEBC15 | Credits | 03 |
| Category | Elective subject | Year & Semester | I & I |
| Prerequisites | Higher secondary chemistry/Biology/Mathematics/Botany/Zoology/Physics | Regulation | 2024 |

Learning objectives

The objectives of this course are to

- Introduce the structure and classification of carbohydrates
- Comprehend the metabolism of carbohydrates
- Study the classification and properties of amino acids
- Elucidate the various levels of organization of Proteins
- Study functions and deficiency diseases of vitamins

| UNITS | Contents | COs | Cognitive Levels |
|-----------------|---|-------------------|----------------------|
| UNIT-I | Definition and classification of carbohydrates Linear and cyclic forms (Haworth projection) for glucose fructose and mannose and disaccharides (Maltose, Lactose sucrose). General properties of monosaccharide and disaccharides. Occurrence and significance of polysaccharides. | CO1 CO3 | K1 K2 K3 |
| UNIT-II | Metabolism- Catabolism and Anabolism. Carbohydrate metabolism – Glycolysis, TCA cycle, HMP shunt and glycogen metabolism and energetics. | CO1 CO2 CO3 | K1 K2 K3 K4 |
| UNIT-III | Amino acids Classifications, Physical properties - amphoteric nature, Isoelectric point and chemical reactions of carboxyl, Amino and both groups. Amino acid metabolism- transamination, deamination and decarboxylation. | CO3 CO4 | K1 K2 K3 |
| UNIT-IV | Proteins Classification-Biological functions physical properties - ampholytes, Isoelectric point, salting in and salting out, Denaturation, nature of peptide bond. Secondary structure α -helix β -pleated sheet Tertiary structure of various forces involved- quaternary structure. | CO2 CO3 CO4 | K1 K2 K3 |

| | | | |
|---------------|--|-----|----|
| UNIT-V | Vitamins | CO2 | K1 |
| | Classification - Fat Soluble vitamins (A, D, E and K) and water Soluble Vitamins and Vitamin C – sources, RDA, biological functions and deficiency diseases. | CO3 | K2 |
| | | CO4 | K3 |
| | | CO5 | |

Recommended Text Books

1 Satyanarayan.U (2014) Biochemistry (4th ed), Arunabha sen Books & Allied (P) Ltd, Kolkata.2.Jain J.L.(2007) Fundamentals of Biochemistry, S.Chand publishers 311

Reference Books

1. David L.Nelson and Michael M.Cox (2012) Lehninger Principles of Biochemistry (6th ed) W.H.Freeman.
2. Voet.D & Voet. J.G (2010) Biochemistry, (4th ed), John Wiley & Sons, Inc.
3. Lubert Stryer (2010) Biochemistry, (7th ed), W.H.Freeman.
4. Satyanarayan, U (2014) Biochemistry (4th ed), Arunabha Sen Books & Allied (P) Ltd, Kolkata.
5. Jain J.L. (2007) Fundamentals of Biochemistry, S.Chand publishers 31.

Website and e-learning source

1.onlinecourses.swayam2.ac.in/cec20_bt12

Course Outcome

| COs | CO Description | Cognitive Level |
|-----|---|-----------------|
| CO1 | Classify the structure of carbohydrates and its properties. | K1,K2,K3 |
| CO2 | Explain the metabolism of carbohydrates and its significance. | K1,K2,K3 |
| CO3 | Classify amino acids and its properties. | K1,K2,K3,K4 |
| CO4 | Explain the classification and elucidate the different levels of structural organization of proteins. | K1,K2,K3 |
| CO5 | Identify the disease caused by the deficiency of vitamins. | K1,K2,K4 |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 | 3 | 2 | 1 | 1 | 1 | - | - | - | - | - | 3 | 1 | 3 |
| CO2 | 3 | 3 | 1 | 1 | 2 | - | 1 | 1 | - | 1 | 3 | 1 | 3 |
| CO3 | 3 | 3 | 1 | 2 | 1 | - | - | 2 | - | 1 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | 3 | 2 | 3 |
| CO5 | 3 | 3 | 2 | 1 | 2 | 1 | - | - | 1 | 1 | 3 | 2 | 3 |

COURSE DESCRIPTORS

| | | | |
|----------------------------|--|----------------------------|-------|
| Title of the Course | PRACTICAL - BIOCHEMISTRY | Hours/Week | 03 |
| Course Code | AUEPBC15 | Credits | 03 |
| Category | Elective Practical | Year & Semester | I & I |
| Prerequisites | Higher secondary chemistry/Biology/Mathematics/Physics | Regulation | 2024 |

Learning objectives

- Identify carbohydrates by qualitative test
- Estimate biomolecules volumetrically
- Estimate protein quantitatively

| UNITS | Contents | COs | Cognitive Levels |
|----------|--|--------------------|------------------|
| UNIT-I | I Qualitative analysis of carbohydrates- 25 Hrs a. Monosaccharide -Glucose, Fructose b. Disaccharides- Lactose, Maltose | CO1 CO3 | K1 K2 K3 |
| UNIT-II | c. Disaccharides – Sucrose (Non reducing) d. Polysaccharides-Starch | CO1,CO2, CO3 | K1,K2 K3,K4 |
| UNIT-III | II Volumetric analysis 15 Hrs 1. Estimation of ascorbic acid using 2,6 dichlorophenol-indophenol as a link solution. 2. Estimation of Glucose by Benedict's method. | CO3 CO4 | K1 K2 K3 |
| UNIT-IV | 1. Estimation of Glycine by Sorenson Formal titration. | CO2,CO3, CO4 | K1,K2,K3 |
| UNIT-V | III Quantitative analysis (Demonstration Expt) 1. Colorimetric estimation of protein by Biuret method | CO2,CO3 CO4,CO5 | K1,K2,K3 |

Recommended Text Books

1. Laboratory manual in Biochemistry, J. Jayaraman, 2nd edition, New Age International Publishers, 2011,
2. An Introduction to Practical Biochemistry, David T. Plummer, 3 rd edition, Tata McGraw-Hill Publishing Company Limited, 2001.

Reference Books

1. Biochemical Methods, Sadasivam S and Manickam A, 4h edition, New Age International Publishers, 2016

Website and e-learning source

1. onlinecourses.swayam2.ac.in/cec20_bt12

Course Outcome

| COs | CO Description | Cognitive Level |
|-----|--|-----------------|
| CO1 | Qualitatively analyze and report the type of carbohydrate based on specific tests | K1,K2,K3 |
| CO2 | Quantitatively estimate the carbohydrates, amino acids and ascorbic acid. | K1,K2,K4 |
| CO3 | Estimate protein by colorimetric method. | K1,K2,K3 |
| CO4 | Estimation of ascorbic acid using 2,6dichlorophenol - indophenol as link solution. | K1,K2,K4 |
| CO5 | Colorimetric estimation of protein by Biuret method. | K1,K2,K4 |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 | 3 | 3 | 3 | 1 | 1 | 3 | - | - | 1 | 1 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 1 | 2 | 3 | 1 | 1 | 1 | 1 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 1 | 3 | - | 2 | 1 | 1 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 3 | - | - | 1 | 1 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 2 | 2 | 3 | - | - | 1 | 1 | 3 | 3 | 3 |

COURSE DESCRIPTORS

| | | | |
|----------------------------|---|----------------------------|--------|
| Title of the Course | CELL BIOLOGY | Hours/Week | 5 |
| Course Code | AUCBC 21 | Credits | 5 |
| Category | CORE -III | Year & Semester | I & II |
| Prerequisites | Higher secondary chemistry/Biology/Mathematics/Botany/Zoology/Physics | Regulation | 2024 |

Objectives of the course:

- ❖ Provide basic understanding of architecture of cells and its organelles.
- ❖ Understand the organization of prokaryotic and eukaryotic genome.
- ❖ Educate on the structural organization of bio membrane and transport mechanism.
- ❖ Impart knowledge on cell cycle, cell division and basics of cells
- ❖ Familiarize the concept of mechanism of cell-cell interactions.

| UNITS | Contents | COs | Cognitive Levels |
|---------|--|-----|------------------|
| UNIT-I | Architecture of cells- Structural organization of prokaryotic and eukaryotic cells, microbial, plant and animal cells. The Ultra structure of nucleus, mitochondria, RER, SER, Golgi apparatus, lysosome, peroxisome and their functions. | CO1 | K2, K3 |
| UNIT-II | Cytoskeleton- microfilament, microtubules and intermediary filament- structure, composition and functions. Organization of Genome - prokaryotic and eukaryotic genome. Organization of chromatin – histones, nucleosome concept, formation of chromatin structure. | CO2 | K1, K2, K3 |

| | | | |
|-----------------|---|-----|----------|
| UNIT-III | Biomembranes - Structural organization of bilipid layer model and basic functions - transport across cell membranes- Uniport, Symport and Antiport. Passive and active transport. | CO3 | K1,K3 |
| UNIT-IV | Cell Cycle - Definition and Phases of Cell cycle - Cell Division - Mitosis and Meiosis and its significance, Cancer Cells - definition, types and characteristics of cancer cells. | CO4 | K2,K3 |
| UNIT-V | Extracellular matrix – Collagen, Laminin, Fibronectin and Proteoglycans- structure and biological role. Structure and role of cadherin, selectins, Integrin, Cell - cell interactions- Types- gapjunctions, tight junctions and Desmosomes. | CO5 | K1,K2,K3 |

Recommended Text Books

1. Arumugam. N, Cell biology. Sara’s publication(10ed, paperback), 2019
2. Devasena.T. Cell Biology. Oxford University Press India-ISBN: 9780198075516, 0198075510, 2012
3. Bruce Albert’s and Dennis Bray. 2018, Essential Cell Biology. (5th Ed). Garland Science.
4. Karp's Cell Biology, Global Edition By Gerald Karp, Janet Iwasa, Wallace Marshall · 2018

Reference Books

1. Arumugam.N. (2019). Cell biology. Saras publication (10ed, paperback)
2. Devasena.T. (2012). Cell Biology. Oxford University Press India – ISBN: 9780198075516, **0198075510**
3. Cooper, G.A.The Cell: A Molecular Approach. Sinauer Associates, Inc ISBN10: 0878931066 / ISBN 13: 9780878931064, 2013
4. E.M.F., D.R,Cell and Molecular Biology. Lippincott Williams &Wilkins Philadelphia – ISBN: 0781734932 9780781734936,
5. Lodish H.A, Berk C.A, Kaiser M, Krieger M.P, Scott A, Bretscher H, Plough and Matsudaira. 2007. Molecular Cell Biology, 6th Edition, WH. Freeman Publishers, NewYork, USA.
6. Mechanics of the cell by David boal, Cambridge publishers. 2nd edition, 2012

Website and e-learning source

1. Cell biology: <https://nicholls.edu/biol-ds/bio1155/Lectures/Cell%20Biology.pdf>
2. The Cell: <https://www.medicalnewstoday.com/article/320878.php>
3. Cell structure: <https://biologydictionary.net/cell>

Course Learning Outcomes (for Mapping with Pos and PSOs)

On completion of the course the students should be able to

| COs | CO Description | Cognitive Level |
|-----|---|-----------------|
| CO1 | Explain the structure and functions of basic components of Prokaryotic and Eukaryotic cells, especially the organelles. | K2, K3 |
| CO2 | Familiarize the Cytoskeleton and Chromatin | K1,K2,K3 |
| CO3 | Illustrate the structure, composition and functions of cell membrane related to membrane transport | K1,K3 |
| CO4 | Elaborate the phases of Cell cycle and Cell division, Mitosis and Meiosis and characteristics of cancer cells. | K2,K3 |
| CO5 | Relate the structure and biological role of extracellular matrix in cellular interactions | K1,K2,K3 |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 | 3 | 3 | 2 | - | - | - | 1 | - | - | 2 | 2 | 2 | - |
| CO2 | 3 | 3 | 2 | - | 3 | 3 | - | - | 1 | 3 | 2 | - | 3 |
| CO3 | 3 | 3 | 3 | - | 3 | 2 | - | 1 | - | 2 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 2 | - | 3 | - | - | - | 2 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 2 | - | 3 | - | 1 | - | 3 | 3 | 3 | 2 |

COURSE DESCRIPTORS

| | | | |
|----------------------------|--|----------------------------|--------|
| Title of the Course | PRACTICAL II -CELL BIOLOGY | Hours/Week | 3 |
| Course Code | AUCPBC22 | Credits | 3 |
| Category | CORE-IV | Year & Semester | I & II |
| Prerequisites | Higher secondary Chemistry/Biology/Mathematics/Botany/ Zoology/Physics | Regulation | 2024 |

Objectives of the course

- ❖ Learn the parts of Microscope.
- ❖ Investigate the Cells under microscope.
- ❖ Image the Cells using different stains.
- ❖ Identify the Cells, Organelles and stages of cell division
- ❖ Identify the spotters.

| UNITS | Contents | COs | Cognitive Levels |
|----------|---|-----|------------------|
| UNIT-I | MICROSCOPY 1. Study the parts of Light and Compound microscope. 2. Preparation of Slides and Micrometry. 3. Examination of prokaryotic and eukaryotic cell. 4. Visualization of animal and plant cell by methylene blue. | CO1 | K1,K2,K3 |
| UNIT-II | STAINING TECHNIQUES 5. Visualization of Nuclear fraction by acetocarmine stain. 6. Staining and Visualization of Mitochondria by Janus Green stain. | CO2 | K2 |
| UNIT-III | GROUP EXPERIMENT 7. Identification of different stages of Mitosis in onion root tip. 8. Identification of different stages of Meiosis in onion bulb. | CO3 | K2,K3 |
| UNIT-IV | SPOTTERS 9. a) Cells: Nerve, Plant and Animal cell b) Organelles: Mitochondria, Chloroplast, Endoplasmic reticulum, | CO4 | K1,K2 |
| UNIT-V | SPOTTERS c) Mitosis stages–Prophase, Anaphase, Metaphase, Telophase | CO5 | K1,K2 |

Website and e learning source

1. Cell organelle: <https://www.microscopemaster.com/organelles.html>
2. Biochemistry books: <https://www.pdfdrive.com/biochemistry-books.htm>
3. Histology studies : http://medcell.med.yale.edu/histology/cell_lab.php#:~:text=
4. Mitosis: <http://amrita.olabs.edu.in/?sub=79&brch=18&sim=237&cnt=1>

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

| COs | CO Description | Cognitive Level |
|-----|--|-----------------|
| CO1 | Identify the parts of Microscope. | K1,K2,K3 |
| CO2 | Understand the Preparation of Slides and staining techniques. | K2 |
| CO3 | Identify the stages of Mitosis & Meiosis | K2,K3 |
| CO4 | Visualize Nucleus and Mitochondria by staining methods | K1,K2 |
| CO5 | Identify the spotters of cells, organelles and stages of Cell division | K1,K2 |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 | 2 | 3 | 3 | - | 3 | 3 | 2 | 1 | - | 3 | 3 | 3 | 2 |
| CO2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | - | 3 | 3 | 3 | 3 |
| CO3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | - | 1 | 3 | 3 | 3 | 2 |
| CO4 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | - | 2 | 3 | 3 | 3 |
| CO5 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | - | 3 | 2 | 2 | 2 | 2 |

COURSE DESCRIPTORS

| | | | |
|----------------------------|--|----------------------------|--------|
| Title of the Course | MEDICINAL DIET | Hours/Week | 2 |
| Course Code | AUSBC24 | Credits | 2 |
| Category | SKILL ENHANCEMENT COURSE-III | Year & Semester | I & II |
| Prerequisites | Higher secondary chemistry/Biology/Mathematics/Botany/Zoology/Physics | Regulation | 2024 |

Objectives of the course:

- ❖ Provide basic knowledge about diet.
- ❖ Understand of diet modification for GI diseases.
- ❖ Plan a diet for liver diseases.
- ❖ Prepare diet chart for Infectious diseases.
- ❖ Plan a diet for Diabetes, Renal and Cardio-vascular diseases.

| UNITS | Contents | COs | Cognitive Levels |
|----------|---|-----|------------------|
| UNIT-I | Principles of Therapeutic Diet: Definitions of Normal diet, Therapeutic diet, Soft Diet and Liquid diet. Objectives of Diet Therapy. Advantages of using normal diet as the basis for Therapeutic diet. | CO1 | K1,K2,K3 |
| UNIT-II | Diet modification in Gastrointestinal diseases: Peptic ulcer, Diarrhea, Lactose intolerance, Constipation and Malabsorption syndrome | CO2 | K1,K2,K3 |
| UNIT-III | Diet Modification in liver and gall bladder in diseases: Etiology, symptoms and dietary treatment in jaundice, hepatitis, Cirrhosis of liver and hepatic coma. | CO3 | K2,K3 |
| UNIT-IV | Diet Modification in Infectious Diseases: Fevers, Typhoid, Tuberculosis and Viral Hepatitis. Dietary modifications in Tuberculosis. | CO4 | K2,K3 |

| | | | |
|---|---|-----|----------|
| UNIT-V | Diet Modification in Diabetes, Renal and Cardio-vascular diseases- Diabetes Acute & Chronic glomerulonephritis, nephrosis, renal failure, kidney stone and Hypertension. | CO5 | K1,K2,K3 |
| Recommended Text Books | | | |
| <ol style="list-style-type: none"> 1. M. Raheena Begum, A Text Book of Foods, Nutrition and Dietetics, Sterling Publishers Pvt. Ltd. 3 rd edition, 2014 2. M.V.Raja Gopal, Sumati. R., Mudambi, Fundamentals of foods and Nutrition, Wiley Eastern Limited, Year-1990. 3. William S.R Nutrition and Diet Therapy, 1985, 5th edition, Mosly Co. St.Louis. 4. Modern Nutrition by Catharineros, Woiters Kiuwe publishers. 5. Complete food and Nutrition Guide By Robert Larson day off, John and Willy Publishers. 6. Food as Medicine :A Handbook of Natural nutrition by Kirsten Hartvig, 2023. ISBN 1801521174 | | | |
| Reference Books | | | |
| <ol style="list-style-type: none"> 1. Nutritional Biochemistry by Patricia Trueman, 2019 ISBN 10:81-8094-031-4. 2. Food as Medicine: A Handbook of Natural Nutrition Paperback, 28 November 2023 by Kirsten Hartvig (Author) 3. Food As Medicine By Guru Dharma Singh Khalsa · 2010 4. William's Essentials of Nutrition and Diet Therapy by Eleanor D .Schlenkar & Joyce Gilbert – 2015, 11th Edition 5. Food and Nutrients in Disease Management, Ingrid Kohlstadt · 2016. | | | |
| Website and e-learning source | | | |
| <ol style="list-style-type: none"> 1. Medicinal diet: https://www.rickysinghmd.com/a-guide-to-the-medicinal-diet/ 2. Healthy diet: https://www.who.int/news-room/fact-sheets/detail/healthy-diet 3. Food and nutrition: https://www.healthline.com/nutrition/food-as-medicine 4. Food as medicine: https://nutrition.org/food-as-medicine/ | | | |

Course Learning Outcomes (for Mapping with Pos and PSOs)

On completion of the course the students should be able to

| COs | CO Description | Cognitive Level |
|-----|---|-----------------|
| CO1 | Possess basic knowledge about diet. | K1,K2,K3 |
| CO2 | Acquire knowledge on diet plan for GI diseases. | K1,K2,K3 |
| CO3 | Sketch diet modifications for liver diseases. | K2,K3 |
| CO4 | Understand diet plan for Infectious diseases. | K2,K3 |
| CO5 | Prepare diet chart for Diabetes Renal and Cardio-vascular diseases. | K1,K2,K3 |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 | 3 | 3 | 3 | - | - | 3 | 1 | 3 | 3 | 3 | 3 | - | 1 |
| CO2 | 3 | 3 | 2 | 2 | 3 | 2 | 1 | 3 | 3 | 3 | 3 | - | 1 |
| CO3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | - | 1 |
| CO4 | 3 | 3 | - | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | - | 2 |
| CO5 | 3 | 3 | - | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | - | 2 |

COURSE DESCRIPTORS

| | | | |
|----------------------------|--|----------------------------|--------|
| Title of the Course | FIRST AID | Hours/Week | 2 |
| Course Code | AUSBC 25 | Credits | 2 |
| Category | SKILL ENHANCEMENT COURSE-IV | Year & Semester | I & II |
| Prerequisites | Higher secondary chemistry/Biology/Mathematics/Botany/Zoology/Physics | Regulation | 2024 |

Objectives of the course:

- ❖ Provide knowledge on the basics of first aid.
- ❖ Perform first aid during various respiratory issues.
- ❖ Demonstrate the first aid to treat injuries.
- ❖ Learn the first aid techniques to be given during emergency.
- ❖ Familiarize the first aid during poisoning

| UNITS | Contents | COs | Cognitive Levels |
|----------|--|-----|------------------|
| UNIT-I | Aims and important rules of first aid, dealing with emergency, types and content of a first aid kit. First aid technique – Dressing and Bandages, fast evacuation technique, transport techniques. | CO1 | K1,K2,K3,K4 |
| UNIT-II | Basics of Respiration – CPR, first aid during difficult breathing, drowning, choking, strangulation and hanging, swelling within the throat, suffocation by smoke or gases and asthma. | CO2 | K1,K2,K3 |
| UNIT-III | Common medical aid- first aid for wounds, cuts, head, chest, abdominal injuries, shocks, burns, amputations, fractures, dislocation of bones. | CO3 | K1,K2,K3,K4 |
| UNIT-IV | First aid related to unconsciousness, stroke, fits, convulsions - seizures, epilepsy | CO4 | K1,K2,K3,K4 |
| UNIT-V | First aid in poisonous bites (Insects and snakes), honey bee stings, animal bites, disinfectant, acid and alkali poisoning | CO5 | K1,K2 |

Recommended Text Books

1. First aid and health Dr. Gauri Goel, Dr. Kumkum Rajput, Dr. Manjul Mungali
ISBN-978-93-92208-19-5
2. The Complete First Aid Pocket Guide Published: 13 November 2018 Author:
John Furst ISBN: 9781507208892
3. ACEP First Aid Manual 5th Edition September 2014 Author: American College

Reference Books

1. A Comprehensive First Aid Manual and Reference Guide By Nigel
Barracough · 2017
2. First Aid and Emergency Care, Jain publication, 1st Edition, January 2024.
3. First Aid for the Basic sciences by Kendall Krause.
4. First Aid made easy by Nigel Barracough-2017 ISBN 09552294

Website and e-learning source

1. First aid training: <https://www.redcross.org/take-a-class/first-aid/first-aid-training/first-aid-online>
2. First aid: <https://www.firstaidforfree.com/>

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

| COs | CO Description | Cognitive Level |
|------|--|-----------------|
| CO1 | Discuss on the rules of first aid, dealing during emergency and first aid techniques | K1,K2,K3,K4 |
| CO2 | Understand the first aid techniques to be given during different types of respiratory problems | K1,K2,K3,K4 |
| CO3 | Provide first aid for injuries, shocks and bone injury | K1,K2,K3,K4 |
| CO4 | Detail on the first aid to be given for unconsciousness, stroke, fits and convulsions | K1,K2,K3,K4 |
| CO 5 | Gain expertise in giving first aid for insect bites and chemical poisoning | K1,K2 |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 | 3 | 2 | 3 | - | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | - |
| CO2 | 2 | 2 | 3 | 1 | 3 | 3 | 3 | 2 | 1 | 3 | 3 | 3 | - |
| CO3 | 2 | 2 | 3 | 2 | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 2 | 1 |
| CO4 | 2 | 3 | 3 | 1 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 2 | - |
| CO5 | 2 | 3 | 3 | 1 | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 3 | 1 |

COURSE DESCRIPTORS

| | | | |
|----------------------------|--|----------------------------|----------|
| Title of the Course | BIOMOLECULES | Hours/Week | 04 |
| Course Code | AUCBC 31 | Credits | 04 |
| Category | Core - V | Year & Semester | II & III |
| Prerequisites | Higher secondary Chemistry/Biology/Mathematics/Botany/ Zoology/Physics | Regulation | 2024-25 |

Objectives of the course:

1. Introduce the structure, properties and biological significance of carbohydrates
2. Comprehend the classification, functions and acid base properties of amino acids
3. Elucidate the various levels of organization of Proteins.
4. Impart knowledge on the classification, Properties and characterization of Lipids.
5. Acquaint with the classification, structure, properties and functions of nucleic acids.

| UNITS | Contents | COs | Cognitive Levels |
|----------------|--|-----|-------------------|
| UNIT-I | Carbohydrates-Classification and biological significance, physical properties - stereo isomerism, optical isomerism, anomers, epimers and mutarotation. Monosaccharides: Occurrence, linear and cyclic structure, Reactions of monosaccharide's due to the presence of hydroxyl, aldehyde and keto groups. Disaccharides: Structure and properties of reducing disaccharides (lactose and mannose), non-reducing disaccharide (sucrose). Polysaccharides: Homopolysaccharides - Occurrence, structure and biological significance of starch, glycogen and cellulose. Heteropolysaccharides - Structure and biological significance of Mucopolysaccharides-Hyaluronic acid, Chondroitin sulphate and Heparin. | CO1 | K1, K2, K3, K4 |
| UNIT-II | Amino acids -Classification based on composition of side chain and nutritional significance. General structure of amino acids. 3 - and 1-letter abbreviations. Modified amino acids in protein and non - protein amino acids. Physical properties of amino acids, isoelectric point, Zwitter ion, titration curve, optical activity. Chemical reactions due to carboxyl group, amino group and side chains. Colour reactions of amino acids. | CO2 | K1, K2, K3 |

| | | | |
|-----------------|---|-----|-------------------|
| UNIT-III | <p>Proteins- Classification based on shape, composition, solubility and functions. Properties of proteins - Ampholytes, Isoelectric point, salting in and salting out, denaturation and renaturation, UV absorption. Levels of Organization of protein structure- Primary structure, Formation and characteristics of peptide bond, phi and psi angle, Ramachandran plot, Secondary structure-α helix, β- pleated sheath, triple helix. Tertiary structure – with reference to myoglobin. Quaternary structure with reference to hemoglobin.</p> | CO3 | K1, K2, K3, K4 |
| UNIT-IV | <p>Lipids -Lipids: Bloor's classification, chemical nature and biological functions. Fatty acids: classification, nomenclature, structure and properties of fatty acids. Simple and mixed triglycerides: structure and general properties, Characterization of fats- iodine value, saponification value, acid number, acetyl number, Polanski number, Reichert–Meissl number along with their significance. Compound lipids – Structure and functions of phospholipids and glycolipids. Derived lipids-Structure and functions of cholesterol, Bile Acids and bile salts.</p> | CO4 | K1,K3, K4, K5 |
| UNIT-V | <p>Nucleic acids- Structure of purine and pyrimidine bases, nucleosides and nucleotides and their biological importance. Watson and Crick double helical model of DNA, Types of DNA: A, B, Z DNA, structure and biological significance. Types of RNA: mRNA, t-RNA, r-RNA, hn-RNA, Sn-RN, Secondary and tertiary structure of t-RNA. Properties of DNA- Hypo chromic and hyper chromic effect, melting temperature. Denaturation and Renaturation of DNA.</p> | CO5 | K1,K3, K4, K5 |

Recommended Text Books

1. Biochemistry, U.Sathyanarayana & U.Chakrapani, 6thedition Elsevier India Pvt. Ltd., Books & Allied Pvt.Ltd. 2023.
2. Fundamentals of Biochemistry, J.L.Jain, SunjayJain, Nitin Jain, 7thedition S.Chand & Company Ltd. 2013.
3. Text book of Medical Biochemistry, MN Chatterjee, Rana Shinde, 8th edition, Jaypee Brothers, 2012.

Reference Books

- 1.David L.Nelson, Michael M.Cox, Principles of Biochemistry, 4th edition W.H.Freeman and Company. 2013
- 2.Voet.D, Voet.J.G.and Pratt, C.W, Principles of Biochemistry, 4th edition John Wiley& Sons, Inc. , 2010
3. Zubay G.L, et.al. Principles of Biochemistry, 1st edition, WMC. Brown Publishers. 1998

Website and e-learning source

1. <https://www.britannica.com/science/biomolecule>
2. <https://en.wikipedia.org/wiki/Biomolecule>
3. <https://www.khanacademy.org/science/biology/macromolecules>

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

| COs | CO Description | Cognitive Level |
|-----|---|-----------------|
| CO1 | Illustrate the structure, the physical and Chemical properties of carbohydrates. | K1, K2, K3, K4 |
| CO2 | Indicate the classification, structure, properties and biological Functions of amino acids. | K1, K2, K3 |
| CO3 | Explain the classification and elucidate the different levels of structural organization of proteins. | K1, K2, K3,K4 |
| CO4 | Understand the classification, structure, properties, functions and characterization of lipids | K1,K3,K4,K5 |
| CO5 | Describe the structure, properties and functions of different types of nucleic acids | K1,K3,K4,K5 |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | - | - | 1 | 1 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | - | 3 | 2 | - |
| CO3 | 3 | 3 | 2 | 3 | - | 3 | - | - | - | 1 | 2 | - | 1 |
| CO4 | 3 | 3 | 2 | 2 | 2 | 3 | - | 2 | -- | 3 | 3 | 2 | 1 |
| CO5 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 1 | 3 | - | 1 |

COURSE DESCRIPTORS

| | | | |
|----------------------------|--|----------------------------|----------|
| Title of the Course | PRACTICAL -III BIOMOLECULES | Hours/Week | 03 |
| Course Code | AUCPBC 32 | Credits | 03 |
| Category | Core – VI | Year & Semester | II & III |
| Prerequisites | Higher secondary Chemistry/Biology/Mathematics/Botany/ Zoology/Physics | Regulation | 2024-25 |

Objectives of the course:

1. Identify the biomolecules Carbohydrates and Amino acids by Qualitative test
2. Determine the quality of Lipids by titrimetric methods
3. Isolate nucleic acids from plant and animal source.

| UNITS | Contents | COs | Cognitive Levels |
|-----------------|--|-----|-------------------|
| UNIT-I | Qualitative test for Carbohydrates a) Glucose b) Fructose c) Arabinose | CO1 | K1, K2, K3, K4 |
| UNIT-II | Qualitative test for Carbohydrates a) Maltose b) Sucrose c) Lactose d) Starch. | CO2 | K1, K2, K3 |
| UNIT-III | Qualitative test for Amino acids a) Arginine b) Cysteine c) Histidine d) Proline e) Tryptophan f) Tyrosine g) Methionine | CO3 | K1, K2, K3, K4 |
| UNIT-IV | Titrimetric methods 1) Determination of Saponification value of edible oil. 2) Determination of Iodine number of edible oil. 3) Determination of Acid number of edible oil. 4) Estimation of Glycine. | CO4 | K1,K3, K4, K5 |
| UNIT-V | Group Experiments 1) Isolation of DNA from plant/animal source. 2) Isolation of RNA from rich source.(Yeast) | CO5 | K1,K3, K4, K5 |

Recommended Text Books

1. David T Plummer, An Introduction to Practical Biochemistry, 3 rd edition Tata Mc Graw- Hill Edition 2017.
2. J.Jayaraman Laboratory Manual in Biochemistry, New Age International (P) Limited second edition 2020.
3. S.SadasivamA. Manickam Biochemical Methods, Newage International Pvt Ltd publisher's third edition 2018.

Reference Books

1. Rageeb, KiranPatil, M.Bakshi Rahman, Sufiyan Ahmad Raees house,1st Edition, A Practical book on Biochemistry Everest publishing 2019.
2. Introductory practical Biochemistry–S.K.Sawhney,Randhir Singh,2nd Ed,2005.
3. Biochemical Tests–Principles and Protocols .AnilKumar, Sarika Gargand Neha Garg.Vinod Vasishtha Viva Books Pvt Ltd, 2015.
4. Harold Varley,Practical Clinical Biochemistry,CBS.6edition,2006.
5. Keith Wilson and John Walker. Principles and Techniques of Practical Biochemistry, 4th edition, Cambridge University press, Britain.1995

Website and e-learning source

- 1.<https://www.pdfdrive.com/instant-notes-analytical-chemistry-e912659.html>14
- 2.<https://www.pdfdrive.com/analytical-biochemistry-e46164604.html>
- 3.<https://www.pdfdrive.com/biochemistry-books.html>

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

| COs | CO Description | Cognitive Level |
|-----|--|-----------------|
| CO1 | Qualitatively analyze the carbohydrates –Monosaccharides and report the type of carbohydrate based on specific tests | K1, K2, K3, K4 |
| CO2 | Qualitatively analyze the carbohydrates –Di, Polysaccharides and report the type of carbohydrate based on specific tests | K1, K2, K3 |
| CO3 | Qualitatively analyze amino acids and report the type of Amino acids based on specific tests | K1, K2, K3,K4 |
| CO4 | Determine the Saponification, Iodine and acid number of Edible oil and Estimation of Glycine | K1,K3,K4,K5 |
| CO5 | Isolate the DNA and RNA from biological sources | K1,K3,K4,K5 |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 3 | 1 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | - | - | 2 | 2 | 1 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 2 | - | 1 | - | 1 | 2 | 1 | - |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | - | - | 2 | 1 | 2 | 2 | 2 |
| CO5 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | - | - | 3 | - | 3 |

COURSE DESCRIPTORS

| | | | |
|----------------------------|--|----------------------------|----------|
| Title of the Course | TISSUE CULTURE | Hours/Week | 02 |
| Course Code | AUSBC34 | Credits | 02 |
| Category | Skill Enhancement | Year & Semester | II & III |
| Prerequisites | Higher secondary Chemistry/Biology/Mathematics/Botany/ Zoology/Physics | Regulation | 2024-25 |

Objectives of the course:

1. Introduce the tools and techniques used in tissue culture technique.
2. Acquire knowledge on preparation of growth medium for culture techniques.
3. Impart knowledge on procedures involved gene transfer.
4. Acquaint with the process of tissue culture technique.
5. Understand the importance of plant and animal tissue culture for the production and evaluation of bioactive compounds

| UNITS | Contents | COs | Cognitive Levels |
|-----------------|---|-----|------------------|
| UNIT-I | Introduction to Tissue culture, Types-seed, embryo, Callus, Organ, Protoplast culture, Advantages and importance of tissue culture, Tools and techniques. | CO1 | K1, K2, K3, K4 |
| UNIT-II | Media and Culture Preparation-pH, temperature, solidifying agents. Role of Micro and macronutrients. Maintenance of cultures. | CO2 | K1, K2, K3 |
| UNIT III | Methods of gene transfer in plants and animals-direct and indirect Gene transfer methods, Cell culture applications. | CO3 | K1, K2, K3, K4 |
| UNIT-IV | Cell culture technique - Explants selection, sterilization and Inoculation. Tissue culture labs. | CO4 | K1,K3, K4, K5 |
| UNIT- V | Transgenic plants for crop improvement. Transgenic plants for molecular farming. Animal Cloning- an overview- Applications of animal cell culture. | CO5 | K1,K3, K4, K5 |

Recommended Text Books

1. Trivedi,P.C. Applied Biotechnology: Recent Advances, panima Publishing corporation,2016
2. Ignacimuthu Applied Plant Biotechnology. Tata McGraw – Hill,2012.
3. Lycett,G.W and Grierson,D.(ed). Genetic Engineering of crop plants, 2013.
4. Chawla, H.S.,”Introduction to Plant Biotechnology”, 3rd Edition, Science Publishers, 2009.

Reference Books

1. Stewart Jr.,C.N.,“Plant Biotechnology and Genetics: Principles, Techniques and Applications” Wiley- Interscience, 2008.
2. Freshney, R.I Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. Wiley-Blackwell, 6th Edition. 2010.
3. Davis, J.M. Basic Cell Culture. Oxford University Press. New Delhi. 2008
4. Davis, J. M. Animal Cell Culture. John Willy and Sons Ltd. USA, 2011
5. Butler, M. Animal Cell Culture and Technology. Taylor and Francis. Key work USA. (2004).

Website and e-learning source

1. <https://www.britannica.com/science/tissue-culture>
2. https://en.wikipedia.org/wiki/Plant_tissue_culture
3. <https://microbeonline.com/animal-cell-culture-introduction-types-methods-applications/>

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

| COs | CO Description | Cognitive Level |
|-----|---|-----------------|
| CO1 | Tools and techniques of plant tissue culture. | K1, K2, K3, K4 |
| CO2 | Acquire knowledge on preparation of tissue culture media | K1, K2, K3 |
| CO3 | Understanding on different methods of gene transfer | K1, K2, K3,K4 |
| CO4 | Preparation of plant and animal cell culture techniques | K1,K3,K4,K5 |
| CO5 | Study of applications of genetically modified plants and animals. | K1,K3,K4,K5 |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | - | 1 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 1 | - | 3 | 2 | 1 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 2 | - | - | - | 1 | 1 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 3 | - | - | 1 | - | 1 | 2 | 1 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | - | 2 | 1 | 1 | 1 | 3 |

COURSE DESCRIPTORS

| | | | |
|----------------------------|--|----------------------------|----------|
| Title of the Course | PLANT BIOCHEMISTRY AND PLANT THERAPEUTICS | Hours/Week | 02 |
| Course Code | AUSBC 35 | Credits | 02 |
| Category | Skill Enhancement | Year & Semester | II & III |
| Prerequisites | Higher secondary Chemistry/Biology/Mathematics/Botany/ Zoology/Physics | Regulation | 2024-25 |

Objectives of the course:

1. Convey the knowledge of photosynthesis.
2. Detail the structure and types of secondary metabolites.
3. Impart the idea on various plant hormones.
4. Emphasize the effects of free radicals and the importance of antioxidants
5. Understand the role of medicinal plants in treating diseases.

| UNITS | Contents | COs | Cognitive Levels |
|-----------------|--|------------|-------------------------|
| UNIT- I | Photosynthesis- Photosynthesis apparatus, pigments of photosynthesis, photo chemical reaction, photosynthetic electron transport chain, path of carbon in photosynthesis- Calvin cycle, Hatch-lack pathway (4ways) CAM pathway, Significance of photosynthesis. | CO1 | K1, K2, K3, K4 |
| UNIT- II | Secondary metabolites: Structure, Types, Sources, Biosynthesis and function of phenolics, tannins, lignins, terpenes and Alkaloids. Medicinal properties of secondary metabolites. | CO2 | K1, K2, K3 |
| UNIT-III | Plant hormones Structure and function of plant hormones such as ethylene, cytokinins, auxins, Absicicacid, Florigin and Gibberlins. | CO3 | K1, K2, K3, K4 |
| UNIT- IV | Free radicals, types, production, free radical induced damages, lipid peroxidation, reactive oxygen species, antioxidant defense system, enzymatic and non-enzymatic antioxidants, role of antioxidants in prevention of disease, Phytochemical as antioxidants. | CO4 | K1,K3, K4, K5 |

| | | | |
|---------------|---|-----|------------------|
| UNIT-V | Plant therapeutics: Bioactive principles in herbs, plants with anti Diabetic, anticancer, antibacterial, antiviral, anti-malaria and anti-inflammatory properties | CO5 | K1,K3, K4, K5 |
|---------------|---|-----|------------------|

Recommended Text Books

1. Singh M.Pand Panda. H.Medicinal Herbs with their formulations, Day a publishing house, Delhi, 2006
2. Plant Physiology-Devlin N.Robert and Francis H. Witham, CBS Publications, 2017.
3. Text Book of Plant Biochemistry and Molecular Biology Publisher: Kalyani, 2024.

Reference Books

1. Khan, I.A and Khanum. A. Role of biotechnology in medicinal and aromatic plants, Vol.1and Vol.10, Ukka2 publications, Hyderabad. 2004
- 2.Plant Biochemistry and Molecular Biology–Hans Walter Heldt, Oxford University, 4th Edition, 2010
3. Plant biochemistry Caroline bowsher, Martinsteer, Alyson Tobin, garland science. (2008),
4. Plant physiology and development (sixth edition) by Lincoln Taiz, Eduardo Zeiger, IanMax Moller and Angus Murphy publisher; Oxford university press, 2015.

Website and e-learning source

1. <https://www.intechopen.com/books/secondarymetabolies-sources-and- applications/ an introductory-chapter-secondary-metabolites>
2. <https:// www.toppr.com/guides/biology/plant-growth-and development/plant growth>

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

| COs | CO Description | Cognitive Level |
|-----|--|-----------------|
| CO1 | Briefly on photosynthetic apparatus, pigments present, pathways, and significance of photosynthesis | K1, K2, K3, K4 |
| CO2 | Discuss about the structure, types, sources, biosynthesis and functions secondary metabolites. | K1, K2, K3 |
| CO3 | Understand the structure and functions of plant hormones. | K1, K2, K3,K4 |
| CO4 | Discuss about free radicals, types and its harmful effects. Role of Enzymatic and non-enzymatic antioxidant in defence mechanism, prevention in disease. | K1,K3,K4,K5 |
| CO5 | Identify the plants with anti diabetic, anticancer, antibacterial, antiviral, anti-malaria and anti-inflammatory properties. | K1,K3,K4,K5 |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 1 | 2 | 1 | 3 | 2 | 1 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 1 | - | 1 | - | 2 | 2 | 1 | 2 |
| CO3 | 3 | 3 | 2 | 3 | 2 | - | 2 | - | 2 | - | 3 | 2 | - |
| CO4 | 3 | 3 | 3 | 2 | 3 | 3 | - | 2 | - | - | - | 3 | 2 |
| CO5 | 3 | 3 | 3 | 2 | 3 | 1 | 1 | - | 2 | - | 2 | 3 | 2 |

COURSE DESCRIPTORS

| | | | |
|----------------------------|--|----------------------------|---------|
| Title of the Course | Biochemical Techniques | Hours/Week | 05 |
| Course Code | AUCBC41 | Credits | 05 |
| Category | Core-VII | Year & Semester | II & IV |
| Pre requisites | Higher secondary Chemistry/Biology/Mathematics/Botany/ Zoology/Physics | Regulation | 2024 |

Objectives of the course:

- To introduce the basic principles, types and applications of various sedimentation techniques.
- To provide an understanding of the underlying principles of chromatographic techniques
- To demonstrate experimental skills in various electrophoretic techniques.
- To appraise the use of colorimetric and spectroscopic techniques in Biology.
- To impart knowledge about the measurement of radioactivity and safety aspects of radioactive isotopes.

| UNITS | Contents | COs | Cognitive Levels |
|----------------|--|-----|-------------------|
| UNIT-I | Centrifugation and Electrochemical techniques Measurement of pH, Standard Hydrogen electrode, Henderson Hesselbalch equation, pH, pOH, types of Buffer, role of buffers in biological system. Centrifugation-Basic principles, RCF, Sedimentation coefficient, Svedberg constant. Types of rotors. Preparative centrifugation- differential and density gradient centrifugation, Rate zonal and Isopycnic techniques, construction, working and applications of analytical ultra centrifuge–Determination of molecular weight (Derivation excluded). | CO1 | K1, K2, K3, K4 |
| UNIT-II | Chromatography Chromatography-adsorption, partition. Principle, instrumentation and applications of paper chromatography, thin layer chromatography, ion-exchange chromatography, gel permeation chromatography, gas chromatography and affinity chromatography. | CO2 | K1, K2, K3 |

| | | | |
|-----------------|---|-----|---------------|
| UNIT-III | Electrophoresis Electrophoresis –General principles, factors affecting electrophoretic mobility. Tiselius moving boundary electrophoresis. Electrophoresis with paper and starch. Principle, instrumentation and applications of agarose gel electrophoresis and SDS-PAGE | CO3 | K1, K2, K3 |
| UNIT-IV | Electromagnetic chemistry Basics of Electromagnetic radiations-Energy, wave length, wave number and frequency. Absorption and emission spectra, Lambert – Beer Law, Light absorption and transmittance. Colorimetry-Principle, instrumentation and applications. Visible and UV spectrophotometry – Principle, instrumentation and applications–enzyme assay, structural Studies of proteins and nucleic acids. | CO4 | K2, K3 |
| UNIT-V | Radioactivity Radioactivity - Types of Radioactive decay, half-life, units of radioactivity, Detection and measurement of radioactivity - Methods based upon ionization - Geiger Muller Counter. Methods based upon excitation-Solid & Liquid scintillation counters. Autoradiography. Biological applications and safety aspects of radioisotopes. | CO5 | K3, K4, K5 |

Recommended Text Books

1. Avinash Upadhyay, Kakoli Upadhyay & Nirmalendu Nath 2020, Biophysical Chemistry, Principles and Techniques, 3rd edition, Himalaya Publishing House.
2. L. Veerakumari, 2009, Bioinstrumentation, 1st edition, MJP Publishers.
3. Keith Wilson & John Walker, 2018, Practical Biochemistry-Principles and techniques, Cambridge University Press, 8th edition.

Reference Books

1. Terrance G. Cooper the tools of Biochemistry, 2011, John Wiley & Sons, Singapore.
2. Guru Mani, Research Methodology for Biological Sciences, 2021, 5th edition, MJP Publishers.
3. Saroj Dua, Neera Garg, Biochemical Methods of Analysis, 2019, 5th edition, Narosa Publishing house.

Website and e-learning source

1. <https://www.britannica.com/science/chromatography>
2. <https://www.youtube.com/watch?v=xgxFQZYXIE>
3. <https://www.youtube.com/watch?v=7onjVBsQwQ8>

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

| COs | CO Description | Cognitive Level |
|-----|--|-----------------|
| CO1 | Describe the types of rotors and centrifugation technique. | K1, K2, K3, K4 |
| CO2 | Demonstrate the principles, operational procedure, applications of planar and column chromatography. | K1, K2, K3 |
| CO3 | Explain the separation of DNA and protein using electrophoretic technique. | K1, K2, K3 |
| CO4 | Illustrates the instrumentation and uses of colorimeter and spectrophotometer. | K2, K3 |
| CO5 | Measurement and Safety aspects of radioactive isotopes. | K3, K4, K5 |

Mapping with Programme Outcomes:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 1 | 1 | 2 | 2 | 2 | 3 |
| CO2 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 1 | 1 | 2 | 2 | 2 | 2 |
| CO3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| CO4 | 2 | 3 | 2 | 2 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 2 | 2 |
| CO5 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |

COURSE DESCRIPTORS

| | | | |
|----------------------------|--|----------------------------|---------|
| Title of the Course | Practical IV- Biochemical Techniques | Hours/Week | 03 |
| Course Code | AUCPBC42 | Credits | 03 |
| Category | Core-VIII | Year & Semester | II & IV |
| Prerequisites | Higher secondary Chemistry/Biology/Mathematics/Botany/ Zoology/Physics | Regulation | 2024 |

Objectives of the course:

- To acquaint the students with colorimetric estimations of biomolecules.
- To impart Knowledge on the estimation of DNA and RNA.
- To acquire Knowledge on Estimation of Minerals.
- To equip skills on Chromatography separation techniques.
- To impart knowledge about the Separation of Serum Proteins.

| UNITS | Contents | COs | Cognitive Levels |
|----------------|--|-----|------------------|
| UNIT-I | Colorimetry – Estimation of Protein 1. Estimation of amino acid by Ninhydrin method. 2. Estimation of protein by Biuret method. | CO1 | K3, K4, K5 |
| UNIT-II | Colorimetry – Estimation of Nucleic Acids 1. Estimation of DNA by Diphenylamine method. 2. Estimation of RNA by Orcinol method. | CO2 | K3, K4, K5 |

| | | | |
|-----------------|---|-----|-------------------|
| UNIT-III | <p>Colorimetry- Estimation of Mineral</p> <p>Estimation of Phosphorus by Fiske and Subbarow method.</p> | CO3 | K3, K4, K5 |
| UNIT-IV | <p>Chromatography</p> <p>1. Separation and identification of sugars and amino acids by paper chromatography.</p> <p>2. Separation and identification of amino acids and lipids by Thin layer chromatography.</p> | CO4 | K1, K2, K3, K4 |
| UNIT-V | <p>Demonstration</p> <p>1. Separation of Serum and Plasma from blood by centrifugation.</p> <p>2. Separation of Serum proteins by SDS-PAGE.</p> | CO5 | K1, K2, K3, K4 |

Recommended Text Books

1. J. Jayaraman, Laboratory Manual in Biochemistry New Age International (P) Limited, 8th edition 2019.
2. S.Sadasivam, A.Manickam Biochemical Methods New age International Pvt Ltd publishers' third edition, 2018.
3. Keith Wilson and John Walker Principles and techniques of Practical Biochemistry Cambridge University Press, 8th edition. 2018.

Reference Books

1. S.K.Sawhney Singh, Introductory Practical Biochemistry. Alpha Science International, Ltd, 5th edition, 2018.
2. David T.Plummer, 2020, An Introduction to Practical Biochemistry, 12th edition, Tata McGraw- Hill publishing company limited.
3. Varley's Practical Clinical Biochemistry by Alan H Gowenlock, published by CBS Publishers and distributors, India, 6th Edition,2006.

Website and e-learning source

<https://www.pdfdrive.com/biochemistry-books.html>

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

| COs | CO Description | Cognitive Level |
|-----|---|-----------------|
| CO1 | Estimate the amount of Biomolecules by Colorimetric method. | K3, K4, K5 |
| CO2 | Quantify the amount of DNA and RNA by Colorimetric method. | K3, K4, K5 |
| CO3 | Estimate the amount of Minerals by Colorimetric method. | K3, K4, K5 |
| CO4 | Separate and identify Sugars, lipids and amino acids by chromatography | K1, K2, K3, K4 |
| CO5 | Demonstrate the separation of proteins Electrophoretically and Operate centrifuge for the separation of serum and plasma. | K2, K3, K4 |

Mapping with Programme Outcomes:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 2 | 2 | 2 | 3 |
| CO2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 3 |
| CO3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 1 | 2 |
| CO4 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 |
| CO5 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 2 |

COURSE DESCRIPTORS

| | | | |
|----------------------------|--|----------------------------|---------|
| Title of the Course | Bioinformatics | Hours/Week | 02 |
| Course Code | AUSBC44 | Credits | 02 |
| Category | Skill Enhancement Course | Year & Semester | II & IV |
| Pre requisites | Higher secondary Chemistry/Biology/Mathematics/Botany/ Zoology/Physics | Regulation | 2024 |

Objectives of the course:

- To impart knowledge on bioinformatics and applications.
- To learn about biological databases.
- To understand the local and global sequence alignment.
- To provide insights on BLAST and Microarray.
- To familiarize about structural genomics and visualization tools.

| UNITS | Contents | COs | Cognitive Levels |
|----------------|--|-----|------------------|
| UNIT-I | Introduction to Bioinformatics Bioinformatics and its applications.–Genome, Metabolome Definition and its applications. Metabolome -Metabolome database, E.coli metabolome database, Human Metabolome database. Transcriptome, Definition and applications. | CO1 | K1, K2, K3 |
| UNIT-II | Biological Databases Definition, types and examples –, Nucleotide sequence database (NCBI, EMBL, Gene bank, DDBJ) Protein sequence database Swiss Prot, TrEMBL, Structural Database, PDB, Metabolic database KEGG | CO2 | K1, K2, K3 |

| | | | |
|-----------------|--|-----|----------------|
| UNIT-III | <p>Sequence Alignment Local and Global alignment Dot-matrix analysis, PAM, BLOSUM. Dynamic Programming concept - Needleman Wunch algorithm, Smith waterman algorithm. Heuristic methods of sequence alignment</p> | CO3 | K1, K2, K4, K5 |
| UNIT-IV | <p>BLAST Features, types (BLASTP, BLASTN, BLASTX), PSI BLAST, result format. DNA Microarray Procedure and applications.</p> | CO4 | K2, K3 |
| UNIT-V | <p>Structural genomics Whole genome sequencing (Shotgun approach), Comparative genomics tools for genome comparison, VISTA servers and pre computed tools. Molecular visualization tools. RASMOL, Swiss PDB viewer. Nutrigenomics- Definition and applications.</p> | CO5 | K1, K2, K3 |

Recommended Text Books

1. Basic of Bioinformatics by Rui Jiang Xuegong Zhang and Michael Q. Zhang, 6th Editors, 2019.
2. Bioinformatics for Beginners Genes, Genomes, Molecular Evolution, Databases and Analytical Tools By: Supratim Choudhuri (Author),2016.
3. Bioinformatics by Sara's publication, by V. Kumaresan, R. Sundaralingam, ISBN 9788194931362, 2021.
4. Introduction to Bioinformatics by Arthur Lesk ISBN 9780198794141, Published by Oxford University Press, 2019.

Reference Books

1. Computation in Bioinformatics Multidisciplinary Applications S.Balamurugan, and T. Krishnan, Dinesh Goyal, Balakumar Chandrasekaran, ISBN-978-1119654766 Published by Wiley-Scrivener,2021
2. Chemo informatics and Bioinformatics in the Pharmaceutical Sciences, Navneet Sharma Ph.D., Pharmaceutics, Himanshu Ojha, Pawan Raghav,RameshK.Goyal,2021.

Website and e-learning source

1. <https://nptel.ac.in/courses/102/106/102106065/>
- 2 <http://www.digimat.in/nptel/courses/video/102106065/L65.html>
- 3 <https://www.slideshare.net/sardar1109/bioinformatics-lecture-notes>

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

| COs | CO Description | Cognitive Level |
|-----|--|-----------------|
| CO1 | Introduce the fundamentals of Bioinformatics and its applications. | K1, K2, K3 |
| CO2 | Classify biological database and to correlate the different file formats. | K1, K2, K3 |
| CO3 | Develop algorithms for interpreting biological data. | K1, K2, K4, K5 |
| CO4 | Discuss the concepts of sequence alignment and its types. | K2, K3 |
| CO5 | Apply the various tools employed in genomic study and Protein visualization. | K1, K2, K3 |

Mapping with Programme Outcomes:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 |
| CO2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 1 | 2 |
| CO3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 2 | 2 | 2 | 2 |
| CO4 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 3 | 3 | 2 | 3 |
| CO5 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 1 | 1 | 2 | 2 | 2 | 2 |

COURSE DESCRIPTORS

| | | | |
|----------------------------|--|---------------------------|---------|
| Title of the Course | Biochemical Pharmacology | Hours/Week | 02 |
| Course Code | AUSBC45 | Credits | 02 |
| Category | Skill Enhancement Course | Year& Semester | II & IV |
| Prerequisites | Higher secondary Chemistry/Biology/Mathematics/Botany/ Zoology/Physics | Regulation | 2024 |

Objectives of the course:

- To introduce the basic concepts of pharmacology.
- To explain the metabolism of drugs and factors responsible for metabolism.
- To acquaint the adverse response and side effects of drugs.
- To familiarize important drugs used for common metabolic disorders.
- To provide an understanding about the action of antibiotics.

| UNITS | Contents | COs | Cognitive Levels |
|---------|--|-----|-------------------|
| UNIT-I | Drugs–classification Drugs– classification based on sources, routes of drug administration -Oral/Enteral, Parenteral and Local application. Absorption of drugs, factors influencing drug absorption, distribution and excretion of drugs. | CO1 | K1, K2, K3, K4 |
| UNIT-II | Drug metabolism Drug metabolism- Phase I and Phase II reactions, role of cytochrome P ₄₅₀ , non- microsomal reactions of drug metabolism. Factors influencing drug metabolism. Therapeutic index. | CO2 | K1, K2, K3 |

| | | | |
|-----------------|--|-----|-------------------|
| UNIT-III | Drug allergy, Drug tolerance Drug allergy, Drug tolerance-IC ₅₀ ,LD ₅₀ of a drug,Drug intolerance, Drug addiction, Drug abuses and their biological effects. Drug resistance-biochemical mechanism | CO3 | K1, K2, K3 |
| UNIT-IV | Therapeutic Drugs Therapeutic Drugs - Analgesics and Non-steroidal anti-inflammatory drugs(NSAIDs)–Aspirin and Acetaminophen. Insulin, Oral anti diabetic drugs- Sulfonyl ureas, Biguanides. Antihypertensive drugs-ACE inhibitors, Calcium channel blockers. Anti-cancer agents–Anti metabolites. | CO4 | K1, K2, K3 |
| UNIT-V | Antibiotics Antibiotics-Definition, Examples and Biochemical mode of action of penicillin, streptomycin, tetracycline and chloramphenicol. | CO5 | K1, K2, K3, K4 |

Recommended Text Books

1. N.Murugesh, A concise textbook of Pharmacology–Sathya Publishers,2021
2. Jayashree Ghosh, A Textbook of Pharmaceutical chemistry–S. Chand & Company Ltd,2017
3. SC Mehta,Ashutosh Kar, Pharmaceutical Pharmacology–NewAge International (P)Limited, Publishers,2025

Reference Books

1. Lippincott's illustrated Reviews-Pharmacology by Mary J. Mycek, Richard A. Harvey, Pamela C. Champe, Lippincott-Raven publishers, New Delhi, Second South Asian Edition 6th June 2024.
2. David E. Golan, Principles of Pharmacology, Wolters Kluwer (India) Pvt. Ltd, 2016
3. R. S. Satoskar, S. B. Elsevier Pharmacology and pharmacotherapy. - ISBN-10: 9788131248867 / ISBN-13: 978-8131248867, 2017.
4. Tripathi, K. Essentials of Medical Pharmacology. Jaypee Publishers - ISBN-10: 9350259370 / ISBN-13: 978-9350259375. 2018.

Website and e-learning source

<https://slideplayer.com/slide/3728296/64/video/What+is+bioremediation%3F.mp4>

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

| COs | CO Description | Cognitive Level |
|-----|---|-----------------|
| CO1 | Classify the different routes of drug administration, metabolism and excretion. | K1, K2, K3, K4 |
| CO2 | Explain the role of cytochromes in drug metabolism. | K1, K2, K3 |
| CO3 | List out the various adverse response and side effects of drugs. | K1, K2, K3 |
| CO4 | Justify the use of synthetic drugs and its pharmacological actions. | K1, K2, K3 |
| CO5 | Demonstrate the importance and mode of action of antibiotics. | K1, K2, K3, K4 |

Mapping with Programme Outcomes:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 |
| CO2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| CO3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 3 | 3 |
| CO4 | 2 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 3 |
| CO5 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 3 | 3 |

COURSE DESCRIPTORS

| | | | |
|----------------------------|---|----------------------------|---------|
| Title of the Course | ENZYMES | Total Hours | 06 |
| Course Code | AUCBC51 | Credits | 04 |
| Category | Core-9 | Year & Semester | III & V |
| Prerequisites | Higher Secondary Chemistry / Biology / Mathematics / Botany / Zoology / Physics | Regulation | 2024 |

Objectives of the course:**The main objectives of this course are to**

- Provide fundamental knowledge on enzymes and their properties.
- Understand the mechanism of action of enzymes and the role of coenzymes in catalysis.
- Introduce the kinetics of enzymes and determine the K_m and V_{max} .
- Explain the effect of inhibitors on enzyme activity
- Understand the role of enzymes in clinical diagnosis and industries.

| UNITS | Contents | COs | Cognitive Levels |
|-----------------|---|-----|------------------|
| UNIT-I | Introduction to enzymes: Nomenclature and Classification based on IUBMB with examples, intracellular localization of enzymes, Isolation and purification of enzymes, enzyme as catalyst-activation energy, Enzyme specificity-absolute, group, linkage and stereo specificities. Non protein enzymes- Ribozymes, abzymes. Concept of active site, Lock and key hypothesis and induced fit theory, Enzyme expression Units-IU, turnover number, katal and specific activity. | CO1 | K1, K2, K3 |
| UNIT-II | Enzyme kinetics Enzyme kinetics --Definition of kinetics, Factors affecting enzyme activity - temperature, pH, substrate and enzyme concentration, activators-cofactors, Derivation of Michaelis-Menten equation for uni-substrate reactions, Lineweaver - Burk plot, Eadie-Hofstee plot significance of K_m and V_{max} and their determination using the plots. | CO2 | K2, K3, K4 |
| UNIT-III | Enzyme inhibition Reversible and irreversible inhibition-types of reversible inhibitors, competitive, non-competitive, un-competitive inhibitors. Graphical representation by L-B plot, (Kinetic derivations are not required), Determination of K_m and V_{max} in the presence and absence of inhibitors. Allosteric enzymes-Sigmoidal curve, positive and negative modulators. | CO3 | K1, K3, K4 |

| | | | |
|----------------|---|-----|---------------|
| UNIT-IV | <p>Mechanism of enzyme catalysis Acid-base catalysis, covalent catalysis, electrostatic catalysis, metal ion catalysis, proximity and orientation effect. Coenzymes-Definition, types, coenzymatic forms of vitamins- NAD/NADP, FAD, FMN, Coenzyme A, TPP, PLP, lipoic acid and biotin. Multi enzyme complexes- Pyruvate Dehydrogenase complex. Isoenzyme with reference to LDH and CK.</p> | CO4 | K1, K2, K4 |
| UNIT-V | <p>Applications of enzymes Immobilized enzymes - methods of immobilization, adsorption, covalent bonding, cross linking, encapsulation, entrapment and applications of immobilized enzymes. Biosensors – e.g. Glucose sensors. Industrial applications of enzymes –Food, textile and pharmaceutical industries.</p> | CO5 | K1, K2, K3 |

Recommended Text Books

- 1.U. Sathyanarayana & U. Chakrapani Biochemistry, 7th edition, 2025, CBS Publishers and Distributors Pvt. Ltd. ISBN: 9788198953803
- 2.Dr.G.R Agarwal, Dr. Kiran Agarwal & O.P. Agarwal, Text book of Biochemistry, (Physiological chemistry),18th edition, 2015, Goel Publishing House,
3. T. Devasena, Enzymology, 1st edition, 2010, Oxford University Press. ISBN 0198064438, 9780198064435

Reference Books

1. Trevor Palmer, Enzymes: Biochemistry, Biotechnology, Clinical Chemistry, 2ndedition, 2008, East West Press Pvt. Ltd. ISBN:9788176710596
2. David Nelson, Michael M.Cox, Principles of Biochemistry,5th edition, 2008, W.H. Freeman and Company, ISBN: 1429222638
- 3.Voet. D, Voet. J.G. and Pratt, C.W, Principles of Biochemistry, 5th edition, 2018 John Wiley & Sons, Inc ISBN: 1119451663
4. Zubay G. L, et.al., Principles of Biochemistry, 5th edition, 2020, Med tech Publishers. ISBN :9384007498

Website and e-learning source

- 1.<https://www.biologydiscussion.com/notes/enzymes- notes>
2. <https://www.britannica.com/science/protein/The-mechanism-of-enzymatic- action>

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

| COs | CO Description | Cognitive Level |
|-----|--|-----------------|
| CO1 | Identify the major classes of enzymes, Isolation and purification of Enzymes. | K1, K2, K3 |
| CO2 | Explain the mechanism of enzyme kinetics and factors affecting enzyme activity. | K2, K3, K4 |
| CO3 | Distinguish the types of inhibition along with its importance in Biochemical reactions. | K1, K3, K4 |
| CO4 | Elaborate on the mechanism of Enzyme catalysis and coenzymes. | K1, K2, K4 |
| CO5 | Comprehend the methods for production of immobilized Enzymes and application of enzymes. | K1, K2, K3 |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 1 | 2 | 2 | 3 | 3 | 2 |
| CO2 | 3 | 2 | 2 | 3 | 2 | 3 | 1 | 1 | 1 | 1 | 2 | 2 | 1 |
| CO3 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 1 |
| CO5 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 1 | 1 | 2 | 3 | 2 | 2 |

COURSE DESCRIPTORS

| | | | |
|----------------------------|--|----------------------------|---------|
| Title of the Course | INTERMEDIARY METABOLISM | Total Hours | 05 |
| Course Code | AUCBC52 | Credits | 04 |
| Category | Core-10 | Year & Semester | III & V |
| Prerequisites | Higher Secondary Chemistry / Biology / Mathematics/Botany/ Zoology/Physics | Regulation | 2024 |

Objectives of the course:

The main objectives of this course are to

- Review the basic concepts of free energy transformation and describe biological oxidation.
- Illustrate the pathways of carbohydrate metabolism.
- Explain the pathways of oxidation and biosynthesis of lipids.
- Detail the catabolism of amino acids and synthesis of specialized products from amino acids.
- Acquaint the metabolism of nucleic acids and its regulation.

| UNITS | Contents | COs | Cognitive Levels |
|---------|--|-----|-------------------|
| UNIT-I | Bioenergetics High energy compounds: Role of high energy compounds, free energy hydrolysis of ATP and other organophosphates, ATP/ADP cycle. Biological Oxidation: Electron transports chain its organization and function. Inhibitors of ETC. Oxidative phosphorylation, P/O ratio, Peter Mitchell's chemiosmosis hypothesis. Mechanism of ATP synthesis, uncouplers of oxidative phosphorylation, substrate level phosphorylation with examples. | CO1 | K2, K3, K4 |
| UNIT-II | Metabolism of carbohydrates Glycolysis, TCA Cycle, Amphibolic nature and integrating role of TCA cycle. Anaplerosis, Pentose Phosphate Pathway (HMP shunt), Gluconeogenesis, Glycogenesis, Glycogenolysis and its regulation, Glyoxylate cycle, Entner Doudoroff pathway and Cori cycle. | CO2 | K1, K2, K3, K4 |

| | | | |
|-----------------|---|-----|---------------|
| UNIT-III | Metabolism of lipids Oxidation of fatty acids - α , β and ω oxidation of saturated fatty acids, Oxidation of fatty acids with odd number of carbon atoms and unsaturated fatty acids, Ketogenesis, Biosynthesis of saturated fatty acids and unsaturated fatty acids, Biosynthesis and degradation of triglycerides, phospholipids and cholesterol. | CO3 | K1, K2, K3 |
| UNIT-IV | Metabolism of amino acids Metabolic nitrogen pool, Catabolism of amino acids: Oxidative deamination, non – oxidative deamination, transamination and decarboxylation, Biogenic amines, Urea cycle and its regulation | CO4 | K1, K2, K3 |
| UNIT-V | Metabolism of nucleotides Biosynthesis of purines and pyrimidines, <i>de novo</i> synthesis and salvage pathways, Degradation of purines and pyrimidines, Conversion of ribonucleotide to deoxyribonucleotide. | CO5 | K2, K3, K4 |

Recommended Text Books

1. U. Sathyanarayana & U. Chakrapani, Biochemistry, 7th edition, 2025, Elsevier India Pvt. Ltd., ASIN: B0FK3J8KNV
2. M.N. Chatterjee and Rana Shinde, Text book of Medical Biochemistry, 9th edition, 2023, Jaypee Brothers Medical Publishers Pvt. Ltd. ISBN 9350254840

Reference Books

1. Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox, 7th Edition, 2017, W.H. Freeman and Company. ISBN 9781319108243
2. Robert K.Murray, Daryl K.Granner, Victor W.Rodwell, Harper's Illustrated Biochemistry, 32nd edition, 2022, Mc Graw Hill Publishers. ISBN 1260469948
3. Voet.D, Voet. J.G, and Pratt C.W., Principles of Biochemistry Fifth edition, 2018, John Wiley & Sons, Inc, ISBN 1119451663
4. Geoffrey L.Zubay, William Parson, Dennis E.Vance , Principles of Biochemistry, 5th Edition, 2020, Wm. C. Medtech Publishers. ISBN 9384007498
5. Garret, R.H. and Grisham, C.M. Biochemistry, 7th Edition 2023. Thomson Learning INC. Brooks cole Publishers. ISBN 0357728459

Website and e-learning source

1. <https://nptel.ac.in/courses/104/105/104105102/>
2. <http://www.nptel videos.in/2012/11/biochemistry-html>
3. https://www.saddleback.edu/faculty/jzoval/my ppt lectures/ch15_metabolism/lecture_notes_ch15_metabolism_current-v2.0.pdf

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

| COs | CO Description | Cognitive Level |
|-----|--|-----------------|
| CO1 | Illustrate the mechanism of flow of electrons. | K2, K3, K4 |
| CO2 | Elaborate the biochemical reactions and integration of pathways of carbohydrate metabolism. | K1, K2, K3, K4 |
| CO3 | Sketch the oxidation and biosynthesis of fatty acids and cholesterol with suitable examples. | K1, K2, K3 |
| CO4 | Explain catabolism of amino acids and synthesis of nonessential amino acids. | K1, K2, K3 |
| CO5 | Describe the metabolism of nucleic acids with necessary illustrations and its regulation. | K2, K3, K4 |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 | 3 | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 2 | 2 | 2 | 2 |
| CO2 | 2 | 3 | 2 | 3 | 3 | 2 | 2 | 1 | 1 | 3 | 3 | 2 | 2 |
| CO3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 2 |
| CO5 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 1 | 3 | 2 | 2 | 2 |

COURSE DESCRIPTORS

| | | | |
|----------------------------|---|----------------------------|---------|
| Title of the Course | MEDICAL LAB TECHNOLOGY | Total Hours | 05 |
| Course Code | AUCBC53 | Credits | 04 |
| Category | Core-11 | Year & Semester | III & V |
| Prerequisites | Higher Secondary Chemistry / Biology /Mathematics/Botany/ Zoology/Physics | Regulation | 2024 |

Objectives of the course:**The main objectives of this course are to**

- Impart knowledge on specimen collection and disposal of waste.
- Acquaint knowledge on collection, preservation and transfusion of blood.
- Quantify the Biomolecules in biological sample.
- Understand the significance of various tests and their interpretation in diseased conditions.
- Acquaint knowledge on enzymes and hormones as markers for diagnosis.

| UNITS | Contents | COs | Cognitive Levels |
|-----------------|---|-----|--------------------|
| UNIT-I | Collection, transport, analysis of specimen–blood, routine urine, feces, sputum, semen, CSF Documentation of samples & results. Disposal of laboratory/hospital waste – Non infectious waste, biomedical waste, infected sharp waste disposal, infected non sharp disposal–color coding as per guidelines. Human ethical clearance in blood collection. | CO1 | K1, K2, K3 |
| UNIT-II | Determination of Blood group and Rh-factor - Basic blood banking procedures- cross matching, screening test. Blood transfusion and hazards | CO2 | K2, K3, K4 |
| UNIT-III | Estimation of blood sugar – Enzymatic method, HbA1c, Qualitative and quantitative analysis of urine sample-NPN-urea, uric acid, Creatinine. Mineral, vitamin and CSF analysis. | CO3 | K1, K2, K3, K4, K5 |

| | | | |
|----------------|--|-----|-------------------|
| UNIT-IV | Immuno diagnostics – Widal test, VDRL test, ASO, RA, CRP and Complement fixation Test. RIA, ELISA, Skin test – Montoux and Lepramin test. | CO4 | K2, K3, K4 |
| UNIT-V | Assay of clinically important enzymes-Estimation of clinically important hormones–Insulin, Thyroid, Reproductive hormones and its clinical significance. | CO5 | K1, K2, K3, K4 |

Recommended Text Books

1. Kanai L Mukherjee and Anuradha Chakravarthy Medical Laboratory Technology IV Edition, Vol I, 2022. ISBN:978-9354664359
2. Tietz, N. Fundamentals of Clinical Chemistry and Molecular Diagnostics 8th edition, 2019, Elsevier publication, ISBN:9788131258231
3. Ramnik sood, Text Book of Medical Laboratory Technology, Visionias Publishers, 2022 ASIN: B0CGXDKL9Z

Reference Books

1. Praful B.Godkar (Author), Darshan P. Godkar (Author) ,Text book of Medical Laboratory Technology Paperback –12th April 2024 published by Bhalani Publishing House. ISBN 9381496803
2. VH Talib (Author) ,Hand book of Medical Laboratory Technology, 3rd Edition, January 2025 CBS Publishers and Distributors Pvt. Ltd. ISBN 9354667600, .

Website and e-learning source

1. <https://www.youtube.com/watch?v=QNYIX5Ne9IQ>.
2. <https://www.slideshare.net/doctorrao/agglutination-tests-and-immuno-assays>.
3. <https://microbenotes.com/introduction-to-precipitation-reaction/>

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

| COs | CO Description | Cognitive Level |
|-----|---|--------------------|
| CO1 | Collect and preserve the biological samples. | K1, K2, K3 |
| CO2 | Perform the routine procedures adopted in blood bank | K2, K3, K4 |
| CO3 | Estimate the various constituents in biological sample. | K1, K2, K3, K4, K5 |
| CO4 | Analyze and interpret the values for both normal and disease conditions. | K2, K3, K4 |
| CO5 | Analyze the assay of enzymes, hormones and interpret clinical implications. | K1, K2, K3, K4 |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 |
| CO3 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 1 | 3 | 2 | 3 | 2 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 1 | 2 | 3 | 2 | 2 | 2 |
| CO5 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 1 | 2 | 3 | 2 | 2 |

COURSE DESCRIPTORS

| | | | |
|----------------------------|--|----------------------------|---------|
| Title of the Course | RESEARCH METHODOLOGY | Total Hours | 04 |
| Course Code | AUEBC54A | Credits | 03 |
| Category | Elective-V | Year & Semester | III & V |
| Prerequisites | Higher Secondary Chemistry / Biology / Mathematics/Botany/ Zoology/Physics | Regulation | 2024 |

Objectives of the course:**The objectives of the course are to:**

- Introduce the components of research.
- Acquaint on the experimental design and literature survey
- Analyze the data and find out the significance statistically
- Highlight the importance of computation in research.
- Provide mechanics of writing a search report hands-on experience in designing and working on small projects.

| UNITS | Contents | COs | Cognitive Levels |
|-----------------|---|-----|-------------------|
| UNIT-I | Characteristics and types of Research Research Methods versus Methodology Research designs in Biochemistry: Experimental <i>in vivo</i> , <i>in vitro</i> , <i>in situ</i> Clinical trials. Identification and criteria of selecting a research problem (Hypothesis); Formulation of objectives; Research plan and its components. Characteristics and types of Research. | CO1 | K2, K3, K4 |
| UNIT-II | Experimental design Objective Design of work, Research Design. Guidelines for design of experiments Literature Search-Databases for literature search, Material and methods of Designing in biological experiments, Compilation and documentation of data. | CO2 | K2, K3, K4, K5 |
| UNIT-III | Statistical Analysis: Measures of variation-standard deviation Non-linear regression Standard error. Analysis of variance for one-way and two-way classified data and multiple comparison procedures. Significance - students “t” test, Chi-square test and Dunnet’s test. | CO3 | K2, K3, K4 |

| | | | |
|----------------|---|-----|---------------|
| UNIT-IV | <p>Computer and its role in research: Computer and its role in research: Basics of MS Word MS Excel: tabulation Calculation and data analysis preparation of graphs, Histograms and charts. Use of statistical software SPSS. Power Point: preparation. Presentations and scientific poster designing</p> | CO4 | K3, K4, K5 |
| UNIT-V | <p>Scientific writing for journals Preparation of Abstract Impact factor, h-index, i10-index citation index. Dissertation/Thesis writing: Scientific writing, IMRAD format, content and chapterization Writing style, drafting titles & sub-titles, Captions and legends. Writing results, Discussion and conclusions. Bibliography and references- Reference styles - Harvard and Vancouver systems. Appendices and acknowledgement; Ethical issues in research; Intellectual property right and plagiarism.</p> | CO5 | K4, K5, K6 |

Recommended Text Books

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K.,. An introduction to Research Methodology, 2019, RBSA Publishers. ISBN:8176111651
2. Kothari, C.R., Research Methodology: Methods and Techniques, 5th Edition. 2023, New Age International. ISBN:9389802555
3. Sinha, S.C. and Dhiman, A.K. Research Methodology, 2002, Ess Publications. 2 volumes. ISBN: 8170003245
4. Gurumani. N, Research Methodology for biological Sciences, 2014, MJP Publishers. ISBN: 9788180940163

Reference Books

1. Dr. Prabhat Pandey, Dr. Meenu Mishra Pandey, Research Methodology: Tools and Techniques, 2015. ISBN 978-606-93502-7-0
2. Coley, S.M. and Sheinberg, C.A., "Proposal Writing",1990, Sage Publications.
3. Day, R.A.,. How to Write and Publish a Scientific Paper,2011 Cambridge University Press. ISBN :0313391971
4. Fink, A., Conducting Research Literature Reviews: From the Internet to Paper. 2009. Sage Publications. ISBN: 9781412971898
5. N Gurumani, Scientific Thesis Writing and Paper Presentation.2021.MJP Publishers. ISBN: 8180940691
6. Suresh C.Sinha and Anil K. Dhiman Research Methodology (2 Vols-Set), 2002, Vedams Books (P) Ltd. ISBN: 9788170003342

Website and e-learning source

1. <https://explorable.com/research-methodology>
2. <http://www.scribbr.com>
3. <http://www.macmillan.ihe.com>.

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

| COs | CO Description | Cognitive Level |
|-----|--|-----------------|
| CO1 | Discuss the types of research and formulate the research plan. | K2, K3, K4 |
| CO2 | Design experimental setup, review the literature, compile and Document the data. | K2, K3, K4, K5 |
| CO3 | Analyze and validate the experimental data using statistical tools. | K2, K3, K4 |
| CO4 | Interpret the data using computational tools. | K3, K4, K5 |
| CO5 | Compile and draft a research report, present results findings and publish ethically. | K4, K5, K6 |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 |
| CO2 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO3 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 1 |
| CO4 | 2 | 2 | 3 | 2 | 3 | 3 | 2 | 1 | 2 | 2 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |

COURSE DESCRIPTORS

| | | | |
|----------------------------|--|----------------------------|---------|
| Title of the Course | BIOENTREPRENEURSHIP | Total Hours | 04 |
| Course Code | AUEBC54B | Credits | 03 |
| Category | Elective-V | Year & Semester | III & V |
| Prerequisites | Higher Secondary Chemistry/Biology/Mathematics/Botany/ Zoology/Physics | Regulation | 2024 |

Objectives of the course:**The objectives of this course are to**

- Impart knowledge on bioentrepreneurship and the types of industries.
- Learn about business plan, proposal and funding agencies.
- Understand the market strategy and the role of information technology in expansion of business.
- Provide insights on legal requirements and accounting to establish as Bio entrepreneurship.
- Familiarize about business Bio incubation centres.

| UNITS | Contents | COs | Cognitive Levels |
|-----------------|---|-----|------------------|
| UNIT-I | Introduction to Bioentrepreneurship; Types of industries–Biopharma, Bio agriculture and CRO; IPR- Trademarks, Copyrights and patents. | CO1 | K1, K2 |
| UNIT-II | Business Plan, Budgeting and Funding Idea or opportunity; Business proposal preparation; fund support from Government agencies like MSME/banks, DBT, BIRAC, Start up and make in India Initiative; dispute resolution skills; (eg - Micro greens production) external environment changes; avoiding/managing crisis; Decision making ability. | CO2 | K1, K2, K3 |
| UNIT-III | Market Strategy- Basics of market forecast for the industry; distribution channels – franchising, policies, promotion, advertising, branding and market; Introduction to information Technology for business administration and Expansion. | CO3 | K1, K2 |

| | | | |
|----------------|--|-----|-------------------|
| UNIT-IV | Legal Requirements, Finance and Accounting; Registration of company in India; Ministry of Corporate Affairs (MCA); basics in accounting: introduction to concepts of balance sheet, profit and loss statement, double entry, book keeping; finance and break-even analysis. | CO4 | K1, K2, K3, K4 |
| UNIT-V | Role of knowledge centre's such as universities, innovation centre's, research institutions (public & private) and business incubators in Entrepreneurship development; quality control and quality assurance; Definition, role and importance of CDSCO, NBA, GLP, GCP, GMP. | CO5 | K2, K3, K4 |

Recommended Text Books

1. Adams, D. J. Enterprise for life scientists: Developing innovation and entrepreneurship in the biosciences. 2016, Bloxham: Scion - ISBN 10: 1904842364 / ISBN 13: 9781904842361
2. Shimasaki, C Biotechnology Entrepreneurship: Starting, managing, and Leading Biotech Companies,2014. Academic London Press - ISBN 10: 0124047300 / ISBN 13: 9780124047303
3. Onetti, A. Business modeling for life science and biotech companies: Creating value and competitive advantage with the milestone bridge. Rout ledge ,2015. -ISBN10: 1138616907 / ISBN 13: 9781138616905
4. Kapeleris, D. H. Innovation and entrepreneurship in biotechnology: Concepts, theories & cases,2006 - ISBN-13: 978-1482210125, ISBN-10: 1482210126

Reference Books

1. Desai, V. The Dynamics of Entrepreneurial Development and Management,2009 New Himalaya. New Himalaya House Delhi: pub - ISBN: 9789350440810 ,9350440814
2. Ono, R.D. The Business of Biotechnology, From the Bench of the Street, 2013 Butter worth-Heinemann - ISBN 10: 1138616907 / ISBN 13: 9781138616905
3. Jordan, J.F, Innovation, Commercialization, and Start-Ups in Life Sciences. London: 2nd Edition ,2021 CRC Press - ISBN-10: 812243049X, ISBN-13: 978-8122430493.

Website and e-learning source

1. <http://www.simplynotes.in/e-notes/mbabba/entrepreneurship-development/>
2. <https://openpress.usask.ca/entrepreneurship-and-innovation-tool-kit/chapter/chapter-1-introduction-to-entrepreneurship/>

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

| COs | CO Description | Cognitive Level |
|-----|--|-----------------|
| CO1 | Understand the concept and scope for entrepreneurship. | K1, K2 |
| CO2 | Gather plan, budget, funding & proposal for business. | K1, K2, K3 |
| CO3 | Acquaint knowledge on Marketing Strategies. | K1, K2 |
| CO4 | Demonstrate the Legal Requirements & difficulties of entrepreneurship in India. | K1, K2, K3, K4 |
| CO5 | Illustrate about the role of knowledge centres for developing Bioentrepreneurship. | K2, K3, K4 |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 | 2 | 3 | 3 | 1 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 1 | 3 | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 2 |
| CO3 | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 1 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 2 |
| CO5 | 2 | 2 | 3 | 1 | 2 | 2 | 3 | 2 | 1 | 2 | 2 | 2 | 2 |

COURSE DESCRIPTORS

| | | | |
|----------------------------|--|----------------------------|---------|
| Title of the Course | Practical V - Medical lab Technology | Total Hours | 03 |
| Course Code | AUEPBC 55 | Credits | 03 |
| Category | Elective-VI | Year & Semester | III & V |
| Prerequisites | Higher Secondary Chemistry / Biology / Mathematics/Botany/ Zoology/Physics | Regulation | 2024 |

Objectives of the course:**The objectives of this course are to**

- Introduce the methods of sample collection (blood & urine) for analytical purpose.
- Impart practical knowledge on the assay of Bleeding time and clotting time.
- Train students on various hematological tests and their significance.
- Understand the estimation procedure for various important biomolecules.
- Help students learn the routine qualitative analysis of urine sample for diagnostic purpose.

| UNITS | Contents | COs | Cognitive Levels |
|----------|---|-----|------------------|
| UNIT-I | a. Collection and preservation of blood and urine samples. b. Blood grouping. | CO1 | K1, K2, K3 |
| UNIT-II | a. Blood clotting time b. Bleeding time c. RBC counting | CO2 | K3, K4, K5 |
| UNIT-III | a. Total and differential count of white blood cells b. Packed cell volume c. Erythrocyte sedimentation rate d. HCG kit test | CO3 | K2, K3, K4 |

| | | | |
|----------------|---|-----|---------------|
| UNIT-IV | <p>Qualitative analysis of normal constituents of urine</p> <p>a) Urea, b) Creatinine, c) Phosphorus, d) Calcium, e) Bilirubin</p> | CO4 | K2, K3, K4 |
| UNIT-V | <p>Abnormal constituents</p> <p>a) Calcium b) Sugar (Glucose, fructose, pentose) c) Protein d) Amino acids (Tyrosine, Histidine, Tryptophan) e) Ketone bodies f) Bile pigments with clinical significance.</p> | CO5 | K2, K3, K4 |

Recommended Text Books

1. Manickam, S.S.. Biochemical Methods, 3rd Edition, 2018. New age International Pvt Ltd publishers - ISBN 10: 8122421407.
2. Plummer, D.T. (n.d.), An Introduction to Practical Biochemistry, 3rd edition, 2017 Tata Mc Graw Hill- ISBN: 9780070994874.
3. Alan H Gowenlock. Varley's Practical Clinical Biochemistry, 6th edition, 2022 CBS Publishers, India. ISBN: 9788123904276
4. B. Godkar,. Text book of Medical Laboratory Technology Vol 1& 2 Paperback, 3rd Edition, 2023, Bhalani Publishers. ISBN: 9789381496190
5. Kanai L Mukerjee. Medical Lab Technology, Vol I & II, 1st edition, 2025. CBS publishers and distributors pvt. Ltd, ASIN: B0G6X6YVTT
6. Ranjna Chawla. Practical Clinical Biochemistry Methods and interpretations (Paper back). 4th Edition, 2022, Jaypee Brothers Medical Publishers, New York. ASIN: B09TQM5FMY

Reference Books

1. Singh, S.K. Introductory Practical Biochemistry (2nd ed.), 2005 Alpha Science International, Ltd- ISBN 10: 8173193029.
2. Ashwood, B. Tietz Fundamentals of Clinical chemistry, 2001 WB Saunders Company, Oxford Science Publications USA-ISBN 10: 0721686346.

Website and e-learning source

1. <https://www.elsevier.com/journals/clinical-biochemistry/0009-9120/guide-for-authors>
2. <http://rajswasthya.nic.in/RHSDP%20Training%20Modules/Lab.%20Tech/Biochemistry/Dr.%20Jagarti%20Jha/Techniques%20In%20Biochemistry%20Lab.pdf>
3. https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical_biochemistrypdf.pdf?sequence=1&isAllowed=y

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

| COs | CO Description | Cognitive Level |
|-----|--|-----------------|
| CO1 | Acquaint knowledge on collection, preservation of blood & urine. | K1, K2, K3 |
| CO2 | Estimate the blood samples and relate their clinical significance. | K3, K4, K5 |
| CO3 | Perform the routine hematological tests. | K2, K3, K4 |
| CO4 | Qualitatively analyze the urine sample for normal constituents. | K2, K3, K4 |
| CO5 | Qualitatively analyze the urine sample for abnormal constituents. | K2, K3, K4 |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 |
| CO2 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 2 |
| CO3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 2 | 3 | 2 | 2 |
| CO4 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 1 | 1 | 3 | 2 | 3 | 3 |
| CO5 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 3 | 3 |