# PERIYAR UNIVERSITY

Periyarpalkalai Nagar, Salem-636011
(Reaccredited with 'A' grade by the NAAC

## DEPARTMENT OF BIOCHEMISTRY

M.Sc. DEGREE

[Choice based credit system (CBCS)]

**OBE REGULATIONS AND SYLLABUS**

(Effective from the academic year 2022-2023 and thereafter)

## 1. Preamble

The Department of Biochemistry was established in the year 2005. The department comprises of one Assistant Professor, one Associate Professor and two professors. The main objective of the department is to inculcate the basic concepts and applications of Biochemistry and thrive in the field of research and development. The department is known for its commitment to the self development of students into well-molded individuals who can take on leadership role in Industry/ Academic/ Government organization. The Department aims in developing human resources in Biochemistry and to expand and transfer knowledge in particular to the rural community residing in and around Salem district of Tamil Nadu, India. There is a greater demand globally, for trained manpower in the areas of Biochemistry for Research and Development in multinational companies, public sectors, quality control labs, biopharmaceutical companies, food industries as well as in universities. The Department is inbuilt and established with numerous research facilities such as high speed Ultra centrifuges, Spectrophotometers, Semi Autoanalyser, colorimeter, Deep freezers, Cold room, sonicator, Gel documentation system, orbital shakers, PCR machines, $CO_2$ incubators, ELISA Reader, centrifuges, incubators, laminar flow, electronic balance, etc.

## 2. General Graduate Attributes

The graduate attributes reflect both disciplinary knowledge and understanding, skills, competencies, that students should acquire/attain and demonstrate while studying Biochemistry program. Some of the characteristic attributes that a graduate should demonstrate are as follows:

1. **Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of Biochemistry
2. **Communication Skills:** express thoughts and ideas effectively in orally and writing
3. **Critical thinking:** Capability of analyzing, interpreting, discussion by following scientific approach to knowledge enrichment.
4. **Problem solving:** apply one's learning skills to imply on real life situations.
5. **Analytical reasoning**: ability to analyze and solve problems quickly and effectively
6. **Research-related skills:** Ability to define problems, analyse, interpret and draw conclusions from data and report the results of an experiment or investigation.
7. **Cooperation/Team work**: Ability to work effectively as a member of a team rather than individually.

8. **Scientific reasoning:** Ability to evaluate ideas and evidence of a particular problem and reason them based on scientific approach.
9. **Reflective thinking:** ability to learn from experience
10. **Information/digital literacy:** Capability to use ICT in a variety of learning situations.
11. **Self-directed learning:** Ability to work independently with efficiency based on the knowledge acquired while learning.
12. **Moral and ethical awareness/reasoning:** Ability to follow moral/ethical values in all aspects of work.
13. **Leadership readiness/qualities:** Capability to guide people to the right destination, in a smooth and efficient way.
14. **Lifelong learning:** Ability to acquire knowledge and skills through self-directed learning aimed at personal development

## 3. Program specific qualification Attributes

The cognitive domain involves knowledge and the development of intellectual skills (Bloom, 1956). This includes concepts that serve in the development of intellectual abilities and skills. There are six major categories of cognitive processes, starting from the simplest to the most complex

- Knowledge and understanding level (K1 and K2)
- Application level (K3)
- Analytical level (K4)
- Evaluation capability level (K5)
- Scientific or synthesis level (K6)

## 4. Vision

To achieve academic excellence in Biochemistry by imparting in-depth knowledge to the students and producing quality students trained in the various facets of Biochemistry, facilitating research activities and cater to the academic, industrial & societal demands. To make university a centre of excellence in the discipline of Biochemistry.

**5. Program objectives and outcomes**

**PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)**

The career perspectives of the Master's program in Biochemistry are

PEO 1: To prepare students for the future careers in the concerned/various relevant fields in which a core understanding of the chemistry of life is important.

PEO 2: To enable the graduates to exhibit leadership, make life long learners with professional and social ethics and make them communicate effectively.

PEO 3: To add highly skilled scientific workforce in the area of biomedical research sectors, academic, industry as well as for research laboratories across the country and the globe by following best practices for improving the professionalization and employability of students.

PEO 4: The practical and technical skills with laboratory-based work and the final year research project prepare the students for a research or technical position by defining specific and transferable skills.

PEO 5: To sensitize and train the students towards research with typical employers include pharmaceutical, biotechnology, food, water and agricultural companies and specialist services, such as toxicological studies.

PEO 6: To train the students in generic and competency skills so as to be able to work in potential places including scientific and medical publishers and the Intellectual Property Office

**PROGRAMME SPECIFIC OBJECTIVES (PSOs)**

The Overall objective of the Program is to promote education and research in biochemistry and provide academic and professional excellence for immediate productivity in industrial, or clinical settings for an ultimate benefit of society and environment.

| | |
|---|---|
| PSO1: | To acquire necessary knowledge and skills in core themes, principles and components of basic Biochemistry |
| PSO2: | To demonstrate the knowledge of biochemical processes from the cellular and molecular aspects |
| PSO3: | To Integrate and apply the techniques studied and to compare and contrast the depth of scientific knowledge in the broad range of fields |
| PSO4: | to be able to understand, analyze and apply the studied basic and concepts in wide variety of applications including diagnostics, biochemical pathway regulation and drug development and use this knowledge and apply the same for multitude of laboratory applications. |
| PSO5: | To provide students with the knowledge and skill base that would enable them to go for self-employment and entrepreneurship |

**PROGRAMME OBJECTIVES (POs)**

PO1: To demonstrate comprehensive knowledge on various areas of Biochemistry.

PO2: To acquire skills in areas related to the current and emerging developments.

PO3: To communicate the concepts, constructs and techniques of the subject learnt in a clear, concise and lucid manner.

PO4: To plan and execute the experiments to the relevant theories of Biochemistry.

PO5: To apply critical thinking, scientific reasoning and mathematical skills in studied areas of Biochemistry.

PO6: To train the students to acquire various relevant generic and competency skills in various aspects of biochemistry so as to be able to work independently in a group or individually

PO7: To make a student life long learner with moral and ethical values

**PROGRAMME OUTCOME (PO'S):-**

M.Sc programme in Biochemistry will provide students with the necessary knowledge and skills to undertake a career in research, either in industry or in an academic setting. The training provided will give students the breadth and depth of scientific knowledge in Biochemistry. On completion of the programme, students will be qualified to apply for a PhD or to gain employment in the pharmaceutical or biotechnology industries, which are among the strongest growth sectors. The programme will be based on a combination of taught modules, independent learning and an extended research project to be carried out either in the University departments or industry or in association with industry at the University. The programme incorporates a substantial element of hands-on research experience, with enhanced experimental skills being gained alongside experienced research workers.

It is intended that, on successful completion of the M.Sc degree programme, students will :

1. **be capable of demonstrating comprehensive knowledge** and have a fundamental/systematic or coherent understanding of major concepts, theoretical principles and experimental findings in biochemistry.
2. **acquire skills in areas related to the current and emerging developments** in the field of Biochemistry.
3. **be identifying and applying appropriate biochemical principles** and methodologies to solve a wide range of problems associated with Biochemistry.
4. **communicate the results of studies undertaken** in Biochemistry accurately in a range of different contexts using the main concepts, constructs and techniques of the subject learnt in a clear and concise manner in writing and oral skills.

5. **Plan and execute the experiments**, investigate, analyze and interpret data collected using appropriate experimental methods, and report the findings of the experiment and relate the interpretations and conclusions to relevant theories of Biochemistry.
6. They will have the **ability to employ critical thinking, scientific reasoning and efficient problem** solving skills in the basic areas of biochemistry.
7. Be able to **demonstrate relevant generic skills and competencies** such as (i) problem solving skills, (ii) investigative skills, (iii) communication skills (iv) analytical skills, (v) ICT skills, (vi) skills such as the ability to work both independently and in a group.
8. **demonstrate professional behaviour** such as (i) unbiased and truthful in all aspects of work (ii) follow moral and ethical practices (iii) Life long learners aimed at personal development and for improving knowledge/skill development (iv) focusing on issues related to social cause.

**6. Candidate eligibility for admission**

Graduates in Biochemistry, Chemistry, Pharmacy, Bachelors of medical lab technology, Microbiology and Life Sciences as principle subject or Biochemistry as subsidiary subject are eligible for admission to the course.

**7. Duration of the course:** Two year degree programme

## 8. Curriculum structure for each semester

### M.Sc. Biochemistry curriculum structure for each semester 2022-2023

| Sem | Course Code | Title of the Course | Marks | | | Exam Duration | Credits |
|---|---|---|---|---|---|---|---|
| | | | CIA | EA | Total | | |
| I | 22UPBIC1C01 | Core I – Biological Molecules | 25 | 75 | 100 | 3 | 4 |
| | 22UPBIC1C02 | Core II - Bioanalytical techniques | 25 | 75 | 100 | 3 | 4 |
| | 22UPBIC1C03 | Core III - Advanced Enzymology | 25 | 75 | 100 | 3 | 4 |
| | 22UPBIC1C04 | Core IV - Cellular Biochemistry | 25 | 75 | 100 | 3 | 4 |
| | 22UPBIC1E01/05 | Elective I | 25 | 75 | 100 | 3 | 4 |
| | 22UPBIC1P01 | Core Practical I (Biological molecules, Enzymology and Bioanalytical Techniques) | 40 | 60 | 100 | 6 | 4 |
| II | 22UPBIC1C05 | Core V - Intermediary Metabolism and Energetics | 25 | 75 | 100 | 3 | 4 |
| | 22UPBIC1C06 | Core VI - Plant Biochemistry | 25 | 75 | 100 | 3 | 4 |
| | 22UPBIC1C07 | Core VII – Advanced Molecular Biology | 25 | 75 | 100 | 3 | 4 |
| | 22UPBIC1P02 | Core Practical II (Molecular and Microbial Techniques) | 40 | 60 | 100 | 6 | 4 |
| | 22UPBIC1E02/06 | Elective II | 25 | 75 | 100 | 3 | 4 |
| | 22UPBIC1E03/07 | Elective III | 25 | 75 | 100 | 3 | 4 |
| | 22UPSOC2H01 | Human Rights | 25 | 75 | 100 | 3 | 2 |
| | | Internship (4 weeks) | | | | | |
| III | 22UPBIC1C08 | Core VIII Gene Technology | 25 | 75 | 100 | 3 | 4 |
| | 22UPBIC1C09 | Core IX - Clinical and diagnostic Biochemistry | 25 | 75 | 100 | 3 | 4 |
| | 22UPBIC1C10 | Core X – Immunology & Immunotechnology | 25 | 75 | 100 | 3 | 4 |
| | 22UPBIC1S01/02/0/04 | Supportive I | 40 | 60 | 100 | 3 | 4 |
| | 22UPBIC1P03 | Core Practical III (Clinical &Diagnostic Biochemistry and genetic engineering) | 25 | 75 | 100 | 6 | 4 |
| | 22UPBIC1E07/08 | Elective IV | 25 | 75 | 100 | 3 | 4 |
| | | Internship (Review) | | | | | 1 |
| | | Supportive II (MOOC) | 25 | 75 | 100 | 3 | 2 |
| IV | 22UPBIC1C11 | Core XI - Research Methodology and Biostatistics | 25 | 75 | 100 | 3 | 4 |
| | 22UPBIC1P04 | Core Practical IV (Clinical Biochemistry and Immunology & Immunotechniques) | 40 | 60 | 100 | 6 | 4 |
| | 22UPBIC1PR01 | Project and Viva-voce | 50 | 150 | 200 | - | 9 |
| | | **TOTAL** | | | **2400** | | **94** |

## ELECTIVE COURSES

Elective course subjects have grouped into Part A and Part B based on specialization. They are Clinical Biochemistry and Industrial Biochemistry.

### PART A- CLINICAL BIOCHEMISTRY

1. 22UPBIC1E 01 - Endocrine system & Hormonal Regulation
2. 22UPBIC1E 02 – Oncology
3. 22UPBIC1E 03 - Human Physiology
4. 22UPBIC1E 04 – Nutritional Biochemistry

### PART B- INDUSTRIAL BIOCHEMISTRY

1. 22UPBIC1E 05 - Biotechnology
2. 22UPBIC1E 06 – Introduction to Bioinformatics
3. 22UPBIC1E 07 – Fundamentals of forensic science
4. 22UPBIC1E 08 – Pharmacology and Clinical Toxicology

### SUPPORTIVE COURSES FOR OTHER DEPARTMENTS

1. 22UPBIC1S 01 - Tools and Techniques in Bioscience
2. 22UPBIC1S 02 - Medical Lab Technology
3. 22UPBIC1S 03 - Clinical diagnosis in health and diseases
4. 22UPBIC1S 04 – Biochemistry-The molecules of life

### VALUE ADDED COURSE

1. PLANT THERAPEUTICS : 22UPBICVA01
2. DOWN STREAM PROCESSING OF ENZYMES : 22UPBICVA02
3. RT PCR APPLICATION IN CANCER BIOLOGY : 22UPBICVA03
4. CLINICAL DIAGNOSIS : 22UPBICVA04
5. BIO-ENTREPRENURSHIP : 22UPBICVA05

**9. Credit calculation**

| Method of teaching | Hours | Credits |
|---|---|---|
| Lecture | 1 | 1 |
| Tutorial/demonstration | 1 | 1 |
| Practical/Internship/ Self-Learning | 2 | 1 |

## CBCS – Scheme of examinations semester wise structure

| Sem | Course Code | Title of the Course | Marks | | | Exam Duration | Credits |
|---|---|---|---|---|---|---|---|
| | | | CIA | EA | Total | | |
| I | 22UPBIC1C01 | Core I – Biological Molecules | 25 | 75 | 100 | 3 | 4 |
| | 22UPBIC1C02 | Core II - Bioanalytical techniques | 25 | 75 | 100 | 3 | 4 |
| | 22UPBIC1C03 | Core III - Advanced Enzymology | 25 | 75 | 100 | 3 | 4 |
| | 22UPBIC1C04 | Core IV - Cellular Biochemistry | 25 | 75 | 100 | 3 | 4 |
| | 22UPBIC1E01/05 | Elective I | 25 | 75 | 100 | 3 | 4 |
| | 22UPBIC1P01 | Core Practical I (Biological molecules, Enzymology and Bioanalytical Techniques) | 40 | 60 | 100 | 6 | 4 |
| II | 22UPBIC1C05 | Core V - Intermediary Metabolism and Energetics | 25 | 75 | 100 | 3 | 4 |
| | 22UPBIC1C06 | Core VI - Plant Biochemistry | 25 | 75 | 100 | 3 | 4 |
| | 22UPBIC1C07 | Core VII – Advanced Molecular Biology | 25 | 75 | 100 | 3 | 4 |
| | 22UPBIC1P02 | Core Practical II (Molecular and Microbial Techniques) | 40 | 60 | 100 | 6 | 4 |
| | 22UPBIC1E02/06 | Elective II | 25 | 75 | 100 | 3 | 4 |
| | 22UPBIC1E03/07 | Elective III | 25 | 75 | 100 | 3 | 4 |
| | 22UPSOC2H01 | Human Rights | 25 | 75 | 100 | 3 | 2 |
| | | Internship (4 weeks) | | | | | |
| III | 22UPBIC1C08 | Core VIII Gene Technology | 25 | 75 | 100 | 3 | 4 |
| | 22UPBIC1C09 | Core IX - Clinical and diagnostic Biochemistry | 25 | 75 | 100 | 3 | 4 |
| | 22UPBIC1C10 | Core X – Immunology & Immunotechnology | 25 | 75 | 100 | 3 | 4 |
| | 22UPBIC1S01/02/0/04 | Supportive I | 40 | 60 | 100 | 3 | 4 |
| | 22UPBIC1P03 | Core Practical III (Clinical &Diagnostic Biochemistry and genetic engineering) | 25 | 75 | 100 | 6 | 4 |
| | 22UPBIC1E07/08 | Elective IV | 25 | 75 | 100 | 3 | 4 |
| | | Internship (Review) | | | | | 1 |
| | | Supportive II (MOOC) | 25 | 75 | 100 | 3 | 2 |
| IV | 22UPBIC1C11 | Core XI - Research Methodology and Biostatistics | 25 | 75 | 100 | 3 | 4 |
| | 22UPBIC1P04 | Core Practical IV (Clinical Biochemistry and Immunology & Immunotechniques) | 40 | 60 | 100 | 6 | 4 |
| | 22UPBIC1PR01 | Project and Viva-voce | 50 | 150 | 200 | - | 9 |
| | | **TOTAL** | | | **2400** | | **94** |

**Teaching methodologies**

The classroom teaching would be through conventional lectures and use of OHP and Power point presentations. The lecture would be such that the students should participate actively in the discussion, student's seminars would be conducted and scientific discussions would be arranged to improve their communicative skill.

In the laboratory, instructions will be given for the experiments followed by demonstration and finally the students have to do the experiments individually. Periodic tests will be conducted for the students. Slow learners will be given special attention

**10. Examinations**

There shall be four semester examinations. Two in the first year and two in the second year. Candidates failing in any subject will be permitted to appear for such failed subjects at subsequent examination. The syllabus has been divided into 4 semesters. The examination for the Semester I & III will be held in November/December and that for the Semester II and IV will be in the month of April/May. The Practical examination will be conducted at the end of each semesters. Candidates failing in any of the practical examination will be permitted to appear for such failed practical examination at subsequent practical examination.

**11. Scheme for evaluation and Attainment Rubrics**

| | | |
|---|---|---|
| **Theory** | External | : 75 Marks |
| | Internal | : 25 Marks |
| | Three test | : 10 Marks |
| | Seminar | : 5 Marks |
| | Assignment | : 5 Marks |
| | Attendance | : 5 Marks |
| **Practical** | External | : 60 Marks |
| | Internal | : 40 Marks |
| | Practical test | : 30 Marks |
| | Record | : 5 Marks |
| | Attendance | : 5 Marks |

**SCHEME FOR PRACTICAL EXAM**

Time – 6 hours Max. Marks = 60

**I Major**

| | |
|---|---|
| Experiment - I | 25 |
| Experiment - II | 25 |
| **II Viva** | 5 |
| **III Record** | 5 |

| | |
|---|---|
| Procedure | 5 |
| Table | 4 |
| Graph | 4 |
| Calculation | 6 |
| Result | 6 |

The Experiments carried out by using Kits

| | |
|---|---|
| Procedure | 5 |
| Observation | 10 |
| Result | 10 |

**QUESTION PAPER PATTERN (THEORY)**

| | |
|---|---|
| Part A : Answer All questions (MCQ) | 20 x 1 = 20 marks |
| Part B : Answer any three questions (Analytical reasoning) | 3 x 5 = 15 marks |
| Part C : Answer All questions (either or type) | 5 x 8 = 40 marks |

Duration of the examination - 3 hours Maximum marks – 75

**FOR RESEARCH**

| S.No. | Particulars | Marks | Examiners |
|---|---|---|---|
| 1 | Dissertation | 30% | Internal Examiner |
| | | 30% | External Examiner |
| 2 | Viva-voce | 20% | Internal Examiner |
| | | 20% | External examiner |

**12. Grading system**

Evaluation of performance of students is based on ten-point scale grading system as given below

| Ten Point Scale | | | |
|---|---|---|---|
| Grade of Marks | Grade Points | Letter Grade | Description |
| 90-100 | 9.0-10.0 | O | Outstanding |
| 80-89 | 8.0-8.9 | D+ | Excellent |
| 75-79 | 7.5-7.9 | D | Distinction |
| 70-74 | 7.0-7.4 | A+ | Very Good |
| 60-69 | 6.0-6.9 | A | Good |

| | | | |
|---|---|---|---|
| 50-59 | 5.0-5.9 | B | Average |
| 00-49 | 0.0 | U | Re-appear |
| ABSENT | 0.0 | AAA | Absent |

## BIOLOGICAL MOLECULES

**COURSE CODE : 22UPBIC1C01**

| Hours | L | T | P | C |
|---|---|---|---|---|
| | 3 | 1 | 0 | 4 |

**MARKS : 100**

**COURSE OBJECTIVES:** To understand the basis of biomolecules, this will provide knowledge about structural -functional relationship of these molecules, and their importance with regard to maintenance and perpetuation of the living systems.

**COURSE OUTCOMES (CO)**

After completion of the course, the students will be able to,

| | |
|---|---|
| **CO1** | Understand and demonstrate how the structure of carbohydrates determines their chemical properties and reactivity. Various functional groups involved in bond formation / linkage and also encourages the student to draw and recognize key structures of carbohydrates. |
| **CO2** | Understand the structure, functional groups, draw and recognize key structures of amino acids and function of amino acids, their interactions, various structural aspects of proteins involved in biology. |
| **CO3** | Understand the structure and function of important biological macro molecules like lipids, its types, composition, its role in biological function. Various functional groups bond formation / linkage. |
| **CO4** | Have knowledge of the structure/conformational freedom of DNA/RNA various functional groups in bond formation / linkage, functional difference help students to draw and recognize key structures of nucleic acids, know their functions in biology. |
| **CO5** | Know about the structure, types of minerals and vitamins in biological reactions, and its relationship with disease. |

**SYLLABUS**

| Unit | Unit title | Intended Learning chapters | Knowledge domain | Hours of Instruction |
|---|---|---|---|---|
| I | Simple and Complex Carbohydrates | Classification of Carbohydrate- Mono, Oligo and polysaccharide - structure, properties and function. Mono Homoglycans- structure, properties and biological function- Starch, Cellulose and Chitin, glycogen. Heteroglycans:, structure, properties and biological function - Heparin, Hyaluranic acid, Agarose. | K1,K2,K3 | 12 |

| | | | | |
|---|---|---|---|---|
| II | Amino acids and Proteins | Aminoacid: classification, Peptide bond and its properties. Physical interactions that determine the properties of proteins–electrostatic forces, vanderwaals interaction, hydrogen bond, hydrophobic interactions. Primary structure, characteristics and importance. Secondary structure- The α, β helix, β-sheets and its significance. Tertiary structure-Collagen and quaternary structure-Hemoglobin. The Ramachandran plot and its significance. | K1,K2,K3 | 14 |
| III | Lipids | Classification of lipids. Saturated and unsaturated lipid and trans fat. Derived lipids: Phospholipids, glycolipids, structure, properties and function. Fatty acids –saturated and unsaturated. Eicosanoids- structure and biological significance. | K1, K2, K3 | 12 |
| IV | Nucleic Acids | Types of DNA: A, B, Z DNA and its structure, properties and function. Types of RNA: - mRNA, tRNA, rRNA, and its structure, properties and function. | K1, K2, K3 | 14 |
| V | Vitamins | Water soluble vitamins- B complex vitamins and Vitamin C - structure, biochemical functions, deficiency diseases, Fat soluble-vitamin A, vitaminA, D, E, K,-structure, biochemical functions, deficiency diseases. | K3, K4 | 13 |

***Program specific attributes***

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

**REFERENCES**

**Text Books**


1. Gajera H.P, Patel S.V, Golakia B.A. 2008 Fundamentals of Biochemistry A Text Book International Book Distributing Co, 2008
2. Mushtaq Ahmed. 2008 Essentials of Biochemistry by Merit Publisher Multan .2008
3. Hiram F Gilbert. 1999. Basic concepts in Biochemistry A students Survival Guide. Second Edition. Mc Graw Hill publishing Inc.


**Reference Books**


1. Zubay,G.L. 1998. Biochemistry, Wm.C. BrownPublishers.
2. Sinden,S.R. DNA structure and function, First Edition**,** Academic Press,1994.

3. Carl Branden and John Tooze, Introduction to Protein Structure, Second Edition, Garland Publishing,1999.
4. Garrett,R. and Grisham,C. 2010. Biochemistry, 4th Edition, Saunders College Publishing

**Weblink**

1. https://nptel.ac.in › courses › pdf › mod10
2. https://www.ccrc.uga.edu › bcmb3100 › Chap11
3. https://nptel.ac.in › courses › pdf › mod12
4. Chemistry and Biochemistry - NOC:Biochemistry - NPTEL

**MAPPING**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | H | M | M | L | L | M | M | L |
| CO2 | H | M | L | L | L | M | M | L |
| CO3 | H | M | L | L | L | M | M | L |
| CO4 | H | L | L | L | L | M | M | L |
| CO5 | H | M | M | L | L | M | M | L |

H-High; M-Medium; L-Low

## BIOANALYTICAL TECHNIQUES

**COURSE CODE : 22UPBIC1C02**

| Hours | L | T | P | C |
|---|---|---|---|---|
| | 3 | 1 | 0 | 4 |

**MARKS : 100**

**COURSE OBJECTIVES :** The objective of this course is to understand the working principles, instrumentation and applications of the instruments in various disciplines of biological sciences

**COURSE OUTCOMES (CO)**

After completion of the course, the students will be able,

| | |
|---|---|
| **CO1** | To explore the basic concepts of pH, buffers and the types of various electrochemical cells and its application. The students will also be able to identify and understand the principle components of a light and electron microscope with biological applications. |
| **CO2** | To explain the principles of the liquid and gas chromatography as well as electro-migration techniques and evaluate strengths and limitations of the most important chromatographic separation and detection methods. |
| **CO3** | To understand how *electrophoresis* facilitates the separation of molecules based on various principles of electrophoresis. |
| **CO4** | To understand the principles of spectroscopy and to analyse and interpret spectroscopic data collected by the methods discussed in the course. |
| **CO5** | To assimilate the principles and applications of centrifuge. Employ the knowledge for the separation of biomolecules/cells/organelles by selecting appropriate centrifugation techniques. |

**SYLLABUS**

| Unit | Unit title | Intended Learning chapters | Knowledge domain | Hours of Instruction |
|---|---|---|---|---|
| I | Electrochemistry and Microscopy | Electrochemistry: Electrochemical cells- Henderson - Hasselbalch equation, buffer, pH measurement-glass electrode. Microscopy - fluorescence and phase contrast microscope. Electron microscopy and its types (SEM and TEM), Confocal Laser Scanning Microscopy. | K1,K2, K3 | 13 |
| II | Chromatographic methods | Chromatography- Principle, instrumentation and applications:- Thin layer, HPLC, RF-HPLC, Gas Chromatography, Supercritical Fluid Chromatography- Chromatofocusing | K1,K2, K3,K4 | 12 |

| | | | | |
|---|---|---|---|---|
| III | Electrophoresis | General principle, migration of charged particle in an applied electric field, factors affecting mobility. SDS-PAGE, 2D-PAGE, isoelectric focusing gels, agarose gel electrophoresis, capillary electrophoresis & Zymography. | K1, K2, K3 | 12 |
| IV | Spectroscopy | Principle, Instrumentation and applications - UV-Visible spectroscopy, Raman spectroscopy- FTIR, ESR, NMR, Mass Spectrophotometry – MS & MALDI and circular dichroism spectroscopy. Fluorimetry, X ray photoelectron spectroscopy. | K1, K2, K3,K4 | 13 |
| V | Centrifugation & Radioactivity | Basic principles of sedimentation; types of rotor; preparative and analytical centrifugation - types and its applications, CsCl density gradient- centrifugation. Radioactivity– solid and liquid scintillation counter- Autoradiography, applications of radioisotopes in biology, radiation hazards and safe disposal of radioactivity waste. | K1, K2, K3,K4 | 15 |

***Program specific attributes***

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

**REFERENCES:**

**Text Books**


1. Wilson,K. and Walker,J. 2010. Principles and Techniques of Biochemistry and Molecular Biology, 7th Edition , Cambridge University. Press.
2. Upadhyay,A. Upadhyay,K. and Nath,N. 2016. Biophysical Chemistry: Principles and Techniques, 4th Edition, Himalaya Publishing. 11th Edition
3. Sharma,B.K. 2014. Instrumental Methods of Chemical analysis, Krishna Prakashan Ltd.


**Reference Books**


1. Skoog.D, Holler F and Crouch S. 2016. Principles of Instrumental Analysis, 7th Edition, Cengage Learning custom publishing.
2. Boyer,R. 2009. Modern Experimental Biochemistry, 3rd Edition, Pearson India.


**Weblink**

1. https://nptel.ac.in/courses/102/103/102103044/
2. https://nptel.ac.in/courses/102/107/102107028/
3. https://nptel.ac.in/courses/103/108/103108100/

**MAPPING**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | H | L | M | L | L | L | M | L |
| CO2 | H | L | L | L | L | M | L | L |
| CO3 | H | M | M | L | M | M | L | L |
| CO4 | H | L | M | L | M | M | L | L |
| CO5 | H | L | M | L | L | L | M | L |

H-High; M-Medium; L-Low

## ADVANCED ENZYMOLOGY

**COURSE CODE : 22UPBIC1C03**

| Hours | L | T | P | C |
|---|---|---|---|---|
| | 3 | 1 | 0 | 4 |

**MARKS : 100**

**COURSE OBJECTIVES** : To understand the classification, kinetics, mechanism of action, regulation and applications of enzymes.

**COURSE OUTCOMES (CO)**

After completion of the course, the students will be able to,

| | |
|---|---|
| **CO1** | Characterize the enzymes in each enzymatic class, examples of such enzymes. Role of coenzymes in the activity of enzymes will be thoroughly understood by the students. |
| **CO2** | Understand the concepts of Purification of enzymes with known examples |
| **CO3** | To understand enzyme active site concepts and its various mechanism of action. |
| **CO4** | Assess the relationship between properties and structure of the enzymes, kinetics of enzymatic reactions and their inhibition with specific examples |
| **CO5** | Relate the regulatory mechanisms of enzyme activity which involve in the maintenance of body's homeostasis |

**SYLLABUS**

| Unit | Unit title | Intended Learning chapters | Knowledg e domain | Hours of Instruction |
|---|---|---|---|---|
| I | Classification and Coenzymes | Enzyme–Nomenclature and classification of enzymes. Effect of pH, temperature and substrate concentrations on enzyme catalyzed reactions. Co-enzymes and Co-factors mechanism of action in enzyme catalyzed reactions: NAD, FAD and TPP. | K1,K2,K3 | 13 |
| II | Enzyme Purification | Enzyme purifications methods: Strategy of enzyme purification, Methods of separation (principle only), Purification table, Intracellular enzyme – Glutathione reductase from *E.coli.*,- Extracellular enzymes – amylase. | K1,K2,K3 | 12 |

| | | | | |
|---|---|---|---|---|
| III | Enzyme active site and catalysis | Active site –Enzyme active site and its concepts- modification using chemical procedures and site-directed mutagenesis. Types of catalysis - Acid base catalysis, covalent catalysis - Mechanism of reaction catalyzed by enzymes - lysozyme. Role of metal ions in enzyme activity – carbonic anhydrase- nonprotein enzymes – ribozymes. | K1, K2,K3 | 12 |
| IV | Enzyme Kinetics and inhibition | Enzyme Kinetics: steady state kinetics, Michaelis Menten kinetics, importance of Vmax, Km, - Lineweaver- Burk plot, Bisubstrate reactions: ordered, random- Enzyme inhibition – Reversible - competitive, non-competitive, mixed inhibition, irreversible inhibition**.** | K1, K2, K3,K4 | 13 |
| V | Enzyme Regulation and applications of enzymes | Enzyme regulation: Allosteric control, Symmetric and sequential modes for action of allosteric enzymes. Mechanism of action and regulation of pyruvate dehydrogenase. Enzyme Immobilization methods. Enzymes in therapy: Enzymes as anti- inflammatory agents, digestive aids. Therapeutic use of streptokinase. | K1,K2,K3, K4 | 15 |

***Program specific attributes***

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4) Evaluation
capability level (K5)
Scientific or synthesis level (K6)

**REFERENCES:**

**Text Books**


1. Palmer,T. 1995.Understanding enzymes, 4 th Edition, Prentise Hall.
2. Allan Svendsen. 2016. Understanding Enzymes: Function, Design, Engineering and Analysis. Pan Standford.
3. Price,N.C. and Stevens,L. 1999. Fundamentals of Enzymology, 3rd Edition, Oxford University Press.
4. Berg,J.M. *et al*., 2012. Biochemistry, 7th Edition, W. H. Freeman & Co.

**Reference Books**

1. Walsh,G. 2014. Protein Biochemistry and Biotechnology, 2nd Edition, John Wiley and Sons Ltd.
2. Chapline,M.F. and Buke,C. 1990. Enzyme technology, 1st Edition, Cambridge University Press.

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2. https://nptel.ac.in/content/storage2/courses/102101007/downloads/PPT/LEC-07-PPT.pdf
3. https://nptel.ac.in/content/storage2/courses/103105054/assignments/Q_&_A_Set_8.pdf

**MAPPING**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | H | L | M | L | L | L | L | L |
| CO2 | H | L | L | L | L | M | M | L |
| CO3 | H | L | M | L | M | M | L | L |
| CO4 | H | L | M | L | M | M | M | L |
| CO5 | H | L | M | L | L | L | M | L |

H-High; M-Medium; L-Low

# CELLULAR BIOCHEMISTRY

**COURSE CODE** : **22UPBIC1C04**

| Hours | L | T | P | C |
|---|---|---|---|---|
| | 3 | 1 | 0 | 4 |

**MARKS** **:** 100

**COURSE OBJECTIVES** : At the end of the course learners will be able to understand the structure of membrane, transport mechanism, cell junctions, adhesion molecules, cell signalling, cell division and differention, cell cycle and death.

**COURSE OUTCOMES (CO)**

**After completion of the course, the students will be able,**

| | |
|---|---|
| **CO1** | Understand the structure of tissue organization and the function of cytoskeleton. |
| **CO2** | Understand the role of cellular membrane transport and its role in living system. |
| **CO3** | Identify and assess the function of cell signaling and secondary messengers. |
| **CO4** | Learn the mitosis and meiosis in a living cell and its role in tumorigenesis. |
| **CO5** | Learn the functions of cell cycle and its complications in health and disease. |

**SYLLABUS**

| Unit | Unit title | Intended Learning chapters | Knowledge domain | Hours of Instruction |
|---|---|---|---|---|
| I | **Cell junctions, cell adhesion** | **Cell and tissue organization:** Molecular organization of prokaryotic and eukaryotic cells, structure and functions of subcellular organelles. **The cytoskeleton**: microtubules, microfilaments and intermediate filaments. Cell Junctions- Anchoring, tight and gap junctions. Major classes of cell adhesion molecules (CAMs)-adherins, integrin. | K1, K2 | 12 |
| II | **Membrane transport** | **Diffusion**-Passive and facilitated. General classes of transport system - uniport, symport, antiport. Active transport- primary and secondary. The P-type ATPase ($Na^+$ $K^+$-ATPase), F-type ATPase (ATP Synthases), ABC- transporters, ionophores, aquaporins, ion channels (ligand - gated and voltage gated). Genetic disorders of membrane transport (Wilson's disease and Menkes disease). | K1,K2 | 12 |
| III | **Cell signalling** | **Cell signalling:** Signalling molecules and their receptors, functions of cell surface receptor, pathways of intra cellular signal transduction, second messengers, G-Protein coupled receptors, receptor tyrosine kinases, Ras, Map Kinase. G-Protein–coupled receptors in heart disease. | K1, K2 | 14 |

| | | | | |
|---|---|---|---|---|
| IV | **Cell division, cell differention.** | **Cell division, cell differention.** Molecular events in mitosis and meiosis stem cells types (embryonic, adults), isolation, identification, expansion, differention and uses, stem cell engineering ethical issues. The impact of mitotic errors on cell proliferation and tumorigenesis. | K1, K2 | 13 |
| V | **Cell cycle and death** | **Cell cycle and death:** The cell cycle phase, regulation of cell cycle factors and genes regulating cell cycle. Cell death-types. Necrosis-causes and mechanism. Apoptosis- morphology, mitochondrial and death receptors pathways. Basic elements in autophagy. | K1, K2 | 14 |

***Program specific attributes***

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level(K5)
Scientific or synthesis level (K6)

**REFERENCES:**

**Text Books**

1. Alberts, B. *et al*., 2014. Molecular Biology of the Cell, 6th Edition, Garland PublishingCo.
2. Lodish *et al*. 2016. Molecular Cell Biology, 8th Edition, W.H. Freeman and Co.
3. Cooper, G.M.and Hausman, R.E. 2013. The Cell: A Molecular Approach,6th Edition,Sinauer Associates,Inc.
4. Text book of Biochemistry with clinical correlations, 7th edition, Thomas M.Devlin,2010.

**Reference Books**

1. Karp Cell & Molecular Biology, Wiley. 8th ed. 2016
2. De Robertis and De Robertis. Cell and Molecular Biology. Lippincott Williams and Williams. (Paperback). 8th ed.2017

**Web link**

1. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/cell-biology
2. https://www.microscopemaster.com/cell-biology.html
3. https://duhslibrary.ac.in/Content/515_17_1467782023Module23.pdf

**MAPPING**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | H | L | M | M | L | L | M | L |
| CO2 | H | L | L | L | L | M | M | L |
| CO3 | H | M | M | L | L | L | M | L |
| CO4 | H | M | M | M | L | M | M | L |
| CO5 | H | L | M | M | L | L | M | L |

H-High; M-Medium; L-Low

## CORE PRACTICAL I

## BIOLOGICAL MOLECULES, ENZYMOLOGY AND TECHNIQUES

| Hours | L | T | P | C |
|---|---|---|---|---|
| | - | - | 5 | 4 |

**COURSE CODE** : **22UPBIC1P01**

**MARKS** : **100**

**COURSE OBJECTIVES** : At the end of the course learners will be able to qualitatively and quantitatively identify the biomolecules present in the given sample

1. Preparation of normal, molar and percentage solution
2. Estimation of reducing sugars
3. Estimation of β-carotene from carrot
4. Estimation of protein
5. Isolation and estimation of ascorbic acid from citrus fruit
6. Isolation, assay and specific activity determination of peroxidase enzyme
7. Determination of substrate concentration using MM plot
8. Identification of types of reversible inhibition by LB plot
9. Separation of amino acids by circular paper chromatography

**OUTCOMES**

The students will be acquainted with hands-on knowledge in the qualitative and quantitative analysis of biomolecules in the given samples.

.

## INTERMEDIARY METABOLISM AND ENERGETICS

| Hours | L | T | P | C |
|---|---|---|---|---|
| | 3 | 1 | 0 | 4 |

**COURSE CODE : 22UPBIC1C05**

**MARKS : 100**

**COURSE OBJECTIVES :** To understand the various metabolic pathways operating in living cells with special emphasis on carbohydrate, lipid, amino acid, nucleic acid metabolism and the electron transport chain.

### COURSE OUTCOMES (CO)

After completion of the course, the students will be able,

| | |
|---|---|
| **CO1** | To demonstrate an understanding of the metabolic pathways - the energy-yielding and energy requiring reactions in life |
| **CO2** | To demonstrate an understanding of the diversity of metabolic regulation. |
| **CO3** | To emphasis the unique role in metabolism for life existence |
| **CO4** | To provide conceptual theoretical knowledge |
| **CO5** | To relate various metabolic connectivity and its control |

### SYLLABUS

| Unit | Unit title | Intended learning chapters | Knowledge domain | Hours of instruction |
|---|---|---|---|---|
| I. | Energetics & Bio-oxidation | Free energy and entropy & enthalpy. Enzymes involved in redox reactions. The electron transport chain - Oxidative phosphorylation and mechanism of action. The chemiosmotic theory. Uncouplers and ionophores. Regulation of oxidative phosphorylation- Inhibitors. | K1 & K2 | 13 |
| II. | Carbohydrate Metabolism | Glycolysis/citric acid cycle and its regulation. The pentose phosphate pathway. Metabolism of glycogen and regulation- Cori cycle. Futile cycles. | K1 & K2 | 14 |
| III. | Metabolism of fats | Biosynthesis of fatty acids - fatty acid synthase complex, Oxidation of fatty acids (β). Role of carnitine in fatty acid transport, Metabolism of triglycerides, Cholesterol - Biosynthesis, regulation, transport and excretion. | K1 & K2 | 13 |

| | | | | |
|---|---|---|---|---|
| IV. | Protein metabolism | Branched Amino acids (BCAAs) leucine, isoleucine, and valine- Aromatic amino acids phenylalanine, tyrosine- Aliphatic Amino Acid Alanine and proline- Catabolism of amino acid nitrogen- transamination, deamination, ammonia formation and the urea cycle. Catabolism of carbon skeletons of amino acids. | K2& K3 | 13 |
| V. | Nucleic acid Metabolism & Porphyrins | Metabolism of purines - De novo and salvage pathways for biosynthesis. Purine catabolism. Biosynthesis and catabolism of pyrimidines. Biosynthesis and degradation of porphyrins and heme. | K1 & K2 | 12 |

***Program specific attributes***

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level(K5)
Scientific or synthesis level (K6)

## REFERENCE

### Text Books

1. S. Melmed et al., 2015. Williams Text Book of Endocrinology, 13th Edition, Saun
2. Thomas M Devlin. 2006. Textbook of Biochemistry with Clinical Correlation 2nd ed Wiley & Sons.

### Reference Books

1. Fundamentals of Biochemistry: Life at the Molecular Level, 5th Edition
2. Donald Voet, Judith G. Voet, Charlotte W. Pratt, 2016
3. Zubey,G.L. 1998. Biochemistry, Wm.C. Brown Publishers
4. Garrett,R. and Grisham,C. 2010. Biochemistry, 4th Edition, Saunders College Publishing.

### Web Link

1. https://archive.nptel.ac.in/courses/104/105/102105034/
2. https://nios.ac.in/media/documents/dmlt/Biochemistry/Lesson-03.pd
3. https://www.osmosis.org/notes/Protein_Metabolism

## MAPPING

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | H | L | M | M | L | L | M | L |
| CO2 | H | L | L | L | L | M | M | L |
| CO3 | H | M | M | L | L | L | M | L |
| CO4 | H | M | M | M | L | M | M | L |
| CO5 | H | L | M | M | L | L | M | L |

H-High; M-Medium; L-Low

## PLANT BIOCHEMISTRY

**COURSE CODE : 22UPBIC1C06**

**MARKS : 100**

| Hours | L | T | P | C |
|---|---|---|---|---|
| | 3 | 1 | 0 | 4 |

**COURSE OBJECTIVES :** To understand the plant cell wall structure, biochemical processes that take place in plant such as plant metabolic processes, photosynthetic reactions, plant hormones, and plant secondary metabolites.

### COURSE OUTCOMES (CO)

After completion of the course, the students will be able,

| | |
|---|---|
| **CO1** | To explain the plant cell wall structure and to understand the plant nuclear, plastid genome organization and explain the biogenesis of organells |
| **CO2** | To explain the basic concepts in photosynthesis and its regulation |
| **CO3** | To understand different biogeocyles and its impact on earth. The basic knowledge on mineral nutrition in plant health and deficiencies will also be understood. |
| **CO4** | To evaluate the impact of hormones in plant growth, flowering and maintenance. |
| **CO5** | To imbibe the mechanism of action of plant defences, antiodixant system in plant defenses and photochemistry of plants. |

### SYLLABUS

| Unit | Unit title | Intended Learning chapters | Knowledg e domain | Hours of Instru cti on |
|---|---|---|---|---|
| I | Plant cell wall and genome organization | Plant cell wall – Structure and function. Water uptake and movement – diffusion, osmosis, aquaporins.<br>Plant genome organization: Plant nuclear and plastid genome organization.<br>Biogenesis of organelles - Interaction between nuclear and organellar genome. | K1,K2, K3 | 13 |

| | | | | |
|---|---|---|---|---|
| II | Photosynthesis and its regulation | Photosynthesis in plants - Structure of organelles involved in photosynthesis. Light receptors - chlorophyll, light harvesting complexes. Light and dark reaction, Photophosphorylation and reduction of $CO_2$- C3&C4. Photorespiration. | K1,K2, K3 | 12 |
| III | Biogeo cycles & Plant mineral nutrition | Mineral Nutrition - Biogeo cycles (Nitrogen)-Nitrate assimilation: structural features of nitrate reductase and nitrite reductase, Regulation of nitrate assimilation. Nutrient absorption and translocation, Nutrient functions in growth and development, Nutrient deficiency symptoms. | K1, K2, K3 | 13 |
| IV | Phytohormones | Phytohormones: Auxins, cytokinins,Abscisic acid, Gibberellins, ethylene-physiological function. Shikimate pathway, Acetate-mevalonate pathway. Special features of secondary plant metabolism-phytochemistry of plants Biochemistry and significance of phenolic compounds, terpenoids, alkaloids. | K1, K2, K3 | 12 |
| V | Plant defense system and phtochemistry | Plant defenses- environmental and genetic control, Antioxidative defence system in plants - reactive oxygen species and their generation, enzymic and non-enzymic components of antioxidative defence mechanism | K1, K2, K3 | 15 |

***Program specific attributes***

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level(K5)
Scientific or synthesis level (K6)

**REFERENCES**

**Text Books**

1. Heldt,H.W. and Piechulla,B. 2016. Plant Biochemistry, 4th Edition, Academic Press.
2. Heldt,H.W. 2004. Plant Biochemistry, 3rd Edition, Academic Press.
3. Buchannan,B. et al, 2015. Biochemistry and Molecular Biology of Plants, 2nd revised Edition, Wiley.
4. Verma S.K. and Verma Mohit. 2007. Text book of Plant Physiology, biochemistry and Biotechnology, 6th Edition, S. Chand.
5. Goodwin and Mercer. 2005.Introduction to Plant Biochemistry.2nd Edition, CBS.

**Reference Books**


1. Dey, P.M. and J.B.Harborne. 1997. Plant Biochemistry, Academic Press, New York.
2. Goodwin, T.W. and E.I. Mercer. 1983. Introduction to Plant Biochemistry. Pergamon Press.
3. Heldt, H.S. 1997. Plant Biochemistry and Molecular Biology. Oxford Univ Press.
4. Lea, P.J and R.C. Leegood. 1993. Plant Biochemistry and Molecular Biology. 2nd Ed. John Wiley.


**Weblink**

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2. http://us.expasy.org
3. http://www.worthington-biochem.com
4. http://www.biochemist.org
5. http://www.gwu.edu/~mpb

**MAPPING**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | H | L | L | L | L | L | M | L |
| CO2 | H | L | M | L | L | M | M | L |
| CO3 | H | L | M | L | L | L | M | L |
| CO4 | H | L | M | M | L | M | M | L |
| CO5 | H | L | L | M | L | L | M | L |

H-High; M-Medium; L-Low

## ADVANCED MOLECULAR BIOLOGY

**COURSE CODE : 22UPBIC1C07**

| Hours | L | T | P | C |
|---|---|---|---|---|
| | 3 | 1 | 0 | 4 |

**MARKS : 100**

**COURSE OBJECTIVES :** To understand the basic structure and functioning of the genetic material, knowledge on the activity of genes and genomes, molecular mechanisms of DNA replication, repair, recombination, transcription, protein synthesis and gene regulation.

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**COURSE OUTCOMES (CO)**

| | |
|---|---|
| **CO1** | Molecular biology gives an in-depth knowledge of biological processes through the investigation of the underlying molecular mechanisms. |
| **CO2** | Describe the processes of replication, repair and recombination |
| **CO3** | Understanding the underlying process of prokaryotic transcription and regulation |
| **CO4** | Explain the mechanism of eukaryotic transcription and regulation |
| **CO5** | Provides the basics of genetic code, translation and targeting |

**SYLLABUS**

| Unit | Unit title | Intended Learning chapters | Knowled ge domain | Hours of Instruct ion |
|---|---|---|---|---|
| I | Chromatin and Genome | Central dogma of Molecular biology. Structure of the bacterial nucleoid, Role of Nucleoid Associated proteins. Eukaryotic chromatin organization.<br>Genome complexity- genome size, C- value paradox, coding and non coding DNA, Introns and exons and repetitive DNA (SINES, LINES, simple sequence repeats - satellite, mini satellite and microsatellite). | K1,K2, | 13 |
| II | Replication, Repairing mechanism and Recombination | DNA replication in prokaryotes and eukaryotes. Proteins responsible for replication. Inhibitors of replication.<br>DNA repair mechanisms – Excision repair, double-strand break repair, recombination repair and SOS response. Recombination – Homologous recombination, site specific recombination- Transposons. | K1,K2 | 12 |

| | | | | |
|---|---|---|---|---|
| III | Transcription | Prokaryotic Transcription-Structure of *E.coli* RNA polymerase, Steps involved in transcription. Transcription inhibitors. Post-transcriptional processing of rRNA and tRNA.<br>Eukaryotic transcription- Structure of RNA polymerase I, II and III. General transcription factors. Steps involved in transcription. Post transcriptional processing of mRNA. | K1,K2 | 13 |
| IV | Transcriptional Regulation | Regulation of transcription in prokaryotes – lac operon and trytophan operon.<br>Regulation of transcription in eukaryotes- Transcriptional factors, Activators and repressors. Steroid hormone receptors. DNA binding motifs- Helix turn helix, zinc fingers, leucine zippers, helix loop helix motifs. | K1, K2 | 12 |
| V | Genetic Code, and Translation | Genetic code - salient features.<br>Mutations– definition, Types of mutation.<br>Mechanism of protein synthesis in bacteria and eukaryotes- amino acid activation, initiation, elongation and termination. Inhibitors of protein synthesis. Co and post-translational modifications. | K1,k2, | 15 |

***Program specific attributes***

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level(K5)
Scientific or synthesis level (K6)

**REFERENCES:**

**Text Books**


**1.** Lodish *et al*. 2012. Molecular Cell Biology, 7th Edition, W.H. Freeman and Co.
2. Weaver,R.F. 2011. Molecular Biology, 5th Edition, WCB McGraw Hill, Higher Education.
3. Karp,G. 2009.Cell and Molecular Biology, 6t h Edition, John Wiley & Sons, Inc.


**Reference Books**


1. Alberts,B. *et al*., 2008. Molecular Biology of the Cell, 5th Edition, Garland Publishing Co.
2. Watson,J.D. *et al*., 2013. Molecular Biology of the Gene, 7th Edition, Pearson Education.
3. Lewin,B. 2007. Genes IX, 9th Edition, Jones and Bartlett Publishers.

**Web Link**

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2. https://www.ncbi.nlm.nih.gov/books/NBK9846/
3. https://www.ncbi.nlm.nih.gov/books/NBK26879/
4. https://www.ncbi.nlm.nih.gov/books/NBK26879/

**MAPPING**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | H | L | L | M | L | L | M | L |
| CO2 | H | L | L | M | L | L | M | L |
| CO3 | H | L | L | L | L | L | M | L |
| CO4 | H | L | L | M | L | L | M | L |
| CO5 | H | L | L | L | L | L | M | L |

H-High; M-Medium; L-Low

## CORE PRACTICAL II

## MOLECULAR AND MICROBIAL TECHNIQUES

| Hours | L | T | P | C |
|---|---|---|---|---|
| | - | - | 5 | 4 |

**COURSE CODE : 22UPBICP02**

**MARKS : 100**

**COURSE OBJECTIVES :** This course is designed to provide hands-on training in molecular and microbial techniques.

1. Isolation and estimation of DNA
2. Isolation and estimation of RNA
3. Estimation of phosphorus
4. Estimation of chlorophyll in leaves
5. Separation of lipids by TLC
6. Separation of aminoacids by TLC
7. Agarose gel electrophoresis of DNA
8. Isolation of pure culture - Serial dilution, pour plate, spread plate, streak plate

**OUTCOMES**

After the completion of this course the students will be able to understand and gain practical experience in molecular and microbial techniques

## GENE TECHNOLOGY

**COURSE CODE : 22UPBIC1C08**

| Hours | L | T | P | C |
|---|---|---|---|---|
| | 3 | 1 | 0 | 4 |

**MARKS : 100**

**COURSE OBJECTIVES :** To familiarize the students with the recent knowledge in gene technology; the completion of this course the students will have be able to comprehension the versatile tools and techniques employed in genetic engineering; and to appraise them about applications of genetic engineering.

**COURSE OUTCOMES (CO)**

| | |
|---|---|
| **CO1** | The student will have knowledge of tools and strategies used in genetic engineering. |
| **CO2** | Understanding the application of genetic engineering techniques in basic and applied research. |
| **CO3** | To understand the concept of the gene expression systems used in genetic engineering. |
| **CO4** | To impact knowledge latest updation and application of genetic engineering |
| **CO5** | To motivate and create interest to uptake genetic engineering for research |

**SYLLABUS**

| Unit | Unit title | Intended learning chapters (K1,K2) | Knowledge domain | Hours of instruction |
|---|---|---|---|---|
| I | Restriction endonucleases, cloning vectors, and ligation | Type II Restriction Endonucleases nomenclature and types of cleavage. Cloning vectors: plasmids (pBR322 and pUC), phage vectors (λ), cosmids, YACs. Methods of ligation of insert and vector DNA molecules: cohesive end method, homopolymeric tailing, blunt-end ligation, linkers and adapters | K1, K2,K3 | 14 |
| II. | Gene cloning methods & screening strategies: | Gene transfer methods: Electroporation, lipofection, microinjection. Choice of host organisms for cloning. Construction of genomic and cDNAlibraries - genomic cloning, cDNA cloning. Differences between genomic and cDNA libraries. Screening of recombinants: marker inactivation (antibiotic resistance, blue-white selection), colony hybridization. | K2,K3 | 12 |

| | | | | |
|---|---|---|---|---|
| III. | Gene Expression systems: | Factors affecting expression of cloned genes. Expression of eukaryotic genes in bacterial expression vector. Fusion proteins, strategies to enhance protein stability, secretion and metabolic load. Expression in eukaryotic cells: Expression in yeast- yeast vectors, GAL system. Reporter genes-types and uses. | K1&K2 | 12 |
| IV. | Gene Manipulation Tools | Blotting techniques: Southern, northern, and western. Principle and applications of DNA fingerprinting, DNA foot printing in situ hybridization, PCR and its types- DNA Sequencing: Automated sequencing. Next generation sequencing. Site-directed mutagenesis (SDM): cassette and oligonucleotide-directed mutagenesis. Protein engineering by directed evolution and DNA shuffling. Hazards and safety aspects of genetic engineering. | K1,K3 | 13 |
| V. | Transgenesis & Gene therapy | Transformation, co-transformation, selectable markers, reporter genes. Transgenic animals - methods of production gene knock out in transgenic mice. Transgenic animals as models of human disease. Application of transgenic mice, animal bioreactors (Pharm animals).Antisense RNA technique. Transgenic plant technology-development and applications. Invivo & Exvivo gene therapy. | K1, K2 | 14 |

***Program specific attributes***

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level(K5)
Scientific or synthesis level (K6)

**REFERENCE:**

**Text Books**


1. Brown,T.A. 2010. Gene cloning and DNA analysis: An introduction, 6 th Edition, Wiley-Blackwell Publishers.
2. Primrose,S.B. and Twyman,R. 2006. Principles of Gene Manipulation and Genomics, 7th Edition, Oxford University Press.
3. Glick,B.R. and Pasternak,J.J. 2009. Molecular Biotechnology - Principles and Applications of Recombinant DNA, 4th Edition, ASM Publishers.


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1. Strachan,T. and Read,A.P. 2003. Human Molecular Genetics, 3rd Edition, Garland Science Publishers.
2. Watson,J.D. *et al*., 2007. Recombinant DNA-Genes and Genomes: A short course, 3rd

Edition, Cold Spring Harbor Laboratory Press.
3. Winnacker,E.L. 1987. From Genes to clones, 1st Edition, Wiley-Blackwell Publishers.
4. Nicholl,D.S.T. 2008. An introduction to Genetic Engineering. 3 rd Edition, Cambridge University Press

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**1.** http://www.aun.edu.eg/molecular_biology/Procedure1/1%20Gene%20cloning%20an%20overview.pdf
2. https://archive.nptel.ac.in/courses/102/103/102103074/
3. https://nptel.ac.in/courses/102103013
4. https://nptel.ac.in/courses/102103074

**MAPPING**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | H | M | M | M | M | L | M | L |
| CO2 | H | M | M | M | M | M | M | L |
| CO3 | H | M | M | M | M | L | M | L |
| CO4 | H | M | M | M | M | M | M | L |
| CO5 | H | M | M | M | M | L | M | L |

H-High; M-Medium; L-Low

## CLINICAL AND DIAGNOSTIC BIOCHEMISTRY

**COURSE CODE : 22UPBIC1C09**

| Hours | L | T | P | C |
|---|---|---|---|---|
| | 3 | 1 | 0 | 4 |

**MARKS : 100**

**COURSE OBJECTIVES :** To impart knowledge about the biochemical basis of various diseases and disorders, and to study various diagnostic and therapeutic methodologies available for diseases and disorders.

### COURSE OUTCOMES (CO)

| | |
|---|---|
| **CO1** | To have a basic knowledge on collection of samples, role of preservatives, time of its additions, need of its addition, and also various procedures involved in collection of clinical samples like blood, urine, stool, CSF, amniotic fluid as well as purpose of collection, biochemical test that could be carried out in the samples. |
| **CO2** | To have a critical understanding on In born errors of metabolism. And its causative factors like genetic defect in specific key metabolic enzymes induced specific diseases of carbohydrate, lipid, protein, purine and pyrimidine metabolism. |
| **CO3** | Enzymatic assay protocols that could help one to diagnose the specific illness like hepatobiliary diseases by comparing with their normal values and by knowing cusative factors . |
| **CO4** | Understand the test available for gastric, liver, pancreas function in order to assess the laboratory results obtained as well as to interpret them. |
| **CO5** | To have a better in-depth knowledge on diagnosis using biochemical parameters, complications, management of diseases like Diabetes mellitus, Atherosclerosis, cancer. |

### SYLLABUS

| Unit | Unit title | Intended learning chapters (K1,K2) | Knowledge domain | Hours of instruction |
|---|---|---|---|---|
| I. | Biological Specimen collection, preservation for analysis | Collection of blood, anticoagulants. Collection of urine - Timed urine. specimens preservatives. Stool – chemical examination. CSF – collection, analysis. Amniotic fluid: collection, analysis. Automation in clinical biochemistry laboratories: Precision, reliability, reproducibility. | K1,K2,K3 | 15 |

| | | | | |
|---|---|---|---|---|
| II. | Inherited metabolic disorders: | Carbohydrate metabolic disorders- glycogen storage diseases, fructose intolerance and fructosuria. Lipid metabolism disorders- Lipid storage diseases, fatty liver and lipoproteinemias. Aminoaciduria –Renal. Disorders of purine, pyrimidine - Hyperuricemia, Hyporuricemia and gout. Porphyrias – Erythropoietic and hepatic. | K1, K2, K3 | 14 |
| III. | Serum Enzymes in clinical diagnosis of disease | Principle and assay of transaminases, phosphatases, isocitrate dehydrogenase, creatine kinase. lactate dehydrogenase, amylase. | K1, K2, K3 | 12 |
| IV. | Organ function tests | Normal structure of liver, kidney, and assessment of its function- LFT, RFT, and Biochemical findings in disease condition- hepatitis, acute and chronic renal failure. | K1, K2,<br>K3 | 12 |
| V. | COVID and associated disease | COVID Vaccine types – Adenovirus and RNA Vaccine, Relationship between Diabetes, Black fungus and COVID. | K3, K4, K5 | 12 |

***Program specific attributes***

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level(K5)
Scientific or synthesis level (K6)

**REFERENCES:**

**Text Books**


1. Burtis,C. and Bruns,D. 20. Teitz Fundamentals of Clinical Chemistry, 7th Edition, W.B. Saunders Company.
2. Devlin,T.M. 2010. Text book of Biochemistry with Clinical Correlation, 7th Edition, John Wiley and Sons.
3. Varley,H. 1980.Practical Clinical Biochemistry, Volume I and II, 5 th Edition, CBS Publishers.


**Reference Books**


1. William J. Marshall & Stephen K. Angert. 2014. Clinical Biochemistry – Metabolic and Clinical aspects. Third Edition. Elsevier Ltd
2. Smith CM, Marks AD and Marks DB. Basic Medical Biochemistry: A Clinical approach. Second Edition, Lippincott Williams and Wilkins.
3. Delvin T. 2011.Biochemistry with clinical correlation. 5th Edition. John Wiley & Sons
4. John Stanbury . James B. Wyngaarden, Donald S. Fredrickson. 1983. The Metabolic Basis of Inherited Disease 5th Ed.-By. McGraw-Hill Companies.

**Weblink**

1. Clinical Biochemistry E-Book: Metabolic and Clinical Aspects
2. Clinical Biochemistry E-Book - 9780702048920 | Elsevier
3. Clinical Biochemistry - 9780702072987 - Elsevier Health
4. http://www.bmrat.org › BMRAT › article › view

**MAPPING**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | H | M | M | M | H | H | L | M |
| CO2 | H | M | M | M | M | M | L | L |
| CO3 | H | M | M | M | H | H | M | L |
| CO4 | H | M | M | M | H | M | L | L |
| CO5 | H | M | M | M | M | H | M | L |

H-High; M-Medium; L-Low

## IMMUNOLOGY AND IMMUNOTECHNOLOGY

**COURSE CODE** **:** 22UPBIC1C10

**MARKS** **:** 100

| Hours | L | T | P | C |
|---|---|---|---|---|
| | 3 | 1 | 0 | 4 |

**COURSE OBJECTIVES** : The candidate will gain knowledge about the molecular and cellular interactions and principles of the immune system, B & T cells maturation and specific response.

**COURSE OUTCOMES (CO)**

| | |
|---|---|
| **CO1** | To provide students with knowledge on how the immune system works. A description of cells involved in the immune response either innate or acquired. Understand the contributions of the organs. Provide basic knowledge of the organization and function of the immune system. |
| **CO2** | Understand the antibodies and immunoglobulins, Be able to distinguish and characterize antibody isotypes and functions. |
| **CO3** | Understand the significance of MHC molecules in terms of immune response. Be able to describe lymphocyte development and their expression of receptors, Compare and contrast the origin, maturation process. |
| **CO4** | Comprehend the over reaction by our immune system leading to hypersensitive conditions and its consequence. |
| **CO5** | Gain knowledge about immunologic processes governing graft rejection and therapeutic modalities for immunosuppression in transplantation. Understand the properties of tumour antigens, immune response to tumours. |

**SYLLABUS**

| Unit | Unit title | Intended Learning chapters | Knowled ge domain | Hours of Instruction |
|---|---|---|---|---|
| I | Immune cell types | Ontogeny and Physiology of immune system. Primary and Secondary lymphoid organs, lymphoid tissues. Cells of the immune system - lymphocytes, mononuclear phagocytes - dendritic cells, granulocytes, NK cells, mast cells and cytokines. | K1,K2 | 13 |

| | | | | |
|---|---|---|---|---|
| II | Antigen and antibodies | Antigen, types of antigen vs immunogens, haptens factors influencing immunogenicity. Immunoglobulins - structure, classification and functions. Isotypes, allotypes and idiotypes. Monoclonal and polyclonal antibody production. Complement activation and its biological consequences. | K1,K2 | 12 |
| III | Vaccines and Hypersensitivity | Types and methods of vaccine development. Vaccination – its rationale schedules and importance of vaccination in public health. Hypersensitivity – types and mechanisms. Immunodeficiency diseases. | K1, K2 | 13 |
| IV | Transplantation Immunology | Overview of Clinical transplantation- Graft rejection - Acute and Chronic. Immune suppression and immune tolerance. Cancer and Immune system- tumours of the Immune system- Tumour antigens, Cancer Immune therapy. | K1, K2, | 13 |
| V | Immuno techniques: | Agglutination and precipitation technique. Immunoelectrophoresis, RIA, immunoblotting. Avidine-biotin mediated immune assay. Immunohistochemistry- immunofluorescence, immune ferritin technique. fluorescent immunoassay, fluorescence cell sorting (FACS), cytokines assay; ELISA and ELISPOT. | K1,k 2, K3 | 14 |

***Program specific attributes***

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level
(K5)
Scientific or synthesis level (K6)

**REFERENCES:**

**Text Books**

1. Jenni Punt, Sharon Stranford et al. 2018. Kuby Immunology. 8th Ed. WH Freeman & Co.

2. Abbas et al. 2018. Cellular and Molecular Immunology. 9th Edition. Elsevier.

3. Janeway, C. (Ed), Travers. 2016. Immunobiology. 8th Ed. Garland Publ.

4. Coico and Sunshine. 2015. Immunology: A short Course. 7th Ed. Wiley-Liss.

**Reference Books**

1. Roitt et al. Roitt's. 2017. Essential Immunology. 13 th Ed. Wiley-Blackwell Sci.

2. Lauren Sompayrae. 2017. The Immune System Work. 4th Edition,

**Web Link**

1. www.whfreemen.com/kuby
2. www.immunologylink.com

**MAPPING**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | H | M | L | M | L | M | M | L |
| CO2 | H | M | L | M | L | M | M | L |
| CO3 | H | M | L | M | L | M | M | L |
| CO4 | H | M | L | M | L | M | M | L |
| CO5 | H | M | L | M | L | M | M | L |

H-High; M-Medium; L-Low

## CORE PRACTICAL III
## CLINICAL & DIAGNOSTIC BIOCHEMISTRY AND GENETIC ENGINEERING

**COURSE CODE : 22UPBIC1P03**

| Hours | L | T | P | C |
|---|---|---|---|---|
| | - | - | 5 | 4 |

**MARKS : 100**

**COURSE OBJECTIVES :** This course is designed to provide hands-on training in clinical Biochemistry and recombinant DNA techniques.

1. Estimation of blood Urea
2. Estimation of serum uric acid
3. Estimation of serum creatinine
4. Estimation of serum calcium
5. Estimation of serum Bilirubin – TB, DB
6. Assay of Aspartate amino transferase
7. Estimation of serum protein, albumin, AG ratio
8. Assay of Alkaline phosphatase
9. Isolation of genomic DNA from liver/plant/ bacterial source
10. Isolation of plasmid DNA from bacteria
11. Restriction digestion of DNA
12. Transformation in *E.coli*
13. PCR demonstration

**OUTCOMES**

The students will be able to understand and apply the hands-on knowledge gained in clinical biochemistry and genetic engineering in their future research activites as well as while establishing clinical laboratories.

## RESEARCH METHODOLOGY AND BIOSTATISTICS

**COURSE CODE : 22UPBIC1C11**

| Hours | L | T | P | C |
|---|---|---|---|---|
| | 3 | 1 | 0 | 4 |

**MARKS :100**

**COURSE OBJECTIVES** : The course emphasizes on various statistical methods and its significance. The students are expected to understand the concepts and solve relevant problems pertaining to each topic for the design of basic research and analysis of research data.

**COURSE OUTCOMES (CO)**

| | |
|---|---|
| CO1 | To get introduced into some basic concepts of research and its methodologies, scientific writing and data presentation |
| CO2 | To understand the guidelines of biosafety and to know the role of funding agency in research development |
| CO3 | To understand the guidelines of bioethics and to perceive the importance of IPR |
| CO4 | To understand the data collection methods and expertise with diagrammatical and graphical representation of data. |
| CO5 | To study the central tendency, variation and correlation analysis, student T test and ANOVA |

**SYLLABUS**

| Unit | Unit title | Intended Learning chapters | Knowled ge domain | Hours of Instruct ion |
|---|---|---|---|---|
| I | Research types and scientific writing | Research –Definition, Types of Research. Choosing a topic and formulation of hypothesis. Scientific writing – logical format for writing thesis and papers – abstract, introduction, review of literature, materials and methods, results – illustration by tables and figures, discussion, and bibliography – Harvard and Vancouver systems. | K1,K2, K3 | 15 |
| II | Biosafety and Funding agency | Safety, general guidelines and funding agencies Biosafety – Levels of Biosafety. Guidelines for DNA research activities. Research bodies & funding agencies – UGC, CSIR, ICMR, DST, DBT,ICAR, DAE, DRDO, DOD, Fellowships. | K2,K3 | 14 |

| | | | | |
|---|---|---|---|---|
| III | Bioethics guidelines | Bioethics and Patenting Ethics in animal experimentation, CPCSEA guidelines. Composition of (human) Institutional evaluation Ethical Committee (IEC) – General ethical issues. Ethical issues in human gene therapy, Embryonic stem cell. Patenting – definition of patent – different types of intellectual property rights. | K2,K3, K4 | 12 |
| IV | Data collection methods | Source of data – Primary and secondary data, collection, observation, interview, enquiry forms, questionnaire schedule and check list. Classification and tabulation of data. Diagrammatic and graphic presentation of data. | K1,K2, K3 | 14 |
| V | Measures central tendency Analysis and Test of significance | Measures of central tendency - arithmetic mean, median, mode. Measures of variation - range, quartile deviation, mean deviation, standard deviation, Coefficient of Karl's Pearson's coefficient of correlation and Spearman's rank method. Regression analysis. Test of significance based on large samples and small samples, Student t test , One way ANOVA. | K2,K3, K4 | 15 |

***Program specific attributes***

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

**Reference Books**

**Text Books**

1. Gupta,S.P. 2011. Statistical Methods, 4th Edition, Sultan Chand & Son Publishers.
2. Lesk, A.M. 2002. Introduction to Bioinformatics, Oxford University Press.
3. Kothari C.R. 2013. Research Methodology : Methods and Techniques, 3 rd Edition, New Age Publishers
4. Ethical guidelines for Biomedical Research on human subjects. ICMR, New Delhi, 2006.
5. P. G. Cooray. 1992. Guide to scientific and technical writing. Publisher P. G. Cooray.

**Reference Books**

1. Daniel,W.W. 2008. Biostatistics - A Foundation for Analysis in Health Sciences, 9 th Edition, John Wiley and Sons, Inc.,
2. Day.R.A. 1989. How to write and publish a scientific paper. 3rd Edition, Cambridge University Press.

**Weblink**

1. https://archive.nptel.ac.in/courses/127/106/127106227/
2. https://nptel.ac.in/courses/121106007
3. https://onlinecourses.nptel.ac.in/noc22_ge08/preview
4. https://archive.nptel.ac.in/courses/102/101/102101056/
5. https://archive.nptel.ac.in/courses/102/106/102106051/

**MAPPING**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | H | L | L | L | M | L | L | L |
| CO2 | H | L | M | L | M | L | L | L |
| CO3 | H | L | M | L | M | M | L | L |
| CO4 | H | L | M | L | M | M | L | L |
| CO5 | H | L | M | L | M | L | L | L |

H-High; M-Medium; L-Low

## CORE PRACTICAL IV
## CLINICAL BIOCHEMISTRY AND IMMUNOLOGY AND IMMUNOTECHNIQUES

**COURSE CODE : 22UPBIC1P04**

| Hours | L | T | P | C |
|---|---|---|---|---|
| | - | - | 5 | 4 |

**MARKS : 100**

**COURSE OBJECTIVE** : This course is designed to provide hands-on training in clinical Biochemistry and immunochemical techniques.

1. Estimation of Glutathione peroxidase
2. Estimation of reduced Glutathione
3. Estimation of Vitamin C
4. Estimation of Lipid peroxidation
5. Estimation of triglycerides
6. Estimation phospholipids
7. Estimation total cholesterol
8. Estimation of HDL and LDL cholesterol
9. Immuno diffusion – Single radial and double diffusion
10. Immunoelectrophoresis
11. Rocket immunoelectrophoresis
12. Agglutination tests
13. Serial dilution of ASO titre,VDRL titre

**OUTCOMES**

The students will have a clear understanding and hands-on experience on the most practical aspect of clinical biochemistry and immunology

# ELECTIVES
# PART A
# **CLINICAL BIOCHEMISTRY**

## ENDOCRINE SYSTEM & HORMONAL REGULATION

**COURSE CODE : 22UPBIC1E01**

| Hours | L | T | P | C |
|---|---|---|---|---|
| | 3 | 1 | 0 | 4 |

**MARKS : 100**

**COURSE OBJECTIVES :** To obtain sound knowledge in Hormonal Biochemistry.

**COURSE OUTCOMES (CO)**

| | |
|---|---|
| **CO1** | To provide core principle and concepts of molecular endocrinology to unable to Students understand and acquire knowledge. |
| **CO2** | To provide clear understanding and critical interpretations of clinical manifestation. |
| **CO3** | To impact the basis theoretical knowledge in molecular endocrine |
| **CO4** | Educating and familiarizing the terms and concepts of molecular endocrinenology |
| **CO5** | To impact complete idea and knowledge in hormones. |

**SYLLABUS**

| Unit | Unit title | Intended learning chapters (K1,K2) | Knowledg e domain | Hours of instruction |
|---|---|---|---|---|
| I. | History and anatomy of Mammalian endocrine system. | Classification of hormones. Hypothalamic hormones. Pituitary hormones (i)Anterior pituitary hormones: biological actions and regulation of growth hormone, ACTH, gonadotropins and prolactin, Leptin. (ii)Posterior pituitary hormones- biological actions of vasopressin- ADH secretion (SIADH) Oxytocin. Hypopituitarism. | K1 & K2 | 13 |
| II. | Thyroid and Parathyroid hormones | Thyroid hormones- synthesis, secretion, regulation, transport, metabolism and physiological functions. Hyper and hypothyroidism. Hormonal regulation of calcium and phosphate metabolism. Secretion and biological actions of PTH, calcitonin and calcitriol. | K1, K2 | 12 |

| | | | | |
|---|---|---|---|---|
| III. | Adrenal Hormones | Adrenal cortical hormones: Synthesis, regulation and biological effects of glucocorticoids and mineralocorticoids. Cushing's syndrome, aldosteronism, CAH, aderenal cortical insufficiency, Addison's disease. Adrenal medullaryhormones: Synthesis, regulation and physiological effects of catecholamines- Phaeochromocytoma. | K1, K2 | 15 |
| IV. | Gonadal, Pancreatic and Gastrointestinal hormones: | Gonadal hormones: Biosynthesis, regulation and biological functions of androgens. Hypogonadism. Pancreatic Hormones: insulin- glucagon and somatostatin. Gastrointestinal hormones-synthesis and physiological function. | K1, K2 | 15 |
| V. | Signal transduction and Neuro transmitter: | Basic concepts, general features of cell signalling. Endocrine, paracrine and autocrine signaling. Receptors-Classification-Nuclear and cytosolic receptors. G-protein-coupled receptors. Second messengers: c-AMP- Neurotransmitter –general features, mechanism and biological function. Neurotransmitter receptor- Cholingeric and adrenergic. | K1 & K2 | 15 |

***Program specific attributes***

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

**REFERENCE:**

**Text Books:**


1. Hadely,M. and Levine,J.E. 2006. Endocrinology, 6 thEdition, BenjaminCummings.
2. Smith,E. *et al*., 1983. Principles of Biochemistry, 7thEdition, McGraw Hill International Book
3. Harper's Illustrated Biochemistry Thirty-First Edition McGraw-Hill Education– Illustrated, 2018.
4. Harold Varley et al, Varley's practical clinical biochemistry,6th edition, London : Heinemann Medical Books ; New Delhi (India) : CBS, 2006, 1988.
5. Dr. M. Suriyavathana , Intermediary Metabolism – A Students Companion, Sara Publication, 2018.


**Reference Books:**


1. Guyton,A.C. and Hall,J.E. 2010. Text book of Medical Physiology, 12th Edition, Saunders Publishers.
2. S. Melmed et al., 2015. Williams Text Book of Endocrinology, 13th Edition, Saun
3. Biochemistry- Donald Voet, J.G. Voet, John Wiley, J O H N WI VP & Publisher Kaye Pace
4. Biochemistry 4th ed- Campbell and Farrell, Brooks/Cole Pub Co.


**MAPPING**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | H | L | M | M | L | M | L | L |
| CO2 | H | L | M | M | L | M | L | L |
| CO3 | H | M | M | M | L | M | L | L |
| CO4 | H | L | M | M | L | M | L | L |
| CO5 | H | L | M | M | L | L | L | L |

H-High; M-Medium; L-Low

## ONCOLOGY

**COURSE CODE : 22UPBIC1E02**

| Hours | L | T | P | C |
|---|---|---|---|---|
| | 3 | 1 | 0 | 4 |

**MARKS : 100**

**COURSE** OBJECTIVES **:** To understand the epidemiology of cancer, mechanism of oncogenesis and apoptosis, and currently available therapeutic treatments.

**COURSE OUTCOMES (CO)**

| | |
|---|---|
| **CO1** | To have an understanding , basic knowledge on various cancer growth and morphology of cancer , terminologies used , types and prevalence of cancer, to have a further in depth knowledge in the continuing units |
| **CO2** | Develop an understanding of how a cancer cell develops into a malignant tumor, the mechanisms of DNA damage through various agents and how this process is linked to cellular transformation and cancer risk. |
| **CO3** | Understand the common cellular and molecular mechanisms that are deregulated in cancer cells and the reason for their deregulation. And also the relationship between diet and cancer, free radicals and antioxidants balance/ role in cancer development. |
| **CO4** | To have a better understanding on the impact of apoptosis, its types on oncogenesis, cancer diagnosis via several different methods, cytotoxicity assays, which will enable the student to be aware on current diagnostic tools and the principles behind it. |
| **CO5** | Having basic knowledge on novel therapeutic approaches available for cancer and its assessment/ identification by different cancer markers. |

**SYLLABUS**

| Unit | Unit title | Intended Learning chapters | Knowled ge domain | Hours of Instruct ion |
|---|---|---|---|---|
| I | Morphology of cancer cell | Structure, characteristics of cancer cell. Abnormal Growth characteristics- hyperplasia, dysplasia, anaplasia and neoplasia. Difference between normal and cancer cell. Paraneoplastic syndrome. | K1,K2 | 13 |
| II | Agents causing cancer and carcinogenesis process | Agents- Chemicals, radiation, Free radicals, foods, environment, mutation. Carcinogenesis process – Initiation, promotion, progression. | K1,K2 | 12 |

| | | | | |
|---|---|---|---|---|
| III | Genetics, molecular biology of cancer | Proto-oncogene, oncogene, tumour suppressor genes involved in cancer. Cell cycle and cancer. Mechanism of apoptosis- Intrinsic and extrinsic pathways. | K1, K2,K4 | 13 |
| IV | Diagnosis and therapy | Biochemical, genetic methods of diagnosis of cancer. Chemotherapy, radiation therapy. Antioxidants and its role in cancer prevention. Principles of cancer biomarkers and their applications. | K1,K2,K3,K4 | 12 |
| V | COVID and cancer | Molecular link between COVID and cancer, cytokine storm, coagulation, Complications of COVID. | K1, K2,K3,K4 | 15 |

***Program specific attributes***

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

**REFERENCES:**

**Text Books**


1. Franks,L.M. and Teich,N.M. 1991. An introduction to Cellular and Molecular Biology of cancer, 2nd Edition, Oxford University Press.
2. Vincent,T. *et al*., 2011. Principles and Practice of Oncology: Primer of the Molecular Biology of Cancer, 1stEdition, Lippincott Williams and Wilkins.
3. Weinberg,R.A. 2013. The Biology of Cancer, 2nd Edition, Garland Science.
4. Hesketh,R. 2013. Introduction to Cancer Biology, Cambridge University Press.


**Reference Books**


1. Momna Hejmadi . 2010 Introduction to cancer biology by, 2nd edition, Ventus Publishing
2. Weinberg R. 2013. The Biology of Cancer , 2nd edition, Garland Publishing Inc.
3. Robert A Weinberg - W.W. Norton. The Biology of Cancer


**Web link:**

1. http://link.springer.com › content › pdf
2. https://pubmed.ncbi.nlm.nih.gov ›

**MAPPING**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | H | L | L | M | L | M | L | L |
| CO2 | H | L | M | M | L | M | L | L |
| CO3 | H | L | M | M | L | M | L | L |
| CO4 | H | L | M | M | L | M | L | L |
| CO5 | H | L | L | M | L | M | L | L |

H-High; M-Medium; L-Low

## HUMAN PHYSIOLOGY

**COURSE CODE : 22UPBIC1E03**

| Hours | L | T | P | C |
|---|---|---|---|---|
| | 3 | 1 | 0 | 4 |

**MARKS 100**

**COURSE OBJECTIVES** : To understand the functions of circulatory systems, digestive system, respiratory system, nerves systems and muscle contraction, molecular organization of muscle and their functions.

**COURSE OUTCOMES (CO)**

| | |
|---|---|
| **CO1** | To understand the composition of blood and function of circulatory system. |
| **CO2** | To gain knowledge about digestion, absorption and excretion. |
| **CO3** | To understand the structure and functions of respiratory system |
| **CO4** | To get introduced into nervous system, neuromuscular system and neurotransmitter. |
| **CO5** | To understand the muscle contraction, molecular organization of muscle and their functions. |

**SYLLABUS**

| Unit | Unit title | Intended Learning chapters | Knowledge domain | Hours of Instruction |
|---|---|---|---|---|
| I | **Blood and circulation** | Composition and functions of blood and plasma. Blood groups. Blood coagulation - mechanism, fibrinolysis, anticoagulants. Hemoglobin - structure, abnormal types, anemia. Structure of heart, cardiac cycle, heart sounds, E.C.G vasomotor circulation, coronary circulation, blood pressure, spleen, lymph, normal composition and function of lymph - role of different lymph cells. | K1,K2 | 14 |
| II | **Digestion, absorption and excretion** | Digestive secretions - composition, functions and regulation of saliva, gastric, pancreatic, intestinal and bile secretions. Digestions and absorption of carbohydrates, lipids, proteins and nucleic acids. Excretory system - structure of nephron. Formation of urine - glomerular filtration, tubular reabsorption of glucose, water and electrolytes, tubular secretion. | K2,K3 | 12 |

| | | | | |
|---|---|---|---|---|
| III | **Respiratory system** | Structure of lungs, mechanism and regulation of respiration. Transport of blood gases - $O_2$ and $CO_2$. Acid-base balance - role of buffers, erythrocytes, respiratory system. Acidosis and alkalosis – metabolic pathway of respiratory system. | K1,K2 | 13 |
| IV | **Nervous system** | Structure and function of nerves, neurons, resting and action potential, transmission of nerve impulses, synaptic transmission, compounds affecting synaptic trans mission, neuromuscular junction, composition and functions of cerebrospinal fluid, brain - chemical composition and metabolic adaptation, neurotransmitters and cAMP, | K1,K2 | 14 |
| V | **Muscle cell structure and function** | Structure of muscle cells and muscle contraction, molecular organization of muscle, proteins of contractile element - their organization and role in contraction, energy for contraction. | K1,K2 | 12 |

***Program specific attributes***

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

## REFERENCES


### Text Book

1. Guyton,A.C. and Hall,J.E. 1996. Human Physiology and Mechanisms of Disease, 6th Edition, Saunders.
2. Chatterjee,C.C. 1985. Human Physiology, 11th Edition. Medical Allied Agency.
3. Ganong,W.F. 2005. Review of Medical Physiology, 22nd Edition, McGraw-Hill.

### Reference Book

1. Vander,A.J. *et al*., 1981. Human Physiology: Tata Mc Graw Hill Publishing Co., New Delhi.
2. Chaudhuri,S.K. 2006. Concise Medical Physiology, New central Book Agency.

**Web link**

1. https://nptel.ac.in/courses/102104058
2. https://dth.ac.in/medical/courses/physiology/1/16/index.php
3. https://dth.ac.in/medical/courses/pathology/9/1/index.php
4. https://onlinecourses.swayam2.ac.in/cec20_bt19/preview

**MAPPING**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | H | L | L | L | M | L | L | L |
| CO2 | H | M | M | L | M | L | M | L |
| CO3 | H | L | M | L | M | L | M | L |
| CO4 | H | M | M | L | M | M | L | L |
| CO5 | H | L | M | L | M | M | L | L |

H-High; M-Medium; L-Low

## NUTRITIONAL BIOCHEMISTRY

**COURSE CODE : 22UPBIC1E04**

| Hours | L | T | P | C |
|---|---|---|---|---|
| | 3 | 1 | 0 | 4 |

**MARKS :100**

**COURSE OBJECTIVES :** To provide an understanding of biochemistry and explores the biochemical activity in the human body of nutrients and food constituents.

**COURSE OUTCOMES (CO)**

| | |
|---|---|
| **CO1** | The students will gain theoretical information on energy metabolism and carbohydrates |
| **CO2** | To study the basics of protein and lipid biomolecules |
| **CO3** | To understand the importance of electrolytes, minerals and vitamins in human body |
| **CO4** | To study and analyze the importance of nutraceuticals and its importance in phytotherapeutics |
| **CO5** | To study the clinical relevance of nutritional biochemistry. |

**SYLLABUS**

| Unit | Unit title | Intended Learning chapters | Knowled ge domain | Hours of Instruct ion |
|---|---|---|---|---|
| I | Introduction to energy metabolism and carbohydrates | **Basic concepts:** Composition of human body. Energy metabolism. Energy expenditure measurement methods - Direct and indirect calorimetry methods. BMR and SDA. Carbohydrates: Dietary requirements of available and unavailable carbohydrates. Physico-chemical properties and Physiological actions of unavailable carbohydrates (dietary fiber). | K1,K2, K3 | 13 |

| | | | | |
|---|---|---|---|---|
| II | Proteins and Lipids | **Proteins:** Protein reserves and requirement at different stages of development. Nitrogen balance studies and affecting factors. Determination of Protein quality. Protein deficiency disorders.<br>**Lipids:** Dietary needs of lipids. Essential fatty acids and their physiological functions.<br>Lipoproteins and functions. | K1,K2, K3 | 14 |
| III | Electrolytes minerals and vitamins | Electrolytes and water balance :<br>Electrolyte concentration of body fluids. Acids base regulation in the human body. Concepts of metabolic and respiratory acidosis and alkalosis. Minerals-Nutritional significance.<br>Vitamins: Biochemical functions, Specific deficiency diseases associated with fat and water – soluble vitamins. Hypervitaminosis of fat soluble vitamins. | K1,K2, K3 | 14 |
| IV | Nutraceuticals and phytotherapeutics | Nutraceuticals: significance in human health. Antioxidants: antioxidant enzymes- mode of action, non-enzymic antioxidants- mechanism of action, Phytotherapeutics: Dietary Metabolism of Phenolic compounds- flavonoids, lycopene, and carotenoids. Overview of Dietary supplements. | K1,K2, K3 | 14 |
| V | Applied nutrition | Eating disorders- Obesity, anorexia nervosa and bulimia nervosa, total parenteral nutrition (TPN). Applied nutrition**:** Nutrition for lifestyle related diseases - cardiovascular diseases, diabetes mellitus and diseases of kidney.<br>nutrition and HIV/AIDS, food and nutrition security in developing countries. | K1,K2, K3,K4 | 15 |

***Program specific attributes***

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

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2. Insel, P. *et al*. 2013. Discovering Nutrition, 4th Edition, Jones and Bartlett Publishers.
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2. Weighley, E.S. 1997. Robinson's Basic Nutrition and Diet Therapy, 8th Edition, Macmillan Publishers.
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**MAPPING**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | L | M | L | M | L | L |
| CO2 | M | L | L | M | L | M | L | L |
| CO3 | M | L | L | M | L | M | L | L |
| CO4 | M | L | L | M | L | M | L | L |
| CO5 | M | L | L | M | L | M | L | L |

H-High; M-Medium; L-Low

# ELECTIVES

# PART B
# **INDUSTRIAL BIOCHEMISTRY**

## BIOTECHNOLOGY

**COURSE CODE** : **22UPBIC1E05**

| Hours | L | T | P | C |
|---|---|---|---|---|
| | 3 | 1 | 0 | 4 |

**MARKS** **:** 100

**COURSE OBJECTIVES** : The objective of this course is to have a basic foundation on bioprocess, industrial, animal,medical and environmental Biotechnology.

**COURSE OUTCOMES (CO)**

| | |
|---|---|
| **CO1** | Understand the basic principles involved in bioprocess technology including fermentation, its types, downstream processing, sterilization of culture media will form a good foundation for advanced learning. |
| **CO2** | Understand the basics in microbiology including isolation of a strain as well as identification, production of microbial metabolites, antibiotics through microbial methods, the need for genetic improvements and the process of carrying it out, Single cell protein and its significance. |
| **CO3** | Understand the basics in histopathology performance, culture media used for animal cell culture systems – primary, secondary cell culture, its characterization, cytotoxicity assays, gene cloning will help the students to have a wider knowledge in the latest technology. |
| **CO4** | Have a basic knowledge on the use of DNA in diagnosing infections via DNA finger printing, pharmaceutical products developed by RDNA technology for certain specific diseases, Vaccine production from plants , studying its types etc will give a strong basic foundation to attain their focused specialization . |
| **CO5** | Having basic knowledge in the pollution monitoring, pollutant degradation via biotechnological methods – bioremediation available for solid waste management , soil pollution reduction will help the students to maintain an eco friendly environment which will protect the future generations on the whole as well as reduced global warming. |

**SYLLABUS**

| Unit | Unit title | Intended Learning chapters | Knowledge domain | Hours of Instruction |
|---|---|---|---|---|
| I | Bioprocess technology | Bioreactors: types, operation of conventional bioreactor, solid substrate fermentation, *Media for industrial fermentation, sterilization of culture media and gases. Batch culture, Fed batch culture, and continuous culture Downstream processing: solid-liquid separation, release of intracellular products, concentration,purification and formulation. | K1,K2.K3 | 11 |

| | | | | |
|---|---|---|---|---|
| II | Industrial Biotechnology | Isolation of microorganism, microbial metabolic products - primary and secondary metabolites, genetic improvement of strains. Metabolite production : Organic solvent – alcohol, organic acids – citric acid and lactic acid, antibiotics – penicillin and streptomycin, vitamins – riboflavin and ascorbic acid.Single cell protein | K1,K2,K3 | 11 |
| III | Animal Biotechnology | Animal cell culture: fundamentals and applications. Organ and tissue slice techniques. Culture media for animal cells, cultured cells – Biology and characterization, primary culture and cell lines, cell viability and cytotoxicity, cell transformation and cell cloning | K1, K2,K3 | 11 |
| IV | Medical Biotechnology | DNA in disease diagnosis : DNA probes, DNA in diagnosis of infectious diseases, genetic diseases, DNA fingerprinting. Pharmaceutical products of DNA technology : Human protein replacement, therapeutic agents for human diseases. Recombinant vaccines : subunit vaccines, DNA vaccines, attenuated recombinant vaccines, plants as edible subunit vaccines. | K1,K2,K3 | 11 |
| V | Environmental Biotechnology | Environmental pollution : Types of pollution, pollution monitoring, biotechnological methods for management of pollution. Biodegradation : xenobiotic compounds. Bioremediation: Types of bioremediation, types of reactions in bioremediation, genetic engineering for efficient bioremediation, bioremediation of contaminated soil and waste land. | K1, K2,K3 | 10 |

**Program specific attributes**

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

**REFERENCES:**

**Text Books**


1. Satyanarayana,U. 2005.. Biotechnology, 1st Edition, Books & Allied Ltd.
2. Clark,D.P.and Pazdernik,N.J. 2009. Biotechnology: Applying the genetic revolution, Elsevier.

3. Singh,B. and Gautam,S.K. 2013. Textbook of Animal Biotechnology, The Energy and Resources Institute, TERI.

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1. Cruger,W. and Cruger,A. 2000. Biotechnology: A text book of Industrial Microbiology, 2nd Edition, Sinauer Associates Inc.
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**MAPPING**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | M | M | L | M | L | L |
| CO2 | M | L | M | M | L | M | L | L |
| CO3 | M | L | M | M | L | M | L | L |
| CO4 | M | L | M | M | L | M | L | L |
| CO5 | M | L | M | M | L | M | L | L |

H-High; M-Medium; L-Low

## INTRODUCTION TO BIOINFORMATICS

**COURSE CODE** : **22UPBIC1E06**

| Hours | L | T | P | C |
|---|---|---|---|---|
| | 3 | 1 | 0 | 4 |

**MARKS** **:** 100

**COURSE OBJECTIVES** : To get introduced to basic concepts of bioinformatics including different data types and perceptive of databases for retrieving, analyzing, understanding and managing biological data.

**COURSE OUTCOMES (CO)**

| | |
|---|---|
| **CO1** | To get introduced to the basic concepts of bioinformatics and its significance in Biological data analysis. |
| **CO2** | Understanding the biological data types and nucleic acid and protein databases. |
| **CO3** | To get exposed into data base similarity searching acquiring local and global alignment. |
| **CO4** | To familiarize the students with nucleic acid sequence analysis using Genbank and comprehension of gene expression analysis utilizing DNA chips. |
| **CO5** | To understand the impact and social issues of Human Genome Project and recent developments in gene therapy. |

**SYLLABUS**

| Unit | Unit title | Intended Learning chapters | Knowled ge domain | Hours of Instruct ion |
|---|---|---|---|---|
| I | **Basics of bioinformatics** | **Bioinformatics:** Introduction, fields related to bioinformatics, objectives, scope, genome mapping as a source of bioinformatics. Role of computers in bioinformatics. Applications of bioinformatics in various fields. | K1,K2, K3 | 13 |
| II | **Biological Database** | Database, database management system and its advantages. Biological databases and information resources. Classification of biological databases: general databases, protein families & sequence motif database, protein –protein interaction databases, PUBMED, ENTREZ | K1,K2, K3 | 14 |
| III | **Sequence Alignments** | Data base similarity searching –Local and Global alignment. BLAST and FASTA. Similarity searching algorithms and program, dot plot. | K1,K2, K3 | 14 |

| | | | | |
|---|---|---|---|---|
| IV | **Genomics** | **Genomics:** Genome mapping & genome projects, methods of gene sequence analysis: Genbank, Genbank assembly, genome annotation, genome similarity. Types of genomics: comparative, structural and functional genomics. Gene functions: analysis of gene expression - DNA chip. | K1, K2, K3 | 15 |
| V | **Human Genome Project** | Human Genome Project: Milestones, types of sequences in Human Genome Project, impact, potential benefits, ethical, legal and social issues. Principles of gene therapy, current status of gene therapy research. Factors affecting gene therapy. Recent developments in gene therapy. | K1,K2, K3,K4 | 13 |

***Program specific attributes***

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

**REFERENCES**

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1. Prakash S.Lohar (2009). Bioinformatics. MJP Publishers.
2. Jean-Michel Claverie and Cedric Notredame. (2012) Bioinformatics-A beginner‟s guide. 1st edition, Wiley- Dream Tech India Pvt. Ltd.
3. Ruchi Singh (2014). Bioinformatics: Genomics And Proteomics. S. Chand & Company Pvt. Ltd. New Delhi.

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1. David. W. Mount. (2001). Bioinformatics. CBS publishers and distributers.
2. D.R. Westhead, J. H. Parish and R. M. Twyman. (2002). Instant notes in bioinformatics. Oxford, UK.
3. Gregory R. Grant and Warren Ewens (2001) Statistical Methods in Bioinformatics: An Introduction
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4. https://www.ncbi.nlm.nih.gov/guide/data-software/

**MAPPING**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | H | L | L | M | L | M | L | L |
| CO2 | H | L | M | M | L | M | L | L |
| CO3 | H | L | M | M | L | M | L | L |
| CO4 | H | L | M | M | L | M | L | L |
| CO5 | H | L | L | M | L | M | L | L |

H-High; M-Medium; L-Low

## FUNDAMENTALS OF FORENSIC SCIENCE

**COURSE CODE : 22UPBIC1E07**

| Hours | L | T | P | C |
|---|---|---|---|---|
| | 3 | 1 | 0 | 4 |

**MARKS : 100**

**COURSE OBJECTIVES** : To understand the fundamental principles and functions of forensic science and the significance of forensic science to human society.

**COURSE OUTCOMES (CO)**

| | |
|---|---|
| **CO1** | To understand The fundamental principles and functions of forensic science.. |
| **CO2** | To gain knowledge in the analytical techniques used in forensic sciences |
| **CO3** | Understanding the basics of toxicology |
| **CO4** | To educate the fundamentals of DNA fingerprint methods |
| **CO5** | To understand fingerprint methods used in forensic sciences |

**SYLLABUS**

| Unit | Unit title | Intended Learning chapters | Knowled ge domain | Hours of Instruct ion |
|---|---|---|---|---|
| I | Basics of forensic science | **Forensic Science:** Definition, History & Development, Scope, Ethics in Forensic Science. **Forensic Evidences**: Concise of Forensic Physical, Biological, Chemical and Psychological evidences, Laws and Principles of Forensic Science- Law of Exchange (Locard), Law of Individuality, Law of Comparison, Branches of Forensic Science | K1.K2. K3 | 13 |
| II | Techniques in forensic science | **Microscopy:** Polarizing, Comparison, Stereoscopic, Fluorescent and Electron Microscopes **X – rays and x-ray based techniques** such as XRD, XRF. **Immunoassays:** Principle, Types, Techniques and applications. Immunoelectrophoresis | K1.K2. K3 | 12 |

| | | | | |
|---|---|---|---|---|
| III | **Forensic toxicology** | **Basics of Toxicology**<br>Significance of toxicological findings. Techniques used in toxicology. Toxicological analysis and chemical intoxication tests.<br>**Poisons:** Definition of Poison, Toxin and Toxicant, Ideal Poison, Classification of poisons based on their origin and Chemical nature, mode of action.<br>Types of poison- Animal, Vegetable, Beverages. | K1.K2. K3 | 13 |
| IV | **Fingerprint in general** | **Fingerprints in General:**<br>Definition of fingerprint, Fingerprint as forensic Evidence, Visible Fingermarks, Latent Fingermarks. Methods in fingerprint- Living,dead and preserving and lifting of fingerprints. Chemistry of latent fingerprint residue. Chemical method, Reagent chemistry and formulations | K1.K2. | 12 |
| V | **DNA Forensics** | Collection of specimens. Polymerase chain reaction – historical perspective, sequence polymorphisms, individualization of evidence. Short tandem repeats (STR) – role of fluorescent dyes, nature of STR loci.<br>Restriction fragment length polymorphism (RFLP) – genetic markers used in RFLP, typing procedure and interpretation of results. Touch DNA. | K1,K2, K3 | 15 |

***Program specific attributes***

Knowledge and understanding level (K1 and K2) Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

## REFERENCES

### Text Books


1. Nanda, B.B. and Tewari, R.K. (2001) Forensic Science in India: A vision for the twenty first century
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**MAPPING**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | M | M | L | M | L | L |
| CO2 | M | L | M | M | L | M | L | L |
| CO3 | M | L | M | M | L | M | L | L |
| CO4 | M | L | M | M | L | M | L | L |
| CO5 | M | L | M | M | L | M | L | L |

H-High; M-Medium; L-Low

# PHARMACOLOGY AND CLINICAL TOXICOLOGY

**COURSE CODE** : **22UPBIC1E08**
**MARKS** **: 100**
**COURSE OBJECTIVES** **:** This course is designed to provide detailed understanding of the pharmacological and toxicological aspects of therapeutics and their diverse modes of drug action.

**COURSE OUTCOMES (CO)**

| | |
|---|---|
| **CO1** | To know the theories and principles of drug action, drug metabolism and pharmacodynamics. |
| **CO2** | To know effects of toxicants on organ system and drug disposition. |
| **CO3** | To provide the dynamic effects various drugs |
| **CO4** | To distinguish therapeutic and deleterious effects of drug use invivo |
| **CO5** | To exactly provide distinct picture of xenobiotics living system. |

**SYLLABUS**

| Unit | Unit title | Intended learning chapters | Knowledge domain | Hours of instruction |
|---|---|---|---|---|
| I. | General Principles | Introduction to pharmacology, sources of drugs, classification of drugs based on sources dosage forms, route of administration, site of action of drugs. Mechanism of action, concept of receptor, combined effect of drugs, factors modifying drug action, dose response curve-ED50 and LD50. | K1 & K2 | 13 |
| II. | Drug metabolism | Absorption, distribution and elimination of drugs, general pathways of drug metabolism (phase-I and Phase-II reactions). Drug metabolizing enzymes. Drug elimination of liver and kidney. | K1, K2,K3 | 12 |
| III. | Drug delivery | Genetically engineered protein and peptide agents. Drug delivery system; Non-conventional routes of administration, oncogenes as targets for drugs, multidrug resistance, production of secondary metabolites by plant culture. Patenting of drug marketing, computer-aided drug design. | K1, K2,K3 | 13 |
| IV. | Principles of therapeutics | General principles of chemotherapy; chemotherapy of parasitic infections, fungal infections, viral diseases. Application for new drug discovery (NDD) according to Indian control authority and USFDA guidelines. Ethical considerations in utilizing human subjects for the drug discovery process. | K1, K2,K3 | 12 |

| | | | | |
|---|---|---|---|---|
| V. | Toxicology | Definition, classification of toxicity-occupational, environmental and pharmaceutical factors affecting toxicity- Drug tolerance, intolerance, addiction, allergy, hypersensitivity, antagonism and synergism. | K1 , K2 | 15 |

***Program specific attributes***

Knowledge and understanding level (K1
and K2) Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

**REFERENCES:**

**Text Books**


1. The pharmacology, Volumes I and II – Goodman,Gilman, 2013; 13th edition.
2. Pharmacology– Rang and Dales, 2018 9th edition.
3. Pharmacology and Pharmacotherapeutics – Satoskar et al., 25edition Popular Prakashar, Mumbai.
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2. Foreman,J.C. and Johansen,T.J. 1996. Text Book of Receptor Pharmacology, 2nd Edition, CRC Press.
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**MAPPING**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | H | L | M | L | L | M | M | L |
| CO2 | H | H | H | M | L | M | M | L |
| CO3 | H | H | M | M | L | L | M | L |
| CO4 | H | H | H | H | M | M | M | L |
| CO5 | H | H | M | M | L | L | M | L |

H-High; M-Medium; L-Low

# SUPPORTIVE COURSES FOR OTHER DEPARTMENTS

## TOOLS AND TECHNIQUES IN BIOSCIENCE

**COURSE CODE : 22UPBIC1S01**

| Hours | L | T | P | C |
|---|---|---|---|---|
| | 3 | 1 | 0 | 4 |

**MARKS : 100**

**COURSE OBJECTIVES :** To understand the principles, instrumentation and applications of major analytical techniques used in biosciences.

**COURSE OUTCOMES (CO)**

| | |
|---|---|
| **CO1** | To understand the techniques in cell fractionation. To understand the techniques and applications of radioisotopes in biology. |
| **CO2** | To understand the principles and applications of centrifugation and microscopy |
| **CO3** | To understand the principles and applications of chromatography. |
| **CO4** | To understand the principles and applications of electrophoretic techniques. |
| **CO5** | To understand the principles and applications of spectroscopy. |

**SYLLABUS**

| Unit | Unit title | Intended Learning chapters | Knowledge domain | Hours of Instruction |
|---|---|---|---|---|
| I | Cell-fractionation technique, Radioisotopes in Biology | **Cell separation methods:** Cell lysis, homogenization, extraction, salting in, salting out, dialysis and ultra filtration. **Radioisotopes in Biology:** Types of radioactive decay, **D**etection and quantitation - GM counter and solid and liquid scintillation counter. Autoradiography and their applications. Applications of radioisotopes. | K1,K2, K3 | 13 |
| II | Centrifugation, Microscopy | **Centrifugation:** Principles of sedimentation**,** Svedberg's constant, Types of rotors**.** Differential and density gradient centrifugation. **Microscopy:** Principles and application of light, fluorescence, scanning and transmission electron microscopy | K1,K2, K3 | 13 |
| III | Chromatographic techniques | **Chromatographic techniques:** General principles of chromatography**.** Principles and applications of paper, TLC, ion exchange, Affinity, FPLC and HPLC. | K1, K2, K3 | 13 |

| | | | | |
|---|---|---|---|---|
| IV | Electrophoretic techniques | **Electrophoretic techniques:** General principles and factors affecting electrophoresis**.** Polyacrylamide gel electrophoresis- SDS-PAGE, 2D-electrophoresis, agarose gel electrophoresis, capillary electrophoresis, isoelectric focusing, high voltage electrophoresis, | K1, K2, K3 | 13 |
| V | Spectroscopic techniques | **Spectroscopic techniques:** Principles of spectrophotometer, Types - Atomic absorption spectroscopy, fluorimeter, UV-Visible, NMR, ESR, X ray photoelectron spectroscopy. | K1, K2,K3 | 13 |

**Program specific attributes**

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

**REFERENCES**

**Text Books**


1. Wilson,K. and Walker,J. 2005. Principles and Techniques of Practical Biochemistry, 6th Edition , Cambridge University. Press .
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4. https://nios.ac.in/media/documents/dmlt/Biochemistry/Lesson-21.pdf

**MAPPING**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | H | M | M | M | L | L | M | L |
| CO2 | H | M | M | M | L | L | M | L |
| CO3 | H | M | M | M | L | L | M | L |
| CO4 | H | M | M | M | L | L | M | L |
| CO5 | H | M | M | M | L | L | M | L |

H-High; M-Medium; L-Low

## MEDICAL LAB TECHNOLOGY

**COURSE CODE** : **22UPBIC1S02**

| Hours | L | T | P | C |
|---|---|---|---|---|
| | 3 | 1 | 0 | 4 |

**MARKS : 100**

**COURSE OBJECTIVES** : This syllabus has been formulated to impart basic knowledge of biochemistry, analytical techniques and to perform clinical laboratory tests accurately and efficiently.

**COURSE OUTCOMES (CO)**

| | |
|---|---|
| **CO1** | To gain knowledge in the general laboratory instruments and equipment and to know about the specimen processing for biochemical analysis. |
| **CO2** | To understand the principles and applications in the analytical techniques. |
| **CO3** | To understand the principles and applications of biochemical tests. |
| **CO4** | To understand the principles and applications of automation of the analytical processes in clinical laboratory. |
| **CO5** | To understand the laboratory information systems. |

**SYLLABUS**

| Unit | Unit title | Intended Learning chapters | Knowledg e domain | Hours of Instructi on |
|---|---|---|---|---|
| I | General approach to medical laboratory sciences | Safety aspects in the clinical laboratory. Basic Chemistry and laboratory calculations. Specimen collection and processing for Biochemical analyses - Blood, urine, sputum, Bone marrow, CSF. | K1,K2,K3 | 13 |
| II | Principles of Analytical techniques | Principles of Colorimeter, Spectrophotometry and AAS. Chromatography (Principle) Partition, adsorption and HPLC. Electrophoresis (Principle only) – Agarose gel, SDS PAGE. Immunochemistry – ELISA and PCR technique – RT PCR | K1,K2,K3 | 12 |
| III | Clinical Chemistry | Biochemical tests – glucose- OGTT and HbA1c, protein, albumin, urea, creatinine, uric acid and cholesterol. Urinary parameters. Electrolytes and blood gases analysis. | K1,K2,K3 ,K4 | 15 |
| IV | Function Test | Liver function test, renal function test, gastric function test, pancreatic function test – serum amylase, trypsin and lipase. Thyroid function test. | K1,K2,K3 | 13 |

| | | | | |
|---|---|---|---|---|
| V | **Automation and Laboratory management and Quality assurance** | Automation of the analytical processes, Types of autoanalyzers - Steps in the automated systems, Total quality management of clinical laboratory. Laboratory information systems | K1,K2,K3 ,K4 | 13 |

**Program specific attributes**

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

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1. Mukherjee,K.L. 1988. Medical Laboratory Technology – A procedure manual for routine diagnostic tests, Vol I , II, III. Tata McGraw Hill Publishing Company Limited.
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3. Devlin,T.M. 1998. Text book of Biochemistry with Clinical Correlation, 4th Edition, John Wiley and Sons.


**Web link**

1. https://nios.ac.in/media/documents/dmlt/Biochemistry/Lesson-23.pdf
2. https://nios.ac.in/media/documents/dmlt/Biochemistry/Lesson-25.pdf
3. https://nios.ac.in/media/documents/dmlt/Biochemistry/Lesson-26.pdf
4. https://nios.ac.in/media/documents/dmlt/Biochemistry/Lesson-27.pdf

**MAPPING**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | H | M | M | M | L | L | M | L |
| CO2 | H | M | M | M | L | L | M | L |
| CO3 | H | M | M | M | L | L | M | L |
| CO4 | H | M | M | M | L | L | M | L |
| CO5 | H | M | M | M | L | L | M | L |

H-High; M-Medium; L-Low

## CLINICAL DIAGNOSIS IN HEALTH AND DISEASES

**COURSE CODE :22UPBIC1S03**

**MARKS :100**

| Hours | L | T | P | C |
|---|---|---|---|---|
| | 3 | 1 | 0 | 4 |

**COURSE OBJECTIVES :** The aim of the course is to understand the diagnostic procedures adopted in various disease conditions and its management.

**COURSE OUTCOMES (CO)**

| | |
|---|---|
| **CO1** | To know about general health, syndrome and common diseases that affects mankind |
| **CO2** | To understand the importance of liver and kidney function test |
| **CO3** | To understand the basics and importance of heart, lung and brain test |
| **CO4** | To know the basic mechanisms of communicable diseases |
| **CO5** | To imbibe and understand the mechanism of non- communicable diseases and their clinical significance |

**SYLLABUS**

| Unit | Unit title | Intended Learning chapters | Knowledg e domain | Hours of Instructi on |
|---|---|---|---|---|
| I | Introduction | Introduction: General health, syndrome and common diseases – communicable and non-communicable diseases. Samples for analysis: Blood, urine, pleural fluid, synovial fluid, cerebrospinal fluid and tissues and histology. General check up: Blood group, Hb, height and weight, waist to hip ratio, electro cardio gram, X-ray, abdomen scan and appearance of scars, urine analysis – routine analysis (protein, sugar, pigments and cells). | K1,K2,K3 | 13 |
| II | Liver and kidney function test | Significance of function test. Tests for liver function: Enzyme assay (SGOT, SGPT, Alkaline phosphatase, GGT), Total protein, albumin /globulin ratio and their significance. Test for kidney function: Urea and creatinine estimation and their significance. | K1,K2,K3 | 12 |

| | | | | |
|---|---|---|---|---|
| III | Heart, lung and brain test | Test for heart function: Blood pressure (cystolic and diastolic), lipid profile (cholesterol, triglycerides, HDL, LDL estimation) and their importance. Test for lung function: Chest X-ray, Spirometry. Test for Brain function: EEG, MRI, CT. Test for Surgery: Bleeding time, clotting time. Special test: X-ray, CT, MRI, Doppler, TMT, angioplasty. | K1,K2,K3 | 15 |
| IV | Diagnosis of microbial infections | Infection: Bacterial, viral, fungal and protozoans. Blood: Total cell count, differential count, erythrocyte sedimentation rate. Infectious diseases: Tuberculosis, Leprosy, Malaria, Hepatitis, Cholera, Dengue, HIV, Chikun gunya and H1N1. TORCH – Panel (infertility profile), Infection in pregnancy, | K1,K2,K3 | 13 |
| V | Non communicable diseases | Non communicable diseases: Diabetes: Blood sugar, urine sugar, glucose tolerance test, HbA1c. Hyper tension: Lipid profile, electrolyte (sodium, potassium, chloride and biocarbonate) investigation. Cancer markers: ELISA. | K1,K2,K3 | 13 |

**Program specific attributes**

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

**REFERENCES**

**Text Books**


1. Burtis,C. and Bruns,D. 2007. Teitz Fundamentals of Clinical chemistry Chemistry, 3rd Edition W.B.Saunders Company.
2. Devlin,T.M. 1998. Text book of Biochemistry with Clinical Correlation, 4th Edition.
3. Varley,H. 1980.Practical Clinical Biochemistry, Volume I and II, 5th Edition, CBS Publishers.


**Reference Books**


1. Mayne,P.D. 1994. Clinical Chemistry in Diagnosis and Treatment, 6 th Edition, Hodder Arnold Publication.
2. Marshall,W.J. and Bangeit, S.K. 1995. Clinical Biochemistry - Metabolic concepts and Clinical aspects, Churchill Livingstone.
3. Guyton,A.C. and Hall,J.E. 2010. Text Book of Medical Physiology, 12th Edition, Saunders.

**Web link**

1. https://nios.ac.in/media/documents/dmlt/Biochemistry/Lesson-07.pdf
2. https://nios.ac.in/media/documents/dmlt/HC/Lesson-29.pdf
3. https://nios.ac.in/media/documents/dmlt/Biochemistry/Lesson-16.pdf
4. https://nios.ac.in/media/documents/dmlt/Biochemistry/Lesson-17.pdf

**MAPPING**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | H | M | M | M | L | L | M | L |
| CO2 | H | M | M | M | L | L | M | L |
| CO3 | H | M | M | M | L | L | M | L |
| CO4 | H | M | M | M | L | L | M | L |
| CO5 | H | M | M | M | L | L | M | L |

H-High; M-Medium; L-Low

## INTRODUCTION TO BIOCHEMISTRY

**COURSE CODE : 22UPBIC1S04**

| Hours | L | T | P | C |
|---|---|---|---|---|
| | 3 | 1 | 0 | 4 |

**MARKS : 100**

**COURSE OBJECTIVES :** This course is an introduction to biochemistry and covers the structure and functions of biological molecules.

**COURSE OUTCOMES (CO)**

| | |
|---|---|
| **CO1** | Understand the basics involved in the structure of carbohydrates like anomerism,stereoisomerism, epimer formation and their types, chemical properties, and functions. |
| **CO2** | Understand the basics in the structure of lipids, classifications like simple and complex lipid including lipopotein and lipo polysaccharides and teir biological functions. |
| **CO3** | Understand the basic structure- types, classification, properties- coagulation, denaturation, function of protein, amino acids and its sequencing. |
| **CO4** | Have a basic knowledge on the structure of DNA, experiments that proved it as a genetic material, as well as to know their properties, functions in biology. |
| **CO5** | Know about the structure, types of vitamins in biological reactions, and its relationship with disease, daily requirement. |

**SYLLABUS**

| Unit | Unit title | Intended Learning chapters | Knowledge domain | Hours of Instruction |
|---|---|---|---|---|
| I | Carbohydrates | Classification-monosaccharides, disaccharides, polysaccharides basic chemical structure, aldoses and ketoses, Structural characteristics -cyclic structure of mo nosaccharides, steroisomerism, anomers and epimers. General reaction and properties. Structure and biological functions of homo- and heteropolysaccharides. | K1,K2,K3 | 13 |
| II | Lipids | Classification, structure, properties and functions of fatty acids, essential fatty acids, fats, phospholipids, sphingolipids, cerebrocides, steroids, bile acids, prostaglandins, lipoamino acids, lipoproteins, phosphatidopeptides, lipopolysaccharides. | K1,K2,K3 | 12 |

| | | | | |
|---|---|---|---|---|
| III | Proteins | Classification, structure and properties of amino acids, biologically active peptides, classification and properties of proteins, sequencing of proteins, conformation and structure of proteins - primary, secondary, tertiary and quaternary structure, coagulation and denaturation of proteins. | K1,K2,K3 | 15 |
| IV | Nucleic acids | Nucleic acids as genetic information carriers, experimental evidence e.g., genetic transformation, Hershey-Chase experiments, action spectrum, etc. Structure and function of nucleotides. Primary, secondary and tertiary structure of nucleic acids, DNA forms and conformations, Denaturation of DNA. Cot curve analysis | K1,K2,K3 | 13 |
| V | Vitamins | Structure, biochemical functions, deficiency diseases, daily requirements of water soluble and fat soluble vitamins and their coenzyme activity. Hypervitaminosis. | K1,K2,K3 | 13 |

**Program specific attributes**

Knowledge and understanding level (K1
and K2) Application level (K3)
Analytical level (K4)
Evaluation capability
level (K5)
Scientific or synthesis level (K6)

**REFERENCES**

**Text Books**


1. Nelson,D.L and Cox,M.M.2013. Lehninger Principles of Biochemistry, 6 th Edition, W.H. Freeman
2. Garrett,R. and Grisham,C. 2010. Biochemistry, 4th Edition, Saunders College Publishing


**Reference Books**


1. Berg,J.M. *et al*. 2012. Biochemistry, 7th Edition, W. H. Freeman & Company, 2012.
2. Voet,D. *et al.*, 2012. Fundamentals of Biochemistry: Life at the Molecular level, 4th Edition, John Wiley and Sons.


**Web link**

1. https://archive.nptel.ac.in/courses/104/102/104102016/
2. https://archive.nptel.ac.in/courses/102/103/102103074/

**MAPPING**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | H | M | M | M | L | L | M | L |
| CO2 | H | M | M | M | L | L | M | L |
| CO3 | H | M | M | M | L | L | M | L |
| CO4 | H | M | M | M | L | L | M | L |
| CO5 | H | M | M | M | L | L | M | L |

H-High; M-Medium; L-Low