KANNUR UNIVERSITY
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**(Abstract)**

FYUG Biochemistry Programme - Scheme and Syllabus - Modified and implemented w.e.f 2026 Admission - Orders Issued

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**ACADEMIC C SECTION**

ACAD C/ACAD C3/21640/2024 Dated: 08.06.2026

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Read:-1. U.O. No. ACAD/FYSC-III/16790/2024 dated 17/08/2024

2. U.O. No. ACADC/ACAD C3/21640/2024 dated 05/02/2025

3. U.O No. ACADC/ACAD C3/21640/2024 dated 29/10/2025

4. U.O No. ACADC/ACAD C3/21640/2024 dated 23/01/2026

5. E-mail dated 23/02/2026 from the Chairperson, Board of Studies in Biochemistry & Bioinformatics

6.E-mail from the Dean, Faculty of Science dated 27/02/2026

7.Minutes of the Meeting of the Standing Committee of the Academic Council, held on 16.05.2026

8. Orders of the Vice Chancellor in the file of even number dated 08.06.2026

**ORDER**

1.The Scheme & Syllabus of the FYUG Biochemistry Programme was approved and implemented in the Affiliated Colleges w.e.f. 2024 admission, vide paper read as (1) above . Certain modifications were subsequently made to the same vide papers read as (2),(3) and (4) above.

2.The Chairperson, Board of Studies in Biochemistry & Bioinformatics, vide paper read as (5) above, has submitted the modified Scheme and Syllabus of the FYUG Biochemistry Programme for implementation w.e.f 2026 Admission .

4.The modified Scheme and Syllabus were forwarded to the the Dean, Faculty of Science and the Dean after verifying the same has recommended approval of the same as per the paper read as (6) above.

5. The modified Scheme and Syllabus along with the remarks obtained from the Dean, Faculty of Science were placed before the Standing Committee of the Academic Council for consideration, as ordered by the Vice-Chancellor.

6. The Standing Committee of the Academic Council, held on 16.05.2026, vide paper read as (7) above recommended approval of the modified Scheme and Syllabus of the FYUG Biochemistry Programme for implementation w.e.f 2026 admission

7.The Vice Chancellor after considering the matter in detail and in exercise of the powers of the

Academic Council conferred under Section 11(1) Chapter III of the Kannur University Act, 1996 and all other enabling provisions read together with has approved the modified Scheme and Syllabus of the FYUG Biochemistry Programme for implementation w.e.f 2026 admission, subject to reporting to the Academic Council.

8.The Scheme and Syllabus implemented w.e.f 2026 admission is appended to this U.O. and uploaded on the University website.

9.Orders are issued accordingly.

*Sd/-*

**Jisha K P**

**Assistant Registrar II**

For REGISTRAR

To: 1. The Principals of Affiliated colleges

2. The Controller of Examinations (Through P A)

3.Chairperson, Board of Studies in Biochemistry & Bioinformatics

Copy To: 1. PA to CE (to circulate the same among the sections concerned under Examination Branch)

2. PS to VC/PA to R

2. PS to VC/PA to R

3. JR II (Exam)

4. DR/AR (Academic)

5. Web manager (to uploading on the website)

6. Computer Programmer

7. SF/DF/FC

Forwarded / By Order

SECTION OFFICER

KANNUR UNIVERSITY
CIVIL STATION P.O.
KANNUR
Pin-670 002
THAVAKKARA

# KANNUR UNIVERSITY

# BOARD OF STUDIES
# IN
# BIOCHEMISTRY AND BIOINFORMATICS (UG)

## SYLLABUS FOR
## FOUR YEAR UG PROGRAM (FYUGP) IN
## BIOCHEMISTRY
## BIOCHEMISTRY HONOURS
## AND
## BIOCHEMISTRY HONOURS WITH RESEARCH

**(2026 ADMISSION ONWARDS)**

## VISION AND MISSION

**Vision:**

To establish a teaching, residential and affiliating University and to provide equitable and just access to quality higher education involving the generation, dissemination and a critical application of knowledge with special focus on the development of higher education in Kasaragod and Kannur Revenue Districts and the Manandavady Taluk of Wayanad Revenue District.

**Mission:**

- To produce and disseminate new knowledge and to find novel avenues for application of such knowledge.
- To adopt critical pedagogic practices which uphold scientific temper, the uncompromised spirit of enquiry and the right to dissent.
- To uphold democratic, multicultural, secular, environmental and gender sensitive values as the foundational principles of higher education and to cater to the modern notions of equity, social justice and merit in all educational endeavours.
- To affiliate colleges and other institutions of higher learning and to monitor academic ethical, administrative and infrastructural standards in such institutions.
- To build stronger community networks based on the values and principles of higher education and to ensure the region's intellectual integration with national vision and international standards.
- To associate with the local self-governing bodies and other statutory as well as nongovernmental organizations for continuing education and also for building public awareness on important social, cultural and other policy issues.

**KANNUR UNIVERSITY**
**PROGRAMME OUTCOMES (PO)**

**PO1. Critical Thinking:**

1.1. Acquire the ability to apply the basic tenets of logic and science to thoughts, actions and interventions.

1.2. Develop the ability to chart out a progressive direction for actions and interventions by learning to recognize the presence of hegemonic ideology within certain dominant notions.

1.3 Develop self-critical abilities and also the ability to view positions, problems and social issues from plural perspectives.

**PO 2. Effective Citizenship:**

2.1. Learn to participate in nation building by adhering to the principles of sovereignty of the nation, socialism, secularism, democracy and the values that guide a republic.

2.2. Develop and practice gender sensitive attitudes, environmental awareness, empathetic social awareness about various kinds of marginalisation and the ability to understand and resist various kinds of discriminations.

2.3. Internalise certain highlights of the nation's and region's history. Especially of the freedom movement, the renaissance within native societies and the project of modernisation of the postcolonial society.

**PO 3. Effective Communication:**

3.1. Acquire the ability to speak, write, read and listen clearly in person and through electronic media in both English and in one Modern Indian Language

3.2. Learn to articulate, analyse, synthesise, and evaluate ideas and situations in a well-informed manner.

3.3. Generate hypotheses and articulate assent or dissent by employing both reason and creative thinking.

**PO 4. Interdisciplinarity:**

4.1. Perceive knowledge as an organic, comprehensive, interrelated and integrated faculty of the human mind.

4.2. Understand the issues of environmental contexts and sustainable development as a basic interdisciplinary concern of all disciplines.

4.3. Develop aesthetic, social, humanistic and artistic sensibilities for problem solving and evolving a comprehensive perspective

**FYUG BIOCHEMISTRY PROGRAMME**
**PROGRAMME SPECIFIC OUTCOMES (PSOS)**

After successful completion of four-year degree program in Biochemistry a student should be able to;

PSO 1 Understand the fundamental concepts, principles and processes underlying the academic field of Biochemistry, its different subfields (clinical, nutritional, molecular biology) and its linkages with related disciplinary areas/subjects;

PSO 2 Demonstrate procedural knowledge that creates different types of professionals in the field of Biochemistry and related fields such as research, pharmaceuticals, Food industry, Clinical laboratories, Teaching, product quality, cosmetics industry, etc.

PSO 3 Employ critical thinking and the scientific method to design, carry out, record and analyse the results of Biochemical experiments and get an awareness of the impact of Biochemistry on the Health and society.

PSO 4 Understand safety of chemicals, transfer and measurement of chemical, preparation of solutions.

PSO 5 Create an awareness of the impact of Biochemistry on the Health, society, and development outside the scientific community

PSO 6 Prepare for professional careers or further education by gaining exposure to the various branches of life science and developing a foundation for specialized areas of interest.

PSO 7. Collaborate effectively with peers in group projects and laboratory work, fostering teamwork and interpersonal skills.

PSO 8. Gain proficiency in using modern technologies and software tools relevant to Life science, including computational biology software, laboratory instrumentation, and data analysis tools.

**COURSESTRUCTUREFORFOURYEARUGPROGRAMME(FYUGP) BIOCHEMISTRY**
**(2024 ADMISSION ONWARDS)**

**SEMESTER 1**

| No | Title | Hours/ week | Credit | CE | ESE | Total marks |
|---|---|---|---|---|---|---|
| 1 | AEC1 (English) | 3 | 3 | 25 | 50 | 75 |
| 2 | AEC2 (Additional Language) | 3 | 3 | 25 | 50 | 75 |
| 3 | MDC 1 | 3 | 3 | 25 | 50 | 75 |
| 4 | DSC A1 (Major) | 4 | 4 | 30 | 70 | 100 |
| 5 | DSCB1 (Minor1) | 4 | 4 | 30 | 70 | 100 |
| 6 | DSCC1(Minor2) | 4 | 4 | 30 | 70 | 100 |
| | Total credits | | 21 | | | |

## SEMESTER II

| No | Title | Hours/week | Credit | CE | ESE | Total marks |
|---|---|---|---|---|---|---|
| 1 | AEC3 (English) | 3 | 3 | 25 | 50 | 75 |
| 2 | AEC4 (Additional Language) | 3 | 3 | 25 | 50 | 75 |
| 3 | MDC 2 | 3 | 3 | 25 | 50 | 75 |
| 4 | DSCA2 (Major) | 4 | 4 | 30 | 70 | 100 |
| 5 | DSCB2 (Minor1) | 4 | 4 | 30 | 70 | 100 |
| 6 | DSCC2(Minor2) | 4 | 4 | 30 | 70 | 100 |
| | Total credits | | 21 | | | |

## SEMESTER III

| No | Title | Hours/w eek | Credit | CE | ESE | Total marks |
|---|---|---|---|---|---|---|
| 1 | MDC 3 | 3 | 3 | 25 | 50 | 75 |
| 2 | VAC 1 | 3 | 3 | 25 | 50 | 75 |
| 3 | DSC A 3 (Major) | 4 | 4 | 30 | 70 | 100 |
| 4 | DSC A 4 (Major) | 4 | 4 | 30 | 70 | 100 |
| 5 | DSCB 3 (Minor1) | 4 | 4 | 30 | 70 | 100 |
| 6 | DSCC3 (Minor2) | 4 | 4 | 30 | 70 | 100 |
| | Total credits | | 22 | | | |

## SEMESTER IV

| No | Title | Hours/week | Credit | CE | ESE | Total marks |
|---|---|---|---|---|---|---|
| 1 | SEC1 | 3 | 3 | 25 | 50 | 75 |
| 2 | VAC 2 | 3 | 3 | 25 | 50 | 75 |
| 3 | VAC 3 | 3 | 3 | 25 | 50 | 75 |
| 4 | DSCA5 (Major) | 4 | 4 | 30 | 70 | 100 |
| 5 | DSCA6 (Major) | 4 | 4 | 30 | 70 | 100 |
| 6 | DSCA7 (Major) | 4 | 4 | 30 | 70 | 100 |
| | Total credits | | 21 | | | |

## SEMESTER V

| No | Title | Hours/ week | Credit | CE | ESE | Total marks |
|---|---|---|---|---|---|---|
| 1 | SEC2 | 3 | 3 | 25 | 50 | 75 |
| 2 | DSC A8(Major) | 4 | 4 | 30 | 70 | 100 |
| 3 | DSC A9(Major) | 4 | 4 | 30 | 70 | 100 |
| 4 | DSC A10 (Major) | 4 | 4 | 30 | 70 | 100 |
| 5 | DSE 1 (A11) | 4 | 4 | 30 | 70 | 100 |
| 6 | DSE 2 (A12) | 4 | 4 | 30 | 70 | 100 |
| | Total credits | | 23 | | | |

## SEMESTER VI

| No | Title | Hours/week | Credit | CE | ESE | Total marks |
|---|---|---|---|---|---|---|
| 1 | SEC3 | 3 | 3 | 25 | 50 | 75 |
| 2 | DSC A13 (Major) | 4 | 4 | 30 | 70 | 100 |
| 3 | DSC A14 (Major) | 4 | 4 | 30 | 70 | 100 |
| 4 | DSC A15 (Major) | 4 | 4 | 30 | 70 | 100 |
| 5 | DSE3 (A16) | 4 | 4 | 30 | 70 | 100 |
| 6 | DSE4 (A17) | 4 | 4 | 30 | 70 | 100 |
| 7 | INTERNSHIP | 2 | 2 | | | |
| | Total credits | | 25 | | | |

**EXIT WITH UG DEGREE/PROCEED TO FOURTH YEAR WITH 133 CREDITS**

17 Major course 17x4 = 68

6 minor course 6x4 = 24

13 foundation courses (AEC, SEC, VAC, MDC) 13x3 = 39

1 Internship 2x1 = 2

**Total** **= 133**

## SEMESTER VII

| No | Title | Hours/week | Credit | CE | ESE | Total marks |
|---|---|---|---|---|---|---|
| 1 | DSC A18 (Major) | 4 | 4 | 30 | 70 | 100 |
| 2 | DSC A19 (Major) | 4 | 4 | 30 | 70 | 100 |
| 3 | DSC A20 (Major) | 4 | 4 | 30 | 70 | 100 |
| 4 | DSC A21 (Major) | 4 | 4 | 30 | 70 | 100 |
| 5 | DSC A22 (Major) | 4 | 4 | 30 | 70 | 100 |
| | Total credits | | 20 | | | |

## SEMESTER VIII

| No | Title | Hours/week | Credit | CE | ESE | Total marks |
|---|---|---|---|---|---|---|
| 1 | DSC A23 (Major) | 4 | 4 | 30 | 70 | 100 |
| 2 | DSC A24 (Major) | 4 | 4 | 30 | 70 | 100 |
| 3 | DSC A25 (Major) | 4 | 4 | 30 | 70 | 100 |
| 4 | PROJECT | | 12 | 40 | 60 | 100 |
| | OR | | | | | |
| 1 | DSE B4 (Minor) | 4 | 4 | 30 | 70 | 100 |
| 2 | DSE B5 (Minor) | 4 | 4 | 30 | 70 | 100 |
| 3 | DSE B6 (Minor) | 4 | 4 | 30 | 70 | 100 |
| 4 | PROJECT | | 12 | 40 | 60 | 100 |
| | OR | | | | | |
| 1 | DSC A20 (Major) | 4 | 4 | 30 | 70 | 100 |
| 2 | DSC A21 (Major) | 4 | 4 | 30 | 70 | 100 |
| 3 | DSC A22 (Major) | 4 | 4 | 30 | 70 | 100 |
| 4 | DSE B4 (Minor)/ MOOC I | 4 | 4 | 30 | 70 | 100 |
| 5 | DSE B5(Minor)/ MOOC II | 4 | 4 | 30 | 70 | 100 |
| 6 | DSE B6(Minor)/ MOOC III | 4 | 4 | 30 | 70 | 100 |

**Mark Distribution for Discipline Specific Courses and Foundation Courses**

The mark distribution for various courses of different credits can be distributed as follows.

| Course | Credit | | Mark | | L | | P | | |
|---|---|---|---|---|---|---|---|---|---|
| | L | P | L | P | CCA | ESE | CCA | ESE | Total marks |
| | 4 | 0 | 100 | 0 | 30 | 70 | 0 | 0 | 100 |
| | 3 | 1 | 75 | 25 | 25 | 50 | 10 | 15 | 100 |
| 4 Credit | 2 | 2 | 50 | 50 | 15 | 35 | 20 | 30 | 100 |
| | 1 | 3 | 25 | 75 | 10 | 15 | 30 | 45 | 100 |
| | 0 | 4 | 0 | 100 | 0 | 0 | 40 | 60 | 100 |
| | Credit | | Mark | | L | | P | | |
| | L | P | L | P | CCA | ESE | CCA | ESE | Total marks |
| | 3 | 0 | 75 | 0 | 25 | 50 | 0 | 0 | 75 |
| 3 Credit | 2 | 1 | 50 | 25 | 15 | 35 | 10 | 15 | 75 |
| | 1 | 2 | 25 | 50 | 10 | 15 | 20 | 30 | 75 |
| | 0 | 3 | 0 | 75 | 0 | 0 | 30 | 45 | 75 |

**KANNUR UNIVERSITY**
**FYUGP -2024 ADMISSION ONWARDS**
**MAJOR PATHWAY COURSES IN BIOCHEMISTRY**
**PROGRAMME STRUCTURE**

| | Semester | Course Code | Name of the Course | CREDITS | | |
|---|---|---|---|---|---|---|
| | | | | Theory | Practical | Total |
| Foundation level 100-199 | I | KU1DSCBCH101 | BIOMOLECULES I | 3 | 1 | 4 |
| | I | KU1DSCBCH102 (MINOR) | FUNDAMENTALS OF BIOCHEMISTRY I | 4 | - | 4 |
| | I | KU1DSCBCH103 (MINOR) | BASIC ENDOCRINOLOGY | 4 | - | 4 |
| | II | KU2DSCBCH104 | BIOMOLECULES II | 3 | 1 | 4 |
| | II | KU2DSCBCH105 (MINOR) | FUNDAMENTALS OF BIOCHEMISTRY II | 4 | - | 4 |
| | II | KU2DSC BCH106 (MINOR) | BASIC PLANT BIOCHEMISTRY | 4 | - | 4 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | II | KU2DSCBCH107 (MINOR) | BIOCHEMISTRY OF BIOLOGICAL MOLECULES | 4 | - | 4 |
| Intermediate level 200-299 | III | KU3DSCBCH201 | CELL BIOLOGY I | 3 | 1 | 4 |
| | III | KU3DSCBCH202 | ENZYMOLOGY | 3 | 1 | 4 |
| | III | KU3DSCBCH203 (MINOR) | FUNDAMENTALS OF BIOCHEMISTRY III | 4 | - | 4 |
| | III | KU3DSCBCH204 (MINOR) | BIOCHEMISTRY OF HEALTH & NUTRITION | 3 | 1 | 4 |
| | IV | KU4DSCBCH205 | BIOPHYSICAL AND BIOCHEMICALTECHNIQUES | 3 | 1 | 4 |
| | IV | KU4DSCBCH206 | CELL BIOLOGY II | 3 | 1 | 4 |
| | IV | KU4DSCBCH207 | MOLECULAR BIOLOGY | 4 | - | 4 |
| Higher level 300-399 | V | KU5DSCBCH301 | IMMUNOLOGY | 3 | 1 | 4 |
| | V | KU5DSCBCH302 | METABOLISM -I | 3 | 1 | 4 |
| | V | KU5DSCBCH303 | CLINICAL BIOCHEMISTRY | 3 | 1 | 4 |
| | V | KU5DSEBCH301 | NUTRITIONAL BIOCHEMISTRY | 3 | 1 | 4 |
| | V | KU5DSEBCH302 | ECOLOGY | 4 | - | 4 |
| | V | KU5DSEBCH303 | MOLECULAR BASIS OF DISEASES | 4 | - | 4 |
| | VI | KU6DSCBCH304 | METABOLISM -II | 3 | 1 | 4 |
| | VI | KU6DSCBCH305 | GENETICS | 4 | - | 4 |
| | VI | KU6DSCBCH306 | ENDOCRINOLOGY | 4 | - | 4 |
| | VI | KU6DSEBCH304 | PROTEOMICS AND NUTRACEUTICALS | 4 | - | 4 |
| | VI | KU6DSE BCH305 | LIFESTYLE DISEASES | 4 | - | 4 |
| | VI | KU6DSEBCH306 | BIOSAFETY AND BIOETHICS | 4 | - | 4 |
| | VI | KU6DSCBCH307 | INTERNSHIP | - | - | 2 |
| Capstone / | VII | KU7DSCBCH401 | RESEARCH METHODOLOGY | 4 | - | 4 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Advanced level 400-499 | VII | KU7DSCBCH402 | PHARMACEUTICAL CHEMISTRY | 4 | - | 4 |
| | VII | KU7DSCBCH403 | PLANT BIOCHEMISTRY | 3 | 1 | 4 |
| | VII | KU7DSCBCH404 | PHYSIOLOGICAL ASPECTS OF BIOCHEMISTRY | 4 | - | 4 |
| | VII | KU7DSCBCH405 | CANCER BIOLOGY | 4 | - | 4 |
| | VIII | KU8DSCBCH406 | COMPUTATIONAL TECHNIQUES IN BIOCHEMISTRY | 3 | 1 | 4 |
| | VIII | KU8DSCBCH407 | BIOSTATISTICS | 4 | - | 4 |
| | VIII | KU8DSCBCH408 | INTELLECTUAL PROPERTY RIGHTS | 4 | - | 4 |
| | VIII | KU8DSCBCH 409 | PROJECT | 12 | - | 12 |
| | VIII | KU8DSEBCH404 | DEVELOPMENTAL BIOLOGY | 4 | - | 4 |
| | VIII | KU8DSEBCH405 | STEM CELL AND REGENERATIVE BIOLOGY | 4 | - | 4 |
| | VIII | KU8DSEBCH406 | ENVIRONMENTAL BIOCHEMISTRY | 4 | - | 4 |
| | VIII | KU8DSEBCH407 | ONLINE /MOOC COURSE I | 4 | - | 4 |
| | VIII | KU8DSEBCH408 | ONLINE/MOOC COURSE II | 4 | | 4 |
| | VIII | KU8DSEBC 409 | ONLINE/MOOC COURSE III | 4 | - | 4 |

**In the VIII semester either 3 courses or a project for 12 credits can be chosen**

## GENERAL FOUNDATION COURSES: BIOCHEMISTRY

| SKILL ENHANCEMENT COURSES (SEC) | | | | | |
|---|---|---|---|---|---|
| **Semester** | **Course Code** | **Name of the course** | **Credits** | | |
| | | | **Theor** | **Practical** | **Total** |
| IV | KU4SECBCH201 | MEDICAL BIOCHEMISTRY | 2 | 1 | 3 |
| V | KU5SECBCH202 | FOOD ADULTERATION AND ANALYSISTECHIQUES | 2 | 1 | 3 |
| VI | KU6SECBCH301 | BASIC BIOCHEMICAL TECHNIQUES | 2 | 1 | 3 |

| VALUE ADDED COURSES (VAC) | | | | | |
|---|---|---|---|---|---|
| **Semester** | **Course code** | **Name of the course** | **Credits** | | |
| | | | **Theory** | **Practical** | **Total** |
| III | KU3VACBCH201 | HEALTH & NUTRITION | 3 | - | 3 |
| IV | KU4VACBCH202 | MEDICINAL PLANTS | 3 | - | 3 |
| IV | KU4VACBCH301 | FOOD SAFETY AND QUALITY CONTROL | 3 | - | 3 |

| MULTIDISCIPLINARY COURSES (MDC) | | | | | |
|---|---|---|---|---|---|
| **Semester** | **Course code** | **Name of the course** | **Credits** | | |
| | | | **Theory** | **Practical** | **Total** |
| I | KU1MDCBCH101 | BIOMOLECULES OF LIFE | 3 | - | 3 |
| II | KU2MDCBCH102 | BASIC BIOCHEMISTRY | 3 | - | 3 |

| DISCIPLINE SPECIFIC MINOR PATHWAY COURSES: BIOCHEMISTRY | | | | | |
|---|---|---|---|---|---|
| **Semester** | **Course code** | **Name of the course** | **Credits** | | |
| | | | **Theory** | **Practical** | **Total** |
| I | KU1DS BCH102 | FUNDAMENTALS OF BIOCHEMISTRY I | 3 | 1 | 4 |
| I | KU1DSCBCH103 | BASIC ENDOCRINOLOGY | 4 | - | 4 |
| II | KU2DSCBCH105 | FUNDAMENTALS OF BIOCHEMISTRY II | 4 | - | 4 |
| II | KU2DSCBCH106 | BASIC PLANT BIOCHEMISTRY | 4 | - | 4 |
| II | KU2DSCBCH107 | BIOCHEMISTRY OF BIOLOGICAL MOLECULES | 3 | 1 | 4 |
| III | KU3DSCBCH203 | FUNDAMENTALS OF BIOCHEMISTRY III | 3 | 1 | 4 |
| III | KU3DSCBCH204 | BIOCHEMISTRY OF HEALTH & NUTRITION | 3 | 1 | 4 |

## I SEMESTER

## KU1DSC BCH 101: BIOMOLECULES I

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| I | DSC | Foundation | KU1DSCBCH101 | 4 | 75 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 4 | 1 | 0 | 25 | 50 | 75 | 1.5 |

**Course Description**

Biochemistry is a study focusing on the life processes of living organisms at both biological and chemical levels. The branch focuses on studying organisms' cells, thereby understanding their structures and various interactions. Biomolecules are the most essential organic molecules, which are involved in the maintenance and metabolic processes of living organisms. Biomolecules have a wide

range of sizes and structures and perform a vast array of functions. The four major types of biomolecules are carbohydrates, lipids, nucleic acids, and proteins.

**Course Prerequisite: NIL Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | State the definition and branches of Biochemistry | |
| 2 | Understand functions of vitamins and minerals | |
| 3 | Understand the nature functions of biomolecules | |

*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO1 | | ✔ | | |
| CO 2 | | | ✔ | |
| CO 3 | | | | ✔ |
| CO 4 | | | ✔ | |
| CO 5 | | | ✔ | |

**COURSE CONTENTS**

**Contents for Classroom Transaction:**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **INTRODUCTION TO BIOCHEMISTRY** | | **10** |
| | 1 | Definition-Branches of Biochemistry | |
| | 2 | Brief study of the foundations of biochemistry (cellular, chemical and physical foundations-fundamental study only). | |
| | 3 | Biochemistry as a molecular logic of living organism. | |
| | 4 | Role and scope of Biochemistry. | |
| | **CARBOHYDRATES** | | **15** |
| | 1 | Definition and classification, Haworth projections. Monosaccharides-, Structure, chemistry & functions | |
| | 2 | Isomerism of carbohydrate- stereoisomers, enantiomers, | |

| | | | |
|---|---|---|---|
| | | epimers, mutarotation | |
| | 3 | Sugar derivatives: amino sugars, sugar alcohol, sugar acids, deoxy-sugar and glycosides | |
| **2** | 4 | Disaccharides- Occurrence, structure (Haworth model), chemistry and functions of sucrose, lactose, maltose, isomaltose and cellobiose | |
| | 5 | Chemical Properties and Reactions-Reducing and non-reducing sugars | |
| | **POLYSACCHARIDES** | | **15** |
| | 1 | Occurrence, structure, chemistry and functions of homopolysaccharides-starch, glycogen, cellulose, chitin and pectin | |
| **3** | 2 | Structure and functions of heteropolysaccharides-hyaluronic acid, chondroitin sulfate and heparin. | |
| | 3 | Biochemical functions of carbohydrates. | |
| | 4 | Glycoconjugates**:** Proteoglycans, glycoproteins, glycolipids. | |
| | **LIPIDS** | | **15** |
| | 1 | Lipids- Definition, Biochemical functions of lipids Classification of lipids- simple, compound and derived. | |
| **4** | 2 | Simple lipids-Physical and chemical properties of fats | |
| | 3 | Characterization of fat – Saponification number, acid number, Iodine number and RM number | |
| | 4 | Compound lipids-Structure and function of phospholipids, glycolipids and lipoproteins. | |
| | 5 | Derived lipids - Fatty acids-saturated and unsaturated. Essential fatty acids. Steroids- Structure of steroid nucleus , Structure of cholesterol | |
| **5** | | **Teacher Specific Module** | 20 |
| | | Qualitative analysis of carbohydrates-Monosaccharide, disaccharides and polysaccharides<br>Qualitative analysis of fats<br>Estimation of reducing sugar.<br>Estimation of cholesterol | |

**Essential Readings:**

1. J L Jain Text book of biochemistry. Chand and company Ltd. New Delhi 2007
2. E.S. West, W.R. Todd etal. Text book of Biochemistry4th edition. Oxford and IBH Publishing. 1974.

3. Nelson, David L. (David Lee), 1942-. Lehninger Principles of Biochemistry. New York: W.H. Freeman, 2005.

**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 2 |
| | 2 | 3 |
| | 3 | 3 |
| | 4 | 3 |
| **2** | 1 | 1 |
| | 2 | 2 |
| | 3 | 2 |
| | 4 | 2 |
| | 5 | 3 |
| | 6 | 3 |
| | 7 | 3 |
| **3** | 1 | 1 |
| | 2 | 1 |
| | 3 | 2 |
| | 4 | 3 |
| | 5 | 2 |
| | 6 | 2 |
| | 7 | 3 |
| | 8 | 4 |
| **4** | 1 | 1 |
| | 2 | 2 |
| | 3 | 2 |
| | 4 | 3 |

**Suggested Readings:**

1. Devlin, Thomas M. Textbook of biochemistry: with clinical correlations. 7th Hoboken: N.J.: Jwiley, 2011.
2. Berg, Jeremy M., John L. Tymoczko, and Lubert Stryer. Biochemistry. 5th ed., W. H freeman, 2002.

**Assessment Rubrics:**

| Evaluation Type | | Marks |
|---|---|---|
| **End Semester Evaluation (Theory)** | | **50** |
| **End Semester Evaluation (Practical)** | | **15** |
| **Continuous Evaluation (Theory)** | | **25** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 5 |
| d) | Viva | 5 |
| **Continuous Evaluation (Practical)** | | **10** |
| a) | Record | 5 |
| b) | Lab performance | 5 |
| Total | | 100 |

**Employability for the Course:**

1. Research Scientist
2. Biochemist
3. Pharmaceutical Scientist
4. Clinical Biochemist

**II SEMESTER**

**KU2DSCBCH104: BIOMOLECULES II**

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| II | DSC | Intermediate | KU2DSCBCH104 | 4 | 75 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 3 | 2 | - | 25 | 50 | 75 | 1.5 |

**Course Description:**

Biochemistry is the study of life processes at the molecular level, focusing on the structure, function, and interactions of biomolecules within living organisms. It involves examining the chemical and biological processes that occur within cells, aiming to understand the underlying mechanisms of life. Biomolecules II explores the structure and function of proteins, nucleic acids, vitamins, and minerals. Students will learn about the biological roles of these essential biomolecules.

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | An understanding about the importance of proteins and peptides | |
| 2 | A knowledge about the salient features of nucleic acids | |
| 3 | A knowledge about the importance of vitamins | |
| 4 | A knowledge about the importance of minerals | |

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | ✓ | | | |
| CO 2 | | ✓ | | |
| CO 3 | | | ✓ | |
| CO 4 | | | ✓ | |
| CO 5 | | | ✓ | |

**COURSE CONTENTS**

**Contents for Classroom Transaction:**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| | **AMINO ACIDS AND PROTEINS** | | **15** |
| | 1 | Amino acids: Definition, structure three letter and single letter abbreviations of amino acids. Classification of amino | |

| | | | |
|---|---|---|---|
| **1** | | acids based on charge and polarity, essential and non-essential amino acids. | |
| | 2 | Proteins: Peptides- Formation of peptide bond. | |
| | 3 | Elementary study of primary, secondary, tertiary and quaternary structure of proteins- (e.g. Hemoglobin and Myoglobin). | |
| | 4 | Forces stabilizing the structure of protein | |
| | 5 | Classification of proteins based on solubility, shape and function | |
| **2** | **NUCLEIC ACIDS** | | **10** |
| | | Nucleic acids: Structure of Purines and Pyrimidines; Nucleotides and Nucleosides | |
| | | DNA: double helix: A, B and Z forms | |
| | | RNA: types | |
| | | Effect of acids, alkali and nucleases on DNA and RNA | |
| **3** | **VITAMINS** | | **20** |
| | 1 | Vitamins: Definition, Classification | |
| | 2 | Fat soluble vitamins- sources, structure and physiological functions | |
| | 3 | Water soluble vitamins-sources, structure and physiological functions | |
| **4** | **MINERALS** | | **15** |
| | 1 | Minerals: Mineral requirement, definition and classification | |
| | 2 | Source and functions of microminerals- Ca, Mg, Na, K&P | |
| | 3 | Source and functions of microminerals- Fe, I, Zn, Cu, | |
| **5** | | **Teacher Specific Module** | 15 |
| | | Qualitative analysis of amino acids-Tyrosine, tryptophan, arginine<br>Estimation of protein<br>Estimation of DNA and RNA | |

**Essential Readings:**

1. J L Jain Text book of biochemistry. Chand and company Ltd. New Delhi 2007
2. E.S. West, W.R. Todd etal. Text book of Biochemistry4th edition. Oxford and IBH Publishing.

1974.
3. Nelson, David L. (David Lee), 1942-. Lehninger Principles of Biochemistry. New York: W.H. Freeman, 2005.

**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 2 |
| | 2 | 3 |
| | 3 | 3 |
| | 4 | 3 |
| **2** | 1 | 1 |
| | 2 | 2 |
| | 3 | 2 |
| | 4 | 2 |
| | 5 | 3 |
| | 6 | 3 |
| | 7 | 3 |
| **3** | 1 | 1 |
| | 2 | 1 |
| | 3 | 2 |
| | 4 | 3 |
| | 5 | 2 |
| | 6 | 2 |
| | 7 | 3 |
| | 8 | 4 |
| **4** | 1 | 1 |
| | 2 | 2 |
| | 3 | 2 |
| | 4 | 3 |

**Suggested Readings:**

4. Devlin, Thomas M. Textbook of biochemistry: with clinical correlations. 7th Hoboken: N.J.: Jwiley, 2011.
5. Berg, Jeremy M., John L. Tymoczko, and Lubert Stryer. Biochemistry. 5th ed., W. H freeman, 2002.

**Assessment Rubrics:**

| **Evaluation Type** | | **Marks** |
|---|---|---|
| **End Semester Evaluation (Theory)** | | **50** |
| **End Semester Evaluation (Practical)** | | **15** |
| **Continuous Evaluation (Theory)** | | **25** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 5 |
| d) | Viva | 5 |
| **Continuous Evaluation (Practical)** | | **10** |
| a) | Record | 5 |
| b) | Lab performance | 5 |
| Total | | 100 |

**Employability for the Course:**

1.Research Scientist
2.Biochemist
3.Pharmaceutical Scientist
4.Clinical Biochemist

## III SEMESTER
## KU3DSCBCH 201: CELL BIOLOGY I

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| III | DSC | Foundation | KU3DSCBCH201 | 4 | 60 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 4 | 0 | 0 | 30 | 70 | 100 | 2 |

**Course description:**

Cell Biology course focusing on the structure, function and regulation of cellular components in both Eukaryotic and Prokaryotic organisms. Students will gain a comprehensive understanding of cell membrane dynamics, organelle structure and function, cell division processes and membrane transport mechanisms.

**Course Prerequisite:** NIL

**Course Outcomes:**

| CO No. | Expected Outcome | Learning |
|---|---|---|
| 1 | To understand the structure of prokaryotic and eukaryotic cell. To know | |
| 2 | In depth knowledge of cell membrane and its composition | |
| 3 | Aware of various transport system existing in Eukaryotes and Prokaryotes | |
| 4 | Compare and contrast the events of cell cycle and its regulation | |
| 5 | To understand cancer development and its causes.<br>To analyse the difference between normal and cancerous cell. | |

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

**Mapping of Course Outcomes to PSOs**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | ✓ | | | |
| CO 2 | | ✓ | ✓ | |
| CO 3 | | | ✓ | |
| CO 4 | | | ✓ | |
| CO 5 | | | | ✓ |

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **CELL- STRUCTURAL ORGANIZATION AND FUNCTIONS OF INTRACELLULAR ORGANELLES** | | **10** |
| | 1 | Discovery of cell and Cell Theory. Ultrastructure of cell: prokaryotic and eukaryotic cell | |
| | 2 | Structure and Functions of Cell wall, mitochondria, chloroplast, ribosomes, endoplasmic reticulum, Golgi complex and lysosomes. | |
| | 3 | Structure and function of nucleus and nucleolus.<br>Morphology of chromosome | |
| | 4 | Cytoskeleton and organization- Microtubules, microfilaments and intermediary filaments. | |
| 2 | **MEMBRANE STRUCTURE AND FUNCTIONS** | | **15** |
| | 1 | Membrane bilayer – Models, Plasma membrane-structure and composition -Fluid mosaic model. | |
| | 2 | Membrane lipids – fluidity, Asymmetry phase transition, Liposomes. | |
| | 3 | Membrane proteins – Types, Orientation, Mobility – Experiments, lipases, proteins or RBC membrane, Bacteriorhodopsin, Porins-aquaporin, solubilisation of proteins, lipid anchored proteins. | |
| 3 | **MEMBRANE TRANSPORT** | | **15** |
| | 1 | Transport across membranes- Exocytosis, Endocytosis, Simple diffusion, facilitated transport-definition, types with examples. Symport, uniport and antiport | |
| | 2 | Active transport- Primary active transport, secondary active transport, sodium/potassium-ATPase | |
| | 3 | GLUT types and mechanism, ion transporter | |

| | | | |
|---|---|---|---|
| | 4 | P- ATPase, V- ATPase, F- ATPase, ABC superfamily – Bacterial PM permeases | |
| **4** | **CELL DIVISION AND CELL CYCLE** | | **15** |
| | 1 | Histone proteins and chromosomal organization | |
| | 2 | Cell Cycle: Different phases including cell division – mitosis & meiosis. | |
| | 3 | Apoptosis and Necrosis. Outline study of apoptotic pathways, role of caspases proteins in apoptotic pathways, cell death receptor and apoptosis | |
| **5** | **Teacher Specific Module** | | **5** |
| | *Directions* | | |

**Essential Readings:**


1. Cooper, G.M. The Cell – A Molecular Approach. Sunderland, MA, Sinauer Associates, Inc., 2013.
2. Karp, Gerald. Cell and Molecular Biology: Concepts and Experiments. 5th ed., Wiley, 2007.
3. Verma, P.S. Cell Biology (Cytology, Biomolecules and Molecular Biology). 1st ed., S Chand Publication, 2016.


**Core suggested and additional reading:**


4. Lodish, Harvey, et al. Molecular Cell Biology. 7th ed., W. H. Freeman and Company, 2013.
5. Alberts, Bruce, et al. Molecular Biology of the Cell. 6th ed., Garland Publishing Inc., 2014.
6. Alberts, Bruce et al. Essential Cell Biology. 4th ed., Garland Press (Taylor & Francis), 2004.


**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 3 |
| | 2 | 3 |
| | 3 | 2 |
| | 4 | 2 |
| **2** | 1 | 3 |
| | 2 | 2 |
| | 3 | 1 |
| | 4 | 6 |
| | 1 | 2 |

| | | |
|---|---|---|
| **3** | 2 | 1 |
| | 3 | 6 |
| | 4 | 4 |
| **4** | 1 | 3 |
| | 2 | 1 |
| | 3 | 2 |
| | 4 | 4 |

**Assessment Rubrics:**

| **Evaluation Type** | | **Marks** |
|---|---|---|
| End Semester Evaluation | | **70** |
| Continuous Evaluation | | **30** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 10 |
| d) | Viva | 5 |
| **Total** | | **100** |

**Employability for the course/Programme**

1. Biochemical companies
2. Research and development
3. Teaching

**KU3DSCBCH202: ENZYMOLOGY**

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| III | DSC | Intermediate | KU3DSCBCH202 | 4 | 75 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 3 | 2 | 0 | 25 | 50 | 75 | 1.5 |

**Course Description:**

This course is designed so that students have a deep knowledge of all aspects of enzymes. It emphasizes on the enzyme kinetics, the mechanisms of enzyme catalysis, and enzymatic regulation. It also aims to provide hands-on practical training with enzyme assay, factors affecting enzymes, and enzyme purification.

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | This course is designed so that students have a deep knowledge of all aspects of enzymes. | |
| 2 | It emphasizes on the enzyme kinetics, the mechanisms of enzyme catalysis, and enzymatic regulation. | |
| 3 | To understand the various mechanisms enzyme regulation and to apply enzyme technology in various fields. | |
| 4 | It also aims to provide hands-on practical training with enzyme assay, factors affecting enzymes, and enzyme purification. | |

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|---|---|---|---|---|---|---|
| CO 1 | | ✓ | | | | |
| CO 2 | | | ✓ | | | |
| CO 3 | | | | ✓ | | |
| CO 4 | | | | ✓ | | ✓ |

**COURSE CONTENTS**

**Contents for Classroom Transaction:**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | | **INTRODUCTION TO ENZYMES AND COENZYME** | **15** |
| | 1 | Holoenzyme, apoenzyme, and prosthetic group; Interaction between enzyme and substrate- lock and key model, induced fit model, Features of active site, activation energy. | |
| | 2 | Enzyme specificity and types; Enzyme Commission system of classification and nomenclature of enzymes (Class and subclass with one example) | |
| | 3 | Coenzymes and their functions - NAD, $NADP^+$, FAD, FMN, lipoic acid, TPP, pyridoxal phosphate, biotin and cyanocobalamin. | |
| | 4 | Measurement and expression of enzyme activity, enzyme assays. Definition of IU, katals, enzyme turn over number and specific activity, Isolation and purification of enzymes and the criteria of purity. | |
| 2 | | **ENZYME KINETICS** | **15** |
| | | Study of the factors affecting the velocity of enzyme catalyzed reaction- enzyme concentration, temperature, pH, substrate concentration, inhibitors and activators (explanation with graphical representation). | |
| | | Derivation of Michaelis-Menten equation and Km value determination and its significance<br>Definition of $V_{max}$ value of enzyme and its significance, Lineweaver-Burk plot (primary and secondary kinetic plots). | |
| | | Reversible and Irreversible enzyme inhibition; competitive, non-competitive, and uncompetitive inhibition. | |

| | | | |
|---|---|---|---|
| | | Allosteric enzymes: Subunit Interactions, regulation of enzyme activity, Jacob and Monod model of allosteric enzymes, Koshland model, detailed discussion using ATCase (Effects of ATP and CTP) as examples. K-Class and V-Class allosteric enzymes.<br>Regulation of enzyme activity (feedback inhibition, covalent modification, zymogen activation, allosteric regulation) | |
| **3** | **APPLICATION OF ENZYMES** | | **15** |
| | 1 | Immobilized enzymes and its application in industry and medicine | |
| | 2 | Industrial (food and beverage, detergent, textile, leather, paper and pulp industry) uses of enzymes: amylases, proteases, pectinases, lactase, rennin, cellulases, laccase. | |
| | 3 | Enzymes in molecular biology (restriction enzymes, ligases and polymerases) | |
| | 4 | Diagnostic and therapeutic enzymes. Abzymes and Ribozyme | |
| 4 | | **PRACTICALS** | **30** |
| | 1 | Effect of temperature on Salivary amylase enzyme activity. | |
| | 2 | Effect of pH on Salivary amylase enzyme activity. | |
| | 3 | Effect of enzyme concentration on Salivary amylase enzyme activity. | |
| | 4 | Effect of substrate concentration on Salivary amylase enzyme activity. | |
| | 5 | Effect of time on Salivary amylase enzyme activity. | |
| | 6 | Determination of Michaelis-Menten constant (KM) of an enzyme by Lineweaver-Burk method. | |

**Essential Readings:**


1. Palmer, Trevor, and Philip Bonner. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry. Horwood Publishing Limited, 2007.
2. Price, Nicholas C., and Lewis Stevens. Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins. Oxford University Press, USA, 1999
3. Jain, J.L., Sunjay Jain, and Nitin Jain. Fundamentals of Biochemistry. S. Chand & Co Ltd, 2008.

4. West, E.S., et al. Textbook of Biochemistry. Oxford & IBH Publishing Co-Pvt. Ltd., 2017.
5. 5.Laidler, K.J., and P.S. Bunting. The Chemical Kinetics of Enzyme Action. Oxford University Press, London, 1987.
6. Voet, Donald, and Judith G. Voet. Fundamentals of Biochemistry. 4th ed., Wiley, 2006.
7. Sawhney, S. K., and Randhir Singh. Introductory Practical Biochemistry. Narosa Publishing House,2010.

**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| 1 | 1 | 3 |
| | 2 | 2 |
| | 3 | 1 |
| | 4 | 6 |
| 2 | 1 | 5 |
| | 2 | 1 |
| | 3 | 1 |
| | 4 | 6 |
| 3 | 1 | 6 |
| | 2 | 4 |
| | 3 | 1 |
| | 4 | 1 |
| 4 | 1 | 7 |
| | 2 | 7 |
| | 3 | 7 |
| | 4 | 7 |
| | 5 | 7 |
| | 6 | 7 |
| | 7 | 7 |
| | 8 | 7 |
| | 9 | 7 |
| | 10 | 7 |

**Suggested Readings:**


1. Palmer, T. Understanding Enzymes. 4th ed., Prentice Hall/Ellis Horwood, London, 1995.
2. Price, Nicholas C., and Lervis Stevens. Fundamentals of Enzymology. 2nd ed., Oxford Science Publications, New York, 2001.
3. Bugg, T. D. H. Introduction to Enzyme and Coenzyme Chemistry. 3rd ed., John Wiley & Sons Ltd., Chichester, UK, 2012.
4. Buchholz, Klaus, Volker Kasche, and Urve Theo Bornscheuer. Biocatalysts and Enzyme Technology. John Wiley & Sons, 2012.


**Assessment Rubrics:**

| **Evaluation Type** | | **Marks** |
|---|---|---|
| End Semester Evaluation (Theory) | | **50** |
| End Semester Evaluation (Practical) | | **15** |
| Continuous Evaluation (Theory) | | **25** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 5 |
| d) | Viva | 5 |
| Continuous Evaluation (Practical) | | **10** |
| a) | Record | 5 |
| b) | Lab performance | 5 |

**Employability for the course/programme:**

1.Academic Researcher.
2.Scientific Laboratory Technician.
3.Medical Researcher.
4.Enzymologist in Drug designing

## IV SEMESTER
## KU4DSCBCH205: BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| IV | DSC | Intermediate | KU4DSCBCH205 | 4 | 75 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 3 | 2 | 0 | 25 | 50 | 75 | 1.5 |

**Course Description:**

The biochemical & biophysical techniques encompass a range of processes, including Protein Purification, perfusion, Homogenization, Differential Centrifugation, Purification of LDH, Characterization of LDH, Western blotting, Gel filtration chromatography, Protein crystallography, PCR, Ligation and transformation and Selection and screening.

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | Toexplaintheprincipleandfunctionofvariousinstrumentsinbiochemistry | |
| 2 | To interpret about working methods of various types of Microscopes. | |
| 3 | To understand different type of separation techniques. | |
| 4 | To analyse detailed working and applications of chromatography and electrophoresis | |

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | | | ✓ | |
| CO 2 | | | | ✓ |
| CO 3 | | | ✓ | |
| CO 4 | | ✓ | | |

**COURSE CONTENTS**

**Contents for Classroom Transaction:**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| **1** | **MICROSCOPIC AND CENTRIFUGAL TECHNIQUES** | | **15** |
| | 1 | Microscopy-Basic principle and applications<br>Types- light, compound, phase contrast microscope | |
| | 2 | Centrifugation-Principle and Components | |
| | 3 | Sedimentation Techniques-Differential, density gradient and ultra-centrifugation | |
| | 4 | Radioisotopes used in biology-p32, I125, I131, Co 60, C14<br>Radiation hazards, Precautions.<br>Measurement of radioactivity by GM Counter and Scintillation counter | |

| | | | |
|---|---|---|---|
| **2** | **ELECTROPHORETIC AND CHROMATOGRAPHIC TECHNIQUES** | | **15** |
| | 1 | Electrophoresis-Theory and Principle | |
| | 2 | Electrophoretic techniques-Paper, Agarose gel, SDS PAGE, immune electrophoresis, isoelectric focusing, Gel documenter | |
| | 3 | Chromatography-Principle and types: Paper, TLC, ion exchange, gel filtration, affinity, GLC and HPLC | |

| | | | |
|---|---|---|---|
| **3** | **SPECTROSCOPIC TECHNIQUES** | | **15** |
| | 1 | Spectroscopy-Laws of light absorption –Beer lamberts law | |
| | 2 | UV and visible spectroscopy: Working and application of UV and visible spectroscopic techniques | |
| | 3 | Principle and application of NMR, Mass spectroscopy, fluorescent spectroscopy<br>X-ray crystallography | |
| 4 | **Teacher Specific Module: Practical's** | | **30** |
| | 1 | Standardization of pH meter | |
| | 2 | Measurements of pH of solutions using pH meters | |
| | 3 | Principles of colorimetry and verification of Beer Lambert law. | |
| | 4 | Separation of pigments by column chromatography | |
| | 5 | Separation of amino acids and sugar by TLC | |
| | 6 | Agarose gel electrophoresis of DNA | |
| | 7 | Sodium dodecyl sulphate-Polyacrylamide gel electrophoresis of proteins. | |
| | 8 | Extraction of enzymes from animal tissues and isoenzyme analysis by PAGE. | |

**Essential Readings:**


1. Banerjee, Pranab Kumar. Introduction to Biophysics. S. Chand & Company, 2008.
2. Roy, R.N. A Textbook of Biophysics. New Central Book Agency Pvt. Ltd, Calcutta, 2001. 3. Upadhyay, Upadhyay, and Nath. Biophysical Chemistry. Himalaya Publishing House, Bangalore,2016.
4. Allen, James P. Biophysical Chemistry. Wiley Blackwell, 2008.
5. Wilson, K., and Walker, J. Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press, 2010.

**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| 1 | 1 | 5 |
| | 2 | 5 |
| | 3 | 1 |
| | 4 | 3 |
| 2 | 1 | 3 |
| | 2 | 1 |
| | 3 | 4 |
| 3 | 1 | 5 |
| | 2 | 5 |
| | 3 | 5 |
| 4 | 1 | 11 |
| | 2 | 10 |
| | 3 | 10 |
| | 4 | 9 |
| | 5 | 9 |
| | 6 | 9 |
| | 7 | 9 |

**Suggested Readings:**


1. Horst.(2010) Basic One and Two-dimensional NMR Spectroscopy, Wiley-VCH. New Jersey.
2. Ir'lurphy. D.B. and Davidson. M. (2012) Fundamentals of Light Microscopy and Electron Imaging-Wild -Blackwell. New Jersey
3. Freielder. D.M.(1983) Physical Biochemistry'-Application to Biochemistry and Molecular Biology. Vol 1. Freeman. New York
4. Sambrook and Russel (2000). *Molecular Cloning Vol 1-3* (3rd edition)- CSHL press.
5. S. Sadasivam, A. Manickam (2010) Biochemical methods 3rd edition**.**
6. Practical Biochemistry Plummer


**Assessment Rubrics:**

| **Evaluation Type** | | **Marks** |
|---|---|---|
| **End Semester Evaluation (Theory)** | | **50** |
| **End Semester Evaluation (Practical)** | | **15** |
| **Continuous Evaluation (Theory)** | | **25** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |

| | | |
|---|---|---|
| c) | Seminar | 5 |
| d) | Viva | 5 |
| **Continuous Evaluation (Practical)** | | **10** |
| a) | Record | 5 |
| b) | Lab performance | 5 |
| | **Total** | **100** |

**Employability for the Course:**

1. Biochemical companies
2. Research and development
3. Teaching
4. Quality control analysis
5. Microbial, Biotechnology and Pharmaceutical Industry

## KU4DSCBCH 206: CELL BIOLOGY II

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| IV | DSC | Intermediate | KU4DSCBCH206 | 4 | 75 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 3 | 2 | 0 | 25 | 50 | 75 | 1.5 |

**Course Description:**

The focus of Cell Biology is the study of the structure and function of the cell. In this course we will focus on Eukaryotic cell biology and will cover topics such as cell cycle regulation, signal transduction, apoptosis (programmed cell death), and cancer cell biology. Throughout the semester we will attempt to relate defects in these various cellular processes and helps to gain a better understanding for what happens when cells don't work as they should.

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | Understand the regulation of cell cycle<br>And to familiarize the interactions between the cells | |
| 2 | Understand signalling molecules and their mechanism of action | |
| 3 | About cell death and make students aware of cancer | |
| 4 | To practically analyse the different cell biology techniques | |
| 5 | Teacher specific | |

*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)*

| Mapping of Course Outcomes to PSOs | | | | | | | |
|---|---|---|---|---|---|---|---|
| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PSO 7 |
| CO 1 | ✓ | | | | | | |
| CO 2 | | ✓ | | | | | |
| CO 3 | | | ✓ | | | | |
| CO 4 | | | | ✓ | ✓ | | |
| CO 5 | | | | | | ✓ | |

**COURSE CONTENTS**

**Contents for Classroom Transaction:**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | | **CELL CYCLE REGULATION AND CELLULAR INTERACTIONS** | **15** |
| | 1 | Phases of eukaryotic cell cycle and their regulations, cyclins and cyclin dependent kinases. | |
| | 2 | Growth factors, nuclear Lamins in cell cycle regulation. Checkpoints in cell cycle regulation | |

| | | | |
|---|---|---|---|
| | 3 | Cell- cell interaction and cell matrix interaction, extracellular matrix- collagens, proteoglycan, fibronectin. Cell-cell adhesion and adhesion proteins- cadherin, Ig superfamily, selectin, integrin, mucin. | |
| | 4 | Cell junctions – occluding, communicating, anchoring junctions. | |
| **2** | **CELL SIGNALLING** | | **15** |
| | 1 | Signalling molecules- Nitric oxide, neurotransmitters, peptide hormones, growth factors, eicosanoids, second messengers. | |
| | 2 | Cell surface receptors - GPCR, receptor protein tyrosine kinases, cytokine receptors | |
| | 3 | Intracellular signalling pathways- cyclic AMP pathways, phospholipase C pathway | |
| | 4 | JAK/STAT pathway, Wnt signalling | |
| | **PROTEIN TARGETTING** | | **15** |
| **3** | 1 | Protein targeting/sorting - definition, types - signal based targeting, vesicle-based trafficking. Overview of major sorting pathways in eukaryotes | |
| | 2 | Protein modifications in ER - covalent addition and processing of carbohydrates (glycosylation) in the ER and Golgi complex, formation of disulfide bonds in the ER. | |
| | 3 | Brief outline of Mechanism for nuclear import and export of proteins, NLS signal | |
| | 4 | Targeting of Peroxisomal Proteins- PTS1-directed import of peroxisomal matrix proteins.<br>Degradation and turnover of protein through the ubiquitin proteasome system: role in apoptosis | |
| | **Teacher Specific Module: Practicals** | | **30** |
| **4** | 1 | Microscope and different types of microscopes | |
| | 2 | Counting yeast cells using haemocytometer | |
| | 3 | Study of mitosis in onion root tip | |
| | 4 | Study of meiosis using permanent slides | |
| | 5 | Cell fractionation | |

**Essential Readings:**


1. Lodish, H., Parnell, J., & Kaiser, C. A. Molecular Cell Biology. WH Freeman and Company, New York and London.
2. Cooper, G. M., & Hausman, R. The Cell: A Molecular Approach. Sinauer Associates, Sunderland, MA.
3. Pollard, Thomas D., & Earnshaw, William C. Cell Biology. Saunders Elsevier, Philadelphia, 2008**.**
4. Verma, P. S., & Agarwal, V. K. Cell Biology, Genetics, Molecular Biology, Evolution, and Ecology. S. Chand & Company Ltd, New Delhi, 2008.
5. Weinberg, Robert A. The Biology of Cancer. Garland Science, 2007.
6. Celis, Julio E. Cell Biology: A Laboratory Handbook. Elsevier Inc., 2006.


**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| 1 | 1 | 1 |
| | 2 | 1 |
| | 3 | 4 |
| | 4 | 4 |
| 2 | 1 | 1 |
| | 2 | 1 |
| | 3 | 1 |
| | 4 | 1 |
| | 1 | 3 |
| 3 | 2 | 3 |
| | 3 | 5 |
| | 4 | 5 |
| 4 | 1 | 6 |
| | 2 | 6 |
| | 3 | 6 |
| | 4 | 6 |
| | 5 | 6 |

**Suggested Readings:**


7. Bruce, A. Molecular Biology of the Cell. Garland Publishing, 1989. .
8. Karp, G. Cell and Molecular Biology: Concepts and Experiments. 5th ed., John Wiley & Sons, Inc., 2008.

**Assessment Rubrics:**

| Evaluation Type | Marks |
|---|---|
| **End Semester Evaluation (Theory)** | **50** |
| **End Semester Evaluation (Practical)** | **15** |

| | | |
|---|---|---|
| Continuous Evaluation (Theory) | | **25** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 5 |
| d) | Viva | 5 |
| Continuous Evaluation (Practical) | | **10** |
| a) | Record | 5 |
| b) | Lab performance | 5 |
| **Total** | | **100** |

**Employability for the Course:**

1. Biochemical companies
2. Research and development
3. Teaching
4. Biotechnology Industr

## IV SEMESTER

## KU4DSCBCH 207: MOLECULAR BIOLOGY

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| IV | DSC | Intermediate | KU4DSCBCH207 | 4 | 60 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 4 | 0 | 0 | 30 | 70 | 100 | 2 |

**Course Description:**

The Molecular Biology course places a strong emphasis on comprehending the structure and functionalities of crucial macromolecules, equip ping students with both theoretical insights and hands-on laboratory competencies. Through detailed exploration, students uncover the intricate mechanisms that regulate cell function, spanning DNA, RNA, and proteins, and examine their interconnections across the domains of biochemistry, genetics, and cell biology. Importantly, the course highlights the revolutionary influence of recent breakthroughs in Molecular Biology, exemplified by the culmination of various large-scale genome projects, which are fundamentally reshaping the contours of contemporary biology.

**Course Prerequisite: NIL**

**Course Outcomes**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | Create the knowledge of DNA replication and repair | |
| 2 | Analyse the mechanism of transcription and post transcriptional modification | |
| 3 | Understand the mechanism of translation and post translational modification | |
| 4 | Understand the regulation of gene expressions | |

*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | | ✓ | | |
| CO 2 | | | ✓ | |
| CO 3 | | | ✓ | |
| CO 4 | | | | ✓ |
| CO 5 | | | | ✓ |

**COURSE CONTENTS**

**Contents for Classroom Transaction:**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **REPLICATION IN PROKARYOTES** | | **10** |
| | 1 | Central dogma of molecular biology | |
| | 2 | Classical experiments in Molecular Biology related to DNA replication. | |
| | 3 | Replication in prokaryotes-conservative, semiconservative and dispersive types, enzymes and protein factors. Mechanism of replication. | |
| | 4 | DNA repair, damage: excision, recombination, sos repair. | |
| 2 | **TRANSCRIPTION IN PROKARYOTES** | | **15** |
| | 1 | Prokaryotic Transcription – RNA polymerase, promoters, etc. | |
| | 2 | Mechanism of transcription. | |
| | 3 | Post-transcriptional modification of RNA in Eukaryotes. | |

| | | | |
|---|---|---|---|
| | 4 | Inhibitors of transcription. | |
| **3** | **TRANSLATION IN PROKARYOTES** | | **15** |
| | 1 | Genetic code – Features, wobble hypothesis | |
| | 2 | Prokaryotic translation- Charged RNA, f-met t RNA, initiator codon, Shine-Dalgarno consensus sequence, Formation of 70 S initiation complex, role of EF-Tu, EF-Ts, EF-G and GTP, nonsense codons and release factors, RF1 and RF2 – Mechanism. | |
| | 3 | Inhibitors of translation. | |
| **4** | **REGULATION** | | **15** |
| | 1 | Regulation of Gene expression in prokaryotes: induction and repression. | |
| | 2 | Operon model-Lac operon, tryptophan operon and Arabinose operon. | |
| | 3 | DNA binding proteins – Histones | |
| 5 | Teacher specific Module ( 5) | | 55 |
| | Directions | | |

**Essential Readings:**


1. Pierce, Benjamin A.. Genetics: A Conceptual Approach. United States, W. H. Freeman, 2013.
2. Russell, Peter JI. Genetics: A Molecular Approach. United Kingdom, Pearson/Benjamin Cummings, 2006.
3. Watson, James D. Molecular Biology of the Gene. United Kingdom, Pearson/Benjamin Cummings, 2008.
4. Rastogi, Veer-Bala. Principles of Molecular Biology. Medtech Publisher,2010.

**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 2 |
| | 2 | 3 |
| | 3 | 1 |
| | 4 | 3 |
| **2** | 1 | 2 |
| | 2 | 3 |
| | 3 | 3 |
| | 4 | 4 |
| **3** | 1 | 2 |
| | 2 | 3 |
| | 3 | 2 |
| | 4 | 1 |
| 4 | 1 | 4 |
| | 2 | 3 |
| | 3 | 3 |
| | 4 | 4 |

**Suggested Readings:**


1. Lewin, Benjamin. Gene IX. Jones and Bartlett Publishers,2017.
2. De Robertis, E.D. P., and De Robertis, E. M.F. Cell And Molecular Biology. India, Lippincott Williams & Wilkins, 1987.Karp, Gerald. Cell and Molecular Biology. John Wiley and Sons.
3. Walker, J.M., and Old, G. E.B. Molecular Biology and Biotechnology. Royal Society of Chemistry, U.K,1988.

**Assessment Rubrics:**

| Evaluation Type | | Marks |
|---|---|---|
| End Semester Evaluation (Theory) | | **70** |
| End Semester Evaluation (Practical) | | **0** |
| Continuous Evaluation (Theory) | | **30** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 10 |
| d) | Viva | 5 |
| **Total** | | **100** |

**Employability for the Course:**

1. Biotechnology companies
2. Research and Development
3. Teaching
4. Molecular diagnostics
5. Entrepreneurship
6. Biological technician

**V SEMESTER**

**KU5DSCBCH301: IMMUNOLOGY**

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| V | DSC | Higher | KU5DSCBCH301 | 4 | 75 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 3 | 2 | 0 | 25 | 50 | 75 | 1.5 |

**Course Description**

Immunology is a dynamic field at the intersection of biology and medicine that investigates the complex mechanisms underlying the body's defence against pathogens and its role in maintaining health. This introductory course offers a comprehensive overview of the fundamental principles of immunology, providing students with a solid foundation in understanding the immune system's structure, function, and regulation. Throughout this course, students will explore the intricate network of cells, molecules, and organs that collectively form the immune system. Topics covered include innate immunity, adaptive immunity, antigen recognition, immune cell development and differentiation, immune responses to infections, mechanisms of immunological memory, and the role of immunology in health and disease.

Students will delve into the diverse array of immune cells such as macrophages, dendritic cells, B cells, and T cells, and their specialized functions in recognizing and eliminating pathogens. Additionally, the course will examine the role of antibodies, cytokines, and other signalling molecules in orchestrating immune responses and maintaining immune homeostasis.

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | Understand the basics of the immune system. | |
| 2 | Comprehend ANTIGEN-ANTIBODY reaction. | |
| 3 | Understand different autoimmune diseases. | |

*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | |
| CO 2 | | | ✓ | ✓ |
| CO 3 | | | ✓ | |

**COURSE CONTENTS**

**Contents for Classroom Transaction:**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **IMMUNE SYSTEM** | | **15** |
| | 1 | Introduction to the immune system | |
| | 2 | Components of immunity: Innate immunity- Anatomic, physiological, phagocytic and inflammatory barriers; Adaptive immunity, Active and passive immunization. | |
| | 3 | Types of vaccines. | |
| 2 | **CELLS AND ORGANS OF IMMUNE SYSTEM** | | **15** |
| | 1 | Organs of the immune system: Central and peripheral lymphoid organs. | |
| | 2 | Cells of the Immune system: stem cells, MHC, maturation of B and T lymphocytes, macrophages, and natural killer cells. | |
| | 3 | Primary and Secondary Immune Responses. | |
| | 4 | A brief account of Humoral and cell-mediated immune responses. | |
| | 5 | Autoimmune diseases- Definition and causes- Types of immune diseases SLE, Rheumatoid arthritis | |
| 3 | **ANTIGEN ANTIBODY REACTIONS** | | **15** |
| | 1 | Antigens: Factors that influence antigenicity, epitopes, haptens | |
| | 2 | Immunoglobulins: Structure of immunoglobulins, Classes of immunoglobulins and their functions. | |
| | 3 | Monoclonal antibody and hybridoma technology | |
| | 4 | complement system: The function of complement, complement activation. | |

| | | | |
|---|---|---|---|
| | 5 | 5 Hyper-sensitivity-Gell and Coombs classification types: Anaphylactic hypersensitivity, type II: antibody- | |
| | | mediated cytotoxic hypersensitivity, type III: Immune complex-mediated hypersensitivity, type IV: cell-mediated delayed hypersensitivity. | |
| | 6 | Antigen-antibody interactions: Precipitation reaction; -lattice hypothesis. | |
| | 7 | Immunodiffusion, Immunoelectrophoresis Agglutination reaction and its applications.<br>ELISA, RIA, Immunofluorescence, Widal and CFT | |
| **4** | **Practicals** | | **30** |
| | 1 | Determination of human blood group antigen and Rh antigen, WIDAL Test | |
| | 2 | Perform DLC of the given blood sample | |
| | 3 | Separate serum and plasma from the given blood sample | |
| | 4 | Perform total leukocyte count of the given sample | |

**Essential Readings:**


1. Kindt, Thomas J., et al. Kuby Immunology. W. H. Freeman, 2007.
2. Delves, Peter J., et al. Essential Immunology. Blackwell Publishing, Massachusetts, USA.


**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| 1 | 1 | 1 |
| | 2 | 3 |
| | 3 | 2 |
| 2 | 1 | 1 |
| | 2 | 2 |
| | 3 | 2 |
| | 4 | 2 |

| | | |
|---|---|---|
| 3 | 1 | 1 |
| | 2 | 1 |
| | 3 | 2 |
| | 4 | 3 |
| | 5 | 2 |
| | 6 | 2 |
| | 7 | 3 |
| | 8 | 1 |
| 4 | 1 | 1 |
| | 2 | 2 |
| | 3 | 2 |
| | 4 | 3 |

**Suggested Readings:**


3. Rastogi, S. C. Elements of Immunology. CBS Publishers & Distributors, 2006.
4. Ananthanarayan, and Paniker, C. K. J. Textbook of Microbiology. Orient Longman.


**Assessment Rubics:**

| **Evaluation Type** | | **Marks** |
|---|---|---|
| **End Semester Evaluation (Theory)** | | **50** |
| **End Semester Evaluation (Practical)** | | **15** |
| **Continuous Evaluation (Theory)** | | **25** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 5 |
| d) | Viva | 5 |
| **Continuous Evaluation (Practical)** | | **10** |
| a) | Record | 5 |
| b) | Lab performance | 5 |
| | **Total** | **100** |

**Employability for the Course:**

1) Biochemical companies
2) Research and Development
3) Teaching
4) Immunological diagnostics
5) Immunological technicians

## V SEMESTER

## KU5DSCBCH302: METABOLISM-I

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| V | DSC | Higher | KU5DSCBCH302 | 4 | 75 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 3 | 2 | 0 | 25 | 50 | 75 | 1.5 |

**Course Description:**

Metabolismisthesetoflife-sustainingchemicaltransformationswithinthecellsof living organisms. The se enzyme catalyzed reactions allow organisms to grow and reproduce, maintain their structures, and respond to their environments. Carbohydrate metabolism denotes the various biochemical processes responsible for the formation, breakdown and interconversion of carbohydrates in living organisms. Carbohydrate metabolism is a fundamental biochemical process that ensures a constant supply of energy to living cells. The most important carbohydrate is glucose, which can be broken down via glycolysis, enter into the Kreb's cycle and oxidative phosphorylation to generate ATP.

**Course Prerequisite: NIL;**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | Evaluate the general principals of cellular energy metabolism. | |
| 2 | Analyse and schematize the oxidative pathways of carbohydrates, Lipids, Proteins & Nucleic acids. | |
| 3 | Explain and schematize the final mitochondrial oxidative pathways | |
| 4 | Understand the inhibitors and uncouplers of ETC. | |

*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)*

| **Mapping of Course Outcomes to PSOs** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PSO 7 |
| CO 1 | | ✓ | | | | | |
| CO 2 | | | ✓ | | | ✓ | |
| CO 3 | | | ✓ | | | | |
| CO 4 | | | | ✓ | ✓ | | |
| CO 5 | | | | | | ✓ | ✓ |

**COURSE CONTENTS**

**Contents for Classroom Transaction:**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | | **INTRODUCTION TO METABOLISM** | **15** |
| | 1 | Bio energetics - Principles of bioenergetics- Thermodynamics Law's - first law, second law and third law | |
| | 2 | Concept of Enthalpy, Entropy and internal energy. | |
| | 3 | Concept of standard free energy change & equilibrium constant. | |

| | | | |
|---|---|---|---|
| | 4 | Role of high-energy phosphates in energy transfer. Structure of ATP | |
| **2** | **CARBOHYDRATE METABOLISM** | | **15** |
| | 1 | Overview of glycolysis and gluconeogenesis pathway. Detailed study of regulatory mechanism and energetics. | |
| | 2 | Overview of citric acid cycle. Detailed study of regulatory mechanism and energetics. | |
| | 3 | Overview of glycogenesis and glycogenolysis-detailed study of hormonal regulation and role of secondary messengers. | |
| | 4 | Overview of Pentose phosphate pathway and Glyoxylate Cycle-Significance | |
| **3** | **LIPID METABOLISM& ETC** | | **15** |
| | 1 | Biosynthesis of fatty acids – fatty acid synthase and regulation of fatty acid synthesis. | |
| | 2 | Oxidation of fatty acids – beta oxidation. Biological regulation and significance of fatty acid metabolism | |
| | 3 | Metabolism of ketone bodies - Formation, utilization, excretion and clinical significance. Metabolism of triglycerides. | |
| | 4 | **MITOCHONDRIAL ELECTRON TRANSPORT CHAIN AND OXIDATIVE PHOSPHORYLATION**<br><br>Electron Transport Chain: Introduction, Structural features of Mitochondria.<br><br>Sequence of electron carriers: NADH dehydrogenase, Succinate dehydrogenase, Cytochrome reductase and<br><br>Cytochrome oxidase (outline of electron transport chain), Inhibitors of electron transport chain. | |

| | | | |
|---|---|---|---|
| | | Structure and function of ATP synthase<br><br>Oxidative phosphorylation: Sites of ATP production, Hypothesis of mitochondrial oxidative Phosphorylation-Chemiosmotic theory, P/O ratio, Inhibitors and Uncouplers | |
| **4** | **Practicals** | | **30** |
| | 1. | Estimation of blood glucose | |
| | 2 | Estimation of serum cholesterol | |
| | 3 | Assay of serum transaminase – SGOT | |
| | 4 | Assay of serum transaminase -SGPT | |
| | 5 | Assay of serum alkaline phosphatase | |

**Essential Readings:**


1. Tymoczko, John L., Jeremy M. Berg, and Lubert Stryer. Biochemistry: A Short Course. Macmillan, 2011.
2. Cox, Michael M. Lehninger Principles of Biochemistry. Freeman, 2013.
3. Garrett, Reginald, and Charles Grisham. Biochemistry. Nelson Education, 2012.
4. Voet, Donald, et al. Fundamentals of Biochemistry. John Wiley & Sons, 2008.
5. Zubay, Geoffrey L., et al. Principles of Biochemistry: Student Study Art Notebook. Wm. C. Brown, 1995.
6. Devlin, Thomas M. Textbook of Biochemistry: With Clinical Correlations. John Wiley & Sons, 2011.
7. Jain, J. L., Jain, S., & Jain, N. Fundamentals of Biochemistry. S. Chand & Co Ltd, 2008.
8. Murray, Robert K., et al. Harper's Illustrated Biochemistry. 26th ed., McGraw Hill, 2003.
9. Chatterjee, M. N. Clinical Chemistry. Jaypee Publications, 1999.


**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 2 |
| | 2 | 7 |
| | 3 | 7 |
| | 4 | 8 |

| | | |
|---|---|---|
| **2** | 1 | 7 |
| | 2 | 2 |
| | 3 | 9 |
| | 4 | 5 |
| **3** | 1 | 9 |
| | 2 | 9 |
| | 3 | 3 |
| | 4 | 2 |
| **4** | 1 | 2 |
| | 2 | 7 |
| | 3 | 9 |
| | 4 | 5 |

**Suggested Readings:**


1. Cox, Michael M. Lehninger Principles of Biochemistry. Freeman, 2013.
2. Voet, Donald, et al. Fundamentals of Biochemistry. John Wiley & Sons, 2008. (Location: New York)


**Assessment Rubics:**

| **Evaluation Type** | | **Marks** |
|---|---|---|
| **End Semester Evaluation (Theory)** | | **50** |
| **End Semester Evaluation (Practical)** | | **15** |
| **Continuous Evaluation (Theory)** | | **25** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 5 |
| d) | Viva | 5 |
| **Continuous Evaluation (Practical)** | | **10** |
| a) | Record | 5 |
| b) | Lab performance | 5 |
| | **Total** | **100** |

**Employability for the Course:**

1. Biochemical companies
2. Research and development
3. Teaching
4. Quality control labs
5. Clinical Biochemist

## V SEMESTER

## KU5DSCBCH303: CLINICAL BIOCHEMISTRY

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| V | DSC | Higher | KU5DSCBCH303 | 4 | 75 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 3 | 2 | 0 | 25 | 50 | 75 | 1.5 |

**Course Description:**

This course typically covers topics such as biochemical pathways, enzyme kinetics, metabolism, hormone regulation, and the role of biomarkers in health and disease. Students learn laboratory techniques for analysing blood, urine, and other bodily fluids to assess organ function, detect abnormalities, and monitor treatment effectiveness. Additionally, the course often includes discussions on the interpretation of laboratory results, quality control measures, and the application of biochemical principles in clinical practice.

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | Gain the knowledge about conducting biochemical analyses of various biological samples. | |
| 2 | Understanding the biochemical basis of diseases and disorders | |

| | | |
|---|---|---|
| 3 | Competence in utilizing biochemical markers and assays to assess organ functions and clinically important enzymes | |

*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)*

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | ✓ | | | |
| CO 2 | | ✓ | | |
| CO 3 | | ✓ | ✓ | |
| CO 4 | | | ✓ | |
| CO 5 | ✓ | | | ✓ |

## COURSE CONTENTS

### Contents for Classroom Transaction:

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | | **INTRODUCTION TO CLINICAL BIOCHEMISTRY** | **15** |
| | 1 | Definition and scope of clinical biochemistry in diagnosis. | |
| | 2 | Collection, preservation, and normal values of important constituents of Biological Fluids- blood, urine &CSF | |
| | 3 | Requirements of setting up of clinical laboratory, collection, preparation, Preservation and handling of Clinical samples. | |
| | 4 | Quality control, Safety measures in clinical Laboratory. | |
| 2 | | **CLINICAL IMPORTANCE OF BIOMOLECULES** | **15** |
| | 1 | Carbohydrates-Estimation of glucose, glycosuria's, GTT's, hyper & hypoglycemia, blood Glucose Regulation and role of hormones; diabetic coma | |
| | 2 | Lipids-lipid profile estimation, Hypercholesterolemia, Hyperlipoproteinemia, atherosclerosis and it risk factors. | |
| | 3 | Amino acids–Phenyl Ketonuria, Alkaptonuria, cystinuria, tyrosinemia, Albinism. | |
| | 4 | Proteins-Albumin, hypoalbuminemia, Hypoproteinemia, | |
| | | Bence Jones proteins, proteins in CSF and their estimation | |
| | | **ORGAN FUNCTION TESTS AND ENZYMOLOGY** | **15** |
| | 1 | Liver Function Test: Jaundice, Types, Clinical Features, Test based on bile pigments–Plasma proteins in health and diseases–PT, PTT, INR. | |

| | | | |
|---|---|---|---|
| **3** | 2 | Gastric Function Test: Examination of Gastric residuum. | |
| | 3 | Kidney Function Test: Clearance test–Urea, Creatinine, PAH test, Concentration and dilution tests. Normal and abnormal constituents of urine. | |
| | 4 | Isoenzymes- SGOT, SGPT, Plasma Lipase, amylase, choline Esterase, LDH and CPK- clinical significance | |
| | 5 | Erythrocyte sedimentation rate (ESR), Clotting Time and Bleeding Time, INR, Packed cell Volume (PCV)- Clinical importance | |
| **4** | **Teacher Specific Module: Practical's** | | **30** |
| | 1 | Estimation of albumin globulin ratio in serum | |
| | 2 | Tests for normal & abnormal constituents of urine | |
| | 3 | Estimation of serum Creatinine | |
| | 4 | Estimation of serum Urea | |
| | 5 | Estimation of serum uric acid | |
| | 6 | Estimation of serum Cholesterol | |
| | 7 | Purification of blood proteins by Dialysis | |

**Essential Readings:**


1. Chatterjea, M. N. Clinical Chemistry. 1st ed., Jaypee Publications, 1999.
2. Bishop, Micheal L., Edward P. Fody, and Larry E. Scoeff. Clinical Chemistry: Techniques, Principles, Correlations. 6th ed., Wolter Kluwer, 2010.


**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 4 |
| | 2 | 8 |
| | 3 | 2 |
| | 4 | 2 |
| | 1 | 1 |

| | | |
|---|---|---|
| **2** | 2 | 1 |
| | 3 | 1 |
| | 4 | 1 |
| | | |
| **3** | 1 | 1 |
| | 2 | 1 |
| | 3 | 2 |
| | 4 | 2 |
| **4** | 1 | 6 |
| | 2 | 6 |
| | 3 | 6 |
| | 4 | 6 |
| | 5 | 6 |
| | 6 | 6 |
| | 7 | 6 |
| | 8 | 6 |

**Suggested Readings:**


3. William, J., and Lapsley Marshall. *Clinical Biochemistry: Metabolic and Clinical Aspects*. Elsevier Health Sciences UK, 2014.
4. Teiz. Fundamentals of Clinical Biochemistry. W.B. Saunders Company.
5. Gaw, Allan, et al. *Clinical Biochemistry E-Book: An Illustrated Colour Text*. Elsevier Health Sciences, 2013.
6. Sattanathan, G., et al. Practical Manual of Biochemistry. Skyfox Press, 2020.


**Assessment Rubics:**

| **Evaluation Type** | | **Marks** |
|---|---|---|
| **End Semester Evaluation (Theory)** | | **50** |
| **End Semester Evaluation (Practical)** | | **15** |
| **Continuous Evaluation (Theory)** | | **25** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 5 |
| d) | Viva | 5 |

| Continuous Evaluation (Practical) | | 10 |
|---|---|---|
| a) | Record | 5 |
| b) | Lab performance | 5 |
| Total | | 100 |

**Employability for the Course:**

1. Clinical laboratory
2. Research and Development
3. Teaching
4. Lab technician
5. Drug industries

**KU5DSEBCH301: NUTRITIONAL BIOCHEMISTRY**

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| II | DSC | Intermediate | KU2DSCBCH104 | 4 | 75 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 3 | 2 | 0 | 25 | 50 | 75 | 1.5 |

**Course Description:**

Nutritional biochemistry courses focus on nutrients. Nutrients are chemical substances required by the body to sustain basic functions and are optimally obtained by eating a balanced diet. There are six major classes of nutrients essential for human health: carbohydrates, lipids, proteins, vitamins, minerals, and water. Carbohydrates, lipids, and proteins are considered macronutrients and serve as a source of energy. Vitamins and minerals are considered micronutrients and play essential roles in metabolism. Vitamins are organic micronutrients classified as either water-soluble or fat-soluble. Minerals are inorganic micronutrients. Minerals can classify as macro minerals and microminerals.

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | Understand the concept of nutrition & health. | |
| 2 | Create knowledge of different types of carbohydrates, their importance, sources, functions. | |
| 3 | Analyse the nutritional aspects of proteins | |
| 4 | To understand the nutritional aspects of minerals and vitamins | |
| 5 | To create the knowledge about to identify what foods good sources of what nutrients. | |

*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)*

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | | ✓ | | |
| CO 2 | ✓ | | | |
| CO 3 | | | ✓ | |
| CO 4 | | | ✓ | ✓ |
| CO 5 | | | ✓ | |

**COURSE CONTENTS**

**Contents for Classroom Transaction:**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| **1** | **BASICS OF NUTRITION** | | **15** |
| | 1 | Concepts of macro and micro nutrients. | |
| | 2 | Physiological fuel value and Respiratory quotient | |
| | 3 | High and low-calorie diets, Balanced diet | |

| | | | |
|---|---|---|---|
| | 4 | Recommended dietary allowance (RDA)Basal metabolic rate (BMR) and factors affecting BMR | |

| | | | |
|---|---|---|---|
| **2** | **NUTRITIONAL ASPECTS OF THE CARBOHYDRATES AND LIPIDS** | | **15** |
| | 1 | Nutritional aspects of the carbohydrates- (Different dietary types, source deficiency) | |
| | 2 | Special role of the non-starch polysaccharides.<br>Nutritional Management of diabetes | |
| | 3 | Nutritional aspects of the lipids- Different dietary types | |
| | 4 | Functions of lipids, Essential fatty acids – sources and functions. Nutritional Management of obesity | |
| **3** | **NUTRITIONAL SIGNIFICANCE OF PROTEINS, MINERALS AND VITAMINS** | | **15** |
| | 1 | Nutritional classification of amino acids and proteins, Essential amino acids – sources and functions | |
| | 2 | Protein Energy Malnutrition-Kwashiorkor and Marasmus. | |
| | 3 | Dietary Macro elements: Ca, P, Mg, Na & K and Dietary Micro elements: Iron, Iodine, Zinc, Copper – sources, functions and deficiencies | |
| | 4 | Nutritional significance- fat soluble and water-soluble vitamins- source, functions and deficiency diseases. | |
| **4** | **Teacher Specific Module: Practical's** | | **30** |
| | 1 | Estimation of total protein | |
| | 2 | Estimation of Vitamin C from fruit juice | |
| | 3 | Qualitative analysis of lipids | |
| | 4 | Qualitative analysis of Egg Albumin | |

| | | | |
|---|---|---|---|
| | 5 | Qualitative analysis of Carbohydrates in foodstuffs. | |
| | 6 | Qualitative analysis of protein in foodstuff | |

**Essential Readings:**


1. Akoh, Casimir C. Food Lipids: Chemistry, Nutrition, and Biotechnology. 4th ed., CRC Press Taylor & Francis Group, 2016.
2. Mann, Jim, and A. Stewart Truswell. Essentials of Human Nutrition. 2nd ed., Oxford University Press Inc., 2002.
3. Rodwell, Victor, et al. Harper's Illustrated Biochemistry. 31st ed., Tata Mc Graw Hill Education, 2018.
4. Underwood, E. Trace Elements in Human and Animal Nutrition. 4th ed., Academic Press, 1977.
5. Bamji, M.S., Kamala Krishnaswami, and G.N.V. Brahmam. The Book of Human Nutrition. 4th ed., Oxford & IBH Publishing, 2011.
6. Swaminathan, M.S. Essentials of Food and Nutrition. Vol. I and II, Ganesh & Co., 1974.
7. Trueman, Patricia. Nutritional Biochemistry. Mjp Publishers, 2007.


**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 7 |
| | 2 | 7 |
| | 3 | 2 |
| | 4 | 2 |
| **2** | 1 | 3 |
| | 2 | 6 |
| | 3 | 5 |
| | 4 | 2 |
| **3** | 1 | 2 |
| | 2 | 2 |
| | 3 | 2 |
| | 4 | 2 |
| **4** | 1 | 9 |
| | 2 | 10 |
| | 3 | 10 |
| | 4 | 12 |

| | | |
|---|---|---|
| | 5 | 12 |
| | 6 | 12 |
| | 7 | 12 |
| | 8 | 8 |
| | 9 | 8 |
| | 10 | 8 |

**Suggested Readings:**


8. Mahan, L.K., and Raymond J. Shanahan. Krause's Food and Nutrition Care Process. 2012.
9. Raymond, J. Elsevier's Publications. ISBN- 978-l-4377-2233-8.
10. The vitamins, Fundamental aspects in Nutrition and Health (2008) l G.F.
11. Coombs Jr. Elsevier's Publications. ISBN-13- 978-0-12- 183493-7.
12. Gibson, Rosalind. Principles of Nutritional Assessment. University Press, 2005.


**Assessment Rubrics:**

| **Evaluation Type** | | **Marks** |
|---|---|---|
| **End Semester Evaluation (Theory)** | | **50** |
| **End Semester Evaluation (Practical)** | | **15** |
| **Continuous Evaluation (Theory)** | | **25** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 5 |
| d) | Viva | 5 |
| **Continuous Evaluation (Practical)** | | **10** |
| a) | Record | 5 |
| b) | Lab performance | 5 |
| Total | | 100 |

**Employability for the Course:**

1. Food industries
2. Research and Development
3. Teaching
4. Dietitians
5. Entrepreneurship

## KU5DSEBCH302: ECOLOGY

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| V | DSE | Higher | KU5DSEBCH302 | 4 | 60 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 4 | 0 | 0 | 30 | 70 | 100 | 2 |

**Course description**

Ecology course typically aims to understand the components of environment and ecosystem how the energy flow occurs in an ecosystem. It also encloses the details of different biochemical cycles and an in-depth study on ecological successions.

**Course prerequisite**: NIL

**Course outcome**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1. | Understand the basic concepts, scope, and significance of ecology. | |
| 2. | Explain ecological interactions and their role in structuring communities. | |
| 3. | Describe ecosystem structure, function, energy flow, and succession. | |
| 4. | Analyze population dynamics and regulatory mechanisms. | |

***Remember (R) , Understand (U), Apply (A), Analyse (An), Evaluate ( E), Create (C)**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|---|---|---|---|---|---|---|
| CO 1 | ✓ | | | | | |
| CO 2 | | ✓ | | | ✓ | |
| CO 3 | | ✓ | ✓ | | | |
| CO 4 | | | | ✓ | | ✓ |

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **Basic concepts of Ecology.** | | **10** |
| | 1 | Concept, scope and significance of ecology. | |
| | 2 | Habitat and niche concept, Ecotone and Edge effect. Ecotypes and Ecoclines. | |
| | 3 | Ecosystem structure and function - Abiotic and Biotic components of ecosystem | |
| | 4 | Biomes - Aquatic and terrestrial ecosystems. | |
| 2 | Ecological Interactions | | **15** |
| | 1 | Ecological and environmental significance of interactions, Prey - Predator relationship (**Lotka–Volterra model).** | |
| | 2 | Positive interaction – Mutualism, Commensalism and Proto - cooperation. | |
| | 3 | Negative interactions – Ammensalism, Parasitism, Predation, Cannibalism and competition. | |
| | 4 | Neutralism, symbiosis, antagonism, antibiosis, competition – intra specific and inter specific. | |

| | | | |
|---|---|---|---|
| **3** | **Ecosystem ecology** | | **15** |
| | 1 | Types of ecosystems: Forest, Grassland, Lentic, Lotic, Estuarine, Marine, Desert, Wetlands. | |
| | 2 | Food chain, food web, ecological pyramids. | |
| | 3 | Ecological succession - types and process of successions (primary and secondary succession; allogenic and autogenic succession, theories of succession), concept of climax. | |
| | 4 | Ecological energetics – energy flow and ecological efficiency. | |

| | | | |
|---|---|---|---|
| 4 | **Population Ecology and Biogeochemical cycles** | | **15** |
| | 1 | Concept of population and meta-population; r- and K - selection, Population growth characteristics - density, dispersion, natality, mortality, growth curves, life tables, age structure and growth patterns (geometric, exponential, logistic, density-dependent). | |
| | 2 | Population regulation - biotic potential, environmental resistances, limits to population growth and Earth's carrying capacity. | |
| | 3 | Gaseous cycles - Carbon cycle and Nitrogen cycle. Sedimentary cycles - Phosphorus cycle and Sulphur cycle. | |
| | 4 | Hydrological cycle and nutrient cycle. | |
| | 5 | **Teacher Specific Module** | **5** |

**Essential Readings**


1. Stiling, Peter D. Ecology: Global Insights & Investigations. McGraw-Hill,2012.
2. Mukherjee, B. Environmental Biology. Tata McGraw-Hill Publishing,1997.
3. Chapman, J. L., and Reiss, M. J. Ecology: Principles and Applications. Cambridge University Press, 1992.
4. Singh, J.S., Singh, S.P., and Gupta, S.R. Ecology, Environment & Resource Conservation. Anamaya Publications, 2008.
5. Colin, R., Townsend, Michael B., and John L. H. Essentials of Ecology. 3rd ed., Blackwell Science Publishers, 2012.

**Reference Distribution**

| MODULE | UNIT | REFERENCE NO. |
|---|---|---|
| 1 | 1 | 2 |
| | 2 | 1 |
| | 3 | 3 |
| 2 | 1 | 4 |
| | 2 | 1 |
| | 3 | 3 |
| | 4 | 2 |
| 3 | 1 | 4 |
| | 2 | 1 |
| 4 | 1 | 3 |
| | 2 | 2 |
| | 3 | 1 |
| | 4 | 4 |

**Suggested readings**


6. Taiz, Lincoln, and Eduardo Zeiger. Plant Physiology and Development. 6th ed., Sinauer Associates, Inc., 2010.
7. Buchanan, Bob B., Wilhelm Gruissem, and Russell L. Jones. Biochemistry & Molecular Biology of Plants. 2nd ed., John Wiley & Sons, Ltd, 2015.
8. Goodwin, T. W., and E. I. Mercer. Introduction to Plant Biochemistry. Pergamon Press, 1983. (Location: Oxford).


**Assessment Rubrics:**

| Evaluation Type | | Marks |
|---|---|---|
| End Semester Evaluation | | **70** |
| Continuous Evaluation | | **30** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 10 |
| d) | Viva | 5 |
| Total | | 100 |

**Employability for the course/Program**

1. Research and development
2. Biotechnology Industry

## KU5DSEBCH303: MOLECULAR BASIS OF DISEASES

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| V | DSE | Higher | KU5DSEBCH303 | 4 | 75 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 3 | 2 | 0 | 25 | 50 | 75 | 1.5 |

**Course Description:**

The molecular basis of diseases course explores how diseases develop at a biological level. It covers topics like genetic mutations and cellular processes that lead to illnesses such as cancer, genetic disorders, and infections. Through lectures and labs, students learn about the molecular reasons behind diseases and how they can be treated.

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | Understanding inflammation at molecular level. | |
| 2 | Thinking critically about scientific information. | |
| 3 | Solving problems related to disease mechanisms | |
| 4 | Gaining practical lab skills | |
| 5 | Teacher specific | |

*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

| Mapping of Course Outcomes to PSOs | | | | | | | |
|---|---|---|---|---|---|---|---|
| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PSO 7 |
| CO 1 | | | | | ✓ | | |
| CO 2 | | | | ✓ | | | |
| CO 3 | | | ✓ | | | | |
| CO 4 | | | ✓ | | | | |
| CO 5 | | ✓ | | | | | ✓ |

**COURSE CONTENTS**

**Contents for Classroom Transaction**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| **1** | **INTRODUCTION TO INFLAMMATION** | | **15** |
| | 1 | Inflammation and Repair/Wound healing: Acute inflammation | |
| | 2 | Vascular changes-cellular events-chemical mediators of inflammation-chronic inflammation- | |
| | 3 | morphologic patterns in acute and chronic inflammation-systemic effects of inflammation- | |
| | 4 | wound healing-mechanism of wound healing-pathologic aspects of inflammation and response | |
| | **CIRCULATORY DYSFUNCTION** | | **15** |
| **2** | 1 | Hemodynamic disorders, Thrombosis & Shock. | |
| | 2 | Edema-hyperemia and congestion hemorrhage-hemostasis and thrombosis- | |

| | | | |
|---|---|---|---|
| | 3 | Endothelium-platelets-coagulation system-genesis of thrombosis-fate of thrombus- | |
| | 4 | Embolism-pulmonary, systemic, amniotic fluid, air and fat infarction-septic shock. | |
| **3** | **BLOOD DISORDERS** | | **15** |
| | 1 | Red & White cell diseases: Normal development of blood cells-anemias-hemolytic-G6PD deficiency-sickle cell | |
| | 2 | Thalassemia's-paroxysmal nocturnal haemoglobinuria-megaloblastic-iron deficiency – chronic disease -aplastic-marrow failure-polycythaemia-bleeding disorders leukopenia | |
| | 3 | Reactive proliferation of white cells –neoplastic proliferation of white cells leukaemia's. | |
| | 4 | Myeloproliferative disorders - plasma cell dyscrasias**.** | |
| **4** | **PRACTICALS** | | **30** |
| | 1 | Determination of blood group | |
| | 2 | Determination of Rh factor | |
| | 3 | Determination of hemoglobin | |
| | 4 | Determination of clotting time | |
| | 5 | Determination of bleeding time | |
| | 6 | Estimation of ESR | |

**Essential Readings:**


1. Cotran, Ramzi S., Vinay Kumar, and Stanley L. Robbins. Pathological Basis of Disease. 8th ed., Prism, India, 2009.
2. Coleman, William B., and Gregory J. Tsongalis, eds. *Molecular pathology: the molecular basis of human disease*. academic Press, 2009.

**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 1 |
| | 2 | 2 |
| | 3 | 4 |
| | 4 | 2 |
| **2** | 1 | 3 |
| | 2 | 1 |
| | 3 | 4 |
| | 4 | 2 |
| | 1 | 1 |
| **3** | 2 | 4 |
| | 3 | 2 |
| | 4 | 2 |
| **4** | 1 | 3 |
| | 2 | 1 |
| | 3 | 1 |
| | 4 | 2 |

**Suggested Readings:**


3. Goodman, Louis S., and Alfred Gilman. Pharmacological Basis of Therapeutics. 11th ed., McGraw-Hill, 2006.
4. Swaminathan, Ramasamyiyer. *Handbook of clinical biochemistry*. World Scientific, 2011.


**Assessment rubrics:**

| **Evaluation Type** | | **Marks** |
|---|---|---|
| **End Semester Evaluation (Theory)** | | **50** |
| **End Semester Evaluation (Practical)** | | **15** |
| **Continuous Evaluation (Theory)** | | **25** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 5 |
| d) | Viva | 5 |

| **Continuous Evaluation (Practical)** | | **10** |
|---|---|---|
| a) | Record | 5 |
| b) | Lab performance | 5 |
| Total | | 100 |

**VI SEMESTER**
**KU6DSCBCH304: METABOLISM II**

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| VI | DSC | Higher | KU6DSCBCH304 | 4 | 75 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 3 | 2 | 0 | 25 | 50 | 75 | 1.5 |

**Course Description:**

Metabolism is the set of life-sustaining chemical transformations within the cells of living organisms. These enzyme catalyzed reactions allow organisms to grow and reproduce, maintain their structures and respond to their environments. Carbohydrate metabolism denotes the various biochemical processes responsible for the formation, breakdown and interconversion of carbohydrates in living organisms. Carbohydrate metabolism is a fundamental biochemical process that ensures a constant supply of energy to living cells. The most important carbohydrate is glucose, which can be broken down via glycolysis, enter into the Kreb's cycle and oxidative phosphorylation to generate ATP.

**Course Prerequisite: NIL**

**Course Learning Outcomes: At the end of the Course, the Student will be able to -**

| No. | Course outcome |
|---|---|
| CO1 | Analyse the biochemical and genetic regulation of various metabolic pathways of amino acids. |

| | |
|---|---|
| CO2 | Understand the biochemical and genetic regulation of various metabolic pathways of nucleic acids. |
| CO3 | Analyse the porphyrin and Xenobiotic metabolism |
| CO4 | Evaluate feedback and reciprocal regulation of metabolic pathways. |

*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)*

| **Mapping of Course Outcomes to PSOs** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PSO 7 |
| CO 1 | ✓ | | | | | | ✓ |
| CO 2 | ✓ | ✓ | | | | | |
| CO 3 | | | | ✓ | ✓ | | |
| CO 4 | | | | | | ✓ | |
| CO 5 | | | | | | ✓ | |

**COURSE CONTENTS**

**Contents for Classroom Transaction:**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **AMINOACID METABOLISM** | | **15** |
| | 1 | Digestion and absorption of proteins, proteolytic enzymes. | |
| | 2 | Trans amination, Oxidative deamination, non-oxidative deamination, Reductive amination and Decarboxylation of amino acids | |
| | 3 | Metabolism of non-essential amino acids | |
| | 4 | Urea cycle- Significance and regulation | |

| | | | |
|---|---|---|---|
| **2** | **NUCLEIC ACID METABOLISM** | | **15** |
| | 1 | Nucleotide biosynthesis- de novo and salvage pathways for biosynthesis of purine and pyrimidine nucleotides. | |
| | 2 | Mechanism of regulation of Nucleotide biosynthesis. | |
| | 3 | Mechanism of purine and pyrimidine catabolism | |
| **3** | **METABOLISM OF PORPHYRIN AND XENOBIOTICS** | | **15** |
| | 1 | Biosynthesis and degradation of Porphyrin | |
| | 2 | Heme formation, Biosynthesis of Bilirubin, Transport and excretion of bile pigment. | |
| | 3 | Phase 1 reactions. Oxidation, reduction, hydrolysis and hydration. | |
| | 4 | Phase 2 reaction/conjugation: methylation, glutathione and amino acid conjugation, detoxification. | |
| **4** | **PRACTICALS** | | **30** |
| | 1 | Estimation of protein by biuret & Lowry ‘s method | |
| | 2 | Estimation of total free amino acid by ninhydrin method | |
| | 3 | Estimation of RNA | |
| | 4 | Estimation of DNA | |

**Essential Readings:**


1. Tymoczko, John L., et al. Biochemistry: A Short Course. Macmillan, 2011.
2. Cox, Michael M. Lehninger Principles of Biochemistry. Freeman, 2013.
3. Garrett, Reginald, and Charles Grisham. Biochemistry. Nelson Education, 2012.
4. Voet, Donald, et al. Fundamentals of Biochemistry. John Wiley & Sons, 2008.
5. Zubay, Geoffrey L., et al. Principles of Biochemistry: Student Study Art Notebook. Wm. C. Brown, 1995.
6. Devlin, Thomas M. Textbook of Biochemistry: With Clinical Correlations. John Wiley & Sons, 2011.
7. Jain, J. L., Jain, S., & Jain, N. Fundamentals of Biochemistry. S. Chand & Co Ltd, 2008.

8. Murray, Robert K., et al. Harper's Illustrated Biochemistry. 26th ed., McGraw Hill, 2003.
9. Chatterjea, M. N. Clinical Chemistry. Jaypee Publications, 1999.

**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 9 |
| | 2 | 9 |
| | 3 | 2 |
| | 4 | 4 |
| **2** | 1 | 4 |
| | 2 | 4 |
| | 3 | 2 |
| | 4 | 4 |
| **3** | 1 | 9 |
| | 2 | 9 |
| | 3 | 3 |
| | 4 | 2 |
| **4** | 1 | 2 |
| | 2 | 7 |
| | 3 | 9 |
| | 4 | 5 |

**Suggested Readings:**

10. Cox, Michael M. Lehninger Principles of Biochemistry. Freeman, 2013.
11. Voet, Donald, et al. Fundamentals of Biochemistry. John Wiley & Sons, 2008.

**Assessment Rubrics:**

| **Evaluation Type** | | **Marks** |
|---|---|---|
| **End Semester Evaluation (Theory)** | | **50** |
| **End Semester Evaluation (Practical)** | | **15** |
| **Continuous Evaluation (Theory)** | | **25** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 5 |

| | | |
|---|---|---|
| d) | Viva | 5 |
| **Continuous Evaluation (Practical)** | | **10** |
| a) | Record | 5 |
| b) | Lab performance | 5 |
| | **Total** | **100** |

**Employability for the Course:**

1. Biochemical companies
2. Research and development
3. Teaching
4. Quality control analysis
5. Clinical Biochemist

**VI SEMESTER**

**KU6DSCBCH305: GENETICS**

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| VI | DSC | Higher | KU6DSCBCH305 | 4 | 60 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 4 | 0 | 0 | 30 | 70 | 100 | 2 |

**Course Description:**

The rapid advancements in understanding the role of the human genome in health and disease. Basic concepts of identifying human chromosome, Inheritance of human traits, and pedigree analysis.

**Course Prerequisite:** NIL

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | History and scope of Genetics | |
| 2 | Understanding the pre-Mendelian genetic concepts | |
| 3 | To study the laws and concepts of Mendelian inheritance | |
| 4 | Principles of deviation from Mendelian inheritance with examples | |
| 5 | Concept s of multiple alleles with examples | |

*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|---|---|---|---|---|---|---|
| CO 1 | | ✓ | | | ✓ | |
| CO 2 | | ✓ | | | | |
| CO 3 | ✓ | | ✓ | | | |
| CO 4 | | | | ✓ | | ✓ |

**COURSE CONTENTS**

**Contents for Classroom Transaction:**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| | **GENETICS** | | **10** |
| | 1 | Introduction: Scope and importance of genetics | |
| | 2 | Brief explanation of the following terms – genes, alleles, genotype, phenotype, genome, homozygous and heterozygous | |

| | | | |
|---|---|---|---|
| 1 | 3 | Wild and mutant alleles, dominant and recessive traits, test cross and back cross, reciprocal cross | |
| | 4 | Mendelian laws, Mendelian traits in man, Chromosome theory of heredity | |
| | 5 | Gene interaction. | |

| | | | |
|---|---|---|---|
| 2 | **POPULATION GENETICS & GENETIC DISORDERS** | | **15** |
| | 1 | Chromosomal mapping, Human genome project | |
| | 2 | Population genetics – gene pool, gene frequency, Hardy – Weinberg law, allele frequency, genetic drift | |
| | 3 | Genetic disorders in man, Chromosomal anomalies: Autosomal (e.g.; Down syndrome) Sex chromosomal anomalies (Klinefelter's syndrome, and Turners syndrome) Autosomal single gene disorder (Sickle cell anemia). | |
| 3 | **RECOMBINATION** | | **15** |
| | 1 | Linkage and crossing over; linkage maps, tetrad analysis. | |
| | 2 | coupling and repulsion hypothesis, theories of crossing over, | |

| | | | |
|---|---|---|---|
| | | three –point test cross | |
| | 3 | Recombination; Homologues and non –homologues recombination | |
| | 4 | transposition and site –specific recombination | |
| | 5 | Bacterial genetics – conjugation, transduction and transformation. | |

| | | | |
|---|---|---|---|
| **4** | **GENETIC ENGINEERING** | | **15** |
| | 1 | Introduction to genetic engineering. Restriction endonucleases, ligases | |
| | 2 | Gene transfer methods- physical, chemical and vector mediated methods | |
| | 3 | Vectors- properties, plasmid vectors (pBR322, phage M13 and lamda vector, cosmid) | |
| **5** | **Teacher Specific Module** | | **5** |
| | *Directions* | | |

**Essential Readings:**


1. Pierce, Benjamin A. Genetics: A Conceptual Approach. W.H. Freeman.
2. Russel, Peter J. iGenetics: A Molecular Approach. Pearson Education.
3. Watson, James D., et al. Molecular Biology of the Gene. Pearson Education.
4. Rastogi, Veer-Bala. Principles of Molecular Biology. Medtech Publisher.


**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 1 |
| | 2 | 1 |
| | 3 | 2 |
| | 4 | 1 |
| | 5 | 1 |
| **2** | 1 | 1 |
| | 2 | 1 |
| | 3 | 1 |
| **3** | 1 | 8 |
| | 2 | 7 |
| | 3 | 4 |
| | 4 | 2 |
| | 5 | 8 |
| **4** | 1 | 6 |
| | 2 | 8 |
| | 3 | 2 |

**Suggested Readings:**


1. Lewin, Benjamin, et al. *Lewin's genes X*. Jones & Bartlett Learning, 2011.
2. De, Robertis EDP, and Robertis EMF De. "Cell and Molecular biology." (2010).
3. Karp, Gerald. *Cell and Molecular Biology*. John Wiley & Sons Incorporated, 2007.
4. Wilson, Keith, et al., eds. *Wilson and Walker's principles and techniques of biochemistry and molecular biology*. Cambridge university press, 2018.


**Assessment Rubrics:**

| Evaluation Type | | Marks |
|---|---|---|
| End Semester Evaluation | | **70** |
| Continuous Evaluation | | **30** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 10 |
| d) | Viva | 5 |
| **Total** | | **100** |

**Employability for the Course:**

1. Genetic counsellor
2. Plant breeder/geneticist
3. Research scientist (life sciences)
4. Molecular Genetic Pathologist
5. Clinical Genetics

**VI SEMESTER KU6DSCBCH306: ENDOCRINOLOGY**

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| VI | DSC | Higher | KU6DSCBCH306 | 4 | 60 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 4 | 0 | 0 | 30 | 70 | 100 | 2 |

**Course Description:**

Endocrinology is a branch of biology and medicine that deals with the endocrine system, which includes glands that secrete hormones directly into the bloodstream. These hormones act as chemical messengers, regulating various bodily functions such as metabolism, growth and development, tissue function, sexual function, reproduction, sleep, and mood. The field of endocrinology is interdisciplinary, drawing knowledge from biology, biochemistry, physiology, and clinical medicine. students typically study Endocrine Glands and Hormones, Hormone Regulation, how hormones affect specific organs and systems in the body, such as metabolism, reproduction, growth, and stress response, Endocrine Disorders, Discussion of recent research findings and emerging therapies in endocrinology, Practical applications of endocrinology in diagnosing and managing various medical conditions related to hormone imbalances.

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | Analyse about scope of endocrinology. | |
| 2 | Discussing hormones of hypothalamus, pineal gland, thyroid gland, adrenal gland, pancreas. | |
| 3 | Evaluate hormones of female and male reproductive system. | |
| 4 | Summarize various endocrinopathies. | |

*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)*

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | | ✓ | | |
| CO 2 | ✓ | | | |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | | ✓ | |
| CO 5 | | ✓ | | ✓ |

**COURSE CONTENTS**

**Contents for Classroom Transaction:**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | | **INTRODUCTION TO ENDOCRINOLOGY** | **10** |
| | 1 | Definition and scope of Endocrinology and Historical and anatomical aspects of mammalian endocrine system. | |
| | 2 | Definition of a hormone- chemical nature of mammalian hormones and types of hormone receptors- secondary messenger system | |
| | 3 | general mechanism of peptide and non- peptide hormones action | |
| | 4 | Feedback regulation of Endocrine System. | |
| 2 | | **ENDOCRINE GLAND AND HORMONES I** | **15** |
| | 1 | The hormones of hypothalamus- Hypo-physio tropic hormones- Neurovascular hypothesis. | |
| | 2 | Pituitary and pineal gland hormones- chemistry, biochemical functions, mechanism of action | |
| | 3 | Thyroid and parathyroid gland hormones- chemistry- biochemical functions- mechanism of action. | |
| | 4 | Adrenal gland hormones- chemistry, mechanism of action, biochemical functions. | |

| | | | |
|---|---|---|---|
| | | **ENDOCRINE GLAND AND HORMONES II** | **15** |
| | 1 | Pancreas- Insulin/glucagon: chemistry-biochemical functions- mechanism of action | |
| | 2 | Somatostatin. And neuro hormones chemistry- mechanism of action. | |
| | 3 | Female reproductive organ hormones – chemistry, biochemical function mechanism of action | |

| | | | |
|---|---|---|---|
| **3** | 4 | Male reproductive organ hormones – chemistry, biochemical function, mechanism of action | |

| | | | |
|---|---|---|---|
| **4** | **DISORDERS OF ENDOCRINE GLANDS** | | **15** |
| | 1 | Endocrinopathies of Hypo-physical, Thyroid, parathyroid, adrenal and pancreas. | |
| | 2 | Disorders of pituitary hormone axis- thyrotoxicosis- hypothyroidism- Hashimoto's thyroiditis | |
| | 3 | metabolic bone diseases- Cushing syndrome- Addison's diseases Diabetes mellitus | |
| | 4 | Androgen deficiency syndromes- Testicular neoplasm Klinefelter's syndrome and Turner's syndrome. | |
| **5** | **Teacher Specific Module** | | **5** |
| | *Directions* | | |

**Essential Readings:**


1. Kronenberg, Henry M., et al., Williams, Peter R., et al. Textbook of Endocrinology. 11th ed., Saunders Elsevier, 2008.
2. Bolander, F. F. Molecular Endocrinology. 3rd ed., Academic Press, 2004.
3. Cox, Nelson. Leininger's Principles of Biochemistry. 3rd ed., MacMillan Worth Publishing, 2000.
4. Hadely, Mac E. Endocrinology. 5th ed., Pearson Education, 2000.


**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 4 |
| | 2 | 1 |
| | 3 | 3 |
| | 4 | 1 |
| **2** | 1 | 1 |
| | 2 | 1 |
| | 3 | 1 |

| | | |
|---|---|---|
| | 4 | 1 |
| **3** | 1 | 1 |
| | 2 | 1 |
| | 3 | 1 |
| | 4 | 1 |
| **4** | 1 | 4 |
| | 2 | 4 |
| | 3 | 4 |
| | 4 | 4 |

**Suggested Readings:**

5. Sembulingum, K., and Prema Sembulingum. Essentials of Medical Physiology. 6th ed., Jaypee Brothers Medical Publications, New Delhi, 2012.

**Assessment Rubrics:**

| **Evaluation Type** | | **Marks** |
|---|---|---|
| End Semester Evaluation (Theory) | | **70** |
| Continuous Evaluation (Theory) | | **30** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 10 |
| d) | Viva | 5 |
| **Total** | | **100** |

**Employability for the Course:**

1. Diagnostic laboratory
2. Research and Development
3. Teaching
4. Drug industries.

## VI SEMESTER

## KU6DSEBCH304: PROTEOMICS AND NUTRACEUTICALS

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| VI | DSE | Higher | KU6DSEBCH304 | 4 | 60 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 4 | 0 | 0 | 30 | 70 | 100 | 3 |

**Course Description:**

This course provides an in-depth exploration of proteomics, focusing on its intersection with nutraceuticals. Students will delve into the analysis of proteins, their functions, structures, and interactions within biological systems, with a specific emphasis on their role in nutrition and health. The course integrates theoretical knowledge with practical applications, including laboratory techniques and case studies.

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | To know the concept of nutraceuticals - extra health benefits in addition to the basic nutritional value of food | |
| 2 | Enable students to recognize the link between nutrition, health and diseases | |
| 3 | Identify major types of health foods and nutraceutical products in the market | |
| 4 | To expose students the market opportunity of nutraceuticals and the nutraceutical industry | |

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | ✓ | | | |
| CO 2 | ✓ | | | |
| CO 3 | | ✓ | ✓ | |
| CO 4 | | | ✓ | ✓ |

## COURSE CONTENTS

### Contents for Classroom Transaction:

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **CONCEPT OF FUNCTIONAL FOODS/NEUTRACEUTICALS**: | | **10** |
| | 1 | Definition and classification of nutraceuticals, dietary supplements, fortified foods, functional foods and Phyto-nutraceuticals. | |
| | 2 | Scope involved in the industry, Indian and global scenario. Relation of functional foods; Nutraceutical (FFN) to foods & drugs. Applications of herbs to functional foods. | |
| | 3 | Concept of free radicals and antioxidants; Nutritive and Non-nutritive food components with potential health Effects | |
| | 4 | Role of nutraceuticals in the prevention and treatment with special reference to diabetes mellitus, hypertension, hypercholesterolemia | |
| | **NUTRACEUTICALS OF PLANT ORIGIN** | | **15** |
| | 1 | Nutraceuticals in Fruits and Vegetables and their Health Benefits; Sources and role of Isoprenoids, Isoflavones, Flavonoids, carotenoids, Tocotrienols, polyunsaturated fatty acids, sphingolipids, lecithin, choline. terpenoids. | |

| | | | |
|---|---|---|---|
| **2** | 2 | Vegetables, Cereals, milk and dairy products as Functional foods. | |

| | | | |
|---|---|---|---|
| **3** | **NUTRACEUTICALS OF ANIMAL ORIGIN** | | **15** |
| | 1 | Animal metabolites- Sources and extraction of nutraceuticals of animal origin. Examples. | |
| | 2 | chitin, chitosan, glucosamine, chondroitin sulphate and other polysaccharides of animal origin. | |
| | 3 | Examples: uses and applications in preventive medicine and treatment. fish oils, and sea foods. | |

| | | | |
|---|---|---|---|
| **4** | **MICROBIAL AND ALGAL NUTRACEUTICALS** | | **15** |
| | 1 | Concept of prebiotics and probiotics -principle, mechanism, production and technology involved, different forms available in the market. | |
| | 2 | Benefits & applications-examples of bacteria used as probiotics. | |
| | 3 | Symbiotic for maintaining good health. Algae as source of omega-3 fatty acids, antioxidants and minerals-extraction and enrichment | |
| **5** | **Teacher Specific Module** | | **5** |
| | *Directions* | | |

**Compulsory Reading**:


1. Shi, John. Asian Functional Foods. CRC Press, 2005.
2. Webb, Geoffrey P. Dietary Supplements and Functional Foods. Blackwell, 2006.


**Further Reading:**


1. Shi, John. Functional Food Ingredients and Nutraceuticals: Processing Technologies. CRC Press, 2007.

2. Bagchi, Debasis. Nutraceutical and Functional Food Regulations in the United States and Around the World. Elsevier/Academic Press, 2008.
3. Shibamoto, Takayuki. Functional Food and Health. Oxford University Press, 2008.
4. Guo, Mingfu. Functional Foods: Principles and Technology. CRC Press, 2009.
5. Verma, Madan L., and Anuj K. Chandel, eds. *Biotechnological production of bioactive compounds*. Elsevier, 2019.
6. Mutanda, Taurai, and Faizal Bux. "Microalgal Cells." *Biotechnological Applications of Microalgae: Biodiesel and Value-Added Products* (2013): 45.
7. Bidlack, Wayne R., and Raymond L. Rodriguez, eds. *Nutritional genomics: the impact of dietary regulation of gene function on human disease*. CRC Press, 2011.
8. Hamilton, Eva May Nunnelley, and Eleanor Noss Whitney. "Nutrition, concepts and controversies." (1982).
9. 11.Montville, Thomas J., and Karl R. Matthews. "Physiology, growth, and inhibition of microbes in foods." *Food microbiology: fundamentals and frontiers* (2012): 1-18.

**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 1 |
| | 2 | 2 |
| | 3 | 6 |
| | 4 | 3 |
| **2** | 1 | 1 |
| | 2 | 2 |
| | 3 | 4 |
| **3** | 1 | 5 |
| | 2 | 3 |
| | 3 | 2 |
| **4** | 1 | 1 |
| | 2 | 6 |
| | 3 | 1 |

**Assessment Rubrics:**

| Evaluation Type | | Marks |
|---|---|---|
| End Semester Evaluation | | **70** |
| Continuous Evaluation (Theory) | | **30** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 10 |
| d) | Viva | 5 |
| **Total** | | **100** |

**Employability for the Course:**

1. Food industries
2. Research and Development
3. Teaching
4. Dietitians
5. Entrepreneurship
6. Food testing lab- technicians

**KU6DSEBCH305: LIFESTYLE DISEASES**

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| VI | DSE | Higher | KU6DSEBCH305 | 4 | 60 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 4 | 0 | 0 | 30 | 70 | 100 | 2 |

**Course Description:**

A brief awareness of the disease that are a part of the changing lifestyle habits of the modern world. The disease includes Parkinson's dementia, Atherosclerosis, Cancer, Diabetes and hypertension.

**Course Prerequisite: NI**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | Attain the knowledge of life style disease, its prevention | |
| 2 | Understand the main reason behind diabetes and hypertension | |
| 3 | Acquire the knowledge of cancer and cardiac disorders. | |
| 4 | Understand the main causes and prevention of Alzheimer's disease, Parkinson's disease. | |
| 5 | Teacher specific | |

*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C

| Mapping of Course Outcomes to PSOs | | | | | | | |
|---|---|---|---|---|---|---|---|
| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PSO 7 |
| CO 1 | ✓ | | | ✓ | | | |
| CO 2 | | ✓ | | | ✓ | | |
| CO 3 | | | ✓ | | | | ✓ |
| CO 4 | | | ✓ | | | ✓ | |
| CO 5 | ✓ | | | ✓ | | | |

**COURSE CONTENTS**

**Contents for Classroom Transaction:**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **CONCEPT OF LIFE STYLE DISEASES** | | **10** |
| | 1 | Concept of life style diseases – importance of life style factors in preventing disease development- diet, exercise, smoking, alcohol, etc | |
| | 2 | Body mass index- determination and significance | |
| | 3 | Obesity – factors leading to development, prevention, management | |
| | 4 | Physiological stress, free radicals and oxidative stress. | |
| 2 | **DIABETES AND HYPERTENSION** | | **15** |
| | 1 | Diabetes – definition, types of diabetes- type 1 and type 2 | |
| | 2 | Characteristics – causes, diagnosis, prevention and management | |
| | 3 | Hypertension – characteristics, causes and risk factors | |
| | 4 | Prevention and management of hypertension | |
| 3 | **CANCER AND CARDIOVASCULAR DISEASES** | | **15** |
| | 1 | Cancer- types, characteristics, causes, Diagnosis, management | |
| | 2 | Genetic basis of cancer – tumour suppressor genes, oncogenes and gene expression | |
| | 3 | Atherosclerosis and cardiovascular diseases | |
| | 4 | Myocardial infarction, congestive heart failure- causes diagnosis and management | |

| | | | |
|---|---|---|---|
| | **ALZHEIMER'S AND PARKINSON'S DISEASE** | | **15** |
| **4** | 1 | Dementia, type of dementia | |
| | 2 | Alzheimer's disease – stages of disease, causes. Pathophysiology and disease mechanism, management of disease | |
| | 3 | Parkinson's dementia- causes, symptoms, molecular pathophysiology of disease | |
| | 4 | Prevention and disease management. | |
| **5** | **Teacher Specific Module** | | |
| | *Directions* | | 5 |

**Essential Readings:**


1. Satyanarayana, U. Biochemistry. Elsevier Health Sciences, 2014.
2. Hall, John E. Guyton and Hall Textbook of Medical Physiology. Saunders, 2015.
3. Karp, Gerald. Cell and Molecular Biology. Wiley, 2013.


**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 2 |
| | 2 | 2 |
| | 3 | 2 |
| | 4 | 2 |
| **2** | 1 | 1 |
| | 2 | 1 |
| | 3 | 2 |
| | 4 | 2 |
| | 1 | 3 |
| **3** | 2 | 3 |
| | 3 | 1 |
| | 4 | 1 |
| **4** | 1 | 2 |
| | 2 | 2 |
| | 3 | 2 |
| | 4 | 2 |

**Suggested Readings:**


1. Lippincott. Diseases and Drug Consult: Neurologic Disorders. Williams & Wilkins, 2009.
2. Kumar, Vijay, and Kiran Dip Gill. *Basic concepts in clinical biochemistry: a practical guide*. Springer Singapore, 2018.


**Assessment Rubrics:**

| Evaluation Type | | Marks |
|---|---|---|
| End Semester Evaluation | | **70** |
| Continuous Evaluation (Theory) | | **30** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 10 |
| d) | Viva | 5 |
| **Total** | | **100** |

**Employability for the Course:**

1. Scientific Researcher
2. Dietitian
3. Teaching
4. Wellness coach

**VI SEMESTER**

**KU6DSEBCH306: BIOSAFETY AND BIOETHICS**

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| VI | DSE | Higher | KU6DSEBCH306 | 4 | 60 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 4 | 0 | 0 | 30 | 70 | 100 | 2 |

**Course Description:**

The course describes the principles of biosafety and biosecurity in laboratory and clinical settings. It explores the emergency response protocols and procedures for incidents involving biohazardous materials. Students will learn about specific regulations applicable to different sectors including research laboratory, agricultural settings and biotechnology industries and analyse ethical frameworks for resolving conflicts and making ethical decisions in biomedical and life science contexts.

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | Define Biosafety and bioethics in the context of modem biotechnology. | |
| 2 | Analyse the potential bio risks associated with biotechnology and molecular genetics research. | |
| 3 | Comprehend basic ethical principles which guide bioscience research. | |
| 4 | Apply the basic concepts of biosecurity and Bioethics on real life issues. | |
| 5 | Teacher specific | |

| **Mapping of Course Outcomes to PSOs** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PSO 7 |
| CO 1 | ✓ | | | | | | |
| CO 2 | ✓ | | ✓ | | | | ✓ |
| CO 3 | | ✓ | | | | | |
| CO 4 | | | ✓ | | ✓ | | |
| CO 5 | | | | | | ✓ | ✓ |

**COURSE CONTENTS**

**Contents for Classroom Transaction:**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **BIOSAFETY** | | **10** |
| | 1 | Introduction - Biosafety issues in biotechnology. | |
| | 2 | Biological Safety Cabinets, Primary Containment for Biohazards. | |
| | 3 | Biosafety Levels - Levels of Specific Microorganisms, infectious Agents and infected Animals. | |
| | 4 | Biological containments and physical containments. | |
| 2 | **BIOSAFETY GUIDELINES** | | **15** |
| | 1 | Guidelines and regulations (National and international including Cartagena Protocol) - operation of biosafety guidelines and regulations of Government of India | |
| | 2 | Definition of GMOs & LMOs. | |
| | 3 | Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture. | |
| | 4 | Environmental release of GMOs - Risk – Analysis, Assessment, management and communication. | |
| 3 | **GUIDELINES FOR rDNA RESEARCH ACTIVITIES** | | **15** |
| | 1 | Large scale experiments, release to environment, import and shipment | |
| | 2 | Mechanism of implementation of biosafety guidelines. | |
| | 3 | Quality control of biologicals produced by rDNA technology. | |
| | 4 | Revised guidelines for research in transgenic plants. | |
| | **BIOETHICS** | | **15** |

| | | | |
|---|---|---|---|
| **4** | 1 | Introduction to ethics and bioethics. Framework for ethical decision making | |
| | 2 | GMO's human genome project, human cloning, designer babies, biopiracy and biowarfare. Eugenics and its possible approaches | |
| | 3 | Animal right activities - Blue cross in India- society for prevention of cruelty against animals. Ethical limits of Animal use. Greenpeace - Human Rights and Responsibilities. | |

| | | |
|---|---|---|
| **5** | **Teacher Specific Module** | |
| | *Directions* | 5 |

**Essential Readings:**


1. Bently, Lionel, et al. *Intellectual property law*. Oxford university press, 2022.
2. Department of Biotechnology, Government of India. Recombinant DNA Safety Guidelines. 1990.
3. Cullet, Philippe. *Intellectual property protection and sustainable development*. New Delhi: LexisNexis Butterworths, 2005.
4. Cotton, Bt, and Bt Brinjal. "B1BT24-BIO ETHICS, BIOSAFETY & INTELLECTUAL PROPERTY RIGHTS." *CMR COLLEGE OF ENGINEERING & TECHNOLOGY*: 45.


**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 1 |
| | 2 | 1 |
| | 3 | 4 |
| | 4 | 4 |
| **2** | 1 | 1 |
| | 2 | 4 |
| | 3 | 2 |
| | 4 | 1 |
| | 1 | 3 |
| **3** | 2 | 2 |
| | 3 | 2 |
| | 4 | 3 |

| | | |
|---|---|---|
| **4** | 1 | 4 |
| | 2 | 1 |
| | 3 | 4 |
| | 4 | 4 |



**Suggested Readings:**


1. Chandrasekaran, Balakumar, et al. "Ethics and Legal Protection of Uses of Computer Applications in Pharmaceutical Research." *Dosage Form Design Parameters*. Academic Press, 2018. 757-770.
2. Furr, A. Keith. *CRC handbook of laboratory safety*. CRC press, 2000.


**Assessment Rubrics:**

| Evaluation Type | | Marks |
|---|---|---|
| End Semester Evaluation (Theory) | | **70** |
| End Semester Evaluation (Practical) | | **0** |
| Continuous Evaluation (Theory) | | **30** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 10 |
| d) | Viva | 5 |
| **Total** | | **100** |

**Employability for the Course:**

1. Biochemical companies
2. Research and development
3. Teaching

## VII SEMESTER

## KU7DSCBCH401: RESEARCH METHODOLOGY

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| VII | DSC | Advanced | KU7DSCBCH401 | 4 | 60 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 4 | 0 | 0 | 30 | 70 | 100 | 2 |

**Course Description:**

This course introduces students to the fundamental principles and practices of research methodology across various disciplines. It focuses on equipping students with the necessary knowledge and skills to design, conduct, and evaluate research studies effectively. Emphasis is placed on understanding different research paradigms, methods, and ethical considerations in research

**Course Prerequisite: NIL Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | Understanding of Research Principles | |
| 2 | Research Design Proficiency: Capability in designing research studies. | |
| 3 | Understanding and adhering to ethical guidelines in research | |
| 4 | Critical Thinking Skills: Developing the ability to evaluate research and findings critically. | |

*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | | ✓ | | |
| CO 2 | | ✓ | | |

| | | | | |
|---|---|---|---|---|
| CO 3 | | | | |
| CO 4 | | | ✓ | |
| CO 5 | | | ✓ | ✓ |



## COURSE CONTENTS

### Contents for Classroom Transaction:

| MODLE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **INTRODUCTION TO RESEARCH** | | **10** |
| | 1 | The concept of research, characteristics of good research, Application of Research, Meaning and sources of Research problem, characteristics of good Research problem, | |
| | 2 | Research process, outcomes, application of Research | |
| | 3 | Meaning and types of Research hypothesis | |
| | 4 | Importance of Review of Literature, Organizing the Review of Literature | |
| 2 | **CLASSIFICATION OF RESEARCH** | | **15** |
| | 1 | Types of research, pure (basic, fundamental) and applied research, qualitative and quantitative. | |
| | 2 | Research Design: Meaning, need, types of research design Exploratory, Descriptive, Casual research Design, Components of research design | |
| | 3 | Features of good Research design. | |
| | 4 | Experiments, surveys and case study Research design | |

| | | | |
|---|---|---|---|
| **3** | **SAMPLING, DATA COLLECTION AND ANALYSIS** | | **15** |
| | 1 | Types and sources of data – Primary and secondary, | |
| | 2 | Methods of collecting data, Concept of sampling and sampling methods – sampling frame, sample, characteristics of good sample, simple random sampling, purposive sampling, convenience sampling, snowball sampling, | |
| | 3 | classification and tabulation of data, graphical representation of data, graphs and charts – Histograms, frequency polygon and frequency curves, bell shaped curve and its properties | |
| | 4 | Statistical Methods for Data Analysis: Applications of Statistics in Research, measures of central tendency and dispersion | |
| **4** | **RESEARCH REPORT** | | **15** |
| | 1 | Research report and its structure, journal articles – Components of journal article. | |
| | 2 | Explanation of various Research Components- Research ethics, Plagiarism and copyright. | |
| | 3 | Structure of an abstract and keywords | |
| | 4 | Thesis and dissertations. Components of thesis and dissertations. Referencing styles and bibliography. | |
| **5** | **Teacher Specific Module** | | **5** |
| | *Directions* | | |

**Essential Readings:**


1. Cooper, Donald, and Pamela S. Schindler. Business Research Methods. 9th ed., Tata McGraw Hill, 2009.
2. Kothari, Chakravanti Rajagopalachari. "Research methodology: Methods and techniques2004." (2004).
3. Sekaran, Uma. Research Methods for Business. 4th ed., Wiley, 2010.

4. Kumar, Ranjit. Research Methodology. 2nd ed., Pearson Education, 2009.

**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 4 |
| | 2 | 1 |
| | 3 | 2 |
| | 4 | 2 |
| **2** | 1 | 3 |
| | 2 | 4 |
| | 3 | 3 |
| | 4 | 2 |
| **3** | 1 | 2 |
| | 2 | 2 |
| | 3 | 2 |
| | 4 | 2 |
| **4** | 1 | 3 |
| | 2 | 1 |
| | 3 | 2 |
| | 4 | 4 |

**Suggested Readings:**

1. 1.Malhotra, Naresh, and Satya Bhushan Dash. Marketing Research. 5th ed., Pearson Prentice Hall, 2009.
2. 2.Kerlinger, Fred N. Foundations of Behavioural Research.

**Assessment Rubrics:**

| Evaluation Type | | Marks |
|---|---|---|
| End Semester Evaluation | | **70** |
| Continuous Evaluation | | **30** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 10 |
| d) | Viva | 5 |
| **Total** | | **100** |

## VII SEMESTER

## KU7DSCBCH402: PHARMACEUTICAL CHEMISTRY

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| VII | DSC | Advanced | KU7DSCBCH402 | 4 | 60 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 4 | 0 | 0 | 30 | 70 | 100 | 2 |

**Course Description:**

Develop and demonstrate depth and breadth of knowledge in biomedical, pharmaceutical, social/administrative/behavioural and clinical sciences. Integrate knowledge from foundational sciences to explain how specific drugs or drug classes work and evaluate their potential value in individuals and populations. Apply knowledge in foundational sciences to solve therapeutic problems.

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | Understand the fundamental concepts of pharmaceutical chemistry and various phases of drug discovery and development. | |
| 2 | Illustrate the relevance of pharmacokinetics and pharmacodynamics in drug discovery phases. | |
| 3 | Analyse the classes and mode of action of various drugs with special emphasis on antimicrobial agents | |
| 4 | Appraise the various sources of natural bioactive compounds and their role as natural pharmaceutical agents. | |

*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|---|---|---|---|---|---|---|
| CO 1 | | ✓ | | | | ✓ |
| CO 2 | | | ✓ | | | |
| CO 3 | | | ✓ | ✓ | | |
| CO 4 | ✓ | | | | ✓ | ✓ |

## COURSE CONTENTS

### Contents for Classroom Transaction:

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **SOURCE AND CLASSIFICATION OF DRUGS** | | **10** |
| | 1 | Introduction to pharmaceutical chemistry, various filed, principles and concepts. | |
| | 2 | sources of drugs, types of drugs dosage forms & routes of | |
| | | administration. | |
| | 3 | Classification of drugs based on sources: mode of | |
| | | administration, site of action, and absorption of drugs | |
| | 4 | Major phases of drug discovery and development- Target | |
| | | identification, target validation, lead discovery, lead | |
| | | optimization-preclinical development. clinical and post | |
| | | clinical steps. | |

| | | | |
|---|---|---|---|
| 2 | **DRUG DISTRIBUTION AND ELIMINATION** | | **15** |
| | 1 | Introduction to pharmacokinetics, pharmacodynamics, Concept of pharmacophores, drug likeliness | |
| | 2 | Drugs Adsorption, distribution, metabolism, and elimination (ADME), Role of kidney in elimination | |
| | 3 | Drug metabolism: chemical pathways of drug metabolism. | |

| | | | |
|---|---|---|---|
| | 4 | Phase I and Phase II reactions, role of cytochrome P450. | |
| **3** | **MODE OF ACTION AND SIDE EFFECTS** | | **15** |
| | 1 | Drug toxicity- Adverse responses and side effects of drugs: allergy, drug intolerance, drug addiction, drugs abuses and their biological effects. | |
| | 2 | Mode of action and uses of the following classes of Drug (structure not expected) Adrenocorticoids - Prednisolone, Dexamethasone, Betamethasone | |
| | 3 | Antibacterial agents- Antibiotics-Major classes- Penicillin, Semi-synthetic penicillin, streptomycin, tetracyclines, Cephalosporins, Chloramphenicol (Brief description) | |
| | 4 | Antifungal and antiviral agents- Major classes and mode of action with examples (Brief description) | |
| **4** | **NATURAL PHARMACEUTICALS** | | **15** |
| | 1 | Identification of pharmaceutical compounds from natural origins- Brief introduction, classes of natural pharmaceuticals- major classes | |
| | 2 | Pharmaceutical compounds from plants- major classes, mode of action with examples | |
| | 3 | Natural pharmaceutical compounds from actinomycetes, fungi and bacteria (other than antibiotics)- major classes, mode of action and examples | |
| | 4 | Natural pharmaceutical compounds from marine sponges- major classes, mode of action, examples | |
| **5** | **Teacher Specific Module** | | **5** |
| | *Directions* | | |

**Essential Readings:**

1. Tripathi, K.D. Essentials of Medical Pharmacology. Jaypee Brothers, 2003.
2. Finar, Il. Organic Chemistry Vol-1. 6th ed., Dorling Kindersley, 2008.

**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 1 |
| | 2 | 1 |
| | 3 | 1 |
| | 4 | 1 |
| **2** | 1 | 1 |
| | 2 | 4 |
| | 3 | 3 |
| | 4 | 4 |
| **3** | 1 | 3 |
| | 2 | 4 |
| | 3 | 2 |
| | 4 | 3 |
| **4** | 1 | 4 |
| | 2 | 1 |
| | 3 | 2 |
| | 4 | 4 |

**Suggested Readings:**


3. Nadendla, Rama Rao. Principles of Organic Medicinal Chemistry. New Age International (P) Limited, 2004.
4. Katzung, Bertram G. Basic & Clinical Pharmacology. McGraw-Hill, 2006.


**Assessment Rubrics:**

| **Evaluation Type** | **Marks** |
|---|---|
| End Semester Evaluation | **70** |
| Continuous Evaluation | **30** |

| | | |
|---|---|---|
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 10 |
| d) | Viva | 5 |
| Total | | 100 |

**Employability for the Course:**

1. Scientist/Research Officer/Research Executive
2. Professor
3. Quality Control & Quality Assurance Analyst
4. Scientific Data Entry Specialist
5. Patent Analyst.
6. Pharmaceutical Patent Analyst.
7. Assistant Manager.

## VII SEMESTER

### KU7DSCBCH403: PLANT BIOCHEMISTRY

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| VII | DSC | Advanced | KU7DSCBCH403 | 4 | 75 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 3 | 2 | 0 | 25 | 50 | 75 | 1.5 |

**Course Description:**

Plant biochemistry course typically aim to understand biochemical processes and molecular mechanisms underlying plant growth, development and metabolism. It explores the metabolic pathways involved in plant growth and development, including photosynthesis, respiration, biosynthesis of phytohormones and secondary metabolites.

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | To know the plant cell organelles and locate its parts along with functions and mechanism of photosynthesis | |
| 2 | In-depth knowledge of different phytohormones and their functions | |

| | | |
|---|---|---|
| 3 | Classify and isolate different secondary metabolites and stress physiology | |
| 4 | Analysis of qualitative and quantitative determination of phytochemicals | |

*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | ✓ | | | |
| CO 2 | | ✓ | | |
| CO 3 | | ✓ | ✓ | |
| CO 4 | | | | ✓ |

## COURSE CONTENTS

### Contents for Classroom Transaction:

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | | **INTRODUCTION TO PLANT CELL AND PHOTOSYNTHESIS** | **15** |
| | 1 | Plant cell organelles Plastids–types, structure, functions Cell wall–properties, plasmodesmata, Glyoximes | |
| | 2 | Plant tissues-vascular tissues, meristem and permeant tissues | |
| | 3 | Photosynthesis - PSI, PS II, LHC, ATP Synthase Light reaction and dark reaction, photophosphorylation | |
| | 4 | Photorespiration, C3, C4, CAM pathways, glyoxylate cycle | |
| 2 | | **PLANT HORMONES** | **10** |
| | 1 | Biosynthesis and physiological functions of auxins, GA | |
| | 2 | Biosynthesis and physiological functions of Cytokinin, ABA, Ethylene | |
| | 3 | Biosynthesis and physiological functions of polyamines, brassino steroids | |
| | 4 | Biosynthesis and physiological functions of Jasmonic acid, salicylic acid | |

| | | | |
|---|---|---|---|
| **3** | **SECONDARY METABOLITES** | | **10** |
| | 1 | Classification, isolation, characterization biosynthetic pathways and applications of alkaloids, phenols, | |
| | 2 | Classification, isolation, characterization, biosynthetic pathways and applications of terpenoids, flavonoids. | |
| **4** | **PLANT STRESS** | | **10** |
| | 1 | Plant stress – biotic and abiotic. abiotic stresses- salinity, floods, drought | |
| | 2 | Biotic stresses – allelopathic substance, insects and disease. | |
| **5** | **PRACTICALS** | | **30** |
| | 1 | Preliminary Phytochemical analysis of plant components- alkaloids, phenolic compounds, tannins, flavonoids, terpenoids and saponins. | |
| | 2 | Plant extraction methods – maceration, digestion, decoction, infusion, percolation, Soxhlet extraction, superficial extraction, ultrasound-assisted, and microwave-assisted extractions. | |
| | 3 | Quantitative estimation of alkaloids, phenolic compounds and tannins, flavonoids, terpenoids and saponins. | |
| | 4 | Estimation of vitamin A | |
| | 5 | Estimation of vitamin E | |
| | 6 | Determination of total phenolic content | |
| | 7 | Separation of Plant pigments by TLC | |

**Essential Readings:**


1. Taiz, Lincoln, and Eduardo Zeiger. Plant Physiology and Development. 6th ed., Sinauer Associates, Inc., 2010.
2. Buchanan, Bob B., Wilhelm Gruissem, and Russell L. Jones. Biochemistry & Molecular Biology of Plants. 2nd ed., John Wiley & Sons, Ltd, 2015.
3. Goodwin, T. W., and E. I. Mercer. Introduction to Plant Biochemistry. Pergamon Press, 1983.
4. Hopkins, W. G., and Hinder, N. P. A. Introduction to Plant Physiology. 3rd ed., John Wiley & Sons Inc., 2004

**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| 1 | 1 | 1 |
| | 2 | 1 |
| | 3 | 1 |
| | 4 | 1 |
| 2 | 1 | 2 |
| | 2 | 1 |
| | 3 | 3 |
| | 4 | 1 |
| 3 | 1 | 1 |
| | 2 | 1 |
| | 3 | 6 |
| | 4 | 6 |
| 4 | 1 | 7 |
| | 2 | 7 |
| | 3 | 7 |
| | 4 | 7 |
| | 5 | 7 |
| | 6 | 7 |
| | 7 | 7 |

**Suggested Readings:**


1. Gupta, Dharmendra K., and Jose Manuel Palma. Plant Growth and Stress Physiology. Springer.
2. Bala, Manju, et al. Practical'sin Plant Physiology and Biochemistry. Scientific Publications.

**Assessment Rubrics:**

| **Evaluation Type** | | **Marks** |
|---|---|---|
| **End Semester Evaluation (Theory)** | | **50** |
| **End Semester Evaluation (Practical)** | | **15** |
| **Continuous Evaluation (Theory)** | | **25** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 5 |
| d) | Viva | 5 |
| **Continuous Evaluation (Practical)** | | **10** |
| a) | Record | 5 |
| b) | Lab performance | 5 |
| Total | | 100 |

**Employability for the Course:**

1. Biotechnology companies
2. Research and Development
3. Teaching
4. Biological technicians

## VII SEMESTER

## KU7DSCBCH404: PHYSIOLOGICAL ASPECTS OF BIOCHEMISTRY

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| VII | DSC | Advanced | KU7DSCBCH404 | 4 | 60 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 4 | 0 | 0 | 30 | 70 | 100 | 2 |

**Course Description:**

Physiology refers to the scientific study of regular functions in living organisms. It is a branch of biology and focuses on how certain organisms survive, work and function. It also studies how all aspects of the body of that organism, such as biological, physical, and chemical, are interrelated and vital to the survival of that organism. In this course we will physiology of blood, heart and circulation, respiration, chemical coordination and excretory system.

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | Understand the process of digestion and absorption | |
| 2 | Illustrate the role of acid base balance by lungs and kidney | |
| 3 | To understand the electrical and chemical co-ordination in human body | |
| 4 | To understand he mechanism of muscular movement | |

*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | ✓ | | | |
| CO 2 | ✓ | | | |
| CO 3 | | ✓ | | |
| CO 4 | | ✓ | ✓ | |
| CO 5 | | | ✓ | ✓ |

**COURSE CONTENTS**

**Contents for Classroom Transaction:**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **DIGESTION AND ABSORPTION** | | **10** |
| | 1 | Structure of digestive tract | |
| | 2 | Digestion and absorption of carbohydrates: amylase, sodium dependent glucose transport | |
| | 3 | Digestion and absorption of proteins: enzymes in protein digestion. Absorption of small peptides and free amino acids, specific transport systems | |
| | 4 | Digestion and absorption of lipids: role of bile acids, action of gastric and pancreatic lipases, micellar formation, absorption of lipids | |
| 2 | **HOMEOSTASIS** | | **15** |
| | 1 | Structure of respiratory system transport of oxygen, role of haemoglobin, dissociation curve of oxyhaemoglobin and its significance, transport of CO2 and chloride shift, | |

| | | | |
|---|---|---|---|
| | | Bohr's effect, Haldane's effect, 2,3 bisphosphoglycerate. | |
| | 2 | Structure and function of nephron, renal blood flow and its importance, formation of urine, composition of urine, GFR, functions of tubules, acid –base balance | |
| | 3 | Various buffer systems of the blood: Acidosis and alkalosis, role of lung and kidney in regulation of acid- base balance. | |
| **3** | **NEUROENDOCRINE SYSTEM** | | **15** |
| | 1 | Nervous system, neurons, mechanism of nerve impulse transmission, action potential Neurotransmitters, synapses: chemical and electrical synapses, Reflex action and reflex arc. Anatomy and physiology of eye. | |
| | 2 | Overview of mammalian endocrine system, classification and chemical nature of hormones, molecular mechanism of hormone action- general aspects, hormone receptors, signal transduction. | |
| | 3 | Biochemistry and mechanism of action of hypothalamus and pituitary hormones, thyroid hormones, pancreatic hormones, adrenal hormones. | |
| **4** | **MUSCLE PHYSIOLOGY** | | **15** |
| | 1 | Structure and composition of adipose tissue, Classification of muscles- Structure of skeletal, smooth and cardiac muscles, Actin, myosin, tropomyosin, troponin, Z disc and H line components. | |
| | 2 | The sliding filament mechanism and subcellular ion movements during the contraction cycle in skeletal muscles | |
| | 3 | Branches and scope of physiology | |
| **5** | **Teacher Specific Module** | | **5** |
| | *Directions* | | |

**Essential Readings:**


1. Hall, John E. Guyton and Hall Textbook of Medical Physiology. Elsevier Health Sciences, 2010.
2. Rodwell, Victor W., et al. Harper's Illustrated Biochemistry. McGraw-Hill Medical Publishing Division, 2015.
3. Tortora, Gerard J., and Bryan H. Derrickson. *Principles of anatomy and physiology*. John Wiley & Sons, 2018..
4. Moyes, Christopher D., and David A. Hood. "Origins and consequences of mitochondrial variation in vertebrate muscle." *Annual Review of Physiology* 65.1 (2003): 177-201.


**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 4 |
| | 2 | 4 |
| | 3 | 4 |
| | 4 | 4 |
| **2** | 1 | 1 |
| | 2 | 1 |
| | 3 | 3 |
| | 4 | 1 |
| **3** | 1 | 4 |
| | 2 | 1 |
| | 3 | 4 |
| | 4 | 1 |
| **4** | 1 | 2 |
| | 2 | 4 |
| | 3 | 4 |
| | 4 | 2 |

**Suggested Readings:**


5. White, A., Handler, P., & Smith, E. L. Principles of Biochemistry. McGraw Hill, 1954.
6. Satyanarayana, U., & Chakrapani, U. Biochemistry. 3rd ed.

**Assessment Rubrics:**

| Evaluation Type | | Marks |
|---|---|---|
| End Semester Evaluation (Theory) | | **70** |
| End Semester Evaluation (Practical) | | **-** |
| Continuous Evaluation (Theory) | | **30** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 10 |
| d) | Viva | 5 |
| **Total** | | **100** |

**Employability for the Course:**

1. Biochemical companies
2. Research and development
3. Teaching
4. Quality control analysis
5. Biotechnology Industry

**VII SEMESTER**

**KU7DSCBCH405: CANCER BIOLOGY**

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| VII | DSC | Advanced | KU7DSCBCH405 | 4 | 60 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 4 | 0 | 0 | 30 | 70 | 100 | 2 |

**Course Description:**

Cancer biology helps to comprehend how cancer develops at the cellular and molecular levels. This understanding is crucial for devising strategies to prevent, diagnose, and treat cancer. Understanding cancer biology aids in the development of diagnostic tools and techniques. These tools enable healthcare professionals to detect cancer early, when treatment is often more effective. Carcinogens are substances or agents that can cause cancer by damaging the DNA of cells, leading to mutations that can promote the uncontrolled growth and division of cells characteristic of cancer. Cancer biology research leads to the identification of potential targets for therapy. Drugs and therapies can be designed to specifically target cancer cells while minimizing harm to healthy cells.

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning domains |
|---|---|---|
| 1 | To understand about cancer. | |
| 2 | To explain about cancer cell biology. | |
| 3 | To analyse about Carcinogenesis & Free radicals and Cancer cell regulation | |
| 4 | To analyse about diagnosis and treatment of cancer. | |

*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | ✓ | | | |
| CO 2 | | ✓ | | |
| CO 3 | | ✓ | ✓ | |
| CO 4 | | | ✓ | ✓ |

**COURSE CONTENTS**

**Contents for Classroom Transaction:**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | | **INTRODUCTION TO CANCER** | **10** |
| | 1 | Growth characteristics of cancers cells. Morphological and ultra-structural properties of cancer cells. | |
| | 2 | Types of growth -hyperplasia, dysplasia, anaplasia and neoplasia. Nomenclature of neoplasms. | |
| | 3 | Differences between benign and malignant tumors. | |
| | 4 | Hall marks of cancer. Epidemiology of cancer. | |

| | | | |
|---|---|---|---|
| 2 | | **CANCER CELL BIOLOGY AND BIOCHEMISTRY** | **15** |
| | 1 | Aberrant metabolism during cancer development. Warburg effect. Paraneoplastic syndromes. Tumor markers. | |
| | 2 | Cellular proto-oncogenes-oncogenes activation. | |
| | 3 | Growth factors- EGF, TNF-α and TGF-β and growth factor receptors–Signal transduction in cancer –transcription factors- NFAT, NF-kB, SMAD and STAT in cancer. | |
| | 4 | RAS signaling in cancer. | |
| | | **CARCINOGENESIS AND FREE RADICALS** | **15** |
| | 1 | Chemical carcinogenesis- stages in chemical carcinogenesis - Initiation, promotion and progression. Ames tests | |

| | | | |
|---|---|---|---|
| **3** | 2 | a) Radiation and Viral carcinogenesis - DNA and RNA viruses in human cancer.<br>b) Free radicals, antioxidants in cancer | |
| | 3 | Cancer cell regulation: Cell Cycle Regulation-Tumour suppressor genes p53, p21, Rb, BRCA1 and BRCA2. | |
| | 4 | Telomeres and Immortality; cell- cell interactions, cell adhesion-invasion and metastasis - VEGF signalling, angiogenesis. | |
| **4** | **DIAGNOSIS AND CANCER TREATMENT** | | **15** |
| | 1 | Different types of diagnostic approach to detect cancer | |
| | 2 | a) Strategies of Cancer Treatment-Chemotherapy-Gene therapy; Immunotherapy-Immune checkpoint therapy and CAR T-Cell therapy.<br>b) Radiotherapy and Cancer Vaccines | |
| | 3 | Nutrition and Cancer management | |

| | | | |
|---|---|---|---|
| | 4 | a) Phytomedicine in Cancer<br>b) Cancer Stem cells | |
| **5** | **Teacher Specific Module** | | **5** |
| | *Directions* | | |

**Essential Readings:**


1. Weinberg, Robert A. The Biology of Cancer. Garland Science, 2013.
2. McKinnell, Robert G., et al. The Biological Basis of Cancer. Cambridge University Press, 2006.
3. Pelengaris, Spiros, and Michael Khan. The Molecular Biology of Cancer. Wiley-Blackwell, 2013.
4. Alison, Malcolm R. The Cancer Handbook. Nature Publishing Group, 2003
5. PDQ Cancer Information Summaries. National Cancer Institute, Bethesda (MD), 2006

**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| 1 | 1 | 1 |
| | 2 | 6 |
| | 3 | 5 |
| | 4 | 1 |
| 2 | 1 | 1 |
| | 2 | 4 |
| | 3 | 3 |
| | 4 | 1 |
| 3 | 1 | 1 |
| | 2 | 2 |
| | 3 | 4 |
| | 4 | 1 |
| 4 | 1 | 1 |
| | 2 | 2 |
| | 3 | 4 |
| | 4 | 3 |

**Suggested Readings:**


6. McKinnell, Robert G., et al. The Biological Basis of Cancer. Cambridge University Press, 2006.
7. Pelengaris, Spiros, and Michael Khan. The Molecular Biology of Cancer. Wiley-Blackwell, 2013.
8. Alison, Malcolm R. The Cancer Handbook. Nature Publishing Group, 2003.
9. Hanahan, Douglas, and Robert A. Weinberg. "Hallmarks of Cancer: The Next Generation." Cell, vol. 144, no. 5, 2011, pp. 646-674. Doi: 10.1016/j.cell.2011.02.013.

**Assessment Rubrics:**

| Evaluation Type | | Marks |
|---|---|---|
| End Semester Evaluation | | **70** |
| Continuous Evaluation | | **30** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 10 |
| d) | Viva | 5 |
| **Total** | | **100** |

**Employability for the Course:**

1. Biotechnology companies
2. Research and Development
3. Teaching
4. Molecular diagnostics
5. Entrepreneurship

**VIII SEMESTER**

**KU8DSCBCH406: COMPUTATIONAL TECHNIQUES INBIOCHEMISTRY**

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| VIII | DSC | Advanced | KU8DSCBCH406 | 4 | 75 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 3 | 2 | 0 | 25 | 50 | 75 | 1.5 |

**Course Description:**

This course helps students understand how to use computer tools to analyse biological data. They learn to interpret genetic information, study protein structures, and understand how diseases develop. Through practical exercises, students gain skills in data analysis and problem-solving, preparing them for careers in research, healthcare, or life science.

**Course Prerequisite: NIL**

**Course Outcomes: Course Learning Outcomes: At the end of the Course, the Student will be able to**

| | |
|---|---|
| C01 | Grasp the basic principles and methodologies of bioinformatics for effective data analysis. |
| C02 | Learn to proficiently analyse biological sequences and structures using computational tools and techniques |
| C03 | Develop skills in predicting and interpreting the three-dimensional structures of biomolecules to enhance understanding of their functions. |
| C04 | Gain practical experience in using bioinformatics software and databases |
| C05 | Improve critical thinking skills to interpret complex biological data and solve problems effectively |

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

**Mapping of Course Outcomes to PSOs**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | ✓ | | | |
| CO 2 | | ✓ | | |
| CO 3 | | ✓ | | |
| CO 4 | | ✓ | ✓ | |
| CO 5 | | | ✓ | ✓ |

## COURSE CONTENTS

### Contents for Classroom Transaction:

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | | **INTRODUCTION TO BIOINFORMATICS** | **15** |
| | 1 | Introduction to bioinformatics, historical perspectives, scope and applications of Bioinformatics. | |
| | 2 | Biological databases, primary and secondary sequence databases, Specialised databases, NCBI-GenBank, EMBnet, EMBL, DDBJ, UniProt, PIR, PDB and KEGG | |
| | 3 | Data mining of biological databases | |
| | 4 | Data submission tools (Webin, Sequin, Bankit) and data retrieval tools (DBGET, BioRS), File format of databases- GenBank Flat files, PIR format | |
| 2 | | **SIMILARITY SEARCHING TOOLS** | **10** |
| | 1 | Similarity searching tools: BLAST and FASTA, types and variants of BLAST, Applications of BLAST | |
| | 2 | Sequence and structural alignment: Global and local alignment, Pairwise and multiple sequence alignment, Dynamic programming algorithm- Needleman Wunsch and Smith Waterman, DotPlot, Bioinformatics tools (EMBOSS and Clustal) | |
| | 3 | Structural alignment: Superposition and threading | |
| | 4 | Molecular phylogenetics: Structural components of phylogenetic trees, Types of phylogram, Steps involved in phylogenetic data analysis- Distance based and character-based methods, Phylogenetic tree evaluation methods | |
| 3 | | **MOLECULAR MODELING IN DRUG DISCOVERY** | **10** |
| | 1 | Introduction to molecular modeling in drug discovery- secondary and tertiary structure prediction of proteins. | |
| | 2 | Secondary structure prediction tools- SOPMA and CFSSP. | |
| | 3 | Tertiary structure prediction; Homology modeling, Steps | |

| | | | |
|---|---|---|---|
| | | involved in homology modeling, | |

| | | | |
|---|---|---|---|
| | 4 | Bioinformatics tools: SWISSMODEL and Modeller. Molecular Visualization- RASMOL and PyMOL | |
| **4** | **MOLECULAR DOCKING** | | **10** |
| | 1 | Molecular docking: Protein- ligand interactions, Types of docking | |
| | 2 | Steps in docking simulation Protein- ligand docking program: AutoDock tools, Webina | |
| | 3 | Protein-protein docking- Major principles and methodologies | |
| | 4 | Protein–protein docking program- Argus lab, PatchDock, HDock server | |
| | | **LABORATORY EXPERIMENTS** | **30** |
| **5** | 1 | Pairwise and multiple sequence alignment of molecular docking | |
| | 2 | Phylogenetic analysis and construction of a phylogenetic tree using Clustal X | |
| | 3 | Prediction of secondary structure of protein by SOPMA | |
| | 4 | Molecular docking (Protein-ligand docking) by Webina | |
| | 5 | Prediction of tertiary structure of protein by Swiss Model server | |

**Essential Readings:**


1. Attwood, T.K., and D.J. Parry-Smith. Introduction to Bioinformatics. PEARSON Education Ltd.
2. Mount, David W. Bioinformatics: Sequence and Genome Analysis.
3. Orengo, C.A., D.T. Jones, and J.M. Thornton. Bioinformatics: Genes, Proteins, and Computers.
4. Durbin, Richard, Sean R. Eddy, Anders Krogh, and Graeme Mitchison. Biological Sequence Analysis.

WEBSITES**:** .www.drugbank.ca ,www.ccdc.cam.ac.uk/products/csd/

**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 1 |
| | 2 | 2 |
| | 3 | 2 |
| | 4 | 2 |
| **2** | 1 | 3 |
| | 2 | 4 |
| | 3 | 3 |
| | 4 | 2 |
| **3** | 1 | 2 |
| | 2 | 2 |
| | 3 | 2 |
| | 4 | 2 |
| **4** | 1 | 1 |
| | 2 | 1 |
| | 3 | 1 |
| | 4 | 1 |
| | 5 | 1 |
| | 6 | 1 |
| | 7 | 1 |
| | 8 | 1 |
| | 9 | 1 |

**Suggested Readings:**


5. Daniel. Biostatistics, 8th ed., John Wisley and Sons, 2006.
6. Durbin, Richard, Sean R. Eddy, Anders Krogh, and Graeme Mitchison. Biological Sequence Analysis.
7. Baxevaris, A.D. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, edited by B.F. Publication, 1998.
8. David W. Bioinformatics: Sequence and Genome Analysis, 2nd ed., CB Spublishers, 2005.


**Assessment Rubrics:**

| Evaluation Type | Marks |
|---|---|
| **End Semester Evaluation (Theory)** | **50** |
| **End Semester Evaluation (Practical)** | **15** |

| **Continuous Evaluation (Theory)** | | **25** |
|---|---|---|
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 5 |
| d) | Viva | 5 |
| **Continuous Evaluation (Practical)** | | **10** |
| a) | Record | 5 |
| b) | Lab performance | 5 |
| Total | | 100 |

**Employability for the Course:**

1. Research Positions.
2. Pharmaceutical Industry.
3. Healthcare Sector.
4. Biotechnology Companies
5. Software and Technology Companies

**VIII SEMESTER**
**KU8DSCBCH407: BIOSTATISTICS**

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| VIII | DSC | Advanced | KU8DSCBCH407 | 4 | 60 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 4 | 0 | 0 | 30 | 70 | 100 | 2 |

**Course Description:**

Biostatistics plays a crucial role in biochemistry by providing the tools and methods necessary for the analysis and interpretation of experimental data. It helps biochemists make sense of complex biological data, identify patterns, and draw meaningful conclusions from their experiments. Biochemistry involves studying the chemical processes and molecules that occur within living organisms. These studies often generate large amounts of data, ranging from gene expression levels

to enzymatic activity and protein structures. Biostatistics enables biochemists to analyse these data sets, assess their reliability, and determine the statistical significance of their findings. By applying statistical techniques, biochemists can identify correlations, establish cause-effect relationships, and determine the probability of observed outcomes occurring by chance. This enables them to draw accurate conclusions, make informed decisions, and design future experiments based on statistical power calculations. Additionally, biostatistics aids in experimental design, helping biochemists determine the appropriate sample sizes, control groups, and randomization techniques. It also guides the selection of appropriate statistical tests, such as t-tests, ANOVA, regression analysis, or survival analysis, depending on the nature of the data and research question.

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | Understand data types and data presentations. | |
| 2 | Understand the concepts of averages and dispersion of measurement values. | |
| 3 | Understand the concept of probability and probability distributions. | |
| 4 | Understand the method of testing statistical hypotheses. | |

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

**Mapping of Course Outcomes to PSOs**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | ✓ | | | |
| CO 2 | ✓ | | ✓ | |
| CO 3 | | ✓ | ✓ | |
| CO 4 | | ✓ | | ✓ |

**COURSE CONTENTS**

**Contents for Classroom Transaction:**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **THE MEANING OF STATISTICS** | | **10** |
| | 1 | Scope of Statistics in Biological and Medical Sciences.<br>Definition of population and sample. | |
| | 2 | Collection of data: Primary and secondary data. | |
| | 3 | Attributes and variables. Qualitative and quantitative data. | |
| | 4 | Types of data: Ungrouped data, grouped data, discrete data and continuous data | |
| 2 | **GRAPHICAL AND DIAGRAMMATIC REPRESENTATION** | | **15** |
| | 1 | Histogram, ogives, simple bar diagrams, and stem and leaf chart. | |
| | 2 | Frequency distribution. | |
| | 3 | Inclusive and exclusive methods. | |
| | 4 | Cumulative frequency distribution. | |
| 3 | **MEASURES OF CENTRAL TENDENCY AND DISPERSION** | | **15** |
| | 1 | Concept of measures of central tendency | |
| | 2 | Arithmetic mean, median, mode, quartiles, and weighted mean. Definitions and examples for ungrouped as well as grouped data. Properties of arithmetic mean | |
| | 3 | Absolute and relative measures, range, quartile deviation, variance, and standard deviation. | |
| | 4 | Coefficient of variation (with simple examples) | |

| | | | |
|---|---|---|---|
| **4** | **CORRELATION AND PROBABILITY** | | **15** |
| | 1 | Definition and types of correlation between two variables.<br>Scatter diagram.<br>Karl Pearson's coefficient of correlation and Spearman's rank correlation coefficient. | |
| | 2 | Definition and examples for ungrouped data.<br><br>Probability -Sample space, Event, Elementary event, Compound event, Impossible events, certain events, equally likely events, mutually exclusive events, and exhaustive events. | |
| | 3 | Dependent and independent events. Definition of probability. Addition law of probability with illustration. | |
| | 4 | Definition of conditional probability. Multiplicative law of probability with illustrative examples. | |
| **5** | **Teacher Specific Module** | | **5** |
| | *Directions* | | |

**Essential Readings:**


1. Pagano, Marcello, Kimberlee Gauvreau, and Heather Mattie. *Principles of biostatistics*. Chapman and Hall/CRC, 2022.
2. Medhi, Jyotiprasad. *Statistical methods: an introductory text*. New Age International, 1992.
3. Bhat, B. R., Srivenkatramana T., and Madhav Rao K. S. Statistics: A Beginner's Text. Vol. I. New Age International (P) Ltd., 1996.
4. Ithal, U. B., and Naik B. U. Statistical Methods I. PhadakePrakashan, Kolhapur.
5. Ithal, U. B., and Naik B. U. Statistical Methods II. PhadakePrakashan, Kolhapur.
6. Gupta, S. C., and V. K. Kapoor. *Fundamentals of mathematical statistics*. Sultan Chand & Sons, 2020.


**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 1 |
| | 2 | 3 |
| | 3 | 7 |
| | 4 | 3 |
| | 1 | 2 |

| | | |
|---|---|---|
| **2** | 2 | 5 |
| | 3 | 3 |
| | 4 | 4 |
| **3** | 1 | 1 |
| | 2 | 2 |
| | 3 | 4 |
| | 4 | 5 |
| **4** | 1 | 7 |
| | 2 | 2 |
| | 3 | 1 |
| | 4 | 3 |

**Assessment Rubrics:**

| **Evaluation Type** | | **Marks** |
|---|---|---|
| End Semester Evaluation | | **70** |
| Continuous Evaluation | | **30** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 10 |
| d) | Viva | 5 |
| **Total** | | **100** |

**Employability for the Course:**

1. Biotechnology companies
2. Research and Development
3. Teaching
4. Entrepreneurshi

## VIII SEMESTER

## KU8DSCBCH408: INTELLECTUAL PROPERTY RIGHTS

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| VIII | DSC | Advanced | KU8DSCBCH408 | 4 | 60 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 4 | 0 | 0 | 30 | 70 | 100 | 2 |

**Course Description:**

1. Define and understand the concept of intellectual property.
2. Differentiate between various forms of intellectual property, including patents, trademarks, copyrights, and trade secrets.
3. Understand the role of organizations like WIPO (World Intellectual Property Organization).
4. Explain the basics of patent law, including the criteria for patentability.

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | Define and explain the fundamental concepts of intellectual property. | |
| 2 | Understand the requirements for patentability and demonstrate the ability to analyze and evaluate patent applications. | |
| 3 | Understand the principles of trademarks, trade secrets and copyright protection. | |
| 4 | Demonstrate an understanding of the legal and trade related aspects of IPR. | |

*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|---|---|---|---|---|---|---|
| CO 1 | ✓ | | | | | |
| CO 2 | ✓ | ✓ | | | | |
| CO 3 | | | ✓ | ✓ | | |
| CO 4 | | | | | ✓ | ✓ |

**COURSE CONTENTS**

**Contents for Classroom Transaction:**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR)** | | **10** |
| | 1 | Overview of IPR, Types of intellectual property (patents, copyrights, trademarks, trade secrets), Importance of IPR in biotechnology | |
| | 2 | Patents in Biotechnology: Basics of patent law, Patentable subject matter in biotechnology | |
| | 3 | Patent filing and prosecution process | |
| | 4 | Patent infringement and litigation | |
| **2** | **IPR AND BIOTECHNOLOGY** | | **15** |
| | 1 | Copyrights and Biotechnology: Basics of copyright law, Protection of biotechnological works under copyright | |
| | 2 | Trademarks in Biotechnology: Basics of trademark law, Trademarks in the context of biotechnological products | |

| | | | |
|---|---|---|---|
| | 3 | Trade Secrets in Biotechnology: Definition and importance of trade secrets, Protection of trade secrets in the biotechnology industry | |
| | 4 | Geographical Indications and Traditional Knowledge | |
| **3** | **BIOETHICS AND PLANT GENETIC RESOURCES** | | **15** |
| | 1 | Ethical issues in research and development | |
| | 2 | Biopiracy, bioprospecting, and access and benefit-sharing agreements | |
| | 3 | Introduction to Plant Genetic Resources and IPR, Importance of Plant Genetic Resources, Nagoya Protocol and its principles | |
| | 4 | Access and Benefit-Sharing (ABS): ABS agreements and their implications for researchers and breeders | |
| **4** | **INTERNATIONAL PERSPECTIVES ON IPR IN BIOTECHNOLOGY** | | **15** |

| | | | |
|---|---|---|---|
| | 1 | International agreements and conventions: GATT, TRIPS, Paris Convention, Budapest treaty, Berne Convention, Patent Cooperation Treaty (PCT), UPOV, Nagoya Protocol. | |
| | 2 | Global strategies for protecting biotechnological inventions. | |
| | 3 | Comparison of IPR regimes across different countries | |
| | 4 | Harmonization efforts and challenges | |
| **5** | **Teacher Specific Module** | | **5** |
| | *Directions* | | |

**Essential Readings:**


1. Universal Law Publishing Co. Intellectual Property Laws: Containing Acts, Rules & Regulations. 2012.
2. Bouchoux, Deborah E. Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets. 3rd ed., 2012.
3. Chandrashekaran, A. Intellectual Property Law. C. Sitaraman and Co Pvt. Ltd., 2009.
4. Cullet, Philippe. Intellectual Property Protection and Sustainable Development. Universal Law Publishing Co., 2008.
5. SorapopKiatpongsan. "Intellectual Property and Patent in Stem Cell Research Era." Faculty of Medicine, Chulalongkorn University, vol. 89, no. 11, 2006, pp. 1984-1986.
6. Pandey, Neeraj, and Khushdeep Dharni. Intellectual Property Rights. PHI Learning Private Limited, 2011.
7. Goel, Deepa, and Shormini Parashar. IPR, Biosafety and Bioethics. Pearson, 2013.


**Reference Distribution:**

| Module | Unit | Reference |
|---|---|---|
| 1 | 1 | 2 |
| | 2 | 3 |
| | 3 | 4 |
| | 4 | 1 |
| 2 | 1 | 6 |
| | 2 | 2 |
| | 3 | 3 |
| | 4 | 1 |
| **3** | 1 | 3 |
| | 2 | 3 |
| | 3 | 4 |
| | 4 | 5 |
| **4** | 1 | 6 |
| | 2 | 1 |
| | 3 | 3 |
| | 4 | 2 |

**Suggested Readings:**


8. Sople, Vinod V. Managing Intellectual Property: The Strategic Imperative. 4th ed., PHI Learning Private Limited, 2011.
9. Parulekar, Ajith, and Sarita D'Souza. Indian Patents Law: Legal and Business Implications. Macmillan Publishers India Ltd., 2009.
10. Thakar, Bharti. Intellectual Property Rights in the Emerging Business Environment. The ICFAI University Press, 2006.


**Assessment Rubrics:**

| Evaluation Type | | Marks |
|---|---|---|
| End Semester Evaluation | | **70** |
| Continuous Evaluation | | **30** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 10 |
| d) | Viva | 5 |
| **Total** | | **100** |

**Employability for the Course:**

1. Patent and Trademark Attorney.
2. IP Solicitor and Litigation.
3. Paralegal.
4. Freelancing.
5. Teaching.
6. Content Writing.

**KU8DSEBCH404: DEVELOPMENTALBIOLOGY**

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| VIII | DSE | Advanced | KU8DSEBCH404 | 4 | 60 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 4 | 0 | 0 | 30 | 70 | 100 | 2 |

**Course description**

The course help to understand production of gametes, fertilization, development of the embryo, emergence of the adult organism, senescence, and death. Developmental biology aims to understand how an organism develops—how a single cell becomes an organized grouping of cells that is then programmed at specific times to become specialized for certain tasks. Developmental biology is the science that investigates how a variety of interacting processes generate an organism's hetero generous shapes, size and structural features that a rise on the trajectory from embryo to adult, or more generally throughout a life cycle.

**Course prerequisite: NIL**

**Course outcome**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1. | Understand the reproduction and reproductive parts of plants. | |
| 2. | Understand the sexual reproduction in animals. | |
| 3. | Understand the cellular changes in the zygote and early, late and post fertilization events | |
| 4. | Understand applications of developmental biology | |

***Remember (R) , Understand (U), Apply (A), Analyse (An), Evaluate ( E), Create (C)***

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | ✓ | | | |
| CO 2 | | ✓ | | |
| CO 3 | | ✓ | ✓ | ✓ |
| CO 4 | | | ✓ | |
| CO 5 | | | ✓ | |

**Contents for Classroom Transaction**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **PLANT DEVELOPMENT** | | **10** |
| | 1 | Microsporangium–Microsporogenesis and male gametophyte, pollen's structure. | |
| | 2 | Megasporangium-Megasporogenesis and female gametophyte, structure of Female embryo sac. | |
| | 3 | Pollination. Fertilization–Pollen-Pistil interaction, double fertilization, triple fusion. | |
| | 4 | Polyembryony, Apomixes, Parthenocarpy, Parthenogenesis. | |
| 2 | **EARLY EMBRYONIC DEVELOPMENT** | | **15** |
| | 1 | Gametogenesis-Oogenesis and Spermatogenesis. Structure of Ovum and Sperm. | |
| | 2 | Fertilization–mechanism of fertilization; recognition of egg and sperm, acrosome reaction, cortical reaction, changes in gametes, blocks to polyspermy. | |
| | 3 | Different types of eggs and patterns of cleavage –types of cleavage based on planes (meridional, vertical, Equatorial and Latitudinal), based on amount of yolk | |

| | | | |
|---|---|---|---|
| | | (Holoblastic & Meroblastic), based on devt. (Determinate & Indeterminate) and based on Pattern (Radial & Spiral). | |
| | 4 | Stages of development–Zygote, Blastula (types of blastula), Morula, Gastrula (major events in gastrulation), Notogenesis, Neurulation and Mesogenesis. | |
| 3 | **LATE AND POSTEMBRYONIC DEVELOPMENT** | | **15** |
| | 1 | Cell-cell communication in development (induction, competence, instructive and permissive interactions, epithelial mesenchymal interactions, paracrine factors). | |
| | 2 | Fate of germ layers and extra embryonic membrane. | |
| | 3 | Implantation of embryo in humans. | |
| | 4 | Placenta (Structure, and functions of placenta). | |
| 4 | **IMPLICATIONS OF DEVELOPMENTA LBIOLOGY** | | **15** |
| | 1 | Teratogenesis: Teratogenic agents and their effects on embryonic development. | |
| | 2 | Invitro fertilization. | |
| | 3 | Observation of blastula and gastrula. | |
| | 4 | Pollengrains of Hibiscus, Balsum and Datura | |
| 5 | | **Teacher Specific Module** | 5 |
| | | *Directions* | |

**Essential Readings**


1. Gilbert, Scott F., John M. Opitz, and Rudolf A. Raff. "Resynthesizing evolutionary and developmental biology." *Developmental biology* 173.2 (1996): 357-372.
2. Mitchell, Barry, and Ram Sharma. *Embryology: Embryology E-Book*. Elsevier Health Sciences, 2012.
3. Balinsky, B. I., and Fabian B. C. An Introduction to Embryology. 5th ed., International Thompson Computer Press, 1981.
4. Carlson, John B., and Nels R. Lersten. "Reproductive morphology." *Soybeans: improvement, production, and uses* 16 (2004): 59-95.
5. Kalthoff. Analysis of Biological Development. 2nd ed., McGraw-Hill Publishers, 2008.

**Reference Distribution**

| MODULE | UNIT | 1 |
|---|---|---|
| 1 | 1 | 4 |
| | 2 | 3 |
| | 3 | 2 |
| | 4 | 4 |
| 2 | 1 | 3 |
| | 2 | 2 |
| | 3 | 1 |
| | 4 | 4 |
| 3 | 1 | 3 |
| | 2 | 1 |
| | 3 | 2 |
| | 4 | 3 |
| 4 | 1 | 1 |
| | 2 | 2 |
| | 3 | 3 |
| | 4 | 2 |

**Suggested readings**


1. Verma, P. S., and V. K. Agarwal. *Chordate Embryology*. S. Chand Publishing, 1975.
2. SS, Bhojwani, S. P. Bhatnagar, and P. K. Dantu. *The embryology of angiosperms*. Vikas Publishing House, 2015.
3. SS, Bhojwani, S. P. Bhatnagar, and P. K. Dantu. *The embryology of angiosperms*. Vikas Publishing House, 2015.
4. Wolpert, Lewis. Principles of Development. 2nd ed., Oxford University Press, 2002.


**Assessment Rubrics**

| Evaluation Type | | Marks |
|---|---|---|
| End Semester Evaluation | | **70** |
| Continuous Evaluation | | **30** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 10 |
| d) | Viva | 5 |
| Total | | 100 |

**Employability for the Course:**

1.Academic Researcher.
2.Scientific Laboratory Technician.
3.Medical Researcher.
4.Cell Biologist.
5.Stem Cell biologist.

## KU8DSEBCH405: STEM CELL AND REGENERATIVE BIOLOGY

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| VIII | DSE | Advanced | KU8DSEBCH405 | 4 | 60 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 4 | 0 | 0 | 70 | 30 | 100 | 2 |

**Course description:**

This course will introduce students to stem cells and its application. Basic stem cell discoveries and their potential clinical application will be discussed.

**Course Prerequisite:** NIL

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | Overview of stem cell biology | |
| 2 | Knowledge of various types of stem cells and their characteristics | |
| 3 | Learn about tissue and organ development | |
| 4 | Understand the molecular basis of pluripotency | |

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create***

**Mapping of Course Outcomes to PSOs**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | ✓ | | | |
| CO 2 | | ✓ | | |
| CO 3 | | ✓ | | |
| CO 4 | | ✓ | ✓ | |
| CO 5 | | | ✓ | ✓ |

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **INTRODUCTION TO STEM CELLS** | | **10** |
| | 1 | Definition and Criteria for Stem Cells | |
| | 2 | Pluripotent, Multipotent and Totipotent Stem cells | |
| | 3 | Primordial germ cells, Embryonic stem cells | |
| | 4 | Amniotic fluid derived stem cells | |
| 2 | **STEM CELL BIOLOGY AND MECHANISMS** | | **15** |
| | 1 | Molecular Basis of Pluripotency | |
| | 2 | Mechanisms of Self Renewal, Role of LIF/JAK/STAT, Nodal/Activin/TFGβ, FGF/MAP kinase pathways | |
| | 3 | Chromatin signature of pluripotent cells, Cell cycle regulators in Stem cells | |
| | 4 | Stem cell niches, change of phenotype and differentiation, Senescence of Dividing somatic cells, ageing and stem cell renewal, Quiescent Stem Cells. | |
| | **TISSUE AND ORGAN DEVELOPMENT** | | **15** |
| | 1 | Differentiation in early development, Potency, Commitment, Polarity | |
| | 2 | Specification of asymmetric divisions, induction, | |

| | | | |
|---|---|---|---|
| **3** | | competence determination and differentiation | |
| | 3 | Morphogenetic gradients, cell fate and cell lineages, Epigenetic silencing and lineage commitment | |
| | 4 | Cellular differentiation of the nervous system, Progenitors in adult brain, Epithelial stem cells | |
| | 5 | Adult progenitor cells, Mesenchymal stem cells, Plasticity; De-differentiation, Cancer stem cells. | |
| **4** | **STEM CELL TECHNOLOGY** | | **15** |
| | 1 | Characteristics and characterization of Human Pluripotent Cells | |
| | 2 | Fluorescence and Magnetic bead assisted cell sorting | |
| | 3 | Derivation, characterization and maintenance of Murine and Human Embryonic Stem Cells, Differentiation of embryonic stem cells | |
| | 4 | Derivation of induced pluripotent stem cells; Derivation and differentiation of Human Embryonic Germ Cells; Genomic Reprogramming, Fate Mapping of Stem Cells. | |
| **5** | **Teacher Specific Module** | | **5** |
| | *Directions* | | |

**Essential Readings:**


1. Lanza, R., and Atala, A. Essentials of Stem Cell Biology. Academic Press, 2013.
2. Huang, N.F., L'Heureux, N., and Song, L. Engineering Stem Cells for Tissue Regeneration. World Scientific Publishing Company, 2018
3. Scott, C.T. Stem Cell Now. Pearson Education, 2006.
4. Marshak, D.R., Gardner, R.L., Gottlieb, D., Lanza, R., and Atala, A. (Eds.) Stem Cell Biology. Cold Spring Harbor Press, 2001.


**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 3 |
| | 2 | 3 |
| | 3 | 2 |
| | 4 | 2 |

| | | |
|---|---|---|
| **2** | 1 | 3 |
| | 2 | 2 |
| | 3 | 1 |
| | 4 | 1 |
| **3** | 1 | 2 |
| | 2 | 1 |
| | 3 | 1 |
| | 4 | 3 |
| | 5 | 2 |
| **4** | 1 | 3 |
| | 2 | 1 |
| | 3 | 2 |
| | 4 | 3 |

**Assessment Rubrics:**

| Evaluation Type | | Marks |
|---|---|---|
| End Semester Evaluation | | **70** |
| Continuous Evaluation | | **30** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 10 |
| d) | Viva | 5 |
| Total | | 100 |

**Employability for the course/Programme**

1. Research and development
2. Biotechnology Industry

## VIII SEMESTER

## KU8DSEBCH406: ENVIRONMENTAL BIOCHEMISTRY

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| VIII | DSE | Advanced | KU8DSEBCH406 | 4 | 60 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 4 | 0 | 0 | 30 | 70 | 100 | 2 |

**Course Description:**

Biochemistry is used in Environmental Science when understanding the environment's effect on living organisms as they interact with environmental pollutants. The pollutants sometimes referred to as xenobiotics can be ingested, inhaled or absorbed through the skin. Using biochemistry, it is possible to study how the different pollutants behave once they are in the body. Where they are transformed, eliminated or stored and how this can affect the different biological process of a normally functioning organism. Xenobiotics studies include pesticides, hazardous wastes, synthetic and natural compounds. The major environmental issues such as global warming, air and water pollution, and energy crisis, need our immediate attention. Major topics include biomass, bioremediation, microbial metabolism for reduction of carbon dioxide, recovery of precious metals from electronic wastes, algae for biofuel production, chemical and biological fixation of $CO_2$ into useful products, waste water treatment and $CO_2$ emissions, monitoring and treatment of water.

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | understand the basic concepts of ecosystem and environmental problems | |
| 2 | Understand the different types of pollution, measurement and control | |
| 3 | Understand the Biopesticides in integrated pest management | |

*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | ✓ | | | |
| CO 2 | | ✓ | | |
| CO 3 | | ✓ | | |
| CO 4 | | ✓ | ✓ | |
| CO 5 | | ✓ | | ✓ |

## COURSE CONTENTS

### Contents for Classroom Transaction:

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| **1** | **ECOSYSTEM AND GLOBAL ENVIRONMENTAL PROBLEMS** | | **10** |
| | 1 | Basic concepts - interactions between environments | |
| | 2 | Biota - concept of habitat and ecological niches - limiting factor. | |
| | 3 | Ozone depletion - UV-B greenhouse effect | |
| | 4 | Acid rain - their impact and approaches for management. | |
| **2** | **ENVIRONMENTAL POLLUTION** | | **15** |
| | 1 | Types of pollution | |
| | 2 | Methods for the measurement of pollution | |
| | 3 | Methodology of environmental management | |
| | 4 | Cumulative frequency distribution. | |
| | **WATER POLLUTION AND CONTROL** | | **15** |
| | 1 | Need for water management – measurement | |

| | | | |
|---|---|---|---|
| **3** | 2 | a) Sources of water pollution - kind of aquatic habitats, (fresh and marine)<br>b) Distribution and impact of environmental factors on the aquatic biota. | |
| | 3 | a) Waste water treatment - waste water collection<br>b) Physico – chemical properties of water | |
| | 4 | a) Physical - chemical and biological treatment processes - activated sludge - oxidation ditches – trickling filter – towers - rotating discs - rotating drums - oxidation ponds.<br>b) Waste water treatment - anaerobic digestion - anaerobic filters - up flow anaerobic sludge blanket reactors - treatment schemes for wastewaters of dairy – distillery tannery - sugar – antibiotic industries. | |
| **4** | **BIOPESTICIDES** | | **15** |
| | 1 | Biopesticides in integrated pest management | |
| | 2 | Bioremediation of contaminated soils and wastelands | |
| | 3 | Solid waste - sourcesand management (composting, vermiculture and methane production) | |
| | 4 | Environmental mutagenesis and toxicity testing. | |
| | 5 | Teacher Specific Module | **5** |
| | | *Directions* | |

**Essential Readings:**


1. Manahan, Stanley E. Environmental Chemistry. CRC Press, 2009.
2. Odum, Eugene Pleasants, Howard T. Odum, and Joan Andrews. Fundamentals of Ecology. Saunders, 1971.
3. Hutzinger, Otto, editor. The Handbook of Environmental Chemistry. Springer Science & Business Media, 1980.

**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| 1 | 1 | 1 |
| | 2 | 3 |
| | 3 | 5 |
| | 4 | 2 |
| 2 | 1 | 6 |
| | 2 | 4 |
| | 3 | 3 |
| | 4 | 2 |
| 3 | 1 | 1 |
| | 2 | 4 |
| | 3 | 2 |
| | 4 | 1 |
| 4 | 1 | 5 |
| | 2 | 6 |
| | 3 | 2 |
| | 4 | 1 |

**Suggested Readings:**


1. Harbison, Raymond D., Marie M. Bourgeois, and Giffe T. Johnson. Hamilton and Hardy's Industrial Toxicology. John Wiley & Sons, 2015.
2. Landis, Wayne G., and Ming-Ho Yu. Introduction to Environmental Toxicology: Impacts of Chemicals upon Ecological Systems. CRC Press, 2003.
3. Lu, Frank C. "Basic Toxicology: Fundamentals, Target Organs, and Risk Assessment." Taylor & Francis, 1996.

**Assessment Rubrics:**

| Evaluation Type | | Marks |
|---|---|---|
| End Semester Evaluation | | **70** |
| Continuous Evaluation | | **30** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 10 |
| d) | Viva | 5 |
| Total | | 100 |

**Employability for the Course:**

1. Biochemical companies
2. Research and development
3. Teaching
4. Quality control analysis
5. Biotechnology Industry

**GENERAL FOUNDATION COURSES: BIOCHEMISTRY**

| **SKILL ENHANCEMENT COURSES (SEC)** | | | | | |
|---|---|---|---|---|---|
| **Semester** | **Course Code** | **Name of the course** | **Credits** | | |
| | | | **Theory** | **Practical** | **Total** |
| IV | KU4SECBCH201 | MEDICAL BIOCHEMISTRY | 2 | 1 | 3 |
| V | KU5SECBCH202 | FOOD ADULTERATION AND ANALYSIS TECHIQUES | 2 | 1 | 3 |
| V I | KU6SECBCH301 | BASIC BIOCHEMICAL TECHNIQUES | 2 | 1 | 3 |

## KU4SECBCH201: MEDICAL BIOCHEMISTRY

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| IV | SEC | Intermediate | KU4SECBCH201 | 3 | 60 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 2 | 2 | 0 | 25 | 50 | 75 | 1.5 |

**Course Description**

Clinical biochemistry is a discipline of medicine that studies biological fluids and tissues to diagnose and monitor disorders. This course often includes subjects such biochemical pathways, enzyme kinetics, metabolism, hormone control, and the use of biomarkers in health and illness. Students study laboratory procedures for testing blood, urine, and other body fluids in order to assess organ function, discover anomalies, and monitor therapy efficacy. Furthermore, the course frequently covers topics such as test result interpretation, quality control methods, and the application of biochemical concepts in clinical practice.

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | Understanding the fundamental principles of biochemistry as they relate to human physiology and pathology. | |
| 2 | Learning the biochemical pathways and metabolic processes involved in normal cellular function and how they are altered in disease states. | |
| 3 | Gaining proficiency in laboratory techniques for analysing biological fluids and tissues to diagnose and monitor diseases. | |
| 4 | Applying biochemical knowledge and skills to contribute to evidence-based medical decision-making and patient management strategies. | |

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***



| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | ✔ | ✔ | | |
| CO 2 | ✔ | | | |
| CO 3 | | ✔ | | |
| CO 4 | | | ✔ | ✔ |

## COURSE CONTENTS

### Contents for Classroom Transaction:

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | | **INTRODUCTION TO CLINICAL BIOCHEMISTRY** | **10** |
| | 1 | Introduction: Definition and scope of clinical biochemistry in diagnosis, use of clinical laboratory and interpretation of results | |
| | 2 | Specimen Collection: Types of Specimens, Method of specimen collection (Blood, serum, Urine and stool) | |
| | 3 | Pre-analytical & analytical variables, Use of preservatives in specimen collection, Use of proper Anticoagulants in specimen collection | |
| 2 | | **HAEMATOLOGY** | **15** |
| | 1 | Haematology: Blood Cells-Normal Values. Importance of RBC – Indices, WBC, Platelets and ESR | |
| | 2 | Lipid profile. -significance | |
| | 3 | Glucose tolerance tests- Clinical significance | |
| 3 | | **BIOCHEMICAL ANALYSIS-I** | **15** |
| | 1 | Biochemical analysis of urine: Heat & acetic acid test, Benedict's test, Fouchet's test, Hay's test | |
| | 2 | Hematology: Determination of hemoglobin, Erythrocyte sedimentation rate, Clotting time | |

| | | | |
|---|---|---|---|
| | 3 | Biochemical analysis of blood: Glucose, Total protein, Cholesterol | |
| **4** | **BIOCHEMICAL ANALYSIS -II** | | **15** |
| | 1 | Total count of RBC using haemocytometer. | |
| | 2 | Differential count of WBC using haemocytometer | |
| | 3 | Determination of human blood group antigens. | |
| **5** | **Teacher Specific Module** | | **5** |
| | *Directions* | | |

**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 5 |
| | 2 | 5 |
| | 3 | 1 |
| | 4 | 3 |
| **2** | 1 | 3 |
| | 2 | 1 |
| | 3 | 4 |
| **3** | 1 | 5 |
| | 2 | 5 |
| | 3 | 5 |
| **4** | 1 | 11 |
| | 2 | 10 |
| | 3 | 10 |
| | 4 | 9 |
| | 5 | 9 |
| | 6 | 9 |
| | 7 | 9 |

**Essential Readings:**


1. Bangert, Stephen K., and William J. Marshall, eds. *Clinical biochemistry: metabolic and clinical aspects*. Churchill Livingstone, 1995.
2. Ahmed, Nessar, ed. *Clinical biochemistry*. Oxford University Press, 2017.
3. Davis, Anil. *Evaluation of Serum Lipid Profile in Pregnancy Induced Hypertension*. Diss. Rajiv Gandhi University of Health Sciences (India), 2010.
4. Singh, Randhir. *Introductory practical biochemistry*. Alpha Science Int'l Ltd., 2000.
5. Sadasivam, S., & Manickam. Biochemical Methods. New Age International (P) Ltd., 1996.

**Assessment Rubrics:**

| **Evaluation Type** | | **Marks** |
|---|---|---|
| End Semester Evaluation (ESE) | | **50(35T+15P)** |
| Continuous Evaluation (CCA) | | **25(15T+10P)** |
| Theory | | **15** |
| a) | Test Paper | 9 |
| b) | Assignment | 3 |
| c) | Seminar | 3 |
| Practical | | **10** |
| a) Record | | 5 |
| b) Viva | | 5 |
| **Total** | | **75** |

Abbreviations: T-Theory/ P-Practical

**Employability for the Course:**

1. Biochemical companies
2. Research and development
3. Teaching
4. Quality control analysis
5. Microbial, Biotechnology and Pharmaceutical Industry

**KU5SECBCH202: FOOD ADULTERATION AND ANALYSIS TECHNIQUES**

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| V | SEC | Intermediate | KU5SECBCH202 | 3 | 60 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 2 | 2 | 0 | 25 | 50 | 75 | 1.5 |

**Course Description:**

- Basic knowledge regarding Food adulteration and food additives
- To exemplify different food adulterants
- To elucidate the adulterants in food products

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | Understand the adulteration of common foods and their adverse impact on health | |
| 2 | Comprehend certain skills of detecting adulteration of common foods. | |
| 3 | Be able to extend their knowledge to other kinds of adulteration, detection and remedies. | |

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | ✔ | ✔ | | |
| CO 2 | ✔ | | | |
| CO 3 | | ✔ | | |
| CO 4 | | | ✔ | ✔ |

**COURSE CONTENTS**

**Contents for Classroom Transaction:**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **FOOD ADDITIVES AND ADULTERATION** | | **10** |
| | 1 | Food adulteration: Definition, incidental and intentional adulteration. | |
| | 2 | Common adulteration in foods, health hazards and risks. | |
| | 3 | Introduction to quality aspects related to food and food | |

| | | | |
|---|---|---|---|
| | | products. | |
| | 4 | Food Additives: Antioxidant, preservatives, nutrient supplements, emulsifiers, thickening agents, sweeteners, colouring and flavouring agents. | |
| **2** | **ADULTERATION OF GHEE AND OIL** | | **15** |
| | 1 | Test for vegetable fat: Nitric acid test, Soda ash test and Valenta test | |
| | 2 | Test for added alkali. Baudouin test. | |
| | 3 | Analysis of butter: Test for Dalda in butter. | |
| | 4 | Adulteration of Paneer: Presence of starch in paneer. | |
| | 5 | Test for sesame oil in other oils<br>Test for added mineral oil | |
| | 6 | Halphen test for cottonseed oil<br>Hexa bromide test for linseed oil | |
| | 7 | Test for added castor oil and Detection of argemone oil in other oils | |
| | 8 | Test for rancidity in oils, Kries test for testing quality of oil. | |
| **3** | **TESTING ADULTERATION OF MILK** | | **15** |
| | 1 | Physical Tests: Detergent Test, Filter Test, Flow Test | |
| | 2 | Chemical Tests: Clot on boiling test. | |
| | 3 | Detects the presence of added carbonates and bicarbonates in milk | |
| | 4 | Test for starch, soda and glucose in milk | |
| **4** | **TESTING ADULTERATION OF SPICES** | | **15** |
| | 1 | Coriander powder: Test for starch & horse dung power. | |
| | 2 | Chili powder: Test for oil soluble dyes, powdered bran, saw dust and brick powder. | |
| | 3 | Turmeric Powder: Test for metanil yellow and lead chromate polish. | |
| | 4 | Cloves: Test for exhausted cloves. | |

| | | | |
|---|---|---|---|
| | 5 | Curry powder: Test for metallic colors. | |
| | 6 | Pepper: Test for papaya seeds | |
| **5** | **Teacher Specific Module** | | **5** |
| | *Directions* | | |

**Essential Readings:**


1. Warner, J.M. Principles of Diary Processing. 1976, Wiley Eastern Ltd., New Delhi.
2. Sreelakshmi. Food Science. 1997, New Age International Pvt. Ltd., New Delhi.
3. Jha, Shyam Narayan. Rapid Detection of Food Adulterants and Contaminants: Theory and Practice. 2015.


**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 2 |
| | 2 | 2 |
| | 3 | 2 |
| | 4 | 2 |
| **2** | 1 | 3 |
| | 2 | 3 |
| | 3 | 3 |
| | 4 | 3 |
| | 5 | 3 |
| | 6 | 3 |
| | 7 | 3 |
| | 8 | 3 |
| **3** | 1 | 3 |
| | 2 | 3 |
| | 3 | 3 |
| | 4 | 1 |
| **4** | 1 | 3 |
| | 2 | 3 |
| | 3 | 3 |
| | 4 | 3 |

**Assessment Rubrics:**

| Evaluation Type | | Marks |
|---|---|---|
| End Semester Evaluation (ESE) | | **50(35T+15P)** |
| Continuous Evaluation (CCA) | | **25(15T+10P)** |
| Theory | | **15** |
| a) | Test Paper | 9 |
| b) | Assignment | 3 |
| c) | Seminar | 3 |
| Practical | | **10** |
| c) Record | | 5 |
| d) Viva | | 5 |
| **Total** | | **75** |

Abbreviations: T-Theory/ P-Practical

**Employability for the Course:**

- Food Industry

=

**KU6SECBCH301: BASIC BIOCHEMICAL TECHNIQUES**

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| V I | SEC | Higher | KU6SECBCH301 | 3 | 60 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 2 | 2 | 0 | 25 | 50 | 75 | 1.5 |

**Course Description:**

The biochemical & biophysical techniques encompass a range of processes, including Protein Purification, perfusion, Homogenization, Differential Centrifugation, Purification of LDH, LDH Enzyme assays, Protein assays, Characterization of LDH, Western blotting, Gel filtration chromatography, Protein crystallography, PCR, Ligation and transformation, Selection and screening and Enzyme Kinetics.

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | To explain the principle and function of various instruments in biochemistry | |
| 2 | To interpret about working methods of various type Microscope. | |
| 3 | To understand different type of separation techniques. | |
| 4 | To analyse detailed working and applications of chromatography and electrophoresis | |

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | ✔ | ✔ | | |
| CO 2 | ✔ | | | |
| CO 3 | | ✔ | | |
| CO 4 | | | ✔ | ✔ |

## COURSE CONTENTS

### Contents for Classroom Transaction:

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **CENTRIFUGALTECHNIQUES** | | **10** |
| | 1 | Centrifugation-Principle and Components | |
| | 2 | Classification | |
| | 3 | Instrumentation of various types of centrifuges | |
| | 4 | Sedimentation Techniques-Differential, density gradient and ultra-centrifugation | |
| 2 | **ELECTROPHORETIC AND CHROMATOGRAPHIC TECHNIQUES** | | **15** |
| | 1 | Electrophoresis-Theory and Principle | |
| | 2 | Electrophoretic techniques-Paper, Agarose gel, SDS-PAGE, immune electrophoresis, isoelectric focusing, | |

| | | | |
|---|---|---|---|
| | | Density gradient gel electrophoresis (DGGE), Gel documenter | |
| | 3 | Chromatography-Principle and types: Paper, TLC, ion exchange, gel filtration, affinity, GLC and HPLC | |
| **3** | **SPECTROSCOPICTECHNIQUES** | | **15** |
| | 1 | Spectroscopy-Laws of light absorption –Beer lamberts law | |
| | 2 | UV and visible spectroscopy: Working and application of UV and visible spectroscopic techniques | |
| | 3 | Principle and application of NMR, E S R spectroscopy, mass spectroscopy, fluorescent and emission spectroscopy, | |
| **4** | **LABORATORY EXPERIMENTS** | | **15** |
| | 1 | Standardization of pH meter<br>Measurements of pH of solutions using pH meters | |
| | 2 | Separation of amino acids by Paper chromatography | |
| | 3 | Separation of Pigments by TLC | |
| | 4 | Separation of pigments by column chromatography | |
| | 5 | DNA and RNA quantitation using spectrophotometer | |
| | 6 | Agarose gel electrophoresis of DNA | |
| | 7 | Sodium dodecyl sulphate-Polyacrylamide gel electrophoresis of proteins | |
| **5** | **Teacher Specific Module** | | **5** |
| | *Directions* | | |

**Essential Readings:**


1. Banerjee, Pranab Kumar. Introduction to Biophysics. S. Chand & Company, 2008.
2. Roy, R. N. *A Textbook of Biophysics*. New Central Book Agency, 2001.
3. Upadhyay, Upadhyay, and Nath. Biophysical Chemistry. Himalaya Publishing House, Bangalore, 2019
4. Allen, James P. Biophysical Chemistry. Wiley Blackwell, New Jersey, 2008.
5. Wilson, K., and J. Walker. Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press, Cambridge, 2010.

**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 5 |
| | 2 | 5 |
| | 3 | 1 |
| | 4 | 3 |
| **2** | 1 | 3 |
| | 2 | 1 |
| | 3 | 4 |
| **3** | 1 | 5 |
| | 2 | 5 |
| | 3 | 5 |
| **4** | 1 | 11 |
| | 2 | 10 |
| | 3 | 10 |
| | 4 | 9 |
| | 5 | 9 |
| | 6 | 9 |
| | 7 | 9 |

**Suggested Readings:**


6. Horst, F. Basic One and Two-dimensional NMR Spectroscopy. Wiley-VCH, 2010, New Jersey.
7. Murphy, D.B., and Davidson, M. Fundamentals of Light Microscopy and Electron Imaging. Wiley-Blackwell, 2012, New Jersey.
8. Freifelder, D.M. Physical Biochemistry: Applications to Biochemistry and Molecular Biology. Vol. 1. Freeman, 1983, New York.
9. Sambrook, J., & Russell, D.W. Molecular Cloning, Vol. 1-3 (3rd edition). CSHL Press, 2000.
10. Sadasivam, S., & Manickam, A. Biochemical Methods, 3rd edition. 2010.
11. Plummer, David. Practical Biochemistry


**Assessment Rubrics:**

| **Evaluation Type** | | **Marks** |
|---|---|---|
| End Semester Evaluation (ESE) | | **50(35T+15P)** |
| Continuous Evaluation (CCA) | | **25(15T+10P)** |
| Theory | | **15** |
| a) | Test Paper | 9 |
| b) | Assignment | 3 |

| | | |
|---|---|---|
| c) | Seminar | 3 |
| Practical | | **10** |
| e) Record | | 5 |
| f) Viva | | 5 |
| **Total** | | **75** |

Abbreviations: T-Theory/ P-Practical

**Employability for the Course:**

1. Biochemical companies
2. Research and development
3. Teaching
4. Quality control analysis
5. Microbial, Biotechnology and Pharmaceutical Industry

| **VALUE ADDED COURSES (VAC)** | | | | | |
|---|---|---|---|---|---|
| **Semester** | **Course code** | **Name of the course** | **Credits** | | |
| | | | **Theory** | **Practical** | **Total** |
| III | KU3VACBCH201 | HEALTH & NUTRITION | 3 | - | 3 |
| IV | KU4VACBCH202 | MEDICINAL PLANTS | 3 | - | 3 |
| IV | KU4VACBCH301 | FOOD SAFETY AND QUALITY CONTROL | 3 | - | 3 |

## KU3VACBCH201: HEALTH AND NUTRITION

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| III | VAC | Intermediate | KU3VACBCH201 | 3 | 45 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 3 | 0 | 0 | 25 | 50 | 75 | 1.5 |

**Course Description:**

Nutritional biochemistry contributes to advancements in food science and technology by providing insights into the nutritional composition of foods, the effects of food processing on nutrient bioavailability, and the development of functional foods enriched with bioactive compounds for health promotion. Overall, nutritional biochemistry plays a vital role in promoting health, preventing diseases, and improving the quality of life through a better understanding of the relationship between nutrients and human physiology. Nutrients are chemical substances required by the body to sustain basic functions and are optimally obtained by eating a balanced diet. There are six major classes of nutrients essential for human health: carbohydrates, lipids, proteins, vitamins, minerals, and water. Carbohydrates, lipids, and proteins are considered macronutrients and serve as a source of energy. Water is required in large amounts but does not yield energy. Vitamins and minerals are considered micronutrients and play essential roles in metabolism**.**

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | To know the basic concept of nutrition | |
| 2 | To explain the nutritional role of carbohydrates and lipids | |
| 3 | To study the nutritional aspects of proteins | |
| 4 | To understand the nutritional aspects of vitamins | |

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | ✔ | ✔ | | |
| CO 2 | | ✔ | | |
| CO 3 | | | ✔ | |
| CO 4 | ✔ | | | ✔ |

**Contents for Classroom Transaction:**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **NUTRITION** | | **10** |
| | 1 | Concepts of macronutrients and micro nutrients. | |
| | 2 | Physiological fuel value and Daily requirement of energy | |
| | 3 | High and low-calorie diets. | |
| | 4 | Basal metabolic rate (BMR) and factors affecting BMR. | |
| 2 | **NUTRITIONAL ASPECTS OF CARBOHYDRATES AND LIPIDS** | | **10** |
| | 1 | Nutritional aspects of the carbohydrates- Different dietary types, source deficiency | |
| | 2 | Nutritional aspects of the lipids, - Different dietary types, source, deficiency | |
| | 3 | Essential fatty acids-Source and its importance | |
| 3 | **NUTRITIONAL ASPECTS OF PROTEINS** | | **10** |
| | 1 | Nutritional classification of amino acids | |
| | 2 | Nutritional classification of proteins | |
| | 3 | Essential amino acids -sources and functions | |
| | 4 | Protein Energy Malnutrition | |
| 4 | **NUTRITIONAL SIGNIFICANCE OF MINERALS AND VITAMINS** | | **10** |
| | 1 | Nutritional significance. Dietary Macro elements: Ca, P, Mg, Na & K | |
| | 2 | Dietary Micro elements: Iron, Iodine, Zinc, Copper etc. | |
| | 3 | Nutritional significance- fat soluble vitamins | |
| | 4 | Nutritional significance- water soluble vitamins | |
| 5 | **Teacher Specific Module** | | **5** |
| | *Directions* | | |

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**Essential Readings:**


1. Akoh, Casimir C. Food Lipids: Chemistry, Nutrition, and Biotechnology. 4th ed., CRC Press Taylor & Francis Group, 2016.
2. Mann, Jim, and A. Stewart Truswell. Essentials of Human Nutrition. 2nd ed., Oxford University Press Inc., 2002.
3. Rodwell, Victor, et al. Harper's Illustrated Biochemistry. 31st ed., Tata McGraw Hill Education, 2018.
4. Underwood, E. Trace Elements in Human and Animal Nutrition. 4th ed., Academic Press, 1977.
5. Bamji, MS., Kamalakrishnaswamy, and G.N.V. Brahmam. The Book of Human Nutrition. 4th ed., Oxford & IBH Publishing, 2017.
6. Swaminathan, M.S. Essentials of Food and Nutrition. Vol. 1 and 2, Ganesh & Co., 1974.
7. Trueman, Patricia. Nutritional Biochemistry. Mjp Publishers, 2007


**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| 1 | 1 | 7 |
| | 2 | 7 |
| | 3 | 2 |
| | 4 | 2 |
| 2 | 1 | 3 |
| | 2 | 5 |
| | 3 | 2 |
| 3 | 1 | 2 |
| | 2 | 2 |
| | 3 | 2 |
| | 4 | 2 |
| 4 | 1 | 9 |
| | 2 | 9 |
| | 3 | 10 |
| | 4 | 10 |

**Suggested Readings:**


8. Mahan, L.K., and S.E. Srrings. Krause's Food and Nutrition Care Process. 2012, Raymond, J., Elsevier's Publications, ISBN-978-1-4377-2233-8.
9. G.F. Coombs Jr. The Vitamins: Fundamental Aspects in Nutrition and Health. 2008, Elsevier's Publications, ISBN-13-978-0-12-183493-7.
10. Gibson, Rosalind. Principles of Nutritional Assessment. 2005, University Press.

**Assessment Rubrics:**

| **Evaluation Type** | | **Marks** |
|---|---|---|
| End Semester Evaluation | | **50** |
| Continuous Evaluation | | **25** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 5 |
| d) | Student extension activity | 5 |
| **Total** | | **75** |

**Employability for the Course:**

1. Food industries
2. Research and Development
3. Teaching
4. Dietitians
5. Entrepreneurship
6. Food testing lab- technicians

**KU4VACBCH202: MEDICINAL PLANTS**

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| IV | VAC | Intermediate | KU4VACBCH202 | 3 | 45 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 3 | 0 | 0 | 25 | 50 | 75 | 1.5 |

**Course Description:**

- Basic knowledge regarding Medicinal plants
- To elucidate the conservation of medicinal plants
- To exemplify different classes of drugs originated from plants

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | Understand the significance of medicinal plants of ethno-medicine in modern research. | |
| 2 | Familiarize highly valuable medicinal plants for medicinal uses. | |
| 3 | Analyse conservation of medicinal plants | |
| | Understand the cultivation of medicinal plants | |

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | ✔ | ✔ | | |
| CO 2 | ✔ | | | |
| CO 3 | | ✔ | | |
| CO 4 | | | ✔ | ✔ |

**Contents for Classroom Transaction:**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **INTRODUCTION TO MEDICINAL PLANTS** | | **10** |
| | 1 | Introduction to Herbal Medicines: Principles of identifying medicinal plants. | |
| | 2 | Basics of the botanical description – basic principles of morphology and taxonomy. | |
| | 3 | Plants as medicines in Ayurveda – Unani – Siddha and Homeopathy Ethno botany | |
| 2 | **BASICS OF ETHNOBOTANY** | | **10** |
| | 1 | Ethnobotany- definition- categories | |
| | 2 | Major tribes of south India- regional studies | |
| | 3 | Ethnomedicinal plants- wild food plants- socio-economic status | |

| | | | |
|---|---|---|---|
| | 4 | Major Indian plants known as Antiseptic, Anti-allergic and Expectorants, digestive problems liver, remedies and Nerve tonics | |
| **3** | **IMPORTANCE OF MEDICINAL PLANTS** | | **10** |
| | 1 | Importance and conservation of medicinal plants – Insitu, exsitu, sacred groves. | |
| | 2 | Role of ICAR, IMPB, BSI, NBPGR and FRLHT in conservation and cultivation of medicinal plants. | |
| | 3 | IPR issues | |
| **4** | **CULTIVATION OF SELECTED MEDICINAL PLANTS** | | **10** |
| | 1 | A general account of the methodology of cultivation of medicinal plants: Rhizome – Curcuma, Ginger | |
| | 2 | A general account of the methodology of cultivation of medicinal plants: Tuber- *Allium cepa* | |
| | 3 | A general account of the methodology of cultivation of medicinal plants: Twigs- *Adhathoda vasica*, *Catharanthus roseus, Phyllanthus amarus, Andrographis paniculata* | |
| | 4 | A general account of the methodology of cultivation of medicinal plants: Leaves – *Aloe vera, Centella asiatica*. | |
| **5** | **Teacher Specific Module** | | **5** |
| | *Directions* | | |

**Essential Readings:**


1. 1.Sharma, Santosh, and A. S. H. W. A. N. I. Kumar. "Tribal uses of medicinal plants of Rajashthan: Kachnar." *Int J Life Sci Pharma Res* 2.4 (2012): 69-76
2. 2.Panda, H. *Handbook on herbal drugs and its plant sources*. NATIONAL INSTITUTE OF INDUSTRIAL RE, 2002


**Further Reading:**


1. Panigrahi, Ashok Kr, and Alaka Sahu. *Glossary of useful and economically important plants*. New Central Book Agency, 2020..
2. Warrier, Panniyampally Krishna. *Indian medicinal plants: a compendium of 500 species*. Vol. 5. Orient Blackswan, 1993.
3. Nair, C. K. N., and N. Mohanan. "Medicinal Plants of India: with special reference to Ayurveda." *(No Title)* (1998).

**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 2 |
| | 2 | 2 |
| | 3 | 2 |
| | 4 | 2 |
| **2** | 1 | 3 |
| | 2 | 3 |
| | 3 | 3 |
| | 4 | 3 |
| | 5 | 3 |
| | 6 | 3 |
| | 7 | 3 |
| | 8 | 3 |
| **3** | 1 | 3 |
| | 2 | 3 |
| | 3 | 3 |
| | 4 | 1 |
| **4** | 1 | 3 |
| | 2 | 3 |
| | 3 | 3 |
| | 4 | 3 |

**Assessment Rubrics:**

| **Evaluation Type** | | **Marks** |
|---|---|---|
| End Semester Evaluation | | **50** |
| Continuous Evaluation | | **25** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 5 |
| d) | Student extension activity | 5 |
| **Total** | | **75** |

**Employability for the Course:**

- Medicinal plant research

## KU4VACBCH301: FOOD SAFETY AND QUALITY CONTROL

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| V | VAC | Foundation | KU5VACBCH301 | 3 | 45 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 3 | 0 | 0 | 25 | 50 | 75 | 1.5 |

**Course Description:**
To learn the significance of food safety, food quality and food laws and regulations. To gain knowledge about the basic aspects of public health and food safety and quality surveillance system

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | To familiarize students to apply protocol for safe food handling techniques, water and waste management | |
| 2 | To understand the role of food packaging and the importance of Nutrition labelling | |
| 3 | To analyse consequences of food poisoning and infection on the health of individuals | |
| 4 | To Understand the basic principles food laws and regulations | |

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | ✔ | ✔ | | |
| CO 2 | ✔ | | | |
| CO 3 | | ✔ | | |
| CO 4 | | | ✔ | ✔ |

**Contents for Classroom Transaction:**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **FOOD SAFETY CONCEPT** | | **10** |
| | 1 | Significance of food safety in the food processing industry | |
| | 2 | Risk classification | |
| | 3 | National and International food regulatory agencies | |
| | 4 | General food laws and food safety regulations, Nutritional labeling regulation. | |
| 2 | **FOOD SAFETY PROGRAMS** | | **10** |
| | 1 | Definitions and importance - Good Manufacturing Practices (GMPs), Facility Maintenance, Personal Hygiene, Supplier control | |
| | 2 | Sanitary Design of Equipment and Infrastructure, | |
| | 3 | Procedures for Raw Material reception | |
| | 4 | Storage and Finished Product Loading | |
| | 5 | Sanitation Program. (Sanitation Standard Operating Procedures (SSOPs) | |
| 3 | **HAZARD ANALYSIS AND RISK ASSESSMENT** | | **10** |
| | 1 | Physical hazards (metals, glass, etc) | |
| | 2 | Chemical hazards (food additive toxicology, natural toxins, pesticides, antibiotics, hormones, heavy metals and packaging components) | |
| | 3 | Biological hazards (epidemiology of biological pathogens: virus, bacteria and fungi) | |
| | 4 | Evaluation of the severity of a hazard Controlling Food Hazards. Hazard Analysis Critical Control Point (HACCP) system. | |
| 4 | **FOOD HYGIENE PROGRAMS AND FOOD LAWS** | | **10** |
| | 1 | Personal hygiene, Training programs, Infrastructure, Personal habits and Hygiene verification | |

| | | | |
|---|---|---|---|
| | 2 | Water in the food industry- Water sources, Water uses, Water quality and Treatments | |
| | 3 | Cleaning and sanitation- cleaning agents, Sanitizing agents, Equipment and systems | |
| | 4 | Food Laws and Regulations; Structure, organization and duties of regulatory system | |
| **5** | **Teacher Specific Module** | | **5** |
| | *Directions* | | |

**Essential Readings:**


1. Food Safety and Standards Act, 2006, Rules 2011, Regulations, 2011. 10th ed., ILBCO India, Indian Law Book Company, 2013.
2. Early, R. Guide to Quality Management Systems for the Food Industry. 1995, Blackie, Academic and Professional, London.
3. Gould, W.A. and Gould, R.W. Total Quality Assurance for the Food Industries. 1998, CTI Publications Inc., Baltimore.
4. Pomeraz, Y. And Meloan, C.E. Food Analysis: Theory and Practice. 1996, CBS Publishers and Distributors, New Delhi.


**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| 1 | 1 | 1 |
| | 2 | 4 |
| | 3 | 4 |
| | 4 | 1 |
| 2 | 1 | 3 |
| | 2 | 6 |
| | 3 | 5 |
| | 4 | 2 |
| | 5 | 1 |
| 3 | 1 | 2 |
| | 2 | 1 |
| | 3 | 2 |
| | 4 | 5 |
| 4 | 1 | 2 |
| | 2 | 4 |

| | | |
|---|---|---|
| | 3 | 5 |
| | 4 | 5 |

**Suggested Readings:**


5. Bryan, F.L. Hazard Analysis Critical Control Point Evaluations: A Guide to Identifying Hazards and Assessing Risks Associated with Food Preparation and Storage. 1992, World Health Organization, Geneva.
6. Kirk, R.S. and Sawyer, R. Pearson's Composition and Analysis of Foods. 9th ed., 1991, Longman Scientific and Technical, England.
7. FAO. Manuals of Food Quality Control. 2-Additives Contaminants Techniques. 1980, Rome.


**Assessment Rubrics:**

| **Evaluation Type** | | **Marks** |
|---|---|---|
| End Semester Evaluation | | **50** |
| Continuous Evaluation | | **25** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 5 |
| d) | Student extension activity | 5 |
| Total | | 75 |

**Employability for the Course:**

1. Entrepreneurship
2. Food Quality Control

| **MULTIDISCIPLINARY COURSES (MDC)** | | | | |
|---|---|---|---|---|
| | | Credits | | |
| Course code | Name of the course | Theory | Practical | Total |
| KU1MDCBCH101 | BIOMOLECULES OF LIFE | 3 | - | 3 |
| KU2MDCBCH102 | BASIC BIOCHEMISTRY | 3 | - | 3 |

**KU1MDCBCH101: BIOMOLECULES OF LIFE**

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| I | MDC | Foundation | KU1MDC BCH 101 | 3 | 45 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 3 | - | 0 | 25 | 50 | 75 | 1.5 |

**Course Description**

Biochemistry is a study focusing on the life processes of living organisms at both biological and chemical levels. The branch focuses on studying organisms' cells, thereby understanding their structures and various interactions. Biomolecules are the most essential organic molecules, which are involved in the maintenance and metabolic processes of living organisms. Biomolecules have a wide range of sizes and structures and perform a vast array of functions. The four major types of biomolecules are carbohydrates, lipids, nucleic acids, and proteins.

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | State the definition and branches of Biochemistry | |
| 2 | Understand basic concepts of structural organization and characterization of carbohydrates, proteins, lipids | |
| 3 | Understand the nature and functions of biomolecules | |

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | ✔ | | | |
| CO 2 | | ✔ | ✔ | ✔ |
| CO 3 | | | ✔ | ✔ |
| CO 4 | | | | |

**Contents for Classroom Transaction:**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **INTRODUCTION TO BIOCHEMISTRY** | | **10** |
| | 1 | Definition-Branches of Biochemistry | |
| | 2 | Biochemistry as a molecular logic of living organism. | |
| | 3 | Role and scope of Biochemistry | |
| 2 | **CARBOHYDRATES AND NUCLEIC ACIDS** | | **10** |
| | 1 | Definition and classification (without structure); Monosaccharides- occurrence, chemistry & functions | |
| | 2 | Disaccharides- occurrence and functions (without structure); sucrose, lactose, maltose | |
| | 3 | Polysaccharides: Definition and classification (without structure);Occurrence and functions of cellulose, starch, glycogen. | |
| | 4 | Nucleic acid-Central dogma of molecular biology | |
| | 5 | Nucleotide and nucleoside | |
| | 6 | Watson and crick model of DNA | |
| 3 | **AMINO ACIDS AND PROTEINS** | | **10** |
| | 1 | Amino acids: Definition, Classification of amino acids based on charge and polarity, essential and non-essential amino acids. | |
| | 2 | Proteins: Definition-Peptides and peptide bond | |
| | 3 | Classification of proteins based on solubility, shape and function | |
| 4 | **LIPIDS** | | **10** |
| | 1 | Definition, Classification of fatty acids: Essential and non-essential fatty acids with examples. (without structure) | |
| | 2 | Definition and classification of lipids (without structure) | |

| | | | |
|---|---|---|---|
| | 3 | Biochemical functions of lipids. | |
| **5** | | *Teacher specific Module* | |
| | | *Directions* | |



**Essential Readings:**


1. Jain, J. L. *Fundamentals of biochemistry*. S. Chand Publishing, 2004.
2. West, Edward Staunton, et al. *Textbook of biochemistry*. Oxford and IBH Publishing, 1974.
3. Nelson, David L., Albert L. Lehninger, and Michael M. Cox. *Lehninger principles of biochemistry*. Macmillan, 2008.


**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 2 |
| | 2 | 3 |
| | 3 | 3 |
| **2** | 1 | 1 |
| | 2 | 2 |
| | 3 | 2 |
| | 4 | 2 |
| | 5 | 3 |
| | 6 | 3 |
| **3** | 1 | 1 |
| | 2 | 1 |
| | 3 | 2 |
| **4** | 1 | 1 |
| | 2 | 2 |
| | 3 | 2 |

**Suggested Readings:**


4. Devlin, Thomas M., ed. *Textbook of biochemistry with clinical correlations*. John Wiley & Sons, 2010.
5. Martin, David W., and Harold Anthony Harper. "Harper's review of biochemistry." *(No Title)* (1983).
6. Berg, Jeremy M., and John L. Tymoczko. *Stryer biochemie*. Vol. 8. Heidelberg: Springer Spektrum, 2018.

**Assessment Rubrics:**

| **Evaluation Type** | | **Marks** |
|---|---|---|
| End Semester Evaluation | | **50** |
| Continuous Evaluation | | **25** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 5 |
| d) | Student extension activity | 5 |
| **Total** | | **75** |

**Employability for the Course:**

1. Research Scientist
2. Biochemist
3. Pharmaceutical Scientist
4. Clinical Biochemist
5. Biotechnology Specialist
6. Forensic Scientist
7. Quality Control/Assurance Specialist
8. Educator/Professor
9. Science Writer/Communicator
10. Entrepreneur

**KU2MDCBCH102: BASIC BIOCHEMISTRY**

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| II | MDC | Foundation | KU2MDCBCH102 | 3 | 45 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 3 | - | 0 | 25 | 50 | 75 | 1.5 |

**Course description**

Basic biochemistry covers the fundamental concepts of essential for understanding the molecular basis of life. The course would examine deeper into the chemical properties of water, including its role its role as a solvent and its unique behaviours due to hydrogen bonding. It would also explore the principles behind buffer solution, their application in biological system. Additionally, topics such as pH scale, and H- H equation provide a comprehensive understanding of buffers in biological system.
**Course prerequisite: NIL**

**Course outcome**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1. | Summarize the fundamental concept of biochemistry and its role in our world | |
| 2. | Students should demonstrate a deep understanding of physical, chemical biological properties of water | |
| 3. | Aware of acid base concept, measurement of acid and base using pH meter. And the concept of buffer | |
| 4. | Attain the knowledge of solution preparation in biochemical assays | |

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | ✔ | | | |
| CO 2 | | ✔ | ✔ | ✔ |
| CO 3 | | | ✔ | ✔ |
| CO 4 | | | | |

## COURSE CONTENTS

### Contents for Classroom Transaction

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **FUNDAMENTALS OF BIOCHEMISTRY** | | 10 |
| | 1. | Introduction to biochemistry- foundations of biochemistry (cellular, chemical, physical) | |
| | | Thermodynamics – First law -Basic concept of entropy, Second law. Standard free energy change and its relation to equilibrium constant | |
| | | Branches of biochemistry – descriptive, dynamic biochemistry. And other branches | |
| | | Role and scope of biochemistry – in medicine, agriculture, research, pharmaceutical, biotechnology | |
| 2 | **WATER THE SOLVENT OF LIFE** | | 10 |
| | 1. | Water - structure of liquid water and ice | |
| | | Physical properties of water. Ionization of water | |
| | | Different interaction with water and biomolecules – hydrophilic, hydrophobic, amphipathic | |
| | | Importance of water in biological system | |
| 3 | **pH, BUFFER AND BIOLOGICAL IMPORTANCE** | | 10 |
| | | Modern concepts of acids and bases – Lowry – Bronsted and Lewis concept. Strong and weak acids – ionization constant Ka and pKa of weak acids | |
| | | pH - pH scale, determination of pH using - pH meter, pH paper | |
| | | Buffer – definition, types of buffers. pH of buffers - Henderson Hassel balch equation | |
| | | Importance of buffer in biological systems | |
| 4 | **SOLUTION** | | 10 |

| | | | |
|---|---|---|---|
| | | Solution - true solution, colloidal solution, suspension. Application of colloids | |
| | | Normality, molarity, molality, percentage solution - simple numerical problem | |
| | | Fundamental principle of diffusion, osmosis | |
| | | Biological importance of osmosis | |
| 5 | | *Teacher specific Module* | 5 |
| | | *Directions* | |

**Essential Readings**


1. Jain, J. L. *Fundamentals of biochemistry*. S. Chand Publishing, 2004.
2. Voet, Donald, Judith G. Voet, and Charlotte W. Pratt. *Fundamentals of biochemistry: life at the molecular level*. John Wiley & Sons, 2016.
3. Fisher, Matthew. "Lehninger principles of biochemistry, ; by David L. Nelson and Michael M. Cox." *The Chemical Educator* 6 (2001): 69-70.
4. Satyanarayana, U., and U. Chakrapani. *Biochemistry, (Updated and Revised Edition)-E-Book*. Elsevier India, 2020.
5. Kellum, John A., and Paul WG Elbers. *Stewart's textbook of acid-base*. Lulu. com, 2009.
6. Deb, A. C. "Fundamentals of Biochemistry. 2006, 8 [sup] th Edition." *New Central Book Agency (P) Ltd: Kolkata, India*: 85-6.


**Reference Distribution**

| MODULE | UNIT | REFERENCE NO. |
|---|---|---|
| 1 | 1 | 3 |
| | 2 | 2 |
| | 3 | 1 |
| | 4 | 1 |
| 2 | 1 | 1 |
| | 2 | 1 |
| | 3 | 1 |
| | 4 | 1 |
| 3 | 1 | 5 |
| | 2 | 1 |
| | 3 | 4 |
| | 4 | 4 |
| | 1 | 4 |

| | | |
|---|---|---|
| 4 | 2 | 3 |
| | 3 | 3 |
| | 4 | 3 |

**Suggested reading:**


7. Silberberg, Martin Stuart. "Principles of general chemistry." *(No Title)* (2007).
8. Brown, Theodore Lawrence. *Chemistry: the central science*. Pearson Education, 2009.


**Assessment Rubrics**

| **Evaluation Type** | | **Marks** |
|---|---|---|
| End Semester Evaluation Silberberg, Martin S. Principles of General Chemistry | | **50** |
| Continuous Evaluation | | **25** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 5 |
| d) | Student extension activity | 5 |
| **Total** | | **75** |

**Employability of the course**

1. Biochemical companies
2. Research and development
3. Teaching

| **DISCIPLINE SPECIFIC MINOR PATHWAY COURSES: BIOCHEMISTRY** | | | | | |
|---|---|---|---|---|---|
| **Semester** | **Course code** | **Name of the course** | **Credits** | | |
| | | | **Theory** | **Practical** | **Total** |
| I | KU1DSCBCH102 | Fundamentals of Biochemistry I | 3 | 1 | 4 |
| I | KU1DSCBCH103 | Basic endocrinology | 4 | | 4 |
| II | KU2DSCBCH105 | Fundamentals of Biochemistry II | 4 | | 4 |
| II | KU2DSCBCH106 | Basic Plant Biochemistry | 4 | | 4 |

| | | | | | |
|---|---|---|---|---|---|
| II | KU2DSCBCH107 | Biochemistry of Biological Molecules | 3 | 1 | 4 |
| III | KU3DSCBCH203 | Fundamentals of Biochemistry III | 3 | 1 | 4 |
| III | KU3DSCBCH204 | Biochemistry of Health and Nutrition | 3 | 1 | 4 |

**KU1DSCBCH102: FUNDAMENTALS OF BIOCHEMISTRY I**

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| I | DSC | Foundation | KU1DSCBCH102 | 4 | 75 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Tota l | ESE (Hours) |
| 3 | 2 | 0 | 25L+10 P | 50L+15P | 100 | 1.5 |

**Course description**

Basic biochemistry covers the fundamental concepts of essential for understanding the molecular basis of life. The course would examine deeper into the chemical properties of water, including its role its role as a solvent and its unique behaviors due to hydrogen bonding. It would also explore the principles behind buffer solution, their application in biological system. Additionally, topics such as pH scale, and H- H equation

**Course prerequisite: NIL**

**Course outcome**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1. | Summarize the fundamental concept of biochemistry and its role in our world | |
| 2. | Students should demonstrate a deep understanding of physical, chemical biological properties of water | |
| 3. | Aware of acid base concept, measurement of acid and base using pH meter. And the concept of buffer | |
| 4. | Attain the practical knowledge of solution preparation in Biochemistry Lab. | |

***Remember (R) , Understand (U), Apply (A), Analyse (An), Evaluate ( E), Create (C)***

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | | ✔ | | |
| CO 2 | | ✔ | | |
| CO 3 | | ✔ | | |
| CO 4 | | ✔ | | |

## COURSE CONTENTS

### Contents for Classroom Transaction

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **MODULE 1** | | |
| | 1. | Introduction to biochemistry- foundations of biochemistry (cellular, chemical, physical). | 4 |
| | 2 | Branches of biochemistry – descriptive, dynamic biochemistry and other branches. | 4 |
| | 3 | Role and scope of biochemistry – in medicine, agriculture, research, pharmaceutical, biotechnology | 4 |
| | 4 | Biochemistry as a molecular logics of living organism. | 4 |
| 2 | **MODULE 2** | | |
| | 1. 1 | Water - structure of liquid water and ice | 6 |
| | 2 | Physical and Chemical properties of water. Ionization of water. . Strong and weak acids – ionization constant Ka and pKa of weak acids. | 8 |
| | 3 | Buffer – definition, types of buffers. pH of buffers - Henderson Hasselbalch equation.Biological Buffers**.** | 8 |
| | 4 | pH - pH scale, determination of pH using - pH meter, pH paper | 8 |
| 3 | **MODULE 3** | | |
| | 1 | Solution - true solution, colloidal solution, suspension. Application of colloids | 4 |
| | 2 | Normality, molarity, molality, percentage solution | 4 |
| | 3 | Osmosis – importance | 4 |
| | 4 | Bonds in biomolecules – covalent bond , ionic bond , electrostatic attraction | 4 |
| 4 | **MODULE 4** | | |

| | | | |
|---|---|---|---|
| | 1 | Determination of pH of a solution using pH paper and pH meter. | 6 |
| | 2 | To prepare molar, molal and percent solution. | 3 |
| | 3 | Preparation of Phosphate buffer | 2 |
| | 4 | Preparation of Acetate buffer | 2 |

**Essential Readings:**


1. 1.Jain, J.L., Jain, Sunjay, Jain, Nitin. Fundamentals of Biochemistry.
2. 2.3.Voet, Donald, Voet, Judith G. Biochemistry. 4th ed.
3. 3., David L., Cox, Michael M. Lehninger Principles of Biochemistry. 4th ed.
4. 4., U., Chakrapani, U. Biochemistry. 6th ed.
5. Introductory Practical Biochemistry (2001). Ed. S.K. Sawhney and Randhir Singh, Narosa Publishing House, New Delhi.
6. 6.Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana.


**Reference Distribution**

| MODULE | UNIT | REFERENCE NO. |
|---|---|---|
| 1 | 1 | 1,2,3 |
| | 2 | 1,2,3,4 |
| | 3 | 1,2,3,4 |
| | 4 | 1,2,3,4 |
| 2 | 1 | 1,2,3,4 |
| | 2 | 1,2,3,4 |
| | 3 | 1,4,5,6 |
| | 4 | 1,4,5,6 |
| 3 | 1 | 5,6 |
| | 2 | 1,5,6 |
| | 3 | 1,2,4, |

| | | |
|---|---|---|
| | 4 | 1,2,4 |
| 4 | 1 | 5,6 |
| | 2 | 5,6 |
| | 3 | 5,6 |
| | 4 | 5,6 |

**Suggested readings:**

Silberberg, Martin S. Principles of General Chemistry.

Brown, Theodore L., LeMay, H. Eugene. Chemistry: The Central Science.

**Rubrics**

**Theory**

| **Evaluation Type** | | **Marks** |
|---|---|---|
| End Semester Evaluation | | **50** |
| Continuous Evaluation | | 25 |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 5 |
| d) | Book review/Debate | 5 |
| d) | Viva-Voce | 5 |
| e) | Field Report | 5 |
| **Total** | | **75** |

Any component of from the above can be taken for CE not exceeding 25 marks

**Practical**

| Evaluation Type | | Marks |
|---|---|---|
| End Semester Evaluation | | **15** |
| Continuous Evaluation | | 10 |
| a) | Test Paper | 10 |
| b) | Record | 5 |
| c) | Lab Skill | 5 |
| d) | Regularity | 5 |
| d) | Viva-Voce | 5 |
| **Total** | | **25** |

Any component of from the above can be taken for CE not exceeding 10 marks

**Employability of the course**

1. Biochemical companies
2. Research and development

**KU1DSCBCH103: BASIC ENDOCRINOLOGY**

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| I | DSC | Foundation | KU1DSCBCH103 | 4 | 60 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 4 | 0 | 0 | 30 | 70 | 100 | 2 |

**Course Description:**

Endocrinology is a branch of biology and medicine that deals with the endocrine system, which includes glands that secrete hormones directly into the bloodstream. These hormones act as chemical messengers, regulating various bodily functions such as metabolism, growth and development, tissue function, sexual function, reproduction, sleep, and mood. The field of endocrinology is interdisciplinary, drawing knowledge from biology, biochemistry, physiology, and clinical medicine. students typically study Endocrine Glands and Hormones, Hormone Regulation, How hormones affect specific organs and systems in the body, such as metabolism, reproduction, growth, and stress response, Endocrine Disorders, Discussion of recent research findings and emerging therapies in endocrinology, Practical applications of endocrinology in diagnosing and managing various medical conditions related to hormone imbalances.

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | To understand about scope of Endocrinology, endocrine system, hormones and second messenger system. | |
| 2 | To understand hormones of Hypothalamus, pineal gland, Thyroid gland, adrenal gland, pancreas, hormones involved in calcium metabolism and neurohormones. | |
| 3 | To understand hormones of female and male reproductive system | |
| 4 | To understand various endocrinopathies. | |

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | | ✔ | | |
| CO 2 | | ✔ | | |
| CO 3 | | ✔ | | |
| CO 4 | | ✔ | | |
| CO 5 | | | | ✔ |

**COURSE CONTENTS**

**Contents for Classroom Transaction:**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **INTRODUCTION TO ENDOCRINOLOGY** | | **10** |
| | 1 | Definition and scope of Endocrinology. | |
| | 2 | Definition of a hormone- chemical nature of mammalian hormones. | |
| | 3 | Types of hormone receptors- secondary messenger system. Peptide and non- peptide hormones action | |
| 2 | **HORMONES** | | **15** |
| | 1 | The Endocrines of Hypothalamus- Hypo-Physiotropic hormones- Neurovascular hypothesis.: chemistry- biochemical functions- | |
| | 2 | Pituitary and pineal gland hormones: chemistry- biochemical functions- | |
| | 3 | Thyroid and parathyroid gland hormones- chemistry- biochemical functions- mechanism of action. | |
| | 4 | Adrenal gland hormones- chemistry, mechanism of action biochemical functions. | |
| 3 | **REPRODUCTIVE HORMONES** | | **15** |
| | 1 | Pancreas- Insulin/glucagon: chemistry- biochemical functions- | |
| | 2 | Male reproductive organ hormones – chemistry, biochemical function | |
| | 3 | Female reproductive organ hormones – chemistry, biochemical function | |
| 4 | **DISORDERS OF ENDOCRINE GLANDS** | | **15** |
| | 1 | Endocrinopathies of Hypo-physeal, Thyroid, parathyroid, adrenal and pancreas. | |

| | | | |
|---|---|---|---|
| | 2 | Disorders of pituitary hormone axis- thyrotoxicosis- hypothyroidism- Hashimoto's thyroiditis | |
| | 3 | Metabolic bone diseases- Cushing syndrome- Addison's diseases Diabetes mellitus | |
| | | | |
| **5** | **Teacher Specific Module** | | **5** |
| | *Directions* | | |

**Essential Readings:**


1. Kronenberg, Henry M. *Williams Textbook of Endocrinology E-Book*. Elsevier Health Sciences, 2007.
2. William Textbook of Endocrinology, 11th ed. Saunders Elsevier, 2008.
3. Bolander, F. F. Molecular Endocrinology, III ed. Academic Press, 2004.
4. Cox, Nelson. Leininger's Principle of Biochemistry, 3rd ed. MacMillan Worth Publishers, 2000
5. Hadely, Mac E. Endocrinology, 5th ed. Pearson Education, 2000.


**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 4 |
| | 2 | 1 |
| | 3 | 3 |
| **2** | 1 | 1 |
| | 2 | 1 |
| | 3 | 1 |
| | 4 | 1 |
| **3** | 1 | 1 |
| | 2 | 1 |
| | 3 | 1 |
| **4** | 1 | 4 |
| | 2 | 4 |
| | 3 | 4 |

**Suggested Readings:**

6. Sembulingum, K., and Prema Sembulingum. Essentials of Medical Physiology, 6th edition, Jaypee Brothers Medical Publications, New Delhi, 2012.

**Assessment Rubrics:**

| Evaluation Type | | Marks |
|---|---|---|
| End Semester Evaluation | | **70** |
| Continuous Evaluation | | **30** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 5 |
| d) | Book review/Debate | 5 |
| d) | Viva | 5 |
| **Total** | | **100** |

**Employability for the Course:**

1. Diagnostic laboratory
2. Research and Development
3. Teaching
4. Drug industries.

**KU2DSCBCH105: FUNDAMENTALS OF BIOCHEMISTRY II**

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| II | DSC | Foundation | KU2DSCBCH105 | 4 | 60 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 4 | 0 | 0 | 30 | 70 | 100 | 2 |

**Course description**

This course provides a foundational understanding of enzymology and its significance. Students learn about the types, biosynthesis, and biological functions of both types of hormones. A course onBioenergetics and experimental techniques used to study biomolecules. A course on Carbohydrate, Lipid, and amino acid metabolism explore the biosynthesis, regulation and importance in biological system.

**Course prerequisite: NIL**

**Course outcome**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1. | Understand the carbohydrate metabolism. | |
| 2. | Understand the amino acid metabolism. | |
| 3. | Understand the lipid metabolism | |
| 4. | Understand the nucleicacid metabolism. | |

***Remember (R) , Understand (U), Apply (A), Analyse (An), Evaluate ( E), Create (C)***

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | | ✔ | | |
| CO 2 | | ✔ | | |
| CO 3 | | ✔ | | |
| CO 4 | | ✔ | | |

## COURSE CONTENTS

### Contents for Classroom Transaction

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **METABOLIC PATHWAY FOR CARBOHYDRATES** | | **10** |
| | 1 | Metabolism – definition, major enzymes, reaction steps, energetics and regulation involved in – glycolysis, gluconeogenesis, glycogen metabolism. | |
| | 2 | Definition, major enzymes, reaction steps, energetics and regulation involved in – TCA cycle | |
| | 3 | Oxidative phosphorylation and ETC. | |
| 2 | **METABOLIC PATHWAY FOR AMINOACIDS** | | **15** |
| | 1 | Metabolism of amino acids- transamination, oxidative deamination, | |
| | 2 | Urea cycle and regulation | |
| | 3 | Metabolism of non-essential amino acids (without structure) | |
| 3 | **METABOLIC PATHWAY FOR LIPIDS** | | **15** |
| | 1 | Transport and activation of fatty acid | |
| | 2 | Beta oxidation and major enzymes, reaction steps, energetics and regulation involved in – beta oxidation | |
| | 3 | Denovo synthesis of fatty acids | |
| 4 | **METABOLIC PATHWAY FOR NUCLEIC ACIDS** | | **15** |
| | 1 | Denovo synthesis of purine and pyrimidine nucleotide and its regulation. | |
| | 2 | Salvage pathway and its significance | |
| | 3 | Catabolism of nucleic acids | |

| | | | |
|---|---|---|---|
| 5 | | Teacher specific Module | 5 |
| | | Directions | |

**Essential Reading:**


1. Jain, J. L. *Fundamentals of biochemistry*. S. Chand Publishing, 2004.
2. Voet, Donald, Judith G. Voet, and Charlotte W. Pratt. *Fundamentals of biochemistry: life at the molecular level*. John Wiley & Sons, 2016.
3. Fisher, Matthew. "Lehninger principles of biochemistry, ; by David L. Nelson and Michael M. Cox." *The Chemical Educator* 6 (2001): 69-70.
4. Satyanarayana, U., and U. Chakrapani. *Biochemistry, (Updated and Revised Edition)-E-Book*. Elsevier India, 2020.
5. Kellum, John A., and Paul WG Elbers. *Stewart's textbook of acid-base*. Lulu. com, 2009.
6. Deb, A. C. "Fundamentals of Biochemistry. 2006, 8 [sup] th Edition." *New Central Book Agency (P) Ltd: Kolkata, India*: 85-6.
7. Chatterjea, M. N., and Rana Shinde. *Textbook of medical biochemistry*. Wife Goes On, 2011.


**Reference Distribution**

| MODULE | UNIT | REFERENCE NO. |
|---|---|---|
| 1 | 1 | 1 |
| | 2 | 2 |
| | 3 | 3 |
| 2 | 1 | 6 |
| | 2 | 6 |
| | 3 | 4 |
| 3 | 1 | 5 |
| | 2 | 7 |
| | 3 | 7 |
| 4 | 1 | 4 |
| | 2 | 3 |
| | 3 | 1 |

**Suggested readings**

8.Delvin, T.M. Textbook of Biochemistry with Clinical Correlation. Wiley & Sons, 2011.
9. Gibson, Rosalind. Principles of Nutritional Assessment. Oxford University Press, 2005.
10. Satyanarayana, U., and U. Chakrapani. *Biochemistry, (Updated and Revised Edition)-E-Book*. Elsevier India, 2020.

**Assessment Rubrics**

| Evaluation Type | | Marks |
|---|---|---|
| End Semester Evaluation | | **70** |
| Continuous Evaluation | | **30** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 5 |
| d) | Book review/Debate | 5 |
| d) | Viva | 5 |
| **Total** | | **100** |

**KU2DSCBCH106: BASIC PLANT BIOCHEMISTRY**

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| II | DSC | Foundation | KU2DSCBCH106 | 4 | 60 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 4 | 0 | 0 | 30 | 70 | 100 | 2 |

**Course Description:**

Plant biochemistry course typically aim to understand biochemical processes and molecular mechanisms underlying plant growth, development and metabolism. It explores the metabolic pathways involved in plant growth and development, including photosynthesis, respiration, biosynthesis of phytohormones and secondary metabolites.

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | To know the plant cell organelles and, locate its parts along with functions and mechanism of photosynthesis | |
| 2 | In-depth knowledge of different phytohormones and their functions | |
| 3 | Classify and isolate different secondary metabolites and stress physiology | |
| 4 | Analysis of qualitative and quantitative determination of phytochemicals | |

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | | ✔ | | |
| CO 2 | | ✔ | | |
| CO 3 | | ✔ | | |
| CO 4 | | | | ✔ |

**COURSE CONTENTS**

**Contents for Classroom Transaction:**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **INTRODUCTION TO PLANT CELL AND PHOTOSYNTHESIS** | | **10** |
| | 1 | Plant cell organelles Plastids–types, structure, functions<br>Cell wall–properties, plasmodesmata, Glyoxysome | |
| | 2 | Plant tissues-vascular tissues, meristem and permeant tissues | |
| | 3 | Photosynthesis - PSI, PS II, LHC, ATP Synthase Light reaction and dark reaction, photophosphorylation | |
| | 4 | Photo respiration, C3, C4, CAM pathways, glyoxylate cycle | |
| 2 | **PLANT HORMONES** | | **15** |
| | 1 | Biosynthesis and physiological functions of auxins, GA, | |
| | 2 | Biosynthesis and physiological functions of Cytokinin, ABA, Ethylene | |
| | 3 | Biosynthesis and physiological functions of<br>Polyamines, brassino steroids | |
| | 4 | Biosynthesis and physiological functions of Jasmonic acid, salicylic acid | |
| 3 | **SECONDARY METABOLITES** | | **15** |
| | 1 | Classification, isolation and characterization of alkaloids, phenols, terpenoids and flavonoids. | |
| | 2 | Biosynthetic pathways of alkaloids, phenols, terpenoids and flavonoids. | |
| | 3 | Applications of alkaloids, phenols, terpenoids and flavonoids. | |
| 4 | **PLANT STRESS** | | **15** |
| | 1 | Plant stress—The stress concept in plants. | |

| | | | |
|---|---|---|---|
| | 2 | Biotic stresses – allelopathic substance, insects and disease. | |
| | 3 | Abiotic stresses- salinity, floods, drought | |
| **5** | **Teacher Specific Module** | | **5** |
| | *Directions* | | |

**Essential Readings:**


1. Taiz, Lincoln, and Eduardo Zeiger. Plant Physiology and Development. Sixth Edition, Sinauer Associates, Inc., 2010.
2. Buchanan, Bob B., Wilhelm Gruissem, and Russell L. Jones. Biochemistry & Molecular Biology of Plants. Second Edition, John Wiley & Sons, Ltd, 2015.
3. Goodwin, T.W., and E.I. Mercer. Introduction to Plant Biochemistry. Pergamon Press, Oxford, 1983.
4. Hopkins, W.G., and Hinder, N.P.A. Introduction to Plant Physiology. 3rd Edition, John Wiley & Sons Inc., New York, 2004.
5. Mukherji, S., and Gosh, A.K. Plant Physiology. New Central Book Agency, Kolkata, 2005


**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 1 |
| | 2 | 1 |
| | 3 | 1 |
| | 4 | 1 |
| **2** | 1 | 2 |
| | 2 | 1 |
| | 3 | 3 |
| | 4 | 1 |
| **3** | 1 | 1 |
| | 2 | 1 |
| | 3 | 6 |
| | 4 | 6 |
| **4** | 1 | 7 |
| | 2 | 7 |
| | 3 | 7 |
| | 4 | 7 |
| | 5 | 7 |
| | 6 | 7 |
| | 7 | 7 |

**Suggested Readings:**


1. Gupta, Dharmendra K., and Jose Manuel Palma. Plant Growth and Stress Physiology. Springer.
2. Bala, Manju, Sunita Gupta, N. K. Gupta, and Manjeet Kaur Sangha. Practicals in Plant Physiology and Biochemistry. Scientific Publications.


**Assessment Rubrics:**

| Evaluation Type | | Marks |
|---|---|---|
| End Semester Evaluation | | **70** |
| Continuous Evaluation | | **30** |
| a) | Test Paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 5 |
| d) | Book review/Debate | 5 |
| d) | Viva | 5 |
| **Total** | | **100** |

**Employability for the Course:**

1. Biotechnology companies
2. Research and Development
3. Teaching
4. Biological technicians

## KUIIDSCBCH107 : BIOCHEMISTRY OF BIOLOGICAL MOLECULES

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| III | DSC | Intermediate | KUIIDSCBCH107 | 4 | 75 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 3 | 2 | - | 25 | 50 | 75 | 1.5 |

**Course Description:**

This course provides a foundational understanding of the molecular building blocks of life. It covers the structure, properties, and functions of proteins, carbohydrates, lipids, and nucleic acids. Through a biochemical lens, students will examine how these molecules interact in metabolic pathways and cellular processes.

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | Understand the concept of biomolecules | |
| 2 | Identify the structure and function of major biological macromolecules: proteins, lipids, carbohydrates, and nucleic acids. | |
| 3 | Explain the chemical properties and interactions that govern biomolecular behavior. | |
| 4 | To understand the nutritional aspects of biomolecules | |
| 5 | Apply biochemical concepts to real-world biological and medical problems.. | |

*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)*

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | ✓ | | | |
| CO 2 | | ✓ | | |
| CO 3 | | ✓ | | |
| CO 4 | | ✓ | | |
| CO 5 | | ✓ | | |

**COURSE CONTENTS**

**Contents for Classroom Transaction:**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| | **CARBOHYDRATE** | | **15** |
| | 1 | Definition and classification. Monosaccharides-, occurrence, chemistry & functions | |

| | | | |
|---|---|---|---|
| **1** | 2 | Isomers of monosaccharides- epimers, anomers, mutarotation | |
| | 3 | Disaccharides- occurrence, and functions of sucrose, lactose, maltose, isomaltose and cellobiose. | |
| | 4 | Polysaccharides: occurrence and functions of cellulose, starch, glycogen, Hyaluronic acid, chondroitin sulfate, heparin. | |

| | | | |
|---|---|---|---|
| **2** | **AMINO ACIDS, PROTEINS AND NUCLEIC ACIDS** | | **15** |
| | 1 | Amino acids: Definition, structure three letter and single letter abbreviations of amino acids. Classification of amino acids based on charge and polarity, essential and non-essential amino acids. | |
| | 2 | Proteins: Peptides- Formation of peptide bond. Elementary study of primary, secondary, tertiary and quaternary structure of proteins- (eg. Haemoglobin and Myoglobin). | |
| | 3 | Nucleic acids: Nitrogenous Base , Ribose sugar and phosphate group. Nucleosides, nucleotides, stability and formation of Phosphodiester linkages. Watson Crick model of DNA | |
| | 4 | Polymorphism of DNA (A ,C,D & Z DNA)<br>Types of RNA(mRNA,rRNA & tRNA) | |
| **3** | **LIPIDS** | | **10** |
| | 1 | Definition, classification-Simple, compound and derived , biochemical functions of lipids | |
| | 2 | Physical and chemical properties of fatty Acids, | |
| | 3 | Test for Fats and Oils : saponification number, acid number, rancidity of fats and iodine number- their applications | |
| | 4 | Importance of Essential Fatty acids. | |
| **4** | **Practical's** | | **30** |
| | 1 | Qualitative Analysis of carbohydrates.<br>Fehling's test, Benedict's test, Barfoed's test, Molisch's | |

| | | | |
|---|---|---|---|
| | | test, Bial's test, Seliwanoff test, Iodine test, Osazone test. | |
| | 2 | Qualitative Analysis of amino acids.<br>- Million's test, Xanthoproteic reaction, Pauly's test, Sakaguchi reaction, Sulphur reaction, Ninhydrin, Biuret. | |
| 5 | | Teachers module | **5** |

**REFERENCES**


1. J L Jain Text book of biochemistry,S. chand and company Ltd.NewDelhi.
2. Text book of Biochemistry:E S West,W R Todd, H S Mason and J T Van Bruggen.
3. Lehninger's Principles of Biochemistry.
4. Practical Biochemistry: Principles and techniques: K. Wilson and J. Walker.
5. Practical Biochemistry by David Plummer
6. Introductory Practical Biochemistry by S.K. Sawhney and R.Singh.
7. Biochemical methods by S.Sadasivan, A.Manickam, New Age international publishers.


**KU3DSCBCH203: FUNDAMENTALS OF BIOCHEMISTRY III**

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| III | DSC | Intermediate | KU3DSCBCH203 | 4 | 75 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 3 | 1 | 0 | 25 L + 10 P | 50 L + 15 P | 100 | 1.5 |

**Course description**

This course provides a foundational understanding of enzymology and its significance. Bioenergetics mainly provides the energy production, utilization at different forms as heat. Students learn about the types, biosynthesis, and biological functions of both plant and animal hormones. Biochemical techniques used to study the biomolecules at different level.

**Course prerequisite: NIL**

**Course outcome**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| **5.** | Understand the basic features of enzymes, different classes of enzymes, enzyme activity and application of enzymes | |
| **6.** | Students can attain the knowledge of energetic in a biological system | |
| **7.** | Attain the knowledge about animal and plant hormones in their growth and development | |
| **8.** | Analyze the biomolecules using different biochemical techniques. | |

***Remember (R) , Understand (U), Apply (A), Analyse (An), Evaluate ( E), Create (C)**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| **CO 1** | | ✓ | | |
| **CO 2** | | | ✓ | |
| **CO 3** | | | ✓ | |
| **CO 4** | | ✓ | | |

## COURSE CONTENTS

**Contents for Classroom Transaction**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **ENZYMES I** | | 10 |
| | 1 | Introduction to enzymes- apo enzyme, holo enzyme, Mcofactors, coenzyme. | |
| | 2 | IUB classification and nomenclature of enzymes. | |
| | 3 | Biological role of enzymes. Diagnostic and therapeutic Enzymes | |
| 2 | **ENZYMES II** | | 15 |
| | 1 | Enzyme kinetics. Energy mechanics of enzymatic reaction. | |
| | 2 | MM equation, inhibition of enzyme reaction. | |
| | 3 | Allosteric enzyme; study of activation of zymogen form of enzyme with e.g. Chymotrypsin | |
| 3 | **BIOENERGETICS** | | 15 |
| | 1 | Principles of bioenergetics and thermodynamics – first and second law. Entropy – standard free energy change and equilibrium constant | |
| | 2 | Phosphorylated compound and thioesters – ATP | |
| | 3 | Separation techniques- homogenization, centrifugation<br>Chromatography – adsorption and partition (TLC, paper, HPLC) | |
| | 4 | Electrophoresis- gel electrophoresis colorimeter & spectrophotometer | |
| 4 | **MODULE 4** | | 30 |
| | 1 | Paper chromatography of aminoacids | |

| | | | |
|---|---|---|---|
| | 2 | Separation of amino acids by TLC | |
| | 3 | Estimation of proteins by biuret method.<br>Qualitative assay of salivary amylase | |
| | 4 | Determination of Urea and creatine | |
| **5** | Teacher specific Module | **Directions** | **5** |

**Essential Readings:**


1. Voet, J.G., Voet, D. Biochemistry. John Wiley & Sons, 2021.
2. Nelson, et al. Lehninger Principles of Biochemistry. W. H. Freeman, 2008
3. Upadhyay. Biophysical Chemistry.
4. Palmer. Enzymes.
5. Chatterjee. Medical Biochemistry.
6. Jain, et al. Fundamentals of Biochemistry. 2022.


**Reference Distribution**

| MODULE | UNIT | REFERENCE NO. |
|---|---|---|
| **1** | **1**<br>**2** | **4**<br>**4** |
| | **3** | **4** |
| **2** | **1** | **1** |
| | **2** | **2** |
| | **3** | **2** |
| **3** | **1** | **1** |
| | **2** | **1** |
| | **3** | **2** |
| | **4** | **7** |

| | | |
|---|---|---|
| **4** | **1** | |
| | **2** | |
| | **3** | |



**Suggested readings:**

7. Delvin, T.M. Textbook of Biochemistry with Clinical Correlation. Wiley & Sons, 2011.
8. Gibson, Rosalind. Principles of Nutritional Assessment. Oxford University Press, 2005.
9. Medical Laboratory Technology: Procedure Manual for Routine Diagnostic Tests – Vol. 2.
10. Sreekumari, S. Biophysical Chemistry.

**Assessment Rubrics**

**THEORY**

| **Evaluation Type** | | **Marks** |
|---|---|---|
| End Semester Evaluation | | 50 |
| Continuous Evaluation | | 25 |
| a) | Test paper | 10 |
| b) | Assignment | 5 |
| c) | Seminar | 5 |
| d) | Book review / debate | 5 |
| e) | Viva – voce | 5 |
| f) | Field Report | 5 |
| **Total** | | **75** |

| **Evaluation Type** | | **Marks** |
|---|---|---|
| End Semester Evaluation | | 15 |
| Continuous Evaluation | | 10 |
| a) | Test paper | 10 |

| | | |
|---|---|---|
| b) | Record | 5 |
| c) | Lab skill | 5 |
| d) | Regularity | 5 |
| e) | Viva – voce | 5 |
| **Total** | | **25** |

## KU3DSCBCH204: BIOCHEMISTRY OF HEALTH & NUTRITION

| Semester | Course Type | Course Level | Course Code | Credits | Total Hours |
|---|---|---|---|---|---|
| III | DSC | Intermediate | KU3DSCBCH204 | 4 | 75 |

| Learning Approach (Hours/ Week) | | | Marks Distribution | | | Duration of ESE (Hours) |
|---|---|---|---|---|---|---|
| Lecture | Practical/ Internship | Tutorial | CE | ESE | Total | |
| 3 | 2 | - | 25 | 50 | 75 | 1.5 |

**Course Description:**

Nutritional biochemistry courses focus on nutrients. Nutrients are chemical substances required by the body to sustain basic functions and are optimally obtained by eating a balanced diet. There are six major classes of nutrients essential for human health: carbohydrates, lipids, proteins, vitamins, minerals, and water. Carbohydrates, lipids, and proteins are considered macronutrients and serve as a source of energy. Vitamins and minerals are considered micronutrients and play essential roles in metabolism. Vitamins are organic micronutrients classified as either water-soluble or fat-soluble. Minerals are inorganic micronutrients. Minerals can classify as macro minerals and microminerals.

**Course Prerequisite: NIL**

**Course Outcomes:**

| CO No. | Expected Outcome | Learning Domains |
|---|---|---|
| 1 | Understand the concept of nutrition & health. | |
| 2 | Create knowledge of different types of carbohydrates, their importance, sources, functions. | |
| 3 | Analyse the nutritional aspects of proteins | |
| 4 | To understand the nutritional aspects of minerals and vitamins | |
| 5 | To create the knowledge about to identify what foods good sources of what nutrients. | |

***Remember ©, Understand (U), Apply (A), Analyse (An), Evaluate ©, Create (C)***

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---|---|---|---|---|
| CO 1 | | ✔ | | |
| CO 2 | | ✔ | | |
| CO 3 | | ✔ | | |
| CO 4 | | ✔ | | |
| CO 5 | | | | ✔ |

**COURSE CONTENTS**

**Contents for Classroom Transaction:**

| MODULE | UNIT | DESCRIPTION | HOURS |
|---|---|---|---|
| 1 | **BASICS OF NUTRITION** | | **15** |
| | 1 | Concepts of macro and micro nutrients. | |
| | 2 | Physiological fuel value and Respiratory quotient | |
| | 3 | High and low-calorie diets, Balanced diet | |
| | 4 | Recommended dietary allowance (RDA)Basal metabolic rate (BMR) and factors affecting BMR | |
| **2** | **NUTRITIONAL ASPECTS OF THE CARBOHYDRATES AND LIPIDS** | | **10** |

| | | | |
|---|---|---|---|
| | 1 | Nutritional aspects of the carbohydrates-(Different dietary types, source deficiency) | |
| | 2 | Special role of the non-starch polysaccharides. | |
| | 3 | Nutritional aspects of the lipids- Different dietary types | |
| | 4 | Functions of lipids, Essential fatty acids – sources and functions | |
| **3** | **NUTRITIONAL SIGNIFICANCE OF PROTEINS, MINERALS AND VITAMINS** | | **10** |
| | 1 | Nutritional classification of amino acids and proteins, Essential amino acids – sources and functions | |
| | 2 | Protein Energy Malnutrition-Kwashiorkor and Marasmus. | |
| | 3 | Dietary Macro elements: Ca, P, Mg, Na& K and Dietary Micro elements: Iron, Iodine, Zinc, Copper –sources, functions and deficiencies | |
| 4 | 4 | Nutritional significance- fat soluble and water-soluble vitamins- source, functions and deficiency diseases. | |
| | | **NUTRITIONAL DISORDERS** | **10** |
| | 1 | Nutritional management of diabetes mellitus | |
| | 2 | Nutritional management of obesity | |
| | 3 | Nutrition for infants, children, pregnant and lactating women | |
| | 4 | Importance of nutrition under stress conditions. | |
| | 5 | Sports nutrition | |
| **5** | **Teacher Specific Module: Practicals** | | **30** |
| | 1 | Qualitative analysis of Carbohydrates-Glucose, Fructose, Sucrose, Lactose, Maltose | |
| | 2 | Qualitative analysis of amino acids-Tyrosine, Arginine, Tryptophan | |

| | | | |
|---|---|---|---|
| | 3 | Qualitative analysis of Peptone | |
| | 4 | Qualitative analysis of Casein | |
| | 5 | Qualitative analysis of Albumin | |
| | 6 | Estimation of total protein | |
| | 7 | Estimation of reducing sugar | |

**Essential Readings:**


1. Akoh, Casimir C. Food Lipids: Chemistry, Nutrition, and Biotechnology. 4th ed., CRC Press Taylor & Francis Group, 2016.
2. Mann, Jim, and A. Stewart Truswell. Essentials of Human Nutrition. 2nd ed., Oxford University Press Inc., 2002.
3. Rodwell, Victor, et al. Harper's Illustrated Biochemistry. 31st ed., Tata McGrawHill Education, 2018.
4. Underwood, E. Trace Elements in Human and Animal Nutrition. 4th ed., Academic Press, 1977.
5. Bamji, M.S., Kamala Krishnaswami, and G.N.V. Brahmam. The Book of Human Nutrition. 4th ed., Oxford & IBH Publishing, 2011.
6. Swaminathan, M.S. Essentials of Food and Nutrition. Vol. I and II, Ganesh & Co., 1974.
7. Trueman, Patricia. Nutritional Biochemistry. Mjp Publishers, 2007.


**Reference Distribution:**

| Module | Unit | Reference No. |
|---|---|---|
| **1** | 1 | 7 |
| | 2 | 7 |
| | 3 | 2 |
| | 4 | 2 |
| **2** | 1 | 3 |
| | 2 | 6 |
| | 3 | 5 |
| | 4 | 2 |
| **3** | 1 | 2 |
| | 2 | 2 |
| | 3 | 2 |
| | 4 | 2 |

| | | |
|---|---|---|
| **4** | 1 | 9 |
| | 2 | 10 |
| | 3 | 10 |
| | 4 | 12 |
| | 5 | 12 |
| | 6 | 12 |
| | 7 | 12 |
| | 8 | 8 |
| | 9 | 8 |
| | 10 | 8 |

**Suggested Readings:**


8. Mahan, L.K., and Raymond J. Shanahan. Krause's Food and Nutrition Care Process. 2012.
9. Raymond, J. Elsevier's Publications. ISBN- 978-l-4377-2233-8.
10. The vitamins, Fundamental aspects in Nutrition and Health (2008) l G.F.
11. Coombs Jr. Elsevier's Publications. ISBN-13- 978-0-12- 183493-7.
12. Gibson, Rosalind. Principles of Nutritional Assessment. University Press, 2005.


**Assessment Rubrics**

| **Evaluation Type** | **Marks** |
|---|---|
| **End semester Evaluation (Theory)** | **50** |
| **End semester Evaluation(Practical)** | **15** |
| **Continuous Evaluation (Theory)** | **25** |
| Test paper | 10 |
| Assignment | 5 |
| Seminar | 5 |
| Viva | 5 |
| **Continuous evaluation (Practical)** | **10** |
| Record | 5 |
| Lab performance | 5 |

**Employability for the Course:**

1. Food industries
2. Research and Development
3. Teaching

4. Dietitians
5. Entrepreneurship
6. Food testing lab- technicians