1

rediffmail

Mailbox of vadlapudikumar

Subject: Re: P.G. Biochemistry syllabus 2024 BOS approval

From: chandru kamanavalli <cmkamanavalli@gmail.com> on Fri, 13 Sep 2024 17:17:30

To: Vadlapudi Kumar <vadlapudikumar@rediffmail.com>

Cc: Manohar Shinde <drsmanohar@gmail.com>, santoshmudde <santoshmudde@gmail.com>, veeke2012 <veeke2012@gmail.com>

P. G. 1-4th Semesters syllabus has been approved

On Fri, 13 Sep 2024, 4:10 pm Vadlapudi Kumar, <vadlapudikumar@rediffmail.com> wrote:

> Dear Sir,
> Greetings from Davangere University,
> This mail is in continuation with our discussion over phone regarding BOS approval for P.G. .Biochemistry Semesters- I to IV syllabus, prepared by revising and updating syllabus under CBCS stream involving internal members of the BOS, Biochemistry, Davangere University. I hereby attach course structure of PG Biochemistry and syllabus for your information and reference.
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> In this connection I seek the approval from the esteemed members of the Board of Studies of Biochemistry, Davangere University for the syllabus attached herewith. The proposed syllabus has to be implemented from the current academic year that commences from the academic year 2024-25 for the PG Biochemistry students of Davangere University. I request you to kindly go through the contents of the syllabus and give your valuable suggestions for any corrections to be done before giving your approval.
> Thanking you,
> Sincerely,
>
> Dr.VADLAPUDI KUMAR
> Department of Biochemistry
> Davangere University
> Shivagangothri, Tholahunase
> DAVANGERE - 577 002
> Karnataka, India

Ref 2024-25

Received through email on 13/09/2024

13/09/2024

Chairman B.O.S.
Department of Biochemistry
Davangere University
Shivagangothri, Davangere-577007

13/09/2024

ದಾವಣಗೆರೆ ವಿಶ್ವವಿದ್ಯಾನಿಲಯ

ಜೀವರಸಾಯನಶಾಸ್ತ್ರ ಅಧ್ಯಯನ ಶಿವಗಂಗೋತ್ರಿ ದಾವಣಗೆರೆ–577 007.

ಡಾ: ವಡ್ಡಪೂಡಿ ಕುಮಾರ್
ಅಧ್ಯಕ್ಷರು **(BOS)**

ಕಛೇರಿ: 08192–208135
email-dvgbiochemistry@gmail.com

ಸಂಖ್ಯೆ: ದಾವಿವಿ/ಜೀರ: 103 :2024–25 ದಿನಾಂಕ: 13–09–2024

ಗೆ
ಮಾನ್ಯ ಕುಲಸಚಿವರು (ಆಡಳಿತ)
ದಾವಣಗೆರೆ ವಿಶ್ವವಿದ್ಯಾನಿಲಯ
ಶಿವಗಂಗೋತ್ರಿ
ದಾವಣಗೆರೆ–577007.

ಮಾನ್ಯರೆ,

ವಿಷಯ:– 2024–25 ನೇ ಶೈಕ್ಷಣಿಕ ಸಾಲಿನ ಸ್ನಾತಕೋತ್ತರ ಜೀವರಸಾಯನಶಾಸ್ತ್ರ ಪದವಿಯ ಪಠ್ಯಕ್ರಮವನ್ನು ಕಳುಹಿಸಿಕೊಡುತ್ತಿರುವ ಬಗ್ಗೆ.

ಉಲ್ಲೇಖ:– ದಾವಿವಿ: ಅ.ಮ./466/2024–25/1781 ದಿನಾಂಕ: 16–08–2024.

*****

ಮೇಲ್ಕಂಡ ವಿಷಯಕ್ಕೆ ಹಾಗೂ ಉಲ್ಲೇಖಕ್ಕೆ ಸಂಬಂದಿಸಿದಂತೆ, 2024–25ನೇ ಶೈಕ್ಷಣಿಕ ಸಾಲಿನ ಸ್ನಾತಕೋತ್ತರ ಜೀವರಸಾಯನಶಾಸ್ತ್ರ ಅಧ್ಯಯನ ವಿಭಾಗದ ಪಠ್ಯಕ್ರಮವನ್ನು ಸಿ.ಬಿ.ಸಿ.ಎಸ್ **(I ರಿಂದ IVನೇ ಸೆಮಿಸ್ಟರ್)** ನಿಯಮಾವಳಿಯನುಸಾರ ಪರಿಷ್ಕರಿಸಿ ದಿನಾಂಕ: 13–09–2024 ರಂದು ಈ–ಮೇಲ್ ಮುಖಾಂತರ ನಡೆದ ಅಧ್ಯಯನ ಮಂಡಳಿಯ ಸಭೆಯಲ್ಲಿ ಮಂಡಿಸಿ ಅನುಮೋದನೆ ಪಡೆಯಲಾಯಿತು. ಸದರಿ ಪರಿಷ್ಕರಿಸಿದ ಪಠ್ಯಕ್ರಮವನ್ನು ತಮ್ಮ ಕಛೇರಿಯ ಮುಂದಿನ ಸೂಕ್ತಕ್ರಮಕ್ಕಾಗಿ ಕಳುಹಿಸಿಕೊಡಲಾಗಿದೆ.

ವಂದನೆಗಳೊಂದಿಗೆ,

ತಮ್ಮ ವಿಶ್ವಾಸಿ,

Chairman BOS
Department of Biochemistry
Davangere University
Shivagangothri, Davangere-577007

ಅಡಕ:

1. 2024–25ನೇ ಶೈಕ್ಷಣಿಕ (P.G) ಜೀವರಸಾಯನಶಾಸ್ತ್ರ ಪಠ್ಯಕ್ರಮ–02 ಪ್ರತಿ.
2. ಕಛೇರಿ ಪ್ರತಿ.

DAVANGERE UNIVERSITY

Dr. VADLAPUDI KUMAR, Ph.D.
Chairman, B.O.S.
Department of Studies in Biochemistry
SHIVAGANGOTHRI
DAVANGERE – 577 007, INDIA.

Mobile: 94800 24337
Tel: 08192-208135 (Office)
Fax: 08192-208420
E-mail: vadlapudikumar@rediffmail.com

No. DU/BC/102/2024-25

Date: 13-09-2024.

Proceedings of Board of Studies (B.O.S.) meeting of Biochemistry Board Davangere University (2024-25)

Board of Studies (B.O.S.) meeting of Biochemistry, Davangere University was held in the D.O.S. in Biochemistry, Davangere University, Shivagangothri (hybrid mode: internal members were present personally and outstation members approved through email circulation) on 13-09-2024 (Friday). Dr. Vadlapudi Kumar, Chairman, B.O.S. welcomed/greeted the board members. Chairman of the board briefed/circulated the agenda to approve M.Sc., Biochemistry Syllabus (that is revised, updated and to be implemented from the academic year 2024-25).

The Board has approved M.Sc., Biochemistry Syllabus (that is revised, updated and to be implemented from the academic year 2024-25).

Chairman and Members in the Board of Studies		Signature
Prof. Vadlapudi Kumar	Chairman	13/09/2024
Prof. Manohar Shinde	External Member (P.G.)	**Given approval (online)**
Prof. C.M. Kamanavalli	External Member (P.G.)	**Given approval (online)**
Dr. Santoshkumar M.	Internal Member	13/09/2024

13/09/2024

(Dr. VADLAPUDI KUMAR)
Chairman B.O.S.
Department of Biochemistry
Davangere University
Shivagangothri, Davangere-577007

rediffmail Mailbox of vadlapudikumar

Subject: Re: P.G. Biochemistry syllabus 2024 BOS approval

From: Manohar Shinde <drsmanohar@gmail.com> on Fri, 13 Sep 2024 17:00:34

To: Vadlapudi Kumar <vadlapudikumar@rediffmail.com>

To

Prof. Vadlapudi Kumar
Chairman BOS in Biochemistry
Davangere University
Davangere

Dear Sir,

I have read the proposed M. Sc. Biochemistry syllabus (1, II, III and IV semester) of your esteemed university.
I hereby approve the M. Sc. biochemistry syllabus proposed to the BOS.

Thanking you

Faithfully

Warm regards

Manohar Shinde Ph. D
Professor, DOS & R in Biochemistry
Tumkur University, Tumakuru -572103
Karnataka, India

On Fri, Sep 13, 2024 at 4:10 PM Vadlapudi Kumar <vadlapudikumar@rediffmail.com> wrote:

> Dear Sir,
> Greetings from Davangere University,
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Received through email on 13/09/2024

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Chairman B.O.S.
Department of Biochemistry
Davangere University
Shivagangothri, Davangere-577007

DAVANGERE UNIVERSITY

Syllabus for

M.Sc., Biochemistry

Choice based credit system (CBCS)

Effective from 2024 – 2025

Department Studies in Biochemistry
Davangere University, Shivagangothri
Davangere-577 007.

13/09/2024

Chairman B.O.S.
Department of Biochemistry
Davangere University
Shivagangothri, Davangere-577007

13/09/2024

Dr. U.S. MAHABALESHWAR
M.Sc., M.Phil., Ph.D.
Professor & Dean, Science & Technology
Davangere University, Shivagangotri,
Davangere-577 007, Karnataka, India.

Registrar
Davangere University
Shivagangotri, Davangere

PREAMBLE

Curriculum updating and adoption of innovative pedagogy are major components of academic excellence aimed at providing exposure to cutting edge technological advancements. The Board of Studies in Biochemistry (PG) is pleased to submit the revised syllabus for M.Sc. Biochemistry course of Davangere University with effect from 2024-2025. Keeping in mind, the advancements in the subject over the past decade, the board has gone through the existing syllabus and has incorporated few recent developments to provide a broader perspective of the subject to the students.

About the department:

The Department of Studies in Biochemistry was established in the year 1993 with M.Sc., programme, and has completed 30 glorious years of inception. The department is presently offering M.Sc., M.Phil. and Ph.D., programmes in major fields of Biochemistry such as Cancer Biology & Neurobiology, Food & Drug Nanotechnology, Plant Biochemistry & Natural Products and Bioremediation and Biocatalysis. The Department has produced about 700 Biochemistry post-graduates, more than 98% of them passing in I class or higher. Many of them are pursuing research in reputed Institutes and Universities in India and abroad. In addition many students of the Department have cleared CSIR- UGC/NET, ICAR-JRF and GATE examinations.

The faculty of the department are active in teaching and research. Faculty members of the Department have published more than 200 research and review articles in refereed journals of international and national repute. Major research projects have been sanctioned to faculty members in the department by DBT, DST, DAE-BRNS, UGC and ICMR with the grant to the tune of Rs.4.5 crore. The department has adequate research facilities *viz.,* Animal Cell Culture Laboratory, Advanced Nanotechnology Laboratory and Plant Tissue Culture Laboratory. The Department has also entered into collaborative research with Industries, pioneer Institutes of India and abroad. The Department organizes International/National seminars, conferences, symposia and workshops inviting eminent scientists and academicians from various Institutes, Universities and Industries across the country.

Program Introduction:

The two-year full-time M.Sc. programme in Biochemistry endeavors to provide students with excellent training in Biochemistry emphasizing on solid background of basic concepts as well as rapid advancement in the field. In addition to theoretical knowledge, considerable emphasis is given on hands on experience in the forefront areas of Biochemistry through practical training. Seeds of the current fruits of modern biology, such as genomics, metabolomics, proteomics so on, were sown during previous century in the form of interdisciplinary collaborations among basic science disciplines contributing to landmark technological innovations. One

of the basic science disciplines which lead to biotechnological advancement is BIOCHEMISTRY, a hybrid of biology and chemistry. Considering its pivotal role in biological sciences, it is imperative to strengthen the fundamental concepts of biochemistry at Postgraduate level with clear and tangible pedagogical approaches. The present curriculum for M.Sc. Biochemistry has been prepared with the objective of providing comprehensive knowledge of biochemistry including biochemical mechanistic basis of genetic and physiological processes, metabolism under normal and pathological conditions, drug discovery, cell signalling and clinical research.

Apart from its traditional approach of providing more weightage to metabolism and molecular physiological aspects, the curriculum has greater emphasis on recent advancement in techniques of biochemistry and molecular biology which enable the students to better understand the core biochemistry and the offshoots such as genomics, metabolomics, proteomics, and bioinformatics. It is hoped, that during the two year program, typical attributes of a competent science postgraduate such as; spirit of inquiry, critical thinking, problem solving, analytical and scientific reasoning, research/industry related skills are discovered and nurtured.

For the design of curriculum, selection of papers and drafting of syllabus for each course, suggestions from stakeholders was obtained at each stage. The course structure was initially framed in a faculty meeting and suggestions were sought from subject experts across the universities from panel. Based on the suggestions, the course structure was re-framed and syllabus for each course was drafted. Subsequently, the revised draft was shown to selected peers and stakeholders for access of suggestions. The re-revised draft was deliberated in a meeting of the Committee of Courses and the final draft was prepared.

Program Objectives:

The proposed programme shall be governed by the Department of Biochemistry, Davangere University, Shivagangothri, Davangere-577007. A two-year program will lead to the award of a M.Sc. degree in Biochemistry. Students will be offered advanced level theory and practical courses in subjects like proteins, cell biology, immunology and, cell signalling, enzymes and their biochemical applications, molecular biology, recombinant DNA technology and applications in biotechnology, developmental biology, proteomics and metabolomics and advanced techniques in genomics. The emphasis is on training students for research. Students will be trained adequately in the various basic tools, techniques and instrumentation in specific research frontiers. Students are also required to present critical reviews on various current and significant topics in seminars for evaluation. The department also offers a basic course in biochemistry for interested students across the University with background in life sciences.

The Department strives to achieve the following programme objectives:

- The foremost objective of the programme is to empower students with clear understanding of the basic concepts of biochemistry and provide them knowledge of the recent advances so that they can independently assess the vast scope in the field.
- The programme aims to train students to enable them to apply biochemical principles, theoretically and experimentally, to understand various complex life processes, while providing biochemical solutions to combat various human diseases.
- It is expected that at the time of completion of the programme each student is confident and independent in their thought processes and can make an informed choice about their subsequent career.
- The program is expected to motivate students for higher education, especially research and provide trained manpower for biotechnology industry. They are expected to be ethically sound and ready for the next phase of their development, skilled in the art of self-reading, oration and scientific writing.

Programme Specific Outcomes (PSOs):

A post-graduate student upon completion of the programme is expected to gain the following attributes:

- In-depth knowledge of Biochemistry with inter-disciplinary perspective of other branches of life sciences.
- Competence for research and innovation in Biochemistry as a skilled experimentalist. Analytical and problem solving skills with regard to biochemical principles of life processes and technologies for combating human diseases.
- Critical thinking about the concepts in Biochemistry and ability to critically review scientific literature for development of new theories and testable hypothesis.
- Capacity for decision making with regard to scientific progress, personal development and career choice.
- Ability to work independently, while still promoting team work and collaboration skills.
- Improving oratory (public speaking), scientific conversation and writing skills. Leadership and organizational skills. Demonstration of integrity, honesty, ethical behavior and sense of responsibility.
- Appreciation of diversity in scientific community and responsibility towards society• and nation. Environmental awareness vis-à-vis bio-waste generation, disposal and management and safety and security issues.

Eligibility and Entrance Test:

A candidate for being eligible for admission to the MSc Biochemistry must have taken either:

a) Bachelor of Science with either Biochemistry or chemistry as one of the mandatory optional subject studied during Under-graduate programme.
b) Bachelor of Science in Life Sciences with a combination of the available Subject(s) with Chemistry
c) Bachelor of Science of another University recognized as equivalent thereto.

Fee structure:
As prescribed by the Davangere University.

Intake:
As per the Regulations of Davangere University

Admission:
As per the Admission Regulations of Davangere University

Duration of the programme:
The duration of the M.Sc. Programme shall be two year and there shall be a University Examination at the end of the course. The Programme shall not be conferred upon a candidate unless he has passed in the entire course subjects; practical's and has to full fill all the requirements as stated in the programme structure. The maximum duration provided to complete the course will be four years.

M.Sc. Biochemistry (CBCS) Programme: Course Structure
(Effective from 2024-25 Academic Year onwards)

	Subject/Paper Code	Title of the Paper	Instruction Hrs./week	Marks			Credits	Examination duration (Hrs.)
				Examination	Internal Assessment	Total Marks		
SEMESTER-I	**THEORY PAPERS**							
	BC 1.1	Fundamentals of Biochemistry and Biomolecules	4	70	30	100	4	3
	BC 1.2	Methods for Biochemical Analysis	4	70	30	100	4	3
	BC 1.3	Cellular and Nutritional Biochemistry	4	70	30	100	4	3
	BC 1.4	Physiology and Microbiology	4	70	30	100	4	3
	PRACTICAL PAPERS							
	BC 1.5	Biomolecules & Methods for Biochemical Analysis	8	40	10	50	4	3
	BC 1.6	Cellular and Nutritional Biochemistry & Physiology and Microbiology	8	40	10	50	4	3
	Mandatory Credits: English Language Communication Skill		2	---	---	---	---	---
SEMESTER-II	**THEORY PAPERS**							
	BC 2.1	Catalysts of Biochemical Transformation	4	70	30	100	4	3
	BC 2.2	Bioenergetics and Intermediary Metabolism	4	70	30	100	4	3
	BC 2.3	Clinical Biochemistry and Toxicology	4	70	30	100	4	3
	BC 2.4	Molecular Inheritance and Developmental Biology	4	70	30	100	4	3
	PRACTICAL PAPERS							
	BC 2.5	Catalysts of Biochemical Transformation & Intermediary Metabolism	8	40	10	50	4	3
	BC 2.6	Clinical Biochemistry and Toxicology & Molecular Inheritance	8	40	10	50	4	3
	Mandatory Credits: Computer Skill		2	---	---	---	---	---

Semester	Subject/Paper Code	Title of the Paper	Instruction Hrs./week	Marks			Credits	Examination duration (3Hrs.)
				Examination	Internal Assessment	Total Marks		
SEMESTER-III	**THEORY PAPERS**							
	BC 3.1	Molecular Biology	**4**	**70**	**30**	**100**	**4**	**3**
	BC 3.2	Biological membranes, Biostatistics and Computer Applications	**4**	**70**	**30**	**100**	**4**	**3**
	BC 3.3	Hormones and Cellular Communication	**4**	**70**	**30**	**100**	**4**	**3**
	BC 3.4	Plant Biochemistry and Specialized chemicals	**4**	**70**	**30**	**100**	**4**	**3**
	BC 3.5	(A) Clinical Biochemistry/ (B) Biochemistry and Nutritional Health/ (C) Biochemistry in Day-To-Day Life **(Interdisciplinary-Elective papers)**	**2**	**40**	**10**	**50**	**2**	**2**
	PRACTICAL PAPERS							
	BC 3.6	Molecular Biology & Biological membranes, Biostatistics and Computer Applications	**8**	**40**	**10**	**50**	**4**	**3**
	BC 3.7	Hormones and Cellular Communication & Plant Biochemistry	**8**	**40**	**10**	**50**	**4**	**3**
SEMESTER-IV	**THEORY PAPERS & PROJECT WORK/DISSERTATION**							
	BC 4.1	Immunochemistry	**4**	**70**	**30**	**100**	**4**	**3**
	BC 4.2	Recombinant DNA Technology and Applied Biology	**4**	**70**	**30**	**100**	**4**	**3**
	BC 4.3	Bioinformatics, Omics Biochemistry and Research Methodology	**4**	**70**	**30**	**100**	**4**	**3**
	BC 4.4	Project Work/Dissertation	**4**	**70**	**30**	**100**	**4**	**3**
	PRACTICAL PAPERS & STUDY TOUR/FIELD VISIT							
	BC 4.5	Immunochemistry & Bioinformatics	**8**	**40**	**10**	**50**	**4**	**3**
	BC 4.6	Recombinant DNA Technology and Applied Biology & Omics Biochemistry	**8**	**40**	**10**	**50**	**4**	**3**
	Study Tour/Field Visit		---	---	---	---	---	---
	Mandatory Credits: Personality Development		**2**	---	---	---	**2**	---
	Total Credits for the Course		**136**	---	---	**2050**	**100**	---

Dr. U.S. MAHABALESHWAR
M.Sc., M.Phil., Ph.D.
Professor & Dean, Science & Technology
Davangere University, Shivagangotri,
Davangere-577 007, Karnataka, India.

Registrar
Davangere University
Shivagangotri, Davangere

Course Code: B.C-1.1

Name of the Course: FUNDAMENTALS OF BIOCHEMISTRY AND BIOMOLECULES

Batch: 2024-25 Batch onwards

Course Credits: 4	**Total No. of Hours: 64** **No. of Teaching Hours per week: 4 Hrs.**

Course Learning Objectives:

a) To gain knowledge on fundamentals of biochemistry and biomolecules.
b) To understand types of bonds, functional groups and reaction mechanism of biomolecules.
c) To learn about importance water, buffers and classification of carbohydrates and derivatives.
d) To study structure, classification and functional importance of aminoacids and proteins.
e) To study the physico-chemical properties and classification of nucleic acids and lipids.

Course Outcomes: On successful completion of the course, the students will be able to,

a) Explain about structural, functional classification of and importance of biomolecules.
b) Illustrate fundamentals aspects such as chemistry and reaction mechanisms of biomolecules.
c) Describe importance of water, buffers, structural and functional significance of carbohydrates.
d) Explain the structural and functional classification and importance of aminoacids and proteins.
e) Describe the physico-chemical properties, structures and functions of nucleic acids and lipids.

Unit-I / Module-I **-16 hrs.**

Basic Concepts of Bioorganic Chemistry: Analogy between Organic and Biochemical reaction. Principles of Chemical Bonding, Types of bonding in biomolecules. Characteristics of chemical bonds-sigma and Pi bonds, hybridization. Properties of covalent, co-ordinate, hydrogen and ionic bonds, hydrophobic and Vander-Waals interactions and their importance in biological systems.

Important functional groups in biochemistry, Homo and heterolytic cleavage, structure and reactivity and C^+, C^- and $C^\cdot$, nucleophile, electrophile, free radicals in biological systems. Isomerism, importance of stereochemistry, types of isomers. Geometric and optical isomerism, absolute and relative configuration. Chirality, relation between chirality and optical activity. Role of metal ions in biological systems.

Heterocyclic compounds- Occurrence in biological systems, structure and properties of furan, pyrrole. Indole, thiazole, imidazole, pyridine, pyrimidine, purine, quinone, pteridine and isoalloxazine.

Reaction mechanisms -Mechanism of Organic Reactions: SN1 and SN2 reaction mechanisms, Chemistry of carbonyl compounds (Reactions with alcohols, amines, etc.), Oxidation-Reduction reactions, keto-enol tautomerism.

Unit-II / Module-II **-16 hrs.**

Water- Structure and Properties of water, Importance of water in biological systems with special reference to the maintenance of native structure of biological molecules. pH, acids and bases. Buffers, buffer capacity and importance of buffers in biological systems (physiological buffers). Henderson–Hasselbalch equation.

Carbohydrates - Brief overview of configuration and conformational aspects of carbohydrates. Structure and stereochemistry of glucose; anomers, epimers, enantiomers, stereoisomers, D and L, + and - notations. Structure, properties and importance of starch, pectin, chitin, peptidoglycans, glycosaminoglycans, glycoproteins, lectins and derived sugars. Importance of oligosaccharides; Structural elucidation of carbohydrates-methylation and periodateoxidation.

Unit-III / Module-III **-16 hrs.**

Amino acids – Structure and classification of aminoacids. Non-protein amino acids, non-standard aminoacids. Stereochemistry, D and L, R and S notions. Titration studies of amino acids, peptide bond and synthesis of peptides by Merrifield solid-phase method.

Proteins - Classification, biological functions, properties of proteins. Structural hierarchy of proteins – primary, secondary, tertiary and quaternary structure of proteins. Sequencing of proteins. Secondary structure of proteins with examples, α-helix, β-pleated sheet, 3_{10}-helix, reverse turns, super secondary structure (collagen). Ramachandran plot and its significance. Tertiary structure of proteins, forces involved in the maintenance of tertiary structure of proteins. Quaternary structure, hemoglobin as an allosteric protein. Protein folding, role of molecular chaperons. Denaturation and renaturation of proteins.

Unit-IV / Module-IV **-16 hrs.**

Nucleic acids - Chemistry of purine and pyrimidine bases. Nucleoside and nucleotides. Physico-chemical properties of nucleic acids-melting of DNA, buoyant density. Denaturation and renaturation kinetics of DNA, Hyperchromic effect, Effects of salts on DNA and Cot curves. Solution properties of DNA – molecular weight – UV absorption. Structure of DNA and RNA and micro RNA, Recent models of DNA-supercoils, cruciform, single stranded DNA and satellite DNA. Methods of sequencing of nucleic acids.

Lipids - Classification, structure and function of major lipid subclasses- acylglycerols, phosphoglycerides, sphingolipids, steroids, eicosanoids, lipoproteins, lipopolysaccharides, cerebrosides, bile acids and gangliosides.

References:

1. Bioinorganic Chemistry: A Survey-Ei-Ichiro Ochiai, Elsevier.
2. Organic Chemistry - Vol. I. Fundamental Principles. I.L .Finar. ELBS.
3. Biochemistry - The Chemical Reactions of Living Cells. David E Metzler.Vol. I & II. Elsevier Academic Press.
4. Text Book of Biochemistry – E.S. West, W.R. Tood, H.S. Mason, J.T.V. Bruggen. 4th Edition, Macmillan Pubs./Oxford & IBH Pubs. Co. Pvt. Ltd., New Delhi (1966/1974).
5. Lehninger Principles of Biochemistry -David L. Nelson and Michael Cox. W.H. Freeman and Company- Macmillan Publisher, Seventh Edition (2017).
6. Biochemistry - Ed Donald Voet and Judith G. Voet. John Wiley & Sons, Inc.
7. Biochemistry -Jeremy M Berg, John L Tymoczko, and Lubert Stryer. W.H. Freeman and Company, New York.
8. Principles of Biochemistry -Lehninger, Nelson and Cox. CBS Publishers & Distribtrs.
9. Harper's Biochemistry - Ed. R.K. Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell. Appleton and Lange, Stamford, Connecticut.
10. Biochemistry – David Rawn, J., Neil Patterson Publishers (1989).
11. Nucleic acid Biochemistry and Molecular Biology - Mainwaring W.I.P et al., Blackwell Scientific Publications.
12. Nucleic Acids in Chemistry and Biology - G Michael Blackburn, et al., RSC Pubs.
13. The Biochemistry of Nucleic acids - Roger L. P. Adams, John T. Knowler, David P. Leader, Springer Nature, Switzerland AG.
14. Bioorganic Chemistry: A chemical Approach to Enzyme Action-Dugas, Hermann.
15. The Organic chemistry of enzyme-catalyzed reactions - Richard B. Silverman, A.P.

Course Code: B.C-1.2
Name of the Course: METHODS FOR BIOCHEMICAL ANALYSIS
Batch: 2024-25 Batch onwards

Course Credits: 4	**Total No. of Hours: 64** **No. of Teaching Hours per week: 4 Hrs.**

Course Learning Objectives:

a) To be familiar with methods for isolation, purification and characterization of biomolecules.
b) To learn biochemical calculations, separation, isolation of biomolecules and centrifugation.
c) To understand principles and applications of chromatography and electrophoresis techniques.
d) To learn about electromagnetic spectrum, principles and applications of spectroscopy.
e) To study principles and applications of biophysical methods and applications of radioisotopes.

Course Outcomes: On successful completion of the course, the students will be able to

a) Describe methods for isolation, purification and characterization of biomolecules.
b) Illustrate biochemical calculations, separation, isolation of biomolecules and centrifugation.
c) Describe analysis of biomolecules by chromatography and electrophoresis techniques.
d) Explain electro-magnetic spectrum, characterization of biomolecules by spectroscopy.
e) Describe the characterization of biomolecules by biophysical methods, and application of radioactive isotopes (tracers) in biochemical transformations.

Unit-I / Module-I **-16 hrs.**

Biochemical calculations - Specific gravity, percent solution, dilution and dilution factors, ionic strength; molarity, normality, mole concept, Avogadro principles; Precision; accuracy; sensitivity; specificity; random error; systematic error. Precision; accuracy; sensitivity; specificity; random error; systematic error.

Introduction for separation methods and isolation methods - Separation Methods and their classification; Zonal and Frontal methods. Approaches to Biochemical investigations - whole organism, perfusion, slices, cultured tissues and cell techniques; Cell fractionation, extraction, methods of precipitation, solubilisation, concentration and membrane dialysis.

Centrifugation- Principle and Definition; Relative centrifugal force (RCF); Different types of rotors used and their importance. Svedberg coefficient; Preparative centrifugation; Differential, Rate-Zonal, isopycnic (Equal density) and equilibrium isodensity centrifugation; Density gradient centrifugation; analytical ultra-centrifugation; Analytical sub cellular fractions. Molecular weight determination of proteins and nucleic acids by sedimentation velocity and sedimentation equilibrium methods.

Unit-II / Module-II **-16 hrs.**

Chromatography-Basic principles of chromatography. Distribution coefficient. Paper, TLC, Gel permeation, Ion-exchange chromatography, Affinity chromatography, GLC, HPLC, FPLC. Different detectors of GLC and their applications. Different types of supporting matrices, pumps and detectors of HPLC and their applications.

Electrophoresis-Basic principle and definition; Types of electrophoresis-Moving boundary and Zone electrophoresis; Factors affecting electrophoretic separation of molecules. Low voltage and High voltage electrophoresis. Principles and applications of PAGE and SDS-PAGE, Isoelectrofocussing, 2-D electrophoresis. Agarose gel electrophoresis, Pulse field electrophoresis; Isotachophoresis; capillary electrophoresis. Southern blotting; Northern blotting and Western blotting.

Unit-III / Module-III

Spectroscopy-Electromagnetic spectrum, Laws governing light absorption (Beer-Lambert law) and their limitations. Visible light-colour complementation, principle and construction of colorimeter and spectrophotometer. Principle, instrumentation and biological applications of UV-Visible spectrophotometry, Turbidimetry, Nephelometry, Flame photometry, Atomic absorption spectrophotometry, Fluorescence spectroscopy. Basic principles of IR spectroscopy; Electron spin resonance spectroscopy; Nuclear magnetic resonance spectroscopy, Mass spectrometry, MALDI-TOF, MS/MS and their applications in structural analysis of biomolecules and metabolic pathways. Principle and applications flow cytometry.

Unit-IV / Module-IV **-16 hrs.**

Biophysical Methods – Principle and applications X-ray diffraction, Optical rotatory dispersion (ORD); Circular dichroism, Drude equation, Motiff equations, Cotton effect; Application for the analysis of few biomolecules. Principle and applications of light scattering for the analysis and characterization of macromolecules.

Radio isotope (Tracer) Techniques - Definition and types of radiation. Units of radio activity. General methods for the production of radioactive isotopes; Basic principles and applications of GM Counter, Liquid scintillation counter and Cerenkov counting, Autoradiography. Hazards of radioactive isotopes, applications of radioactive isotopes in biochemical investigations.

References:

1. The Tools of Biochemistry – Terrance E. Cooper (John Wiley).
2. Analytical Biochemistry – David J Homes and Hazel Peak. Prentice Hall (Longman).
3. A Manual of Radiobiology – John. C. Steward and D.M. Hawcroft.Seattle: University of Washington Press (1977).
4. Practical Clinical Biochemistry –Harold Varley. London William Heinemann.
5. A Biologist's Guide to Principles and Techniques of Practical Biochemistry-K.Wilson and K.H. Goulding, Cambridge University Press; 3rd edition (1991)
6. Physical Biochemistry – K E Van Holde (Prentice-Hall, 1998)
7. Instrumental Methods of Chemical Analysis – Gurdeep R Chatwal and Sham K Anand, Himalayan Publishing House.
8. Practical Biochemistry: Principles and Techniques – Wilson and Walker, Edward Armold, 3rd Edition (1981)
9. Biophysical Chemistry (Principles and Techniques) – A Upadhyay, KUpadhyay and N Nath, Himalayan Publishing House.
10. Protein Purification Methods – Eds. Harris, E.L.V. and Angal.S., IRL-press.
11. Physical Chemistry with application to Biological Systems - Raymond Chang.
12. Principles and Techniques of Biochemistry and Molecular Biology - Keith Wilson and John Walker, Cambridge University Press.
13. Modern Experimental Biochemistry - R.F.Boyer (Ed.), Benzamin Cummings.
14. Experimental Biochemistry - Robert Switzer and Liam Garrity, W.H. Freeman.
15. Biochemical Calculations- Irvin, H. Segel, 2nd Edn., (1976) Jhon Wiley and sons.
16. Principles of Instrumental Analysis- D.A. Skoog, F. J. Holler, S.R. Crouch, Holt-Saunder/ Cengage Learning.

Course Code: B.C-1.3

Name of the Course: CELLULAR AND NUTRITIONAL BIOCHEMISTRY

Batch: 2024-25 Batch onwards

Course Credits: 4	**Total No. of Hours: 64** **No. of Teaching Hours per week: 4 Hrs.**

Course Learning Objectives:

a) To learn structural organization of cell, cell cycle, nutrition, nutrients and nutrition therapy.
b) To understand the structural and functional organization of microbial, animal and plant cells.
c) To acquire knowledge on cellular interactions, cell cycle and processes of cell death.
d) To learn basic principles nutrition, food analysis, energy requirement and dietary nutrients.
e) To acquire knowledge on vitamins and minerals, balanced diet, and nutrition therapy.

Course Outcomes: On successful completion of the course, the students will be able to

a) Describe structural organization of cell, cell cycle, importance of nutrition and nutrients.
b) Distinguish structural and functional organization of microbial, animal and plant cells.
c) Describe ultrastructure of cell, cell cycle and processes of cell death.
d) Explain basic principles nutrition, food analysis, energy requirement and dietary nutrients.
e) Illustrate daily requirement of vitamins, and minerals, and also nutrition therapy.

Unit-I / Module-I **-16 hrs.**

Ultra structure of Cell: Cell classification, cell variability (size, shape, complexity, functions). Structural organization of prokaryotic and eukaryotic cells. Characteristic features and functional difference of plant and animal cell systems. Sub cellular organelles and marker enzymes.

Cell organelles: The ultrastructure of nucleus, mitochondria, chloroplast, endoplasmic reticulum (rough and smooth), Golgi apparatus, lysosomes, peroxisomes and their functions. Plasma membrane structure and composition. Small molecular and bulk transport system across the membrane (brief).

Cytoskeletons: microfilaments, microtubules and intermediate filaments- distribution, types, structure and chemical composition. Cell movement, biological significance and chemotaxis.

Unit-II / Module-II **-16 hrs.**

Cellular interactions: Introduction to cell-cell and cell- matrix interaction, Cell adhesion molecules, extracellular matrix, proteoglycan and collagen, cell- cell adhesion, Catherins. Junction between the cells desomsomes, hemi-desmosomes and tight junctions, communication via gap junctions, plasmadesmata.

Cell cycle: specific events in the cell cycle-G1, S, G2, and M phase. Role of Cyclin and Cyclin-dependant kinases in cell cycle progression. Cdk inhibitor proteins and check points, regulation of the cell cycle. Cell division-Binary fission, mitosis and meiosis-phases and events of karyokinesis and cytokinesis.

Apoptosis and Necrosis: Factors resulting to Cell death. Necrosis –types and physiological signal and cellular changes underlying necrosis. Apoptosis- Programmed cell death. Cellular changes underlying apoptosis. Inflammosomes-role in death of infected cells, autophagy and significance.

Unit-III / Module-III **-16 hrs.**

Principles of Nutrition: Basic principle of balanced diet. Energy source and nutrition, Concepts of macro and micro nutrients, essential nutrients and their classification. Food groups, proximate analysis of foods, chemical and biological analysis for nutrients. Food as source of energy, methods of determining energy value of foods, calorimetry, physiological fuel value, daily requirement of energy, high and low calorie diets. Basal metabolic rate (BMR), factors affecting BMR, specific dynamic action of foods.

Dietary Nutrients: Carbohydrates- Dietary sources, dietary fiber, essentiality of carbohydrates. Proteins- Essential amino acids, evaluation of nutritive value of dietary proteins, PER, BV, nutritional classification of proteins, supplementary value of proteins, protein calorie malnutrition; Kwashiorkor and Marasmus.

Fats-sources, invisible fat, essential fatty acids, PUFA.

Unit-IV / Module-IV **-16 hrs.**

Vitamins and Minerals: Fat soluble and water soluble vitamins, provitamins, antivitamins, dietary sources, daily requirements, structure and function. Deficiency symptoms of B and C vitamins and fat soluble vitamins, hypervitaminosis, vitamin - like compounds. Macro and micro elements, sources, requirements, functions and deficiency symptoms. Water metabolism; distribution in body, water balance and factors affecting water balance.

Diet for nutrition therapy: Balance diet- dietary constitution and importance. Recommended daily allowances (RDA), special nutrition for infants, children, during pregnancy, lactation and old age. Nutrition for diabetes and cardiovascular disease patients. Wellness diets, fitness diets, obesity. BMI (Body mass index) and its significance. Nutraceuticals, types and health importance. Prebiotics and Probiotics; Food as medicine for health and disease management.

References:

1. Molecular Biology of the Cell- Bruce Alberts et al., Garland Publications.
2. Biochemistry – A.L. Lehninger, Worth Publishers/Kalyani Publishers.
3. Principles of Biochemistry – White Handler, Smith et al., McGraw-Hill (1986).
4. Cell and Molecular Biology - Gerald Karp, 4thedition, Wiley publishers.
5. Biochemistry - David Rawn, J. Neil Patterson Publishers (1989).
6. Biochemistry. Ed Donald Voet and Judith G. Voet, John Wiley & Sons, Inc.
7. Biochemistry - Christopher K. Mathews and Van Holde, Pearson Education.
8. Biochemistry - Lubert Stryer, W.H. Freeman and company.
9. Biochemistry - Robert Roskoski, W.B. Saunders company (1996).
10. Principles of Biochemistry - H. Rober Horton et al., Pearson Education.
11. Cell and Molecular biology - E. D. P. De Roberties and E. M. F. De Roberties, Lea and Fabiger International edn.
12. The Cell: A Molecular Approach – G.M. Cooper and R.E. Hausman, ASM Press.
13. Applied Cell and Molecular Biology - Gabinindel Waite and Lee R. Waite, McGraw
14. Hill publishers.
15. Molecular Cell Biology -Dornell, Lodish and Baltimore. WH Freeman, Scientific American Books, New York (1997).
16. Cell biology: Organelle Structure and Function -David E. Sadava, Jones & Bartlett Pubs.

17. Becker's World of the Cell – Jeff Hardin and Gregory Bertoni, Pearson Pub.
18. Cell and Molecular Biology – Phillip Sheeler and Don Bianchi, John Wiley & Sons.
19. Principles of Cell Biology – George Plopper, Jones & Bartlett Publishers.
20. Advanced Textbook on Food & Nutrition-Dr. M. Swaminathan, Volumes 1 & 2, The Bangalore Press.
21. Advanced Nutrition and Human Metabolism - 7th Edn. Sareen S Gropper, Jack L Smith, & Timothy P Carr, Cenage Learning (2018).
22. Introduction to Human Nutrition - 2nd Edn. Michael J. Gibney, Susan A. Lanham-New, Aedin Cassidy, Hester H. Vorster, Wiley-Blackwell (2009).
23. Modern Nutrition in Health and Disease - 10 Ed. Shills et al., Lippincott Williams & Wilkins.
24. Nutrition: Everyday Choices - 1st Edition; Mary B. Grosvenor, Lori A. Smolin Wiley.
25. Bioactive Food as Dietary Interventions for Liver and Gastrointestinal Disease – R. Watson. V. Preedy, Elsevier (2012).
26. Nutrition and Metabolism - 2nd Edn., Lanham S, Mac Donald I and Roche H. The Nutrition Society, London, UK.
27. Introduction to Human Nutrition - 2nd Edn., Gibney M, Lanham S, Cassidy A and Vorster H. The Nutrition Society, London, UK.

Course Code: B.C-1.4

Name of the Course: PHYSIOLOGICAL BIOCHEMISTRY AND MICROBIOLOGY

Batch: 2024-25 Batch onwards

Course Credits: 4	**Total No. of Hours: 64** **No. of Teaching Hours per week: 4 Hrs.**

Course Learning Objectives:

a) To acquaint knowledge on physiological processes and fundamentals of microbiology.
b) To learn about tissues, blood circulation, digestive system and microscopy.
c) To understand respiratory system, cardiovascular system, excretory stem and vision.
d) To acquaint knowledge on nervous system, synaptic transmission and muscle system.
e) To understand fundamentals of microbiology, microbial techniques and microbial diseases.

Course Outcomes: On successful completion of the course, the students will be able to

a) Describe physiological processes in human and fundamentals and techniques of microbiology.
b) Explain about tissues, processes of blood circulation, and digestion.
c) Illuminate respiratory system, cardiovascular system, excretory stem and vision.
d) Describe central and peripheral nervous system, synaptic transmission and muscle system.
e) Explain about fundamentals of microbiology and microbial techniques.

Unit-I / Module-I **-16 hrs.**

Human Physiology

Tissues - Epithelial tissues, Connective tissues, Muscular tissue and Nervous tissue.

Biochemistry of vision- Structure of rod cells and cone cells, photosensitive pigments and mechanism of rod vision -sensory transduction in vision.

Blood and Circulation: Blood composition- formation and functions of erythrocytes, leucocytes and thrombocytes, formed elements, plasma and serum composition and function, hemoglobin and hemostasis. Blood clotting factors and their mechanism, clotting disorders, clot dissolution and anti-clotting factors. Blood volume and its regulation.

Digestive System: Digestion, absorption and assimilation of carbohydrates, dietary fibers, proteins, fats.

Unit-II / Module-II **-16 hrs.**

Excretory system - Anatomy of kidney and nephron, urine formation, urine concentration, waste elimination and micturition. Role of kidney in the regulation of water balance, electrolyte balance and acid-base maintenance.

Respiratory System: Mechanics of respiration and movement of O_2 and CO_2 through lungs, arterial and venous circulation, Bohr effect, O_2 andCO_2 binding hemoglobin. Regulation of respiratory system and waste elimination.

Cardiovascular system - Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG-its principle and significance. Cardiac cycle, cardiac output, Starling hypothesis. Blood pressure and its regulation.

Unit-III / Module-III **-16 hrs.**

Nervous system: Introduction, central and peripheral nervous system. Neuron, glial and other cells of nervous system, myelin sheath composition and function. Resting membrane potential of excitable cells-Nernst and Goldmann equations, initiation and propagation of action potential.

Synapse: Types, properties and synaptic transmissions. General classification of neurotransmitters, agonists and antagonists of neurotransmitters. Neuromuscular junction, neural control of muscle tone and posture.

Muscle System-Types of muscles: Smooth, skeletal and cardiac muscle, contractile and other proteins of muscle. Fine structure of muscle fiber, mechanism and regulation of muscle contraction. Role of calcium and calmodulin in muscle contraction.

Unit-IV / Module-IV **-16 hrs.**

Microbiology - History and scope of microbiology. Five kingdom classification. Classification of microorganisms- based on their mode of nutrition, requirement of physical factors (temperature, pH, salinity, pressure) extremophiles. Study of salient features, structure, life cycle of viruses (T4 phage and λ phage).

Techniques in Microbiology- Sterilization techniques, preparation and composition of media. Staining techniques. Isolation, screening and identification techniques.

Microscopy-Resolving power of microscope. Light microscopy, bright field microscopy, dark field microscopy, phase contrast microscopy, fluorescence microscopy, confocal microscopy, Electron microscopy, SEM and TEM specimen preparation.

Study of growth curve of bacteria, measurement of microbial growth, monophasic, biphasic and synchronous growth. Bacteriostatic, bactericidal agents and antibiotics.

References:

1. Text Book of Biochemistry with Clinical correlations - Thomas Devlin. John Wiley & Sons, New York (1997).
2. Lehninger Principles of Biochemistry -David L. Nelson and Michael Cox. W.H. Freeman and Company- Macmillan Publisher, Seventh Edition (2017).
3. Principles of Human Physiology; Cindy L. Stanfield, Pearson 6th edition (2016).
4. Human Physiology: The Mechanisms of body function - Eric P. Widmaier, Hershel Raff Kevin T. Strang. McGraw-Hill Education.
5. Cellular Physiology & Neurophysiology - Mordecai, P. Blaustein, Elsevier Sci.
6. Human Biochemistry - Orten and Neuhans, 10th Edn. Mosbey International.
7. The Neuron: Cell and Molecular Biology - Irwin B Lavitan, Leonard K Kaczmarck, Oxford University press.
8. Human Physiology: The mechanisms of Body functions - A.J. Vander et al., McGraw-Hill.
9. Molecular Biology of the Cell - Bruce Alberts, Alexander D Johnson, Julian Levis, David Morgan, Martin Raff,New York: Garland Science (2002).
10. Cellular Physiology of Nerve and Muscle - Gary G Mathew, Blackwell Publishing Ltd
11. Text Book of Medical Physiology - Guyton and Hall. Elsevier Saunders.

12. Human Physiology – C.C. Chatterjee. CBS Publishers and Distributors.
13. Microbiology: Principles and applications - John. G. Creager, Jacquelyn, G. Black and Vee. E. Davison, Prentice Hall; Instructor's edition.
14. General Microbiology - Eds. Boyd. R.F. Times Mirror.
15. General Microbiology - Eds. Stanieret.al., Mc. Millan.
16. Text book of Microbiology – W. Burrongles.
17. Fundamental Principles of Bacteriology – A.J. Salle. Tata McGraw Hill Education.
18. Microbiology - Michael Peliczar, E.C.S. Chan, Noel R. Krieg, Tata McGraw Hill Edn.
19. Fundamentals & Principles of Bacteriology - Salle, AJ Tata McGraw-Hill, Davis.
20. Prescott, Harley, and Klein's Microbiology - Christopher J. Woolverton, Joanne Willey, and Linda Sherwood, McGraw-Hill Science pubs.

Course Code: B.C-2.1
Name of the Course: CATALYSTS OF BIOCHEMICAL TRANSFORMATION
Batch: 2024-25 Batch onwards

Course Credits: 4	**Total No. of Hours: 64** **No. of Teaching Hours per week: 4 Hrs.**

Course Learning Objectives:

a) To learn classification, kinetics, inhibition, purification, applications of enzymes; co-enzymes.
b) To acquaint knowledge on classification, specificity, kinetics and active site of enzymes.
c) To study enzyme inhibition, mechanism of enzyme action and kinetics of allosteric enzymes.
d) To learn about multi-substrate enzyme catalyzed reactions, role of cofactors and co-enzymes.
e) To study about multi-enzyme complex, isozymes, purification and application of enzymes.

Course Outcomes: On successful completion of the course, the students will be able to

a) Explain classification, kinetics, inhibition, purification, applications of enzymes; co-enzymes.
b) Illustrate on classification, specificity, kinetics and active site structure of enzyme.
c) Illuminate enzyme inhibition, mechanism of enzyme action and kinetics of allosteric enzymes.
d) Explain about multi-substrate enzyme catalyzed reactions, role of cofactors and co-enzymes.
e) Describe multi-enzyme complex, isozymes, purification and application of enzymes.

Unit-I / Module-I **-16 hrs.**

Introduction - A brief history, classification and nomenclature of enzymes, remarkable properties of enzymes.
Specificity and types of specificity: active site, lock and key hypothesis, induced fit hypothesis.

Kinetics of single substrate enzyme catalyzed reactions: Michaelis-Menten equation, Briggs-Haldane equation, Lineawever-Burk plot, Eadie-Hofstee plot, Hanes plot, Eissenthal and Cornish Bowden plot, Significance of Km and Vmax.

Investigation of active site structure: Trapping the E-S complex, use of pseudo-substrates and affinity labeling reagents; photooxidation, site directed mutagenesis.

Unit-II / Module-II **-16 hrs.**

Enzyme inhibition: Reversible inhibition: Competitive, non-competitive, uncompetitive, mixed and partial inhibition, substrate inhibition and allosteric inhibition, irreversible inhibition, suicide inhibition. Determination of Ki (Dixon plot). The effect of changes in pH, temperature.

Sigmoidal kinetics and allosteric enzymes : Introduction, properties, cooperativity, kinetics of ATCase, MWC model, KNF model, Covalent modification of enzymes, Zymogen activation, amplification of initial signals, substrate cycle, enzyme interconvertible cycles, feedback inhibition, multi-branched feedback inhibition. Mechanism of enzyme action- acid base catalysis, electrostatic and covalent catalysis.

Unit-III / Module-III **-16 hrs.**

Kinetics of multi-substrate enzyme catalyzed reactions: Single displacement reactions, double displacement (ping-pong) reactions, Alberty and Cleland notation, Investigation of reaction mechanisms, primary and secondary plots.
Mechanism of enzyme action without cofactors: Chymotrypsin; Ribonuclease; Lysozyme.

Mechanism of enzyme action with cofactor: Metalloenzymes: Carboxypeptidase A, matrix-metallo protease, monoamine oxidase.

Mechanism of co-enzyme action: Introduction, Nicotinamide nucleotides (NAD^+ $NADP^+$), Flavin nucleotides (FMN and FAD), Thiamine pyrophosphate (TPP), Pyridoxal Phosphate (PLP), Tetrahydrofolate (THF) and coenzyme A (CoA).

Unit-IV / Module-IV **-16 hrs.**

Multi-enzyme complex: Properties and mechanism of action of pyruvate dehydrogenase (PDH) complex, fatty acid synthase and glutamate synthase.

Isoenzymes: Introduction, properties and mechanism of action of lactate dehydrogenase (LDH), ATcase, alcohol dehydrogenase and creatine kinase.

Purification of enzymes: Introduction, objectives and strategy, choice of source, methods of homogenization, separation (based on size / mass, polarity, solubility, specific binding) and criteria of purity.

Applications of enzymes: Immobilized enzymes, preparation and properties, industrial applications of enzymes for biological transformation, biodegradation, fabrication of biosensors and green synthesis of useful products.

References:

1. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry - Trevor Palmer, Philip Bonner, Horwood Publications Ltd, England.
2. Fundamentals of Enzymology - Nicholas Price and Lewis Stevens, Oxford University Press.
3. Lehninger Principles of Biochemistry -David L. Nelson and Michael Cox. W.H. Freeman and Company- Macmillan Publisher, Seventh Edition (2017).
4. Biochemistry - Ed Donald Voet and Judith G. Voet. John Wiley & Sons, Inc.
5. Biochemistry -Jeremy M Berg, John L Tymoczko, and Lubert Stryer. W.H.Freeman and Company, New York (2002).
6. Biochemistry – Lubert Stryer. W.H. Freeman Publishers
7. Biochemistry – A.L. Lehninger, Worth Publishers/Kalyani Publishers.
8. Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis - Robert A. Copeland. Wiley-VCH Pubs.
9. Practical Enzymology - Hans Bisswanger. Wiley-VCH Pubs.
10. Catalysis in Chemistry and Enzymology - William Jencks, McGraw-Hill, New York.
11. Enzyme Kinetics: Behavior and Analysis of Rapid Equilibrium and Steady-State Enzyme Systems - Irwin H. Segel. Wiley Pubs.
12. Fundamentals of Enzyme Kinetics - Athel Cornish-Bowden. Wiley Pubs., New York.
13. Introduction to Enzyme and Coenzyme Chemistry - Tim Bugg. Wiley Pubs., New York.
14. Enzyme Kinetics and Mechanism - Paul F. Cook and W. Wallace Cleland. Garland Sci.
15. Enzyme Kinetics - Alejandro G. Marangoni. Wiley Pubs., New York.
16. Understanding the Control of Metabolism - David Fell. Portland Press.
17. How Enzymes Work: From Structure to Function - Haruo Suzuki. Jenny Stanford Ps.
18. Comprehensive Enzyme Kinetics - Vladimir Leskovac. Springer Pubs.

Course Code: B.C-2.2

Name of the Course: BIOENERGETICS AND INTERMEDIARY METABOLISM

Batch: 2024-25 Batch onwards

Course Credits: 4	**Total No. of Hours: 64** **No. of Teaching Hours per week: 4 Hrs.**

Course Learning Objectives:

a) To learn about bioenergetics, metabolic transformation of biomolecules and regulation.
b) To acquaint basic concepts of thermodynamics, metabolism and oxidative phosphorylation.
c) To study metabolic transformation of glucose, other carbohydrates and regulation.
d) To learn about metabolic transformation of lipids, ROS and oxygen utilizing enzymes.
e) To study metabolic transformation of aminoacids, nitrogen bases and regulation.

Course Outcomes: On successful completion of the course, the students will be able to

a) Explain bioenergetics, metabolic transformation of biomolecules and regulation.
b) Illuminate basic concepts of thermodynamics, metabolism and oxidative phosphorylation.
c) Describe metabolic transformation of glucose, other carbohydrates, energetics and regulation.
d) Illustrate metabolic transformation of lipids, ROS and oxygen utilizing enzymes.
e) Explain metabolic transformation of aminoacids, nitrogen bases and regulation.

Unit-I / Module-I **-16 hrs.**

Thermodynamics: Laws of thermodynamics, free energy, free energy change, enthalpy and entropy. High energy compounds and group transfer reactions. Biological energy transducers, Coupled reactions. Measurement of ΔH and ΔG. Redox systems in biology, redox potential, membrane potentials. Some biochemically important half reactions. Calculation of energy yield from biological oxidation reduction reactions.

Introduction to Metabolism: Anabolism, catabolism, stages in metabolic pathways, compartmentalization and integration of metabolic pathways in cells. General modes for regulation of metabolic pathways.

Oxidative phosphorylation: Mitochondrial electron transport chain, components, iron-sulfur proteins, schematic representation and mechanism of oxidative phosphorylation; role of inhibitors, uncouplers and ionophores in understanding mechanism of oxidative phosphorylation; chemiosmotic theory; substrate level phosphorylation, futile cycles, thermogenesis, brief account on ATP- synthase and P/O ratio.

Unit-II / Module-II **-16 hrs.**

Carbohydrate Metabolism: Introduction, glycolysis, regulation of glycolysis. Fates of pyruvate under aerobic and anaerobic conditions. Feeder pathways for glycolysis and entry of galactose and fructose to glycolysis. Entry of pyruvate and conversion of pyruvate into acetyl CoA. TCA cycle-amphibolic nature, energetics and regulation. Anapleurosis; Glyoxylate cycle. Energetics of glucose oxidation. Alternative pathways of glucose oxidation-HMP-shunt (pentose phosphate) pathway, Glucuronate pathway, Entner-Doudoroff pathway; Gluconeogenesis, Glycogen metabolism-Biosynthesis, degradation and regulation. Transportation of cytosolic NADH by Aspartate-malate and glycerol phosphate shuttle systems. Coris' cycle. Hormonal regulation of carbohydrate metabolism.

Unit-III / Module-III **-16 hrs.**

Lipid metabolism: Degradation of triglycerols, phospholipids and glycolipids. β-oxidation of even and odd numbered fatty acids, energetics of β-oxidation scheme; ω-

oxidation, oxidation of unsaturated fatty acids; Alternate route for fatty acid oxidation – formation of ketone bodies and their oxidation. Biosynthesis of fatty acids, mitochondrial and extra mitochondrial chain elongation and desaturation pathways. Biosynthesis of prostaglandins, leukotrienes and thromboxanes. Biosynthesis of triglycerols, phospholipids and sphingolipids. Regulation of fatty acid metabolism. Hormonal regulation of lipid metabolism. Biosynthesis and degradation of cholesterol and related steroids, regulation of cholesterol synthesis. Integration of lipid and carbohydrate metabolism.

Oxygen utilizing enzymes: Generation of reactive oxygen species (ROS), Role of Mixed function oxidases (Cytochrome P450), hydroxylase and monoxygenase, catalase, peroxidase and superoxide dismutase.

Unit-IV / Module-IV **-16 hrs.**

Nitrogen metabolism: General metabolic reactions of amino acids, oxidative deamination non-oxidative deamination, transamination, role of PLP, decarboxylation, racemization reactions and their mechanisms; Degradation and biosynthesis of individual amino acids. Regulation of amino acid metabolism. Urea cycle and its regulation.

Biosynthesis and degradation of porphyrins. Biosynthesis of Purine and Pyrimidine (*De novo* synthesis), nucleotides and their interconversion. Regulation of biosynthesis, Salvage pathway of Purines and Pyrimidine nucleotides. Biosynthesis of deoxynucleotides and co-enzyme nucleotides. Chemical inhibition of biosynthesis of nucleic acid precursors. Degradation of purines and Pyrimidines.

References:

1. Lehninger Principles of Biochemistry -David L. Nelson and Michael Cox. W.H. Freeman and Company- Macmillan Publisher, Seventh Edition (2017).
2. Biochemistry of Plants - Eds. Stump and Conn. Academic Press (1981)
3. Text Book of Biochemistry with Clinical Correlations–T.M. Devlin, John Wiley&Sons
4. Harper's Review of Biochemistry -D W Martin, Lange Publications (1983).
3. Biochemistry -Geoffrey Zubay, Wm.C. Brown Publishers (1998).
4. Biochemistry -Jeremy M Berg, John L Tymoczko, and LubertStryer. W.H. Freeman and Company, New York (2002).
5. Biochemistry - Ed Donald Voet and Judith G. Voet. John Wiley & Sons, Inc.
6. Students Companion to Stryer Biochemistry –Gumportet al., Freeman (1989).
7. Biochemistry: Mechanisms of Metabolism – Cunninghan, Earlene Brown McGraw Hill Book Publication.
8. Amino Acid Metabolism –David A Bender, Wiley Blackwell.
9. Biochemistry of the Amino acids -Alton Meister,Academic press. Vol I & II 2nd Edition (1965).
10. The Metabolic Basis of Inherited Diseases –John B. Stanbury at al. McGraw Hill, 5th Edition (1983).
11. Biochemistry - David Rawn J, Neil Patterson Publishers(1989).
12. Understanding the Control of Metabolism - David Fell. Portland Press.
13. Biochemistry - The Chemical Reactions of Living Cells. David E Metzler.Vol. I & II. Elsevier Academic Press.
14. Text Book of Biochemistry – E.S. West, W.R. Tood, H.S. Mason, J.T.V. Bruggen. 4th Edition, Macmillan Pubs./Oxford & IBH Pubs. Co. Pvt. Ltd., New Delhi (1966/1974).

Course Code: B.C-2.3

Name of the Course: CLINICAL BIOCHEMISTRY AND TOXICOLOGY

Batch: 2024-25 Batch onwards

Course Credits: 4	**Total No. of Hours: 64** **No. of Teaching Hours per week: 4 Hrs.**

Course Learning Objectives:

a) To study disorders of biochemical transformations and basics of Toxicology.
b) To learn biological sampling, clinical laboratory, disorders of biochemical transformations.
c) To study diseases of digestion, disorders of liver, blood and blood cells, diagnostic enzymes.
d) To learn disorders of kidneys, diagnosis of neurological disorders and clinical pharmacology.
e) To study concepts of toxicology, toxins, toxicity testing, pharmacokinetics detoxification.

Course Outcomes: On successful completion of the course, the students will be able to

a) Illustrate disorders of biochemical transformations and basics of research methodology.
b) Describe biological sampling, clinical laboratory, disorders of biochemical transformations.
c) Explain diseases of digestion, disorders of liver, blood and blood cells, clinical enzymology.
d)Illuminate disorders of kidneys, diagnosis of neurological disorders and clinical pharmacology.
e) Describe concepts of toxicology, toxins, toxicity testing, pharmacokinetics and detoxification.

Unit-I / Module-I **-16 hrs.**

Introduction to Clinical Biochemistry; Biological sampling: collection, preservation and storage of clinical samples- Blood, Urine, CSF and amniotic fluid. Automation in clinical biochemistry laboratory and factors in quality control.

Disorders of carbohydrate metabolism: Glycogen storage disorders, lactose intolerance, pentosuria, galactosemia, fructosuria, hypoglycemia, hyperglycemia, factors influencing blood glucose levels; diabetes mellitus- types, diagnosis of diabetes mellitus, GCT (Glucose Challenge Test) and GTT (Glucose Tolerance Test), glycosylated hemoglobin; role of oral anti-diabetic drugs.

Disorders of lipid metabolism: Significance of plasma lipoproteins, cholesterol, triglycerides and phospholipids in health and diseases; hyperlipidemia, hyperlipoproteinemia, Gaucher's diseases, TaySach's and Niemann-Picks diseases; Abeta-lipopoproteinemia, hypercholesterolemia and atherosclerosis.

Unit-II / Module-II **-16 hrs.**

Disorders of amino acids and nucleotide metabolism: Hyperurecemia, phenylketonuria, alkaptonuria, maple syrup urine, gout, Leish–Nyhan syndrome, albinism, histidinemia.

Digestive diseases: Role of pancreatic enzymes, malnutrition, malabsorption, steatorrhea, pancreatitis, assay of pancreatic enzymes in duodenal content.

Disorders of liver: Functions of liver. Jaundice, hepatitis, liver cirrhosis and fatty liver. Gall bladder stone and its analysis; liver function tests; lipid profiling. role of liver in detoxification of xenobiotics.

Disorders of kidneys: Formation and composition of urine, abnormal constituents of urine. Renal diseases: nephritis, kidney stones; renal function tests; clearance tests; dialysis and kidney transplantation.

Unit-III / Module-III **-16 hrs.**

Hematology and Hematological disorders: significance of plasma proteins and their electrophoretic profile in health and diseases. Hemorrhagic disorders: Hemophilia, Von Willebrand disease, purpura, thalassemia, porphyria.

Diagnosis of neurological disorders: Composition and significance of cerebrospinal fluid, neurological disorders: Meningitis, Alzheimer's disease, Parkinson's disease and multiple sclerosis.

Diagnostic enzymes: Biochemical diagnosis of diseases by enzyme assays –SGOT, SGPT, CPK, cholinesterase, LDH.

Clinical pharmacology: Source and nature of drugs, classification and nomenclature. Basic principles of drug action.

Unit-IV / Module-IV **-16 hrs.**

Toxicology

Introduction and Scope of Toxicology: Definitions-Toxin, toxicant, toxicity and Toxicology. Factors influencing toxicity.

Environmental Toxicology: Toxicants contaminating food; toxicants present in atmosphere; toxicants present in hydrosphere heavy metals; biocides.

Mechanism of action of toxicants: Biochemical basis for the human toxicity of aromatic hydrocarbons (benzopyrene). Toxicant receptors, interaction mechanism of action of pesticides axonic poisons synaptic poisons reactions of acetyl choline esterase and acetyl choline and organophosphate, organochlorine compounds, carbarol, heavy metals, radio-metals and synthetic dyes and dye-intermediates. Occupational toxicity, Drug toxicity and xenobiotic toxicity to different organs.

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Toxicity testing: Genotoxicity, carcinogenicity, teratogenicity and tissue specific toxicity of toxic chemicals and drugs. Cyp assays, cell-based assays. *In vitro* Pre-clinical phase I and Phase II assays, Diagnosis of toxic effects in liver, bladder, pancreas and kidney. Pharmacodynamics study.

Antidotal therapy: Types antidotal procedures: procedure decreasing absorption or translocation of toxicants physical removal of poisons by use of ementics gastric lavage. cathartics Use of chemicals for enhancing termination of action toxicants and specific toxicity test .

Pharmacokinetics: Absorption, distribution and elimination of drugs; routes of drug administration. Drug–protein interactions. Pharmacogenetics; Detection and dose response curves. LD_{50}, ED_{50}, LC_{50} and IC_{50}. Determination of Limit of detection and quantification.

Biochemical mechanisms of detoxification: Role of liver and kidney in detoxification. Hydroxylation, deamination, dehalogenation, desulfuration, epoxidation, peroxygenation, and reduction. Metabolism of xenobiotics – Role of Phase-1 detoxification enzymes: monooxygenases or cytochromes P450, non-P450 enzymes. Role of Phase-2 detoxification enzymes: Glucuronyl transferase, sulfonyl transfease, acetyl transferase, glutathione-S-transferase.

References:
1. Text Book of Biochemistry with Clinical Correlations – Thomas H. Devlin
2. Clinical Biochemistry –Controw & Trumper, , W.B. Saunders Pub (1986).
3. Harper's Review of Biochemistry with Clinical Correlations –D W Martin et al.
4. Principles of Biochemistry – A. White, P. Handler &E. Smith, McGraw – Hill.
5. Clinical Chemistry In: Diagnosis and Treatment – J. Zilva, P. Pannal.
6. Essentials of clinical pathology - Shirish M. Kawthalkar. JPB1st edition (2010).
7. Clinical pathology, hematology and blood banking – Maheshwari Nanda, JPB.
8. Clinical pathology - James carton, Richard Dallyand P Ramani,OUP Oxford.
9. Molecular Toxicology; Nick Plant, Garland Science (2003).
10. Introduction to Exotoxicology, En. D.W. Connell, Blackwell Scientific (2000).
11. Molecular Pharmacology, ed. T. Kenakin, Blackwell Science Inc (1997).
12. Toxicological Chemistry and biochemistry; Manahan, Stanley E. CRC Press LLC (2003).
13. Concepts of Toxicology. Ed. Dr. Omkar, Shobanlal Nagih. Chand & Co., New Delhi (1994).

Course Code: B.C-2.4
Name of the Course: MOLECULAR INHERITANCE AND DEVELOPMENTAL BIOLOGY
Batch: 2024-25 Batch onwards

Course Credits: 4	**Total No. of Hours: 64** **No. of Teaching Hours per week: 4 Hrs.**

Course Learning Objectives:
a) To study fundamental concepts of inheritance and basic concepts of developmental biology.
b) To learn basic principles of inheritance and sex-linked inheritance.
c) To study sex determination, eukaryotic chromosomes gene mapping and recombination.
d) To learn extrachromosomal inheritance, human genetics, mutations, chromosomal alterations.
e) To study basics of development, gametogenesis, morphogenesis and theories of evolution.

Course Outcomes: On successful completion of the course, the students will be able to
a) Illustrate fundamental concepts of inheritance and basic concepts of developmental biology.
b) Explain basic principles of inheritance and sex-linked genes and pattern of inheritance.
c) Describe sex determination, eukaryotic chromosomes gene mapping and recombination.
d) Explain extrachromosomal inheritance, human genetics, mutations, chromosomal alterations.
e) Illustrate basics of development, gametogenesis, morphogenesis and theories of evolution.

Unit-I / Module-I **-16 hrs.**

Mendelian Principles: Principle of segregation, monohybrid crosses, Dominance, recessiveness, Principle of independent assortment, dihybrid ratios.

Concept of gene: Allele, multiple alleles- ABO blood type alleles and Rh factor alleles in man; Pseudo allele, complementation test.

Extension of Mendelian principles: Co-dominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, Phenocopy, linkage and crossing over.

Sex linkage and Sex-linked inheritance: Sex linkage, Morgan's discovery of sex linked inheritance, Pattern of inheritance of sex linked genes, X-linked traits in humans, deleterious recessive sex-linked genes in man. Sex liked gene expression. Sex influenced dominance & sex limited character.

Unit-II / Module-II **-16 hrs.**

Sex determination: Mechanism of sex determination, identification of sex chromosomes, XX-XY mechanism of sex determination, the Y-chromosome and sex determination in mammals, the balance concept of sex determination in drosophila, environmental factors and sex determination, dosage compensation.

Organization of Eukaryotic chromosome: Histones and Non-histones, Nucleosomes, Higher order of organization, Chromosomal banding, Gene structure in eukaryotes, pseudogenes, gene clusters, spacers, single copy genes, repetitive sequences, tandem gene clusters, RNA genes, histone genes.

Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids.

Recombination: Homologous and Non-homologous recombination. Recombination and crossing over, Site specific recombination, Holliday model, Transposable elements.

Unit-III / Module-III **-16 hrs.**

Extrachromosomal Inheritance: Criteria for extrachromosomal inheritance, cytoplasmic organelles, organization of mitochondrial and Plastid DNA.

Microbial Genetics: Methods of genetic transfers-Transformation, Conjugation, Transduction and Sexduction. Mapping genes by interrupted mating, Fine structure analysis of genes.

Human Genetics: Pedigree analysis, lod score for linkage testing, Karyotypes, genetic disorders.

Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTZ mapping.

Mutation: Nature of mutation and mutagens, different kinds of mutation, detection and isolation of mutants, temperature sensitive mutants, Mechanism of mutation, Utility of mutants, Insertional mutagenesis.

Structural & Numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, Ploidy and their genetic implications.

Unit-IV / Module-IV **DEVELOPMENTAL BIOLOGY** **-16 hrs.**

Basic concepts of development: Potency, commitment, specification, induction, competency, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.

Gamatogenesis and Fertilization in Animals: Production of gametes, cell surface molecules in sperm egg recognition in animals, embryo sac development, zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals, embryogenesis.

Morphogenesis and Organogenesis: Cell aggregation and differentiation, axes and pattern formation in Drosophila, amphibian, and chick, organogenesis, post embryonic development, metamorphosis, environmental regulation of normal development.

Emergence of Evolutionary Thoughts : Theories of evolution, Concept of Oparin and Haldane; experiment of Miller, neutral evolution, divergent evolution , convergent evolution, evolutionary time scale, Eras periods and Epoch, molecular clocks.

Molecular Evolution: Population genetics- population, gene pool, gene frequency, Hardy-Weinberg law, concept and rate of change in gene frequency, through natural selection, migration and random genetic drift. Speciation; Allopatricity and Sympatricity speciation.

References:

1. Principle of Genetics - Gardner, Simmons and Snustad, Wiley, 8th Edition.
2. Molecular Cell Biology 2nd Edition–James Darnell, Harvey Lodish, and David Baltimore, Scientific American Inc; 2nd Edition(1990).
3. Molecular Biology of the Gene –J.D. Watson et al. Pearson, 7th Edition (2013).
4. Genes - Benjamin and Lewin. Jones and Bartlett Publishers.
5. The Tex Book of Genetics - U. Goodenough, 3/Ed. Saunders College Publishing.
6. Lehninger Principles of Biochemistry -David L. Nelson and Michael Cox. W.H. Freeman and Company- Macmillan Publisher, Seventh Edition (2017).
7. Genetics - M.W. Stickberger, Macmillan Publisher.
8. Principles of Genetics - Peter Snustad and Michael J. Simmons. Wiley, New York.
9. Biochemistry -Jeremy M Berg, John L Tymoczko and Lubert Stryer. W.H. Freeman and Company, New York.
10. Genetics: A Conceptual Approach - Benjamin A. Pierce. Macmillan Publishers.
11. Genetics – Edgar Altenberg.
12. Introduction to Genetics: A Molecular Approach - T. A Brown. CRC Press.
13. Human Molecular Genetics - Tom Strachan and Andrew Read, Bioscientific Publishers Ltd.
14. Genetics Essentials: Concepts and Connections - Benjamin A. Pierce. W.H. Freeman & Co. Pubs.
15. Cell and Molecular Biology - Gerald Karp, Janet Iwasa and Wallace Marshall.
16. Biochemistry - Ed Donald Voet and Judith G. Voet. John Wiley & Sons, Inc.
17. Biochemistry - Geoffrey Zubey Browder, L.N.C.A. Erickson, W.R. Jeffery, (1991).
18. Developmental Biology – S. F. Gilberts, Sinauer Associates Inc.
19. Gene Activity in Early Development - Eric H. Davidson, Academic Press, New York.
20. Development – The Molecular Genetic Approach. Springer – Verlngberten.
21. Cytology Genetics and Evolution- P.K. Gupta
22. Genetics, Evolution and Cell Biology – Verma and Agarwal. S Chand; Reprint Edn (2006).
23. Genetics – Ursula Goodenough. Elsevier; 2nd edition (1984).
24. Gene Control – David Latchman. Garland Science Pubs.

Course Code: B.C-3.1

Name of the Course: MOLECULAR BIOLOGY

Batch: 2024-25 Batch onwards

Course Credits: 4	**Total No. of Hours: 64** **No. of Teaching Hours per week: 4 Hrs.**

Course Learning Objectives:

a) To learn central dogma, DNA replication, gene expression, damage and repair mechanisms.
b) To study DNA as genetic material, DNA replication in prokaryotes and eukaryotes.
c) To acquire knowledge on DNA-protein, protein-protein interactions and DNA transcription.
d) To learn translation in prokaryotes and eukaryotes, post-translational modifications of proteins.
e) To study regulation of gene expression, DNA damage and repair in prokaryotes and eukaryotes.

Course Outcomes: On successful completion of the course, the students will be able to

a) Illustrate central dogma, DNA replication, gene expression, damage and repair mechanisms.
b) Explain DNA as genetic material, DNA replication in prokaryotes and eukaryotes.
c) Describe DNA-protein, protein-protein interactions and DNA dependent RNA synthesis.
d) Explain genetic code, protein synthesis, post-translational modifications and targeting.
e) Illustrate regulation of gene expression, DNA damage and repair in prokaryotes and eukaryotes.

Unit-I / Module-I **-16 hrs.**

Introduction to Molecular Biology; Central Dogma; Experimental evidences for DNA as genetic material.

DNA Replication in prokaryotes and eukaryotes: Basic rules for replication of all nucleic acids; Messelson and Stahl experiment; Universality of semi-conservative DNA replication; Okazaki experiments; geometry and topological constraints of DNA replication; DNA super coiling; linking number, key enzymes of DNA replication, events on replication fork, fidelity of DNA replication; *De novo* initiation, Covalent extension mode of initiation. Models of viral DNA replication: ϕX174 DNA; Adenovirus, SV-40, M13-phage DNA replication; Qβ virus and HIV RNA replication. Inhibitors of *E. coli.* DNA replication; replication of eukaryotic chromosomal DNA; telomerase and telomeric sequences; regulation of DNA replication and inhibitors.

Unit-II / Module-II **-16 hrs.**

Transcription: DNA – protein interactions; protein-protein interactions; the organization of transcriptional units-structural genes and regulatory sequences; basic features of RNA; polynucleotide phosphorylase; prokaryotic transcription- RNA polymerase; transcription factors; different modes of transcription termination; regulation of transcription and inhibitors; Eukaryotic transcription-eukaryotic RNA polymerases; regulatory sequences; exons and introns; transcription factors; mechanism of splicing; regulation of transcription and inhibitors. Post-transcriptional modifications of hnRNA; processing and generation of rRNAs and tRNA. RNA enzymes and their characteristic features.

Unit-III / Module-III **-16 hrs.**

Translation: Genetic code and properties; deciphering the genetic code-Nirenberg and Khorana's contributions; The genetic code of mitochondria and exceptions to the universal code; t-RNA structure; prokaryotic and eukaryotic translation factors; codon-anti-codon interaction; role of aminoacyl-tRNA synthetases; composition of ribosomes; Prokaryotic translation process and regulation. Eukaryotic translation process and regulation. Inhibitors of translation. Post–translational modifications- signal peptide hypothesis, role of cell organelles, protein sorting and targeting, protein turnover and role of ubiquitin system.

Unit-IV / Module-IV **-16 hrs.**

Regulation of gene expression: General aspects of regulation of gene expression. DNA-protein and protein-protein interactions. Regulation of gene expression in prokaryotes; operon concept; fine structure of 'lac' operon and its regulation. The dual promoters – 'gal' operon model. Dual functions of the repressor – 'Ara' operon. 'Trp' (biosynthesis) operon, transcriptional control by attenuation and mechanism of attenuation. Regulation of gene expression in eukaryotes; a brief account on DNA methylation and heterochromatin. RNA mediated regulation of gene expression, RNA intereference and riboswitches.

DNA Damage and Repair: Nature of Mutations-transitions, transversions; point mutations. DNA damage by chemical agents and radiation - deamination, depurination, alkylation, oxidation nucleotide bases and pyrimidine dimerization. DNA damage caused by base analogues and intercalating agents. Recognition, mechanism of DNA damage and dynamics of DNA repair. DNA repair systems – Photoreactivation repair, excision repair, nucleotide excision repair, recombinational repair, double-strand break repair and transleision DNA synthesis (SOS repair).

References:

1. Molecular Biology– David Freifelder, Narosa Publishers (1987).
2. Essential of Molecular Biology – David Freifelder.
3. Microbial Genetics – David Freifelder, Jones and Bartlett Publishers.
4. Genes –Series-V to XI – Benjamin & Lewin, Jones and Bartlett Publishers.
5. Molecular Biology of the Gene – J.D. Watson et al., Pearson Publishers.
6. Molecular Biology - David Clark Nanette Pazdernik Michelle McGehee. Academic.
7. Principles of Biochemistry - Geoffrey Zubey, Wm.C. Brown Publishers.
8. Molecular Biology of the Cell – Davidson, Lodish, Darnell and Baltimore.
9. Molecular Biology –Robert F Weaver. McGraw-Hill Higher Education.
10. Landmark Experiments in Molecular Biology – Michael Fry. Academic Press.
11. Molecular Biology: Concepts for Inquiry – Jennifer A Hackett.
12. Molecular Biology: Genes to Proteins - B. E. Tropp. Jones and Bartlett Publishers.
13. Recombinant DNA: Genes and Genomes - James D. Watson et al., W.H. Freeman Pubs.
14. Fundamental Molecular. Biology- Lizabeth A. Allison. Wiley-Blackwell Pubs.
15. Lehninger Principles of Biochemistry -David L. Nelson and Michael Cox. W.H. Freeman and Company- Macmillan Publisher, Seventh Edition (2017).
16. Biochemistry –Donald Voet and Judith G. Voet. John Wiley & Sons, Inc.
17. Molecular Biology of the Cell- Bruce Alberts et al., Garland Publications.
18. Genetics and Molecular Biology - Robert F. Schleif. John Hopkins University Press.
19. Nucleic acid Biochemistry and Molecular Biology - Mainwaring W.I.P et al., Blackwell Scientific Publications.
20. Nucleic Acids in Chemistry and Biology - G Michael Blackburn, et al., RSC Pubs.
21. The Biochemistry of Nucleic acids - Roger L. P. Adams, John T. Knowler, David P. Leader, Springer Nature, Switzerland AG.
22. Biochemistry - Geoffrey Zubay, Brown publications.
23. Genetics – Ursula Goodenough. Elsevier; 2nd edition (1984).
24. Gene Control – David Latchman. Garland Science Pubs.

Course Code: B.C-3.2

Name of the Course: MEMBRANE BIOCHEMISTRY, BIOSTATISTICS AND COMPUTER APPLICATIONS

Batch: 2024-25 Batch onwards

Course Credits: 4	**Total No. of Hours: 64** **No. of Teaching Hours per week: 4 Hrs.**

Course Learning Objectives:

a) To learn membrane composition and transport; basics of biostatistics and computer applications.
b) To study composition of biological membrane and motion of membrane constituents.
c) To acquire knowledge on various transport systems across biological membranes.
d) To learn fundamentals of biostatistics and applications in biological data analysis.
e) To acquire knowledge on computers applications in data storage and analysis, networking.

Course Outcomes: On successful completion of the course, the students will be able to

a) Explain membrane composition and transport; basics of biostatistics and computer applications.
b) Illuminate composition of biological membrane and motion of membrane constituents.
c) Describe various transport systems across biological membranes of prokaryotes and eukaryotes.
d) Explain fundamentals of biostatistics and applications in biological data analysis.
e) Illustrate computers applications in data storage and analysis; basics of networking and internet.

Unit-I / Module-I **-16 hrs.**

Introduction to biological membranes.

Molecular constituents of membrane: Lipid composition, Proteins, Sterol, Carbohydrates.

Motion of membrane lipids and proteins: lateral and flip-flop, role of flippases.

Membrane proteins: peripheral proteins and integral proteins. Membrane asymmetry, protein-lipid interactions, factors affecting membrane fluidity. The supramolecular architecture of membrane: Unit membrane hypothesis, fluid model, fluid-mosaic model. Techniques used to study membrane structure: freeze fracture, fluorescence microscopy, and Patch-clamp technique.

Unit-II / Module-II **-16 hrs.**

Membrane transport: Introduction to membrane transport, thermodynamics of membrane transport, Non-mediated transport systems, mediated transport systems (primary and secondary active transport), group translocation, co-transport.

Organization of transport system: Homocellular, Transcellular, Intracellular. Example of carrier mediated transport system. 1. Human erythrocyte glucose transporter

Examples of active transport system: 1. Sodium potassium ATPase- Discovery, specificity, stoichiometry, structure, model, inhibitors. 2. Amino acid transport by γ-glutamyl cycle 3. ATP-ADP exchanger.

Specialized mechanism for transport of macromolecules: Molecular architecture of nuclear pore complex, nuclear localization signals, import and export of proteins and nucleic acids.

Bacterial transport system: Lactose permease, PEP-dependent phosphor transferase, bacterial porins.

Ionophores: Introduction, classification, cation carriers, channel formers.

Unit-III / Module-III **-16 hrs.**

Biostatistics: Aim , scope, definition and elementary idea of statistics in biology; Basic terminology - population, sample, variable, parameter, primary and secondary data, screening and representation of data, tabulation and diagrammatic representation of statistical data, pie charts.

Measures of central tendency and dispersion: mean, median, mode, quartiles and percentiles. Measures of dispersion; range, variance, standard deviation, standard error, coefficient of variation, symmetry, measures of skewness and kurtosis.

Bivariate data: Scatter plot, correlation coefficient(r) - positive and negative correlation, properties (without proof), interpretation of r, linear regression. Fitting of lines of regression, regression coefficient, and coefficient of determination. Tests of significance: Sample test (chi square, t-test, F –test), large sample test (Z test) and standard error, p value of the statistics, ANOVA- one way and two way classification.

Unit-IV / Module-IV **-16 hrs.**

Introduction to computers: Basic components of computers- hardcore, CPU, input, storage devices, software, concept of file, folders and directories, commonly used commands, flow charts and programming techniques. Introduction in MS OFFICE, software concerning word, processing, spreadsheets and presentation software, operating system. Introduction to MS WORD, word processor- editing, copying, moving, formatting, table insertion, drawing flow charts.

Application of computer in biostatistics: Introduction to MS Excel – use of worksheet to use of in-built statistical functions for computations of mean, SD, correlation, regression coefficient etc. Use of bar diagram, histogram, scatter plots etc., graphical tools in EXCEL for presentation of data.

Networking concepts: networking fundamentals, client, server, LAN, WAN, Flp, TelNET, INTERNET, NIC NET, WWW, html, email, introduction to MEDLINE, eCODand PUBMED, for accessing biological information.

References for Membrane Biochemistry:

1. Biochemistry of antimicrobial action - T. J. Franklin, George Alan Snow, Chapman and hall 5thedition (2015).
2. Biochemistry- Geoffrey Zubay Addision Wesly, 2014.
3. Biochemistry -Jeremy M Berg, John L Tymoczko, and Lubert Stryer. W.H. Freeman and Company, New York (2002).
4. Biochemistry with clinical correlation. Thomas M. Devlin 6th Edition(2014).
5. Membrane and their cellular functions- J. B. Finean, R. Coleman & R.H. Michell, 5th ed Black John Wiley & Sons publishers, Oxford press (2014).
6. Ann. Rev. Biochemistry (1986) and Ann. Rev. Biochemistry (1998).

References for Biostatistics and Computer Applications: Statistics in biology –

7. Bliss , C .I.K Mc. Graw Hill New York (1967).
8. Practical statistics for experimental biologist - Wardlaw, A.C, John Wiley and Sons (1985).
9. How computers work – Ron white, Tech media.
10. Statistical methods in biology – Norman T. J. Bailey, Cambridge University Press (2012).
11. Biostatistics – W Daniel, John Wiley & Sons; 7thRevised edition (2004).
21. Fundamentals of Biostatistics by Khan and Khanum.
22. INTERNET- CDC publication India.

Course Code: B.C-3.3

Name of the Course: HORMONES AND CELLULAR COMMUNICATION

Batch: 2024-25 Batch onwards

Course Credits: 4	**Total No. of Hours: 64** **No. of Teaching Hours per week: 4 Hrs.**

Course Learning Objectives:

a) To learn about endocrine glands, classification and functions of hormones, and cell signalling.
b) To study endocrine system, structural and function of hormones and growth factors.
c) To neurotransmitters, second messengers and mechanism of action of hormones.
d) To acquaint cell signalling cascade, receptors and their classification, signalling proteins.
e) To study intracellular signalling, protein kinases, cancer and apoptosis signalling.

Course Outcomes: On successful completion of the course, the students will be able to

a) Illuminate endocrine glands, classification and functions of hormones, and cell signalling.
b) Describe endocrine system, structural and function of hormones and growth factors.
c) Illustrate neurotransmitters, second messengers and mechanism of action of hormones.
d) Explain cell signalling cascade, receptors and their classification, and also signalling proteins.
e) Illustrate intracellular signalling, protein kinases, cancer and apoptosis signalling.

Unit-I / Module-I **-16 hrs.**

Introduction to endocrine system: An over view of Mammalian endocrine system-Location and inter-relationship of endocrine glands in man. Endocrine, Paracrine and autocrine secretions. Local hormones, neuroendocrine secretions and neurotransmitters.

Definition of Hormone, classification and chemistry of hormones produced by hypothalamus, pituitary, thyroid, parathyroid, pancreas, adrenals, gonads and GI tract. Functions and abnormalities due to over and under production of the hormones secreted by pituitary, thyroid, parathyroid, pancreas, adrenals and gonads. Regulation of hormone production and release.

Pineal gland – Melatonin and circadian rhythm.

Growth factors: Structure, mechanism of action and receptor-EGF, PDGF, IGF.

Chalones: Definition and Functions.

Unit-II / Module-II **-16 hrs.**

Neurotransmitters and Receptors: Mechanism of actions of neurotransmitters-Acetylcholine, catecholamine, serotonin, L-DOPA; amino acids- glutamate, aspartate, GABA, glycine, and neuropeptides like somatostatin/enkephalins. Structure, subtypes and functions of receptors of ACh, GABA, glycine, serotonin, glutamate and peptide neurotransmitters; activation by ligands and interaction with effectors. Biochemical basis of neurological diseases.

Mechanism of hormone action:

Membrane-bound, cytoplasmic and nuclear hormone receptors, regulation of receptor number.

Signal transduction- Second messengers- Definition, structural and functional classification and functions of second messengers like cAMP, CREB, cGMP, phosphoinositides, arachidonic acid, diacylglycerol, Ca^{2+} and nitric oxide (NO). Role of second messengers and protein kinases.

Termination of hormone action and metabolism of hormones, conversion of cholesterol to steroid hormones; Production and Mechanism of paracrine action of prostaglandins, prostacylins, thromboxanes and leukotrienes. Anti-hormones.

Unit-III / Module-III **-16 hrs.**

Definition of Cell Signaling, general principles of cell signaling and communication; various forms of communication between cells; signaling process and its stages – Signal recognition, transduction and cellular effect; Types of cell signaling – Autocrine signaling, Direct contact signaling, Paracrine signaling, Synaptic signaling, Endocrine (Distance) signaling.

Signal Recognition: Characteristic features and classification of Receptors.
Cell surface receptors - G-protein coupled receptors, cytokine receptors, Receptor tyrosine kinases, TGFβ receptors, Hedgehog (Hh) receptors, Wnt receptors, Notch receptors; Regulation of receptor functions.
Intra cellular receptors - Receptors for nitric oxide, steroid hormone receptors, and thyroid hormone;
Signaling proteins: Adaptors, activators, bifurcators, integrators and effectors. Effectors on intracellular signaling- Adenylate cyclase, Phospholipase–C, Nitric oxide synthase, guanylate cyclase and their activation.

Unit-IV / Module-IV **-16 hrs.**

Intracellular signaling: Downstream cascades of Receptor Tyrosine Kinase, Extracellular-signal-regulated kinases (Erk), MAPK-Ras–Raf, SoS signaling pathways; Regulation of signaling cascades, positive modulation and negative modulation.

Protein Kinases: Structural characteristics of protein kinases. **F**unctional classification of protein kinases; Ca^{2+}/calmodulin-dependent protein kinases, CdKs, GSK, RLKs types and specificity; structure and regulation of protein kinases and role of phosphatases. Integration of cell signaling pathways.

Cancer: Transformation of normal cell to tumor causes of cancer. Genetic rearrangements in progenitor cells; oncogenes; tumor suppressor genes and their activation by P53 and TGF–β; cancer and the cell cycle; benign, malignant and metastasis.
Apoptotic signaling - Pro– and anti–apoptotic signaling. Role of MAP/Erk in cell death; Regulation of apoptosis by Bcl–2; Classification, structure and functions of caspases and their cascade in apoptosis. Preventive and therapeutic interventions for cancer.

References:

1. Principles of Biochemistry: Mammalian Biochemistry - Emil Smith, Robert Hill, Robert Legman, Robert Lefkowitz, Philip Handler, Abraham White. Published by McGraw-Hill.
3. Hormones - Norman, Anthony W., Litwack, Gerald. Academic Press (2014).
4. Essential Endocrinology – Brook, Charles, Marshall and Nicholas J. John Wiley & Sons.
5. Endocrinology and Metabolism - Felig, Philip, Frohman, Lawrence A. McGraw-Hill Professional Publishing.
6. Endocrinology – Hadley, Mac E., Levine, Jon E. Addison-Wesley Publishers.
7. Text Book of Biochemistry with Clinical Correlations – Thomas H. Devlin.

8. Clinical Biochemistry – Controw & Trumper, W.B. Saunders Pub (1986).
9. Harper's Review of Biochemistry with Clinical Correlations - Ed. Martin et al.
10. Outlines of Biochemistry – Abraham White, Philip Handler, Emil Smith.McGraw – Hill publisher.
10. Lehninger Principles of Biochemistry -David L. Nelson and Michael Cox. W.H. Freeman and Company- Macmillan Publisher, Seventh Edition (2017).
11. Annual Reviews of Biochemistry – Volumes.
12. Molecular Cell Biology– James Darnell, Harvey Lodish, and David Baltimore, Scientific Amer Inc.
13. Molecular Biology of the Cell - Bruce Alberts, Alexander D Johnson, Julian Levis, David Morgan, Martin Raff, New York.
14. Molecular Endocrinology - Franklyn Bolander. Academic press, 3rd Edition (2014).
15. Basic Medical Endocrinology -H Maurice Goodman. Academic press. Academic Press; 4th edition (2008).
16. Introduction to Endocrinology -Negi, Chandra S, Prentice Hall India Learning Private Limited. New Delhi (2009).
17. Vertebrate Endocrinology. David O Norris, James A Carr, Academic press. 5th Edition (2013).
18. Williams Textbook of Endocrinology - Shlomo Melmed Kenneth Polonsky P. Reed Larsen Henry Kronenberg, Saunders (2011).
19. Knobil & Neill's Physiology of Reproduction, J.D. Neill, Academic Press Elsevier, 4th Edition.
20. Biochemistry of Signal Transduction and Regulation, Gerhard Krauss (2014). Wiley-VCH Verlag GmbH & Co.
21. The Biochemistry of Cell signaling; Ernst J.M. Helmreich (2001), Oxford University Press.
22. Signal transduction and human disease; Toren Finkel, and J. Silvio Gutkind (2003), John Wiley & Sons, Inc.
23. Text Book of Cell signaling and cancer; Jacques Robert (2019) Springer Publishers.
24. Cell Signaling-Principle and Mechanism; Wendell Lim, Bruce Mayer, Tony Pawson (2014); Garland Science press.
25. When Cells Die; A Comprehensive Evaluation of Apoptosis And Programmed Cell Death; Richard, A. Lockshin, and Zahra Zakeri (2003), Wiley Liss.

Course Code: B.C-3.4

Name of the Course: PLANT BIOCHEMISTRY AND SPECIALIZED CHEMICALS

Batch: 2024-25 Batch onwards

Course Credits: 4	**Total No. of Hours: 64** **No. of Teaching Hours per week: 4 Hrs.**

Course Learning Objectives:

a) To study plant-cell, growth regulators, metabolism, biotic and abiotic stress responses.
b) To acqaint knowledge on plant cell, photosynthesis, plant cell membranes and transport.
c) To learn about plant growth regulators, totipotency, *in vitro* plant regeneration.
d) To learn plant responses during biotic and abiotic stresses.
e) To study plant specialized metabolism, specialized chemicals and overproduction strategies.

Course Outcomes: On successful completion of the course, the students will be able to

a) Illustrate plant-cell, growth regulators, metabolism, biotic and abiotic stress responses.
b) Describe plant cell, photosynthesis, photorespiration, plant cell membranes and transport.
c) Illustrate plant growth regulators, totipotency, *in vitro* plant regeneration and callogenesis.
d) Describe plant responses to various biotic (pathogen) and abiotic (environment) stresses.
e) Explain plant metabolism, specialized chemicals and strategies for overproduction.

Unit-I / Module-I **-16 hrs.**

Plant cell- structure, anatomy and molecular components; Cytoskeleton- an overview. Plant cell cycle and its regulation. Energy production in plant cells and its control. Carbon assimilation and other related pathways; An overview of photosynthesis; C3, C4 plants and crussulacean acid metabolism (CAM); photorespiration; Significance of RUBiSCO. Structure, function and mechanism of action of phytochromes, cryptochromes and phototropins.

Plant cell membranes and membrane transport: Introduction to plant cell membranes and membrane constituents. Organization of transport systems across plant membranes; Different types of pumps operate at plant cell and organelle membranes; classification and importance of H^+-ATPases. Ion channels-properties and significance; Aquaporins and water transport.

Unit-II / Module-II **-16 hrs.**

Plant growth regulators and Tissue Culture: Biosynthesis, and functional significance of auxins, cytokinins, gibberellins, abscisic acid, ethylene, brassinosteroids, polyamines, jasmonic acid, salicylic acid.

An overview of plant tissue culture – Totipotency of plant cell; preparation and surface sterilization of explants; composition and constituents of regular media, conditions for culture maintenance. Influence of plant growth regulators on *in vitro* plant regeneration, callogenesis.

Unit-III / Module-III **-16 hrs.**

Plant Primary Metabolism

Metabolism of sucrose and starch. Sulfur metabolism, non-protein thiols and sulfur cycle. Nitrogen metabolism -Symbiotic nitrogen fixation, nitrate and ammonium assimilation.

Plant biotic stress responses: Introduction; An overview of plant pathogens and diseases; Host-pathogen interactions and plant defense responses - hypersensitive response; systemic acquired resistance; induced systemic resistance; Plant biotic stress response-pathogen and insects.

Plant abiotic stress responses - Salt stress, drought and heavy metal stress responses; osmotic adjustment and significance of osmotic agents such as proline, sugar alcohols and quaternary ammonium compounds; An overview of oxidative stress and oxidative damage. Antioxidant enzymes and stress tolerance. Phytoremediation.

Unit-IV / Module-IV **-16 hrs.**

Plant-specialized chemicals (Secondary Metabolites): Introduction; Classification of plant-specialized chemicals. Sub-classification of alkaloids, phenolics and terpenoids. Classification of flavonoids. An overview of primary metabolism contribution to specialized chemicals (secondary metabolites) biosynthesis.

Amino acids as precursors for biosynthesis of alkaloids. Tyrosine derived alkaloids; Tryptophan derived alkaloids. Important routes (pathways) of specialized chemicals (secondary metabolites) biosynthesis- phenylpropanoid pathway; Acetate-mevalonate pathway; Biogenic isoprene rule; Acetate-malonate pathway.

Strategies and approaches for the over production of plant secondary metabolites - plant cell suspension cultures, hairy root cultures, metabolic engineering, heterologous gene expression and combinatorial biochemistry.

References:

1. Lehninger's Principles of Biochemistry - Nelson & Cox. CBS Publishers & Distributors.
2. Biochemistry –Donalt Voet and Judith G Voet. John Wiley and Sons.
3. Biochemistry –Lubert Stryer et al. W.H. Freeman & Company, New York.
4. Principles of Biochemistry - Moran, Horton, Scrimgeour, Perry. Pearson, 5thEdition (2011).
5. Plant Biochemistry - P.M. Dey & J.B. Harborne. Hart Court Asia Pte Ltd.
6. Plant Biochemistry and Molecular Biology - P. Lea & Richard C Leegood. John Wiley & Sons.
7. Introduction to plant Biochemistry - Goodwin and Mercer. CBS Publisher and Distributors.
8. Biochemistry and Molecular Biology of Plants - Buchanan, Greussem and Jones. American Society of Plant Physiologists.
9. Review articles published in, The Plant Cell, Plant Molecular Biology.
10. Articles published in Annual Review of Plant Biology, Annual Review of Plant Physiology and Molecular Biology.
11. Articles published in Trends in Plant Sciences.
12. Plant Cell Tissue and Organ Culture: Fundamental Methods - O.L. Gamborg& G.C. Phillips Narosa Publishers, New Delhi (1995).

Course Code: B.C-3.5(A)
Name of the Course: CLINICAL BIOCHEMISTRY (Interdisciplinary-Elective Paper)
Batch: 2024-25 Batch onwards

Course Credits: 2	**Total No. of Hours: 32** **No. of Teaching Hours per week: 3 Hrs.**

Course Learning Objectives:

a) To learn about body fluids and tests for clinical diagnosis and disorders of metabolism.
b) To acquire knowledge on body fluids, clinical diagnosis, liver and kidney function tests.
c) To study disorders associated with bimolecular metabolic transformations.

Course Outcomes: On successful completion of the course, the students will be able to

a) Explain fundamentals of clinical diagnosis and disorders of bimolecular transformations.
b) Illustrate the significance of body fluids, clinical diagnosis, liver and kidney function tests.
c) Describe disorders associated with bimolecular metabolic transformations.

Unit-I / Module-I **-16 hrs.**

Introduction and Scope of clinical Biochemistry. Blood: Composition of Blood, signification of plasma proteins, Anemia, Hemophilia, Thalassemia. Cerebrospinal fluid (CSF): Composition of CSF and its Variation in Health and disease. Meningitis, Alzheimer's disease, Parkinson's diseases.

Kidneys- Anatomy of Kidney fine Structure of nephron, Composition and formation of urine, abnormal constituents of urine.

Liver- functions of liver, significance of lipoproteins, liver disorders; jaundice –types, Liver cirrhosis, Liver function tests (emphasis on enzymes).

Unit-II / Module-II **-16 hrs.**

Disorders of Carbohydrates metabolism: Role of glucose as major fuel molecule glycogen storage disorders, lactose intolerance, hypoglycemia, hyperglycemia, Diabetes mellitus.

Abnormalities of Lipid metabolism- Cholesterol and Hyper cholestrolemia, betalipoproteinemia, Atherosclerosis, Ketosis and acidosis, Nieman Pick's disease and Tay Sach's disease.

Abnormalities of amino acids and nucleotide metabolism: Phenylketonuria, Maple syrup urine, Gout.

References:

1. Text Book of Biochemistry with Clinical Correlations – Thomas H. Devlin
2. Clinical Biochemistry -Controw & Trumper. W.B. Saunders Publishers.
3. Harper's Review of Biochemistry with Clinical Correlations Ed. Martin et al.
4. Clinical Biochemistry – Zilva and Pannal.

Course Code: B.C-3.5(B)

Name of the Course: BIOCHEMISTRY AND NUTRITIONAL HEALTH

(Interdisciplinary-Elective paper)

Batch: 2024-25 Batch onwards

Course Credits: 2	**Total No. of Hours: 32** **No. of Teaching Hours per week: 3 Hrs.**

Course Learning Objectives:

a) To learn about biochemistry of food and nutrition, functional foods and health foods.

b) To acquire knowledge on biochemistry of food and nutrition, prebiotics and probiotics.

c) To study functional foods, enzymes in fruit beverages, malting, fortification and health foods.

Course Outcomes: On successful completion of the course, the students will be able to

a) Illuminate biochemistry of food and nutrition, functional foods and health foods.

b) Explain biochemistry of food and nutrition, prebiotics and probiotics.

c) Describe functional foods, enzymes in fruit beverages, malting, fortification and health foods.

Unit-I / Module-I **-16 hrs.**

Definition of Biochemistry: Definition of life, different forms of life-micro-organisms to human beings. Building blocks of life. Introduction to the common macro- and micro constituents of unicellular and multicellular organisms. Differences encountered in plant and animal kingdoms.

Food and Nutrition: Importance of food for existence of life. Modes of nutrition in life forms – Comparable and contrasting features. Human Health and Disease: Nutrition (Health), definition, classification, food and non-food sources. Nutraceuticals; use of nutraceuticals in traditional health sciences.

Prebiotics and probiotics: Mechanics and usefulness of probiotics and prebiotics in gastro intestinal health and other benefits. Beneficiary microbes; prebiotic ingredients in foods; types of prebiotics and their effects on gut microbes.

Unit-II / Module-II **-16 hrs.**

Functional foods: Definition, development of functional foods, benefits and sources of functional foods in Indian diet. Effects of processing conditions and storage. Development of nutraceuticals and functional foods; Standards for health claims.

Enzymes: Introduction and essentiality to life forms. Use of enzyme in beverages- fruit juices, beer, wine, and distilleries; dairy, baking, oils and fats, plantation products, animal products.

Malting, Germination and its Health benefits: Grains – process, characteristics, nutritional benefits and uses. Fruit beverages; importance of beverage fortification, Health benefits of fortification, Selection of nutrients for fortification, Levels to be added, Characteristics of fortificants and method of fortification, Bioavailability, Organic Vs inorganic salts.

Health-Foods: Selection of nutrients, Technology of incorporation of fortificants, bioavailability and nutritional therapeutics.

References

1. Biochemistry Ed. Donald Voet & Judith G. Voet, John Wiley & Sons, Inc.(2010).
2. Lehninger Principles of Biochemistry -David L. Nelson and Michael Cox. W.H. Freeman and Company- Macmillan Publisher, Seventh Edition (2017).
3. Nutrition: Science and Applications, 3rd Edn. Lori A. Smolin, Mary B. Grosvenor, Wiley (2013).
4. Introduction to Human Nutrition, 2nd Edn. Michael J. Gibney, Susan A. Lanham-New, Aedin Cassidy, Hester H. Vorster, Wiley-Blackwell (2009).
5. Nutrition: Everyday Choices, 1st Edition; Mary B. Grosvenor, Lori A. Smolin Wiley (2006).
6. Bioactive Food as Dietary Interventions for Liver and Gastrointestinal Disease; Watson Elsevier (2012).
7. Food, Nutrition and Health. Tapsell L. Oxford University Press (2010).

Course Code: B.C-3.5(C)
Name of the Course: BIOCHEMISTRY IN DAY-TO-DAY LIFE
(Interdisciplinary-Elective paper)
Batch: 2024-25 Batch onwards

Course Credits: 2	**Total No. of Hours: 32** **No. of Teaching Hours per week: 3 Hrs.**

Course Learning Objectives:

a) To learn approaches to biochemical investigations and techniques for analysis of biomolecules.
b) To study cell fractionation, principles and applications of centrifugation and chromatography.
c) To learn principles and applications of electrophoresis, immunoassays and spectroscopy.

Course Outcomes: On successful completion of the course, the students will be able to

a) Illustrate approaches to biochemical investigations and techniques for analysis of biomolecules.
b) Describe cell fractionation, principles and applications of centrifugation and chromatography.
c) Explain principles and applications of electrophoresis, immunoassays and spectroscopy.

Unit-I / Module-I **-16 hrs.**

Definition of Biochemistry: Definition of life, different forms of life, microorganisms to human beings. Building blocks of life. Introduction to the common macro- and microconstituents of unicellular and multicellular organisms. Differences encountered in plant and animal kingdoms.

Food and Nutrition: Importance of food for existence of life. Modes of nutrition in life forms –Comparable and contrasting features.

Human Health and Disease: Nutrition (Health), definition, classification, food and non-food sources. Nutraceuticals, use of nutraceuticals in traditional health sciences. Role of omega-3 fatty acids, carotenoids, dietary fiber, phytoestrogens; glucosinolates; organosulphur compounds in health and disease (prevention and control).

Food additives: Definitions, functions and uses in processed food products. Chemical, technological and toxicological aspects of acid, base buffer systems, salts and chelating/sequestering agents, leavening agents, antioxidants, emulsifying and stabilizing agents, anti-caking agents, thickeners, firming agents, flour bleaching agents and bread improvers.

Sweetening agents: Artificial sweeteners, composition, uses. Natural and synthetic colors, food Flavors, Spices and flavoring constituents, flavors in food industries.

Unit-II / Module-II **-16 hrs.**

Enzymes: Introduction and essentiality to life forms. Use of enzyme in beverages- fruit juices, beer, wine, and distilleries; dairy, baking, oils and fats, plantation products, animal products. Malting and germination of grains – process, characteristics, nutritional benefits and uses. Domestic use products like detergents. Textiles-Denim processing. Leather industry.

Food processing and fortification: Principles, objectives and rationale, selection and basis of fortificants. Technology of fortifying cereal products. Characteristics of nutrients used in cereal fortification. Fortification methods. Fortification premixes, Design and composition of premixes and quality control. Fortification of bread, pasta, noodles, biscuits, and breakfast cereals. Beverages; importance of beverage fortification, Health benefits of fortification, Selection of nutrients for fortification, Levels to be added, Characteristics of fortificants and method of fortification, Bioavailability, Organic Vs inorganic salts.

Health foods, selection of nutrients, Technology of incorporation of fortificants, bioavailability.

References:

1. Biochemistry Ed. Donald Voet & Judith G. Voet, John Wiley & Sons, Inc.(2010).
2. Lehninger- Principles of Biochemistry; D.L.Nelson and M.M. Cox, 8th Edn. MacMillan Publications (2022).
3. Nutrition: Science and Applications, 3rd Edn. Lori A. Smolin, Mary B. Grosvenor, Wiley (2013).
4. Introduction to Human Nutrition, 2nd Edn. Michael J. Gibney, Susan A. Lanham-New, Aedin Cassidy, Hester H. Vorster, Wiley-Blackwell (2009).
5. Nutrition: Everyday Choices, 1st Edition; Mary B. Grosvenor, Lori A. Smolin Wiley (2006).
6. Bioactive Food as Dietary Interventions for Liver and Gastrointestinal Disease; Watson Elseveir (2012).
7. Food, Nutrition and Health. Tapsell L. Oxford University Press (2010).

Course Code: B.C-4.1
Name of the Course: MOLECULAR IMMUNOLOGY
Batch: 2024-25 Batch onwards

Course Credits: 4	**Total No. of Hours: 64** **No. of Teaching Hours per week: 4 Hrs.**

Course Learning Objectives:

a) To study about immune system, immune responses, hypersensitivity and vaccines.
b) To acquaint knowledge on history of immunology, immunity and immune system.
c) To learn about antigens, immunoglobulins and their diversity, immunochemical techniques.
d) To study antigen presentation, activation of T Cells, B Cells and effector responses.
e) To acquaint knowledge on hypersensitivity, autoimmunity and vaccines.

Course Outcomes: On successful completion of the course, the students will be able to

a) Illuminate cells, organs and molecules of immune system, immune responses and vaccines.
b) Illustrate history of immunology, immunity, cells and organs of immune system.
c) Describe antigens, immunoglobulins and their diversity, immunochemical techniques.
d) Explain antigen presentation, activation of T Cells, B Cells, and cytokines, effector responses.
e) Describe monoclonal antibodies, hypersensitivity, autoimmune responses and vaccines.

Unit-I / Module-I **-16 hrs.**

Overview of the immune system. History of immunology, types of immunity – immunity to infection; Immunological and non-immunological surface protective mechanism. Immune response during bacterial (tuberculosis), parasitic (malaria), and viral (HIV) infections.

Cells and Organs of the immune system- Cells, tissues and organs of the immune system. The two facets of the immune response system; the thymic system and bursal system. Compartmentalization; lymph nodes and Spleen. Cells involved in immune response T-cells, B-cells, and Macrophages.

Complement system – Composition, pathways of activation of complement – Classical pathway, alternate pathway.

Unit-II / Module-II **-16 hrs.**

Antigens - Definitions of self-antigens, foreign antigens, haptens, epitopes, adjuvants and mitogens. Immunogenicity versus antigenicity, Factors that influence immunogenicity. Protein antigens, carbohydrate antigens, Bacterial cell surface antigens, blood group antigens, tumor antigens and viral antigens. T-dependent and T-independent antigens, super antigens. Bases of antigen specificity, forces of antigen-antibody attraction.

Immunoglobulins - Isolation and purification of immunoglobulins. Basic structure of antibodies. Fine structure of Immunoglobulins, Antibody classes and biological activities. Hypervariable region. Antigenic determinants on immunoglobulins – isotypic, allotypic and idiotypic variations and idiotypic network. Antibody mediated effector functions.

Organization and expression of immunoglobulin genes - Theories of formation of antibodies. Diversity of antibodies, genetics of immunoglobulin diversity, mechanisms contributing to antibody diversity. Immunoglobulin genes, Isotype switching. Synthesis, assembly and secretion of immunoglobulins. Regulation of Immunoglobulin-gene transcription. Development of malignancy. Kinetics of Ag-Ab reactions, Specificity, affinity binding of antibodies.

Immunochemical Techniques- Precipitation, Agglutination, Flocculation. Immunodiffusion-radial immunoduffusion, Ouchterlony double immunodiffusion; Immunoelectrophoresis- Rocket immune electrophoresis, Counter-current immunoelectrophoresis, Complement fixation test, Radio immunoassay, ELISA, Western blotting, Immunofluorescence- Fluorescent antibody techniques, Flow cytometry.

Unit-III / Module-III **-16 hrs.**

Major Histocompatibility complex - General organization and inheritance of the MHC. MHC molecules and genes. Genomic map of MHC genes. MHC and immune responsiveness. MHC and disease susceptibility.

Antigen Processing and presentation - Self MHC restriction of T cells. Role of antigen-presenting cells. Endogenous antigens. The cytosolic pathway, exogenous antigens; the endocytic pathway. Presentation of non-peptide antigens.

T-Cell structure, Maturation, Activation and Differentiation - αβ and γδ T- cell receptors -structure and roles. Organization and rearrangement of TCR genes.TCRCD3 complex. Alloreactivity of T-cells. Thymic selection of the T-cell repertoire. T-cell activation-signal transduction pathways. T-cell differentiation. Cell death and T-cell populations.

B-cell generation, activation and differentiation - B-cell receptor complex. B-cell maturation. B-cell activation and proliferation. The humoral response: Phases of the humoral immune response. Germinal centers and antigen induced B-cell differentiation. Regulation of B-cell development.

Soluble factors - Cytokines and their receptors. Interferons, interleukins-structure and functions. Therapeutic uses of cytokines and their receptors. Cytokines in hematopoiesis.

Cell mediated effector responses - Mechanism of T-cell cytotoxicity and NK cell cytotoxicity. Antibody dependent cell mediated cytotoxicity.

Unit-IV / Module-IV **-16 hrs.**

Monoclonal antibodies - Hybridoma technology for production of monoclonal antibodies. Chimeric and Hybrid monoclonal antibodies. Monoclonal antibodies constructed from Ig-gene libraries. Applications of monoclonal antibodies.

Immunopathology -Hypersensitivity reactions- Immediate and delayed type reactions, their causes and treatment; Autoimmunity; Organ specific and Systemic autoimmune diseases - causes and treatment. Immunodeficiency disorders-Primary immunodeficiencies. AIDS and other acquired or secondary immunodeficiencies. Immunological changes during AIDS. Tolerance mechanisms, breakdown of self-tolerance. Transplantation immunity- mechanism of graft rejection; prevention of graft rejection. Immunosuppressors-Physical, chemical and biological immunosuppressants; cancer immunity and cancer immunotherapy.

Vaccines - Types, Development of Vaccines- conventional vaccines- attenuated, killed organisms and subunit vaccines; modern vaccines-recombinant vaccines and DNA vaccines. Vaccines against AIDS and tropical infectious diseases-Leprosy, malaria and TB. Vaccines for control of fertility, Anti-HCG vaccines and anti-sperm antigen vaccine.

References:

1. Cellular and Molecular Immunology - A. Abbas, A. Lichtman, S. Pillai. Saunders, Elsevier, USA.
2. Kuby Immunology - Jenni Punt, Sharon Stranford, Patricia Jones, Judith A Owen, WH Freeman Publisher.
3. Roitt's Essential Immunology - Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt,Wiley-Blackwell.
4. Antibodies– A Laboratory Manual - Edward A. Greenfield, 2nd Edition. CSHL Press.
5. Primer to the Immune Response -TakMak Mary Saunders Bradley Jett, Elsevier
6. Autophagy: Cancer, Other Pathologies, Inflammation, Immunity, Infection, and Aging - M.A. Hayat Academic Press (2014).
7. Immunology at a Glance - J.H.L. Playfair and B. M. Chain, Wiley-Blackwell.
8. Immunology; Jan Klein, Wiley.
9. Prescott's Microbiology - Joanne Willey, Linda Sherwood, Christopher J. Woolverton, McGraw Hill Education.
10. Fundamental Immunology - William E Paul. Wolters Kluwer Health/Lippincott Williams & Wilkins.
11. Immunology - D. M Weir and John Stewart. Churchill Livingstone, Edinburgh.
12. Immunobiology - Charles Janeway. Paul Travers, London.
13. Essentials of clinical immunology - Helen Chapel. ELBS.
14. Immunology: An Illustrated Outline - David Male. Garland Science Pubs.
15. Introductory Immunology: Basic Concepts for Interdisciplinary Applications - Jeffrey K. Actor. Elsevier Science.
16. Lippincott Illustrated Reviews: Immunology - Doan, Thao et al. Wolters Kluwer Pubs.

Course Code: B.C-4.2

Name of the Course: RECOMBINANT DNA TECHNOLOGY AND APPLIED BIOLOGY

Batch: 2024-25 Batch onwards

Course Credits: 4	**Total No. of Hours: 64** **No. of Teaching Hours per week: 4 Hrs.**

Course Learning Objectives:

a)To acquaint knowledge on rDNA technology, fermentation, cellculture and nanobiotechnology.
b) To study basics of recombinant DNA technology, restriction endonucleases and vectors.
c) To learn DNA ligation, introduction into cells, selection, genomic and cDNA libraries, PCR.
d) To study cloned DNA expression, recombinant proteins and applications of rDNA technology.
e) To understand industrial microbiology, fermentation, cell culture and nanobiotechnology.

Course Outcomes: On successful completion of the course, the students will be able to

a) Illuminate rDNA technology, fermentation technology, cell culture and nanobiotechnology.
b) Explain fundamentals of recombinant DNA technology, restriction endonucleases and vectors.
c) Illustrate DNA ligation, introduction into cells, selection, genomic and cDNA libraries, PCR.
d) Describe cloned DNA expression, recombinant proteins and applications of rDNA technology.
e) Explain industrial microbiology, fermentation technology, cell culture and nanobiotechnology.

Unit-I / Module-I **-16 hrs.**

Concept and emergence of recombinant-DNA technology: Gene- concept, structure and organization, basic techniques involved in rDNA technology.

Restriction endonucleases and DNA-Modifying enzymes: restriction enzymes; nomenclature, classification, properties and applications. Specificity, sticky ends and blunt ends, isoschizomers, and isocaudamers. Restriction modification: DNA methylation systems in E. coli, other enzymes used in cloning (ligase, exonucleases, terminal transferases, DNA polymerases, RNA Polymerases, Reverse Transcriptase, alkaline phosphatases, polynucleotide kinases)

Vectors: Ideal properties of a vector, Plasmids - Basic proportions of plasmid (F, R and Col plasmids, copy number and its control, replication of ColE1 plasmid, plasmid incompatibility) Isolation and purification of plasmid and genomic DNA. Natural plasmids, pSC 101, artificial plasmids - pBR322, pUC; viral vectors - λ bacteriophage vector- promoter and control circuit of bacteriophage, single stranded vector-M13 phage, T7 SV40.

High capacity vectors - Cosmids, Phagemids, brief overview of vectors based on plant and animal viruses, Tiplasmid. Artificial chromosomes (YAC, BAC, HAC etc.)

Unit-II / Module-II **-16 hrs.**

Joining of DNA molecules: Covalent linkage of DNA fragments to vector molecules: role of DNA ligase, Linkers, adapters, homopolymer tailing. Restriction mapping.

Introduction of DNA into cells: Transformation, transfection, chemical methods: calcium phosphate method, electroporation, microinjection, gene gun, Short gun approach, lipofection, protoplast fusion/somatic cell hybridization and biolistic methods.

Selection and screening of recombinant clones: Direct screening; Insertional inactivation of marker gene, inversion of revertible mutation. Indirect screening: Immunological techniques, nucleic acid hybridization, colony and plaque hybridization, screening using probes; construction of gene probes, and differential screening.

Genomic and cDNA library strategies: Criteria for the construction of an ideal genomic library, cDNA synthesis and library construction, chromosome walking, chromosome jumping, jumping library construction, selection of a clone from library.

Polymerase chain reaction: Amplification, specificity, determination of Tm value, Taq polymerase, primer designing; degenerate primers, nested primers, variants of PCR techniques and their applications; Nested PCR, inverse PCR, RT-PCR, real time (qRT) PCR, cloning of PCR product and colony PCR.

Unit-III / Module-III **-16 hrs.**

Expression of cloned DNA: Optimization of protein expression in heterologous systems using upstream and downstream signals, transcription expression vectors (lac promoter, tryptophan promoter, lambda cI and T7, based promoter), directional cloning. Translational expression vectors.

Recombinant proteins: secretion, purification and application of fusion proteins. Microarray analysis, Proteomics - 2-D PAGE and protein mass spectra.

Applications of recombinant DNA technology: Production of recombinant proteins in bacterial and eukaryotic cells – Recombinant insulin, growth hormone, factor VIII, recombinant vaccines and antibiotics. Genetically modified plants and GM foods. Complex human proteins, Gene therapy, nucleic acid therapeutic agents, prodrug activation therapy; Ethical, legal and social issues related to genetic engineering.

Unit-IV / Module-IV **APPLIED BIOLOGY** **-16 hrs.**

Introduction to Industrial Microbiology: Scope of industrial microbiology; Choice of microorganisms: screening – primary screening and secondary screening techniques.

Fermentation Technology: Fermentation equipments and its uses; Media composition, bacteria, yeast and mold cultures, single and mixed cultures, propagation, maintenance and evaluation of cultures, factors affecting activity of cultures. Types of fermentation processes. Production of antibiotics (Penicillin and Tetracycline), production of vitamins (Riboflavin, Vitamin A) and production of acids (Acetic acid, citric acid, lactic acid).

Animal Cell culture: Primary cells, cell lines, immortalization of cells, basic steps of cell culture, isolation of primary cells and stem cells, cell culture assays (cell viability and cytotoxicity tests, migration and invasion assays), applications of animal cell culture.

Nanobiotechnology: Definition and methods of preparation of nanobioparticles. Applications in drug designing and drug delivery. Nanobiosensors – Construction, uses and applications in medical, industrial and environmental processes.

References:

1. Recombinant DNA: A short course - Watson J.D et al., W.H. Freeman & Co Ltd.
2. Plant Protoplasts and genetic engineering - Y.P.S. Bajaj Springer –Vol. I & II, (1989).
3. Guide to molecular cloning techniques - Methods in Enzymology Vol. 152, Academic press.
4. Industrial Microbiology - Brinton M. Miller and Warren Litsky. McGraw-Hill Inc., US Publication.
5. Industrial Microbiology – L.E. Casida, Wiley Eastern Ltd.
6. Prescott and Dunn's Industrial Microbiology - Gerald Reed, Globe, London. CBS Publication.
7. Guide to molecular cloning techniques - Methods in Enzymology Vol. 152 Academic press.
8. Molecular biotechnology: Principles and Applications of Recombinant DNA -Bernard R. Glick, Jack J. Pasternak, American Society for Microbiology CSHL Press.
9. Molecular cloning: A Laboratory Manual - Sambrook and Russell Vol. 1,2, 3.CSHL Press.
10. Molecular Biology of the Cell -. Bruce Alberts et al., 7thEdnGarland Publications (2008).
11. Principles and Techniques of Biochemistry and Molecular Biology - Keith Wilson and John Walker, Cambridge University Press, 7th Edition (2010).
12. Gene Cloning and DNA analysis- An Introduction - T. A. Brown, , Wiley- Blackwell Publishing, 5th Edition.
13. Principles of Gene Manipulations - S.B. Primrose, R.M. Twyman, and B. Old, Wiley-Blackwell, 6th Edition (2001).
14. Molecular biology and Biotechnology - J.M. Walker and R. Rapley, RSC.
15. Plant Biotechnology and Agriculture -Arie Altman and Paul Hasegawa Academic Press.
16. A. Nagy, M. Gertsenstein, K Vintersten, R. Behringer. 2003. Manipulating the mouse embryo: a laboratory manual, Cold spring Harbor Press, New York, USA.
17. Stem cell biology edited by Daniel R. Marshak, Richard L. Gardner, David Gottlieb,2001.
18. Cold Spring Harbor Laboratory Press.
19. Essentials of Stem Cell Biology, 3rd Edition, edited by Lonza and Atla, Academic Press, 2013.
20. Bio Nanotechnology – Elisabeth S. Papazoglou, Aravind Parthasarathy. Morgan and Claypool Publishers.
21. Biomedical Nanotechnology - Neelina M Malsch, Taylor and Francis Group, New York.

Course Code: B.C-4.3

Name of the Course: BIOINFORMATICS, OMICS BIOCHEMISTRY AND RESEARCH METHODOLOGY

Batch: 2024-25 Batch onwards

Course Credits: 4	**Total No. of Hours: 64** **No. of Teaching Hours per week: 4 Hrs.**

Course Learning Objectives:

a) To learn fundamentals of bioinformatics, omics biochemistry and research methodology.
b) To study definition of bioinformatics, databases, data retrieval and analysis.
c) To learn sequence and structure analysis, phylogenetics, genomes and drug development.
d) To study definitions and fundamentals of omics biochemistry.
e) To learn elementary research methodology.

Course Outcomes: On successful completion of the course, the students will be able to

a) Explain fundamentals of bioinformatics, omics biochemistry and research methodology.
b) Describe definition of bioinformatics, databases, data retrieval and analysis.
c) Iilustrate sequence and structure analysis, phylogenetics, genomes and drug development.
d) Explain definitions and fundamentals of omics biochemistry.
e) Describe elementary research methodology.

Unit-I / Module-I **-16 hrs.**

BIOINFORMATICS

Introduction; Definition and Scope of Bioinformatics, Inter-relationship with various branches of life sciences.

Databases: Definition, Information generation, storage, editing and retrieval. Classification of databases - Database management system, RDBMS, Database management public agencies. NCBI data model, structures of EBI and Genome Net, GenBank Sequence database.

Data Retrieval from databases and Analysis: Database search engines - Entrez and DBGET/Link DB, SRS. Searching sequence databases by similarities criteria, FASTA, BLAST and its variants.

Unit-II / Module-II **-16 hrs.**

Sequence alignment and database searching: Introduction, protein and nucleic acid sequence analysis, Models of sequence analysis. Sequence comparison, Tools, approaches and models for multiple sequence analysis.

Phylogenetic analysis: Tools and approaches for Tree building; Basic concepts and methods of phylogenesis evaluation. Evolutionary relationships.

Structure analysis: Structural databases – PDB, MMDB; Tools and approaches for protein structural analysis. Homology modeling and Molecular modeling. **Structure viewing** - RasMol, etc. **Tools for Protein structural classification:** CATH, SCOP. **Protein families** - protein families and pattern data bases, protein domain families.

Genome projects: Introductory aspects. An overview of Human Genome project.

Drug development: Phases of drug development, Molecular modification of lead compounds, pharmacophore modelling. Computer aided drug design: Ligand based and Structure based methods, QSAR, Prodrugs and soft drugs.

Unit-III / Module-III: Omics Biochemistry **-16 hrs.**

Introduction to biology of omics. Definitions brief over view of genome and genomics; transcriptome and transcriptomics; proteome and proteomics; glycome and glycomics; lipidome and lipidomics; interactome and interactomics; metabolome and metabolomics; immunomics and pharmacogenomics.

Genomics- Whole genome sequencing and/or analysis; Preparation of cosmid libraries, bacterial artificial chromosomal libraries, shotgun libraries; Sequencing - conventional sequencing (Sanger, Maxam and Gilbert Methods), automated sequencing, next generation sequencing. Sequence analysis – BLAST, Sequence assembly, Gene prediction; Comparative genomics - Orthologs, paralogs, and homologs.

Proteomics - Introduction, principle and techniques – 2D gel electrophoresis, 2D-DIGE, MALDI-TOF, Quadrupole Time-of-Flight (Q-TOF); Significance and applications of proteomics in modern biology.

Transcriptomics: – cDNA- and oligo arrays; Serial Analysis of Gene Expression (SAGE). Microarray analysis, types of microarrays and applications, EST, SAGE, **Microarray data:** normalization and analysis; Genevestigator and OncoMine –browsing microarray-derived gene expression profiles, tissue and stage-of-development-specific patterns of expression, co-expression of genes. Assembly of EST: CAP3program; Whole genome analysis of mRNA and protein expression.

Unit-IV / Module-IV **-16 hrs.**

Research methodology: Meaning of Research; Objectives of Research; Motivation in Research; Types of Research; Research Approaches; Significance of Research; An overview of Research Process.

Definition of Research problem and selecting the research problem; Techniques involved in defining a research problem.

Collection and review of research literature, sources of literature and their evaluation. Designing research methodologies. General strategies for preparation of research proposals. Data representation in technical reports, posters, presentation in scientific conferences and workshops. Preparation of manuscripts for publication in national and international journals. Yardsticks employed in evaluation of manuscripts for publications.

References:

1. Bioinformatics- Concepts, Skills and Applications. --- S.C. Rastogi, Namita Mendiratta and Parag Rastogi (2003). CBS Publishers and Distributors, New Delhi.
2. Bioinformatics – A practical guide to the Analysis of Genes and Proteins. Andreas D Baxevains and B.F. Francis Ovellette. (2002) John Wiley & Sons.

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3. Developing Bioinformatics – Computer Skills. An Introduction to software tools for Biological Applications. --- Cynthia Gibas & Per Jambeck. (2003) O'RELLY Pubs.
4. Bioinformatics- Managing Scientific Data. Zoe'Lacroix and Terence Critchlow. (2003) Morgan Kaufmann Pubs.
5. Bioinformatics- Sequence and Genome Analysis--- David Mount (2003) CBS Publishers and Distributors.
6. Genomics,Proteomics and Metabolomics in Nutraceuticals and Functional Foods by Debasis Bagchi, Anand Swaroop, Manashi Bagchi; WileyPublication.
7. Biocode: The New Age of Genomics. By Dawn Field and Neil Davies, Oxford UniversityPress.
8. The Proteomics Protocols Handbook by JohnM.Walker(Editor), HumanaPress.
9. Introduction to Genomics by Arthur M. Lesk, Oxford University Press.
10. Clinical Genomics by Shashikant Kulkarni and JohnPfeifer, AcademicPress.
11. Clinical Proteomics: Methods and Protocols (Methods in Molecular Biology) by Antonia Vlahou, Manousos Makridakis, HumanaPress.
12. Research Methodology: Methods and Techniques. C.P. Kothari. New Age International Publishers.
13. Practical Research Methods: A User-friendly guide to mastering research. – Dr. Catherine Dawson. How to Books Ltd., UK.
14. The crafts of Research – Wayne C Booth. University of Chicago Press.
15. Research Methodology - Gupta Mukul and Gupta Deepa. Prentice Hall, India Pubs.
16. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches - John W. Creswell. SAGE Publishers.

QUESTION PAPER PATTERN
I Semester M.Sc. Examination, February, 2025
(2024-25 CBCS; New Syllabus)
BIOCHEMISTRY
24BOCA01: Fundamentals of Biochemistry and Biomolecules

Time: 3 Hours **Max. Marks: 70**

Note: *Answer Part-**A**, **four** questions from Part-**B** and **four full** questions from Part-**C***

PART – A

1. Answer **any five** of the following: **(2×5 = 10)**

a)

b)

c)

d)

e)

f)

g)

PART – B

(5×4 = 20)

2.

3.

4.

5.

6.

7.

PART – C

(10×4 = 40)

8.

9.

10.

11.

12.

13.

***

Registrar
Davangere University
Shivagangotri, Davangere

Dr. U.S. MAHABALESHWAR
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SCHEME FOR PRACTICAL EXAMINATION

Scheme and Question Paper pattern

1. Write the principle and procedure that you would adopt.....		**10 Marks**
2. Determine/Estimate the amount of .....present in the given Biological sample.		**20 Marks**
3. Laboratory Record.	**5*+5 =**	**10 Marks**
4. Viva-Voce.	**5*+5 =**	**10 Marks**

# # #

*5 Marks for internal assessment

Continuous Assessment Programme/Internal Assessment

Sl. No.	Continuous Assessment Programme/Internal Assessment	Maximum Marks
(1)	(2)	(3)
01	Two Session Tests with proper record for assessment (5+5 = 10)	**10**
02	Assessment of Seminars with proper record	**05**
03	Assessment of Assignment with proper record	**05**
04	• Attendance with proper record	**10**
TOTAL MARKS		**30**

- <75%-0 Mark
  75-80%-02 Mark
  80-85%-04 Marks
  85-90%-06 Marks
  90-95%-08 Marks
  >95%-10 Marks

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Question Paper Pattern:

Paper Name: Inorganic Chemistry

Paper Code: 1.1

Time: 3 Hours **Max. Marks: 70**

Part- A

1. Answer **any five** of the following questions **(2X5 = 10)**

a.

b.

c.

d.

e.

f.

g.

h.

Part- B

Answer **any Four** of the following questions **(5X4= 20)**

2.

3.

4.

5.

6.

7.

Part- C

Answer **any Four** of the following questions **(10X4=40)**

8.

9.

10.

11.

12

13.

Registrar
Davangere University
Shivagangotri, Davangere

CHAIRMAN
DOS in Chemistry
Davangere University
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