



**KARNATAK UNIVERSITY, DHARWAD
ACADEMIC (S&T) SECTION**

**ಕರ್ನಾಟಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಧಾರವಾಡ
ವಿದ್ಯಾಮಂಡಳ (ಎಸ್&ಟಿ) ವಿಭಾಗ**



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NAAC Accredited
'A' Grade 2014

website: kud.ac.in

No. KU/Aca(S&T)/JS/MGJ(Gen)/2024-25/1612

Date:

ಅಧಿಸೂಚನೆ

27 JUL 2024

ವಿಷಯ: ಸರಕಾರದ ಆದೇಶ ದಿನಾಂಕ: 08.05.2024 ಅನುಸಾರ 2024-25ನೇ ಶೈಕ್ಷಣಿಕ ಸಾಲಿನಿಂದ ಎಲ್ಲ ಸ್ನಾತಕ ಪದವಿಗಳಿಗೆ NEP ಅಡಿಯಲ್ಲಿ ಪ್ರೋಗ್ರಾಂ ವಿನ್ಯಾಸ (Curriculum Structure)ದಂತೆ ಪರಿಷ್ಕೃತ ಪಠ್ಯಕ್ರಮದ ಅನುಷ್ಠಾನ ಕುರಿತು.

- ಉಲ್ಲೇಖ: 1. ಸರ್ಕಾರದ ಪ್ರಧಾನ ಕಾರ್ಯದರ್ಶಿಗಳು, ಉನ್ನತ ಶಿಕ್ಷಣ ಇಲಾಖೆ ಇವರ ಆದೇಶ ಸಂಖ್ಯೆ: ಇಡಿ 166 ಯುಎನ್‌ಇ 2023, ದಿ: 08.05.2024.
2. ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯ ನಿರ್ಣಯಗಳ ಸಂ:2, 3, 4, 5, 6, 7, 8 & 9, ದಿ:16.07.2024.
3. ಮಾನ್ಯ ಕುಲಪತಿಗಳ ಅನುಮೋದನೆ ದಿನಾಂಕ: 27/07/2024

ಮೇಲ್ಕಾಣಿಸಿದ ವಿಷಯ ಹಾಗೂ ಉಲ್ಲೇಖಗಳನ್ವಯ, ಉಲ್ಲೇಖ-01ರ ಸರಕಾರ ಆದೇಶಾನುಸಾರ 2024-25ನೇ ಶೈಕ್ಷಣಿಕ ಸಾಲಿನಿಂದ ಅನ್ವಯವಾಗುವಂತೆ, ಈ ಕೆಳಗಿನ ಎಲ್ಲ ಸ್ನಾತಕ ಪದವಿಗಳ NEP ಅಡಿಯ ಪ್ರೋಗ್ರಾಂ ವಿನ್ಯಾಸ (Curriculum Structure)ದಂತೆ ಪರಿಷ್ಕೃತ ಪಠ್ಯಕ್ರಮ ರಚನೆ ಕುರಿತಾಗಿ ಸಂಬಂಧಿಸಿದ ಅಭ್ಯಾಸಸೂಚಿ ಮಂಡಳಿ ಹಾಗೂ ನಿಖಾಯಗಳ ಶಿಫಾರಸ್ಸಿನಂತೆ ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯ ಅನುಮೋದಿತ ಪದವಿಗಳ ಪಠ್ಯಕ್ರಮಗಳನ್ನು ಕ.ವಿ.ವಿ. ಅಂತರ್ಜಾಲ www.kud.ac.in ದಲ್ಲಿ ಭಿತ್ತರಿಸಲಾಗಿದೆ. ಸದರ ಪಠ್ಯಕ್ರಮಗಳನ್ನು ಕ.ವಿ.ವಿ. ಅಂತರ್ಜಾಲದಿಂದ ಡೌನ್‌ಲೋಡ್ ಮಾಡಿಕೊಳ್ಳಲು ಸೂಚಿಸುತ್ತ ವಿದ್ಯಾರ್ಥಿಗಳು ಹಾಗೂ ಸಂಬಂಧಿಸಿದ ಎಲ್ಲ ಬೋಧಕರ ಗಮನಕ್ಕೆ ತಂದು ಅದರಂತೆ ಕಾರ್ಯಪ್ರವೃತ್ತರಾಗಲು ಕ.ವಿ.ವಿ.ಯ ಎಲ್ಲ ಅಧೀನ ಹಾಗೂ ಸಂಬಂಧ ಮಹಾವಿದ್ಯಾಲಯಗಳ ಪ್ರಾಚಾರ್ಯರುಗಳಿಗೆ ಸೂಚಿಸಲಾಗಿದೆ.

ಅ.ನಂ.	ಪದವಿ				ಸೆಮಿಸ್ಟರ್
1	1	B.A	8	BTM	1 ರಿಂದ 6ನೇ ಸೆಮಿಸ್ಟರ್
	2	BSW	9	B.Sc	
	3	B.Sc. (H.M)	10	BCA	
	4	B.Com	11	B.Com (CS)	
	5	B.Com (E-Commerce Operation)	12	B.Com (Retail Operations)	
	6	B.Com (Banking Financial Services & Insurance)	13	B.Com (Logistics)	
	7	BBA	14	BBA (Logistics Management)	
2	1	B.Sc (Data Science)	2	B.Sc (Artificial Intelligence & Machinery Learning)	1 ಮತ್ತು 2ನೇ ಸೆಮಿಸ್ಟರ್
3	1	BASLP	3	BPA	1 ರಿಂದ 8ನೇ ಸೆಮಿಸ್ಟರ್
	2	BVA	4	B.Sc. Pulp & Paper	

ಅಡಕ: ಮೇಲಿನಂತೆ

A. Channappa
ಕುಲಸಚಿವರು.

ಗೆ,
ಕರ್ನಾಟಕ ವಿಶ್ವವಿದ್ಯಾಲಯದ ವ್ಯಾಪ್ತಿಯಲ್ಲಿ ಬರುವ ಎಲ್ಲ ಅಧೀನ ಹಾಗೂ ಸಂಬಂಧ ಮಹಾವಿದ್ಯಾಲಯಗಳ ಪ್ರಾಚಾರ್ಯರುಗಳಿಗೆ. (ಕ.ವಿ.ವಿ. ಅಂತರ್ಜಾಲ ಹಾಗೂ ಮಿಂಚಂಚೆ ಮೂಲಕ ಭಿತ್ತರಿಸಲಾಗುವುದು)

ಪ್ರತಿ:

1. ಕುಲಪತಿಗಳ ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು / ಕುಲಸಚಿವರ ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು / ಕುಲಸಚಿವರು (ಮೌಲ್ಯಮಾಪನ) ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
2. ಅಧೀಕ್ಷಕರು, ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆ / ಗೌಪ್ಯ / ಜಿ.ಎ.ಡಿ. / ವಿದ್ಯಾಮಂಡಳ (ಪಿ.ಜಿ.ಪಿ.ಎಚ್.ಡಿ) ವಿಭಾಗ, ಸಂಬಂಧಿಸಿದ ಕೋರ್ಸುಗಳ ವಿಭಾಗಗಳು ಪರೀಕ್ಷಾ ವಿಭಾಗ, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
3. ನಿರ್ದೇಶಕರು, ಕಾಲೇಜು ಅಭಿವೃದ್ಧಿ / ವಿದ್ಯಾರ್ಥಿ ಕಲ್ಯಾಣ ವಿಭಾಗ / , ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
4. ನೋಡಲ್ ಅಧಿಕಾರಿಗಳು, ಯು.ಯು.ಸಿ.ಎಂ.ಎಸ್. ಘಟಕ, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
5. ಎನ್.ಇ.ಪಿ. ನೋಡಲ್ ಅಧಿಕಾರಿಗಳು, ಸಿ.ಡಿ.ಸಿ. ವಿಭಾಗ, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.



KARNATAKUNIVERSITY,DHARWAD

**B. Sc.
(Biochemistry as one of the optional)**

SYLLABUS

With effect from 2024-25

**DISCIPLINE SPECIFIC CORE COURSE (DSC) FOR SEM I -VI,
SKILL ENHANCEMENT COURSE (SEC)FOR SEM IV/V/VI and ELECTIVE
COURSES FOR SEM V AND VI**

AS PER NEP (Revised):2024

Karnatak University, Dharwad
B.Sc. Biochemistry as one of the optional
Effective from 2024-25

Sem.	Type of Course	Theory/P ractical	Course Code	Course Title	Instructi on hour/ week	Total hours / sem	Duration of Exam	Marks			Credits
								Formati ve	Summ ative	Total	
I	DSC-1	Theory	C 1 BIC1 T 1	Principles of Biochemistry and Cell Biology	04hrs	60	03hrs	20	80	100	04
	DSC-2	Practical	C 1 BIC1 P 1	Principles of Biochemistry and Cell Biology	04hrs	56	03hrs	10	40	50	02
II	DSC-3	Theory	C 2 BIC1 T 1	Biomolecules and Cellular Biochemsitry	04hrs	60	03hrs	20	80	100	04
	DSC-4	Practical	C 2 BIC2 P 1	Biomolecules and Cellular Biochemsitry	04hrs	56	03hrs	10	40	50	02
III	DSC-5	Theory	C 3 BIC1 T 1	Nutrition and Biochemical Techniques	04hrs	60	03hrs	20	80	100	04
	DSC-6	Practical	C 3 BIC1 P 1	Nutrition and Biochemical Techniques	04hrs	56	03hrs	10	40	50	02
1V	DSC-7	Theory	C 4 BIC1 T 1	Enzymology and Human Physiology	04hrs	60	03hrs	20	80	100	04
	DSC-8	Practical	C 4 BIC1 P 1	Enzymology and Human Physiology	04hrs	56	03hrs	10	40	50	02
*V	DSC-9A	Theory	C 5 BIC2 T 1	Molecular Biology and Recombinant DNA Technology	04hrs	60	03hrs	20	80	100	04
	DSC-10A	Practical	C 5 BIC2 P 1	Molecular Biology and Recombinant DNA Technology	04hrs	56	03hrs	10	40	50	02
	DSC-9B	Theory	C 5 BIC2 T 2	Biological Oxidation and Metabolism of Biomolecules	04hrs	60	03hrs	20	80	100	04
	DSC-10B	Practical	C 5 BIC2 P 2	Biological Oxidation and Metabolism of Biomolecules	04hrs	56	03hrs	10	40	50	02
*VI	DSC-11A	Theory-	C 6 BIC2 T 1	Endocrinology and Clinical Biochemistry	04hrs	60	03hrs	20	80	100	04
	DSC-12A	Practical	C 6 BIC2 P 1	Endocrinology and Clinical Biochemistry	04hrs	56	03hrs	10	40	50	02
	DSC-11B	Theory-	C 6 BIC2 T 2	Immunology	04hrs	60	03hrs	20	80	100	04
	DSC-12B	Practical	C 6 BIC2 P 2	Immunology	04hrs	56	03hrs	10	40	50	02
V	EC-1	Theory	C 5 BIC5 T 1	General Biochemistry and Biochemical Techniques	03hrs	45	03hrs	20	80	100	03
VI	EC-2	Theory	C 6 BIC5 T 1	Clinical Biochemistry	03hrs	45	03hrs	20	80	100	03
IV/V/VI **	SEC	Practical	C 0 BIC6 P 1	Self-Employment Skills in Clinical Biochemistry Lab Management	04hrs	56	03hrs	10	40	50	02

***student shall either DSC 9A and DSC10A or DSC 9B and DSC10B in 5th semester. Similarly, DSC 11A and DSC12A or DSC 11B and DSC12B in 6th semester.**

**** Student shall study Skill of this subject either in 4th / 5th / 6th but not in all the semester.**

Karnatak University, Dharwad
B.Sc. (Biochemistry)

Programme Specific Outcomes (PSO):

On completion of the 03 years Degree in **Biochemistry** students will be able to:

- PSO1 : Deliver quality tertiary education through learning while doing and reflect universal and domain-specific value in Biochemistry.
- PSO2 : Involve, communicate and engage key stakeholders, preach and practice change as a continuum.
- PSO3 : Develop the ability to address the complexities and interface among of self, societal and national priorities.
- PSO4 : Generate multi – skilled leaders with a holistic perspective that cuts across other disciplines.
- PSO5 : Instill both generic and subject – specific skills to succeed in the employment market.
- PSO6 : Foster a genre of responsible students with a passion for lifelong learning and entrepreneurship.
- PSO7 : Develop sensitivity, resourcefulness in the field of Biochemistry, and competence to render service to families, communities and the nation at large.
- PSO8 : Promote research innovation and design (product) development favoring all the disciplines in Biochemistry.
- PSO9 : Enhance digital literacy and apply them to engage in real time problem solving and ideation related to all fields of Biochemistry.
- PSO10 : Appreciate and benefit from the symbiotic relationship among the five core disciplines of Biochemistry- Principles of Biochemistry and Cell Biology, Biomolecules and Cellular Biochemistry, Nutrition and Biochemical Techniques, Enzymology and Human Physiology Molecular Biology and Recombinant DNA Technology, Biological Oxidation and Metabolism of Biomolecules, Endocrinology and Clinical Biochemistry, Immunology, General Biochemistry and Biochemical Techniques, Clinical Biochemistry and Self-Employment Skills in Clinical Biochemistry Lab Management.

B.Sc. Semester–I

Discipline Specific Course (DSC)- Subject: Biochemistry

The Course Biochemistry in I semester has two papers (Theory Paper–I for 04 credits & Practical Paper-II for 2credits) for 06 credits: Both the papers are compulsory. Details of the courses are as under.

Course Title:- Principles of Biochemistry and Cell Biology

Course Code: C1BIC1T1

DSC-1	Theory	C1BIC1T1
DSC-2	Practical	C1BIC1P1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/ Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-1	Theory	04	04	60hrs.	3hrs.	20	80	100

Course Outcomes (COs):

On successful completion of the course, the student will be able to understand:

- CO 1: Water as solvent of life, buffer and importance of buffers in biological systems
- CO 2: Atom and chemical bonding, colloids and their role in biological system.
- CO 3: Organic reactions, Chemical kinetics and catalysis, Thermodynamics, Exothermic and Endothermic reactions.
- CO 4: The differences between animal and plant cellular system, Cell organelles and Cytoskeleton elements.
- CO 5: The basic principles of biochemistry and understanding of cell and cell organelles.

Unit	Title: Principles of Biochemistry and Cell Biology	60 hrs
Unit I	Introduction: Scope, history and development of Biochemistry. Milestones in Biochemistry. Water and Buffers: Water as solvent of life, Dissociation of water, Ionic products of water, Concept of pH. pOH, simple numerical problems on pH, Dissociation of weak acids and electrolytes, Brownsted-Lowry concept of acids and bases, titration curves of weak acid and bases. Meaning of Ka and pKa values, Buffer and its action, Buffers in biological system, Henderson-Hasselbalch equation and its significance. Determination of pH using indicators, pH meter. Meaning of Normality, Molarity, Molality and Mole fraction, percentage solutions, (numerical problems from above). The Atom and Chemical bonding: Elementary composition of living matter, structure of atom, ionisation potential, nature of chemical bonding, Types of chemical bonding (Electrovalent, covalent and co-ordinate bonds) Characteristics of bonding (Bond length, bond angle, and bond energy) , Hydrogen bonds and weak interactions, atomic and molecular orbitals, formation of molecules (in brief).	15hrs

Unit II	Colloids: Meaning of true solution, colloidal solution and coarse suspension, differences between lyophilic and lyophobic sols, fundamental study of Donnan membrane equilibrium, application in biological system, methods of preparation of colloidal solution, Membrane permeability, separation of colloidal solutions, Elementary studies: Tyndall effect, Brownian movement, applications of colloidal chemistry in biological system-dialysis, Emulsion and emulsifying agents. Their role in biological system. Colligative properties: Osmotic pressure and its measurements by Berkely and Hartley's method. Laws of osmotic pressure. Hypo, hyper and isotonic solutions. Effects of osmotic pressure on living cells.	15hrs
Unit III	Types of organic reactions: Types of reactions- Oxidation- reduction reaction, substitution, addition, condensation, elimination, decarboxylation, reversible and irreversible reactions with an example each. Chemical kinetics and catalysis: Introduction to chemical kinetics, equilibrium reactions, law of mass action, equilibrium constant, definition of catalysis, characteristics of catalysis reactions- positive, negative and auto catalysis, fundamental ideas of promoters and catalytic poisoning. Thermodynamics: Basic principles of thermodynamics, terminology, free energy, standard free energy, enthalpy, entropy, laws of thermodynamics, exothermic and endothermic reactions with examples.	15hrs
Unit IV	Types of cells: Prokaryotic and eukaryotic cell, differences between animal and plant cellular system. Cell organelles: Structure and functions of sub cellular organelles-cell wall, plasma membrane, nucleus, chromosome, mitochondria, chloroplast, ribosome, endoplasmic reticulum, Golgi complex, lysosome, glyoxysomes, peroxisomes. Marker enzymes, Cytoskeletal elements: Types, microfilaments, microtubules and intermediary filaments- distribution, types, structure and chemical composition, biological importance, function.	15hrs

References/Text books:

1. Principles of Physical Chemistry - BR Puri, Madan S Pathania, LR Sharma, Vishal Publishing Co.
2. Cell Biology -P.S. Verma and V.K. Agarwal S, Chand Publishing(2016).
3. Essentials of Cell Biology -Sanjay Kumar Sharma, Agrotech press 1st edition.
4. Cell Biology - C. B. Powar, Himalaya publishing House, 2010
5. Cell Biology: Fundamentals and Applications -Arunima Mukerjee, oxford Book Company, 2009
6. Cell and Molecular Biology -E.D.P De Robertis and E.M.F. De Robertis, Lea and Febiger.
7. The Cell: A Molecular Approach -Geoffrey Cooper and Robert.E. Hausman, Sinauer Associates, 2018
8. Molecular Cell Biology -J.E. Darnell, H.Lodish, David Baltimore.W.H. Freeman and Co,2002

B.Sc. Semester-I

Discipline Specific Course (DSC)

Course Title: Principles of Biochemistry and Cell Biology (**Practical**)

Course Code: C1BIC1P1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/ Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-2	Practical	02	04	56 hrs.	3 hrs.	10	40	50

List of the Expedients, each will have 4rs / Week

Expt. No.	Title: Principles of Biochemistry and Cell Biology (Practical)	56.hrs
1	Preparation of solutions: Percentage solutions, Molar solutions, Normal solutions and Dilution of Stock solutions	4 Hrs
2	Standardization of pH meter.	4 Hrs
3	Preparation of Buffer solutions using pH meters.	4 Hrs
4	Titration curve of : Strong acid v/s weak base, Weak acid v/s strong base	4 Hrs
5	Isolation of mitochondria.	4 Hrs
6	Isolation of chloroplast.	6 Hrs
7	Estimation of given HCl using approximate N/10 NaOH and potassium biphthalate.	8 Hrs
8	Estimation of Mohr's salt using approximate N/10 KMnO ₄ and Oxalic acid crystals.	8 Hrs
9	Estimation of H ₂ O ₂ using approximate N/10 KMnO ₄ solution.	8 Hrs
10	Estimation of Hardness of water using EDTA solution and ZnSo ₄	6 Hrs

B.Sc. Semester– II

Discipline Specific Course (DSC)

Course Title:- Biomolecules and Cellular Biochemistry (Theory)

Course Code: C2BIC1T1

DSC-1	Theory	C2BIC1T1
DSC-2	Practical	C2BIC1 P 1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/ Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-3	Theory	04	04	60hrs.	3hrs.	20	80	100

Course Outcomes (COs):

On successful completion of the course, the student will be able to understand:

- CO1: The importance of Biomolecules each as carbohydrates, Amino acids and proteins in biological system
- CO2: The cell membrane & its structure
- CO3: The cell cycle, cell division and cell death.
- CO4: Lipid fluid mosaic model of cell membrane.

Unit	Title: Biomolecules and Cellular Biochemistry	60 hrs
Unit I	Carbohydrates: Classification and biological importance. Stereochemistry of monosaccharides, Enantiomers, Epimers, anomers and diastereomers. Structure and biological importance of Monosaccharides: Structure and biological importance of Glucose, fructose, Galactose, Mannose and Ribose. Oxidation, Reduction and reaction with phenyl hydrazine. Disaccharides: Structure and biological significance of sucrose, lactose, maltose and Isomaltose. Polysaccharides: Classification, Partial structure, occurrence and importance of homopolysaccharides- starch, glycogen and cellulose. Heteropolysaccharides -occurrence, repeating units and importance of glycosaminoglycans- chondroitin sulphate, keratan sulphate, dermatan sulphate and heparin. LIPIDS: Classification and biological role. Fatty acids: Nomenclature of saturated and unsaturated and unsaturated fatty acids. Physiological properties/ importance. Acylglycerols and their properties like saponification value, iodine value, acid value and their significance. Phospholipids: Structure of lecithin, cephalins, phosphatidylcholine, plasmalogens, and cardiolipin. Biological role of phosphoglycerides. Structure and functions of (compound- phospho and glycolipids and derived lipids). Sphingolipids: Structure and importance of sphingomyelin. Glycosphingolipids: Structure and importance of gangliosides and cerebroside. Eicosanoids.	15 hrs
Unit II	Amino acids: Definition, structure and classification of amino acids based on polarity and charge, Stereoisomerism, structure of standard amino acids, three letter and single letter abbreviations of amino acids, non standard and non protein amino acids. Ionisation of amino acids – Acid- base properties, titration curves of amino acids, zwitterionic properties, optical activity of amino acids, reactions of amino acids- Ninhydrin, phenylisothiocyanate, dansyl chloride and formaldehyde and their practical significance. Peptides and proteins: Definition and formation of peptide bond, structure and function of glutathione, vasopressin and oxytocin. Proteins: Classification based on structure and functions,	15 hrs

	elementary studies of primary, secondary, tertiary and quaternary structure of protein. Tertiary structure of myoglobin and quaternary structure of Hemoglobin. Denaturation of proteins. Nucleic acids: Components of nucleic acids, structure of common purine and pyrimidine bases, tautomeric forms of bases, structure of nucleoside, nucleotide and polynucleotides. DNA: Watson and Crick model of DNA, forms of DNA, physical properties of DNA, T_m curve of DNA. RNA: types of RNA (t- RNA, m-RNA, r-RNA) unusual bases of nucleic acids.	
Unit III	Cell wall and Cell membrane: Prokaryotic- Gram positive and Gram negative bacteria, eukaryotic cell wall - composition and functions. Cell membrane: Fluid mosaic model, monolayer, bilayer and liposomes as a model membrane system, Lateral and transverse movement of lipids and proteins, membrane fluidity and factors affecting membrane fluidity. Membrane transport- simple diffusion and facilitated diffusion. Passive transport, active transport, Primary active transport (Na⁺- K⁺ ATPase pump) and Secondary active transport (Na⁺- glucose transporter), Ion channel (voltage gated and ligand gated- acetyl choline receptors), Endocytosis, phagocytosis, pinocytosis and exocytosis in brief.	15 hrs
Unit IV	Extracellular matrix: Cell matrix proteins, cell matrix interactions, cell- cell interactions. junctions-adherence junction, tight junction, gap junction, desmosomes, hemidesmosomes, focal adhesions. Non-junctional adhesions-Cadherins, Integrins and Selectins. Cell division and Cell cycle: Types of cell division-Binary fission (Bacteria), budding (bacteria and yeast). Somatic cell division and reduction cell division, cytokinesis,. Stages in mitosis and meiosis. Overview of cell cycle, stages and checkpoints. Cell death: Definition and differences between apoptosis and necrosis.	15 hrs

Recommended books:

1. Harper's Illustrated Biochemistry-Rodwell, Bender, Botham, Kennelly and Weil, Lange Publishing, 31st Edition.
2. Text book of Biochemistry-Vasudevan, Shree Kumari, jAYPEE Brothers Medical Publishers, 2016.
3. Biochemistry-U Satyanarayana and U Chakrapani, Elsevier India, 2016
4. Biomolecules and Cell Biology-Prof.R.K Gupta, Rastogi Publications.
5. Cell Biology-P.S. Verma and V.K. Agarwal (2016). S Chand Publishing.
6. Essentials of Cell Biology-Sanjay Kumar Sharma, Agrotech press 1ST edition.
7. Cell Biology- C.B. Powar, Himalaya publishing House, 2010
8. Cell Biology: Fundamentals and Applications- Arunima Mukerjee, Oxford Book Company, 2009
9. Cell and Molecular Biology-E.D.P De Robertis and E.M.F. De Robertis, Lea and Febiger.
10. The Cell-Geoffrey Cooper and Robert.E. Hausman, Sinauer Associates, 2018
11. Molecular Cell Biology -J.E. Darnell, H. Lodish, David Baltimore. W.H Freeman and Co, 2002
12. Lehninger Principles of Biochemistry-David L. Nelson and Michael M. Cox, W.H. Freeman, Seventh Edition.
13. Text Book of Biochemistry-Edward S West, Wilbert R Todd, Howard S Mason, John T Van Bruggen, Macmillan.
14. Principles of Biochemistry- Donald Voet, Charlotte W Pratt, Judith G Voet, Wiley, International Student Version Edition (2012)
15. Lippincott's Illustrated Reviews, Biochemistry- Denise Ferrier, Wolters Kluwer India Pvt. Ltd. Seventh edition (2017).

B.Sc. Semester–II

Discipline Specific Course (DSC)

Course Title: Biomolecules and Cellular Biochemistry (Practical)

Course Code: C2BIC1P1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/ Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-4	Practical	02	04	56hrs.	3hrs.	10	40	50

List of the Experiments, each will have 4rs / Week

Expt. No.	Title: Housing and Interior Decoration(Practical)	56.hrs
1	Qualitative analysis of Carbohydrates: Glucose, Fructose, Lactose, Maltose, Sucrose and starch	4 Hrs
2	Qualitative analysis of Amino acids	4 Hrs
3	Qualitative analysis of Proteins: Albumin, casein	4 Hrs
4	Qualitative analysis of Lipids	4 Hrs
5	Study of mitosis using onion root tips.	4 Hrs
6	Study of meiosis using onion flower bud.	4 Hrs
7	Determination of Acid value of an oil sample.	8 Hrs
8	Determination of Saponification number.	8 Hrs
9	Determination of Iodine value.	8 Hrs
10	Qualitative analysis of Amino acids	8 Hrs

B.Sc. Semester– III

Discipline Specific Course (DSC)-

Course Title:- Nutrition and Biochemical Techniques (Theory)

Course Code: C3BIC1T1

DSC-1	Theory	C3BIC1T1
DSC-2	Practical	C3BIC1 P 1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/ Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-3	Theory	04	04	60hrs.	3hrs.	20	80	100

Course Outcomes (COs):

On successful completion of the course, the student will able to understand:

- CO1: The balanced diet, nutrient sources, BMR, SDA, RDA etc.
- CO2: The sources and its function Nutrients and Micro nutrients.
- CO3: The (CHO)_n , Proteins, lipids as a source of energy. Biochemical techniques such as cell fractionation centrifugation and chromatography.
- CO4: Importance of spectroscopy and Radioactivity Electrophoresis.

Unit	Title: Nutrition and Biochemical Techniques	60 hrs
Unit I	Introduction: Basic principles of Balanced Diet, energy source and nutrients, nutritional requirements, food as source of nutrients, proximate analysis of food. Energy balance: Definition of SI units of calorific value of foods, Bomb calorimeter, Respiratory Quotient (RQ) – definition, calculation of non-protein RQ with respect to carbohydrates, lipids, measurements of energy expenditure by direct and indirect methods, Basal metabolic rate (BMR)- measurement by Benedict's method, factors affecting BMR, Specific dynamic action of food (SDA) energy requirement and recommended dietary allowances (RDA) for children, adults, during pregnancy and lactation.	15 hrs
Unit II	Carbohydrates: introduction and their role as fuel molecules, sources and requirements, storage forms, protein sparing effect of carbohydrates, dietary fibers. Lipids: Dietary sources of fats, essential fatty acids and their biological importance. Proteins: Dietary sources, their role in diet, Nutritional classification of proteins- complete and incomplete proteins, nutritive value of proteins-PER, NPU and biological value of proteins(BV), essential and non-essential amino acids, nitrogen balance, protein energy malnutrition-Kwashiorkar and Marasmus. Micronutrients-Vitamins: Structure, sources, daily requirement, function and deficiency disorders of, Fat soluble vitamins (A, D, E , K) , water soluble (B complex, C), Hyper vitaminosis. Minerals:Source, daily requirement, function and deficiency of, Macroelements:Ca, P, Mg, K, Na and Cl. Microminerals: Co, Cu, Fe, Zn, and Mn.	15 hrs

Unit III	Cell fractionation: Scope of isolation and purification of biomolecules, sample selection, methods of tissue homogenisation, salt and organic solvent extraction, fractionation, dialysis and reverse dialysis, ultra filtration and lyophilisation. Centrifugation: Principle of sedimentation technique, different types of centrifuges, types of rotors, Preparative centrifugation: Principle, procedure and application of differential and density gradient centrifugation. Chromatography: Basic principle of chromatography, adsorption and partition chromatography- Ascending, descending and circular paper chromatography. Principle, procedure and applications of TLC. Principle and applications of Gel permeation chromatography, Ion exchange chromatography, affinity chromatography.	15 hrs
Unit IV	Electrophoresis: Paper and gel electrophoresis. Principle and applications of SDS- PAGE, Agarose gel electrophoresis. Spectroscopy: Electromagnetic spectrum, Laws of light absorption, Beer – Lambert’s law, molar extinction coefficient, principle and applications of colorimeter, UV- Vis spectrophotometer. Principles of light microscopy. Radiochemistry: Natural and artificial radioactivity, Nature and properties of α, β, γ rays, units of radioactivity, measurement of radioactivity by GM and Scintillation counters. Isotopes and Isobars, applications of radio isotopes-^3H, ^{14}C, ^{131}I, ^{60}Co, ^{32}P. Radiation hazards and precautions.	15 hrs

Recommended books:

1. Harper’s Illustrated Biochemistry-Rodwell, Bender, Botham, Kennelly and Weil, Lange Publishing, 31st Edition.
1. Text book of Biochemistry-Vasudevan, Shree Kumari, JAYPEE Brothers Medical Publishers, 2016.
2. Biochemistry-U Satyanarayana and U Chakrapani, Elsevier India, 2016
3. Hand book of food and nutrition-Dr.M.Swaminathan, Bappco Publisher (2010)
4. Food Science-Srilakshmi, New Age International Publisher 7th Edition.
5. Nutritional Biochemistry-DC Sharma, CBS Publisher (2014).
6. Text Book of Nutrition and Biochemistry-Prasad R Manjeshwar, Sheetal Distributors (2019)
7. Text Book of human Nutrition –Anjana Agarwal and Shobhaudipi, Jaypee Brothers Medical Publisher, 1st Edition (2014)
8. Human Nutrition and Dietics-Sir Stanely Davidson, Reginald Passmore, martin A Eastwood, Churchi Living stone, 10th Edition, 1999.
9. Biophysical Chemistry-Dr.Avinash Upadhyay, Dr.Kakoli Upadhyay and Dr.Nirmalendu Nath, Himalaya Publishing House, Fourth Edition.
10. Wilson and Walker’s Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, 8th Edition.
16. Molecular Cell Biology -J.E. Darnell, H. Lodish, David Baltimore. W.H Freeman and Co, 2002
17. Lehninger Principles of Biochemistry-David L. Nelson and Michael M.Cox, WH. Freeman, Seventh Edition.
18. Text Book of Biochemistry-Edward S West, Wilbert R Todd, Howard S Mason, John T Van Bruggen, Macmillan.
19. Principles of Biochemistry- Donald Voet, Charlotte W Pratt, Judith G Voet, Wiley, International Student Version Edition (2012)
20. Lippincott’s Illustrated Reviews, Biochemistry- Denise Ferrier, Wolters Kluwer India Pvt. Ltd. Seventh edition (2017).

B.Sc. Semester– III
Discipline Specific Course (DSC)

Course Title: Nutrition and Biochemical Techniques (Practical)

Course Code: C3BIC1P1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/ Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-6	Practical	02	04	56hrs.	3hrs.	10	40	50

List of the Expedients, each will have 4rs / Week

Expt. No.	Title: Nutrition and Biochemical Techniques	56.Hrs
1	To study the parts of Microscope.	4 hrs
2	Separation of amino acids by circular paper chromatography.	4 hrs
3	Separation of amino acids by Ascending paper chromatography.	4 hrs
4	Separation of amino acids by Descending paper chromatography.	4 hrs
5	Separation of amino acids by Two dimensional paper chromatography.	4 hrs
6	Demonstration of separation of Lipids/ amino acids by TLC	4 hrs
7	Determination of absorption maxima.	4 hrs
8	Verification of Beer's law	4 hrs
9	Determination of Molar extinction coefficient of any colored compound.	4 hrs
10	Estimation of ascorbic acid by colorimetric method	4 hrs
11	Estimation of calcium in milk using KMnO ₄ and oxalic acid crystal	4 hrs
12	Qualitative analysis of milk	4 hrs
13	Detection of adulterants in food.	4 hrs
14	Isolation of: Starch from potato	4 hrs

B.Sc. Semester-IV

Discipline Specific Course (DSC)

Course Title:- Enzymology and Human Physiology (Theory)

Course Code: C4BIC1T1

DSC-1	Theory	C4BIC1T1
DSC-2	Practical	C4BIC1P1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/ Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-7	Theory	04	04	60hrs.	3hrs.	20	80	100

Course Outcomes (COs):

On successful completion of the course, the student will able to understand:

- CO1: The role of Enzymes and its classification, their activity, theory of catalysis Enzyme kinetics and Inhibition.
- CO2: Allosteric behavior and coenzymes including applications.
- CO3: Human physis logical process such of Digests Respiration Excretion.
- CO4: Body Fluids NS, Muscular system and Bone composition and composition.

Unit	Title: Enzymology and Human Physiology	60 hrs
Unit I	Introduction: History, IUB system of enzyme classification (class and subclass with an example each), definition with examples of holoenzyme, apoenzyme, prosthetic group, coenzyme, cofactor, activator, inhibitor, metalloenzyme. Units of enzyme activity: IU, Ketal, specific activity, Enzyme specificity. Theories of enzyme catalysis: Lock and key theory, Koshland's induced fit theory. Enzyme Kinetics: Factors affecting enzyme activity-enzyme concentration, substrate concentration, pH and temperature. Michaelis-Menten equation for unisubstrate reaction, Km, Vmax and its significance, LB plot, its significance and limitations. Enzyme inhibition: Reversible inhibition- competitive, non-competitive, uncompetitive inhibitions, Irreversible inhibition, suicide inhibition.	15 hrs
Unit II	Allosteric enzymes: allosteric modulators, feedback inhibition, ATCase as an example. Kinetic properties of allosteric enzyme, K enzymes, V enzymes. Coenzyme: Role of NAD⁺ NADP⁺, FMN, TPP and lipoic acid in enzyme catalysis. Isozymes: Lactate dehydrogenase, Multi enzyme complex- Pyruvate dehydrogenase complex. Applications of enzymes: Immobilization of enzymes. Detergent enzymes, Application of enzymes in detergents, food, leather and textile industries. Pharmaceutical applications of enzymes.	15 hrs

Unit III	Digestion and Absorption: Composition and functions of Saliva, gastric, bile, pancreatic and intestinal juices. Generation of gastric HCl, Digestion and absorption of carbohydrates, proteins and lipids. Respiratory system: Transport of oxygen and carbon dioxide in blood, carbonic anhydrase, chloride shift, oxygen dissociation curve, Bohr effect, pH regulation. Excretory system: Structure and function of nephron, renal excretory mechanism (glomerular filtration, tubular reabsorption, and tubular secretion), composition of urine, electrolytic balance, pH regulation by kidneys.	15 hrs
Unit IV	Body fluids :Blood-constituents of blood, types of cells, components of plasma, types of plasma protein and function, mechanism of blood clotting (intrinsic and extrinsic pathway), clotting factors, anticoagulants, fibrinolysis. Lymph: formation and flow of lymph. CSF: composition and functions. Nervous system: Generalised structure of neuron,types of neurons, resting membrane potential, action potential, Conduction of action potential along an axon.Synaptic transmission, neurotransmitters and inhibitors of neurotransmission. Muscular system: Types of muscles, sarcomere, muscle proteins, sarcomere, mechanism of muscle contraction (sliding filament theory), source of energy for muscle contraction Bone: Composition and structure of long bone, growth and remodeling of long bone, factors affecting its growth.	15hrs

Recommended books:

1. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry-Trivore Palmer and Philip Bonner, Wood Head publishing, 2nd Edition.
2. Principles of Enzyme Technology-Khan.M.Y, Khan Farha, PHI Learning Pvt Ltd, 1st Edition.
3. Enzymology-T.Devasena, Oxford University Press, 1st Edition.
4. Harper's Illustrated Biochemistry-Rodwell, Bender, Botham, Kennelly and Weil, Lange Publishing, 31st Edition.
5. Essentials of Enzymology-Rufus O Okotore, Xlibris(2015).
6. Lehninger Principles of Biochemistry-David L.Nelson and Michael M.Cox, WH. Freeman, 7th Edition .
7. Guyton and Hall Text Book of Medical Physiology-John.E. Hall, Elsevier
8. Concise medical Physiology-Sujith K. Chaudhury, New Central Book Agency, 6th Edition.
9. Human Physiology- CC Chatterjee, CBS Publisher, 12th Edition.
10. Anatomy and Physiology-Tortora.G.J., Wiley, Global Edition.

B.Sc. Semester–IV
Discipline Specific Course (DSC)

Course Title: Enzymology and Human Physiology (Practical)

Course Code: **C4BIC1P1**

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/ Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-8	Practical	02	04	56hrs.	3hrs.	10	40	50

List of the Expedients, each will have 4rs / Week

Expt. No.	Title: Enzymology and Human Physiology (Practical)	56.hrs
1	Calibration curve.	4 hrs
2	Determination of activity of salivary amylase/Urease/Esterase/Invertase.	4 hrs
3	Determination of specific activity of salivary amylase/Urease/Esterase/Invertase.	4 hrs
4	Effect of pH on activity of salivary amylase/Urease/Esterase/Invertase.	4 hrs
5	Effect of Temperature on activity of salivary amylase/Urease/Esterase/Invertase.	4 hrs
6	Effect of enzyme concentration on activity of salivary amylase /Urease /Esterase / Invertase.	4 hrs
7	Determination of Km and Vmax.	4 hrs
8	Effect of activator on activity of salivary amylase.	4 hrs
9	Demonstration of determination of glycogen in liver.	4 hrs
10	Preparation of Immobilized Enzymes (Amylase/Urease/Esterase/Invertase).	4 hrs
11	Determination of activity of immobilized enzyme/ Serine proteases.	4 hrs
12	Determination of activity of Serine proteases	4 hrs
13	Titration acidity of urine.	4 hrs
14	Estimation of Haemoglobin by colorimetric method.	4 hrs

B.Sc. Semester–V

Discipline Specific Course (DSC)-

Student shall select DSC 9A & 10 A or 9B & 10 B for 06 credits only

Course Title:- Molecular Biology and Recombinant DNA Technology (Theory)

Course Code: C5BIC2T1

DSC-1	Theory	C5BIC2T1
DSC-2	Practical	C5BIC1P1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/ Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-9A	Theory	04	04	60hrs.	3hrs.	20	80	100

Course Outcomes (COs):

On successful completion of the course, the student will be able to understand:

- CO1: Importance of Central Dogma.
- CO2: Replication-Transcription-Translation DNA damage Mutagens and its repair mechanism.
- CO3: RDT, Concept of RDT, Tools and techniques of RDT.
- CO4: Application of Genetic Engineering.

Unit	Title: Molecular Biology and Recombinant DNA Technology (Theory)	60 hrs
Unit I	Introduction: DNA as a genetic material, experiment of Avery, MacLeod and McCarty, Griffith's and Hershey and Chase experiments. DNA replication: Central dogma, Mode of DNA replication- conservative, semi-conservative and dispersive, Mechanism of prokaryotic DNA replication, role of DNA polymerase, DNA ligase, primase and Helicase. Transcription: Concept of Gene, RNA polymerase, promoters, stages of transcription in prokaryotes, RNA polymerase. Genetic code: Deciphering of genetic code, Nirenberg and Khorana contributions, general features of genetic code, wobble hypothesis. Translation: activation of amino acids, Initiation, elongation and termination in prokaryotes, Inhibitors of protein synthesis in prokaryotes.	15 hrs
Unit II	DNA damage: Types of mutagens and their action- physical and chemical. Chromosomal mutations- deletion, duplication, inversion, translocation, aneuploidy and polyploidy. Gene mutation- somatic versus gametic mutation, point versus multiple mutation, induced versus spontaneous mutations, forward versus back mutation, dominant versus recessive mutation. Transition Versus transversion mutations. DNA Recombination and DNA Repair: Types of recombination- homologous- holiday model, site specific, illegitimate DNA repair mechanisms. Concept of operon: Operon definition, theories related to operon (Jacob- Monod, Beadle-Tatum), General structure of operon- operator, repressor, promoter and regulator site, introns and exons, gene regulation- positive and negative mode. Regulation of Lac operon.	15 hrs

Unit III	Tools of RDT: Steps involved in gene cloning. Restriction enzymes- nomenclature, types, Polynucleotide kinase, nucleases, DNA polymerase, DNA ligase, Reverse transcriptase, alkaline phosphatase, polynucleotide kinase, terminal transferase. Vectors: General properties of vector, types, pBR322, λ phage vectors, M13, Cosmids Phagemids. Artificial chromosome vectors-BACs and YACs. Ligation- Linkers and adapters. Construction of chimeric DNA. Eukaryotic and Prokaryotic host cells. Introduction of r-DNA into host cells: Preparation of competent cells, transformation, transduction, transfection, electroporation, liposome mediated transfer. Identification of recombinants: Antibiotic resistance, blue –white selection.	15 hrs
Unit IV	Techniques involved in Genetic engineering: Brief account on cloning. Polymerase chain reaction- designing of primers for PCR, technique and its application, DNA finger printing and its application, DNA sequencing by Sanger's method. Blotting techniques: Southern and Northern blotting and their applications. Applications of Genetic engineering: Transgenic plants, transgenic animals, Therapeutic proteins- Insulin, Brief account on Bioethics and Biosafety.	15hrs

Recommended books:

1. Essentials of Molecular Biology-Malathi.V, Pearson India, 1st Edition.
2. Molecular Biology of the Gene-James D Watson, Pearson,
3. Lehninger Principles of Biochemistry-David.L.Nelson and Michael M.Cox, WH. Freeman, seventh Edition.
4. Text Book of Biotechnology-RC Dubey, McGraw hill Education, 1st Edition.
5. Text Book of Biotechnology-HK Das, Wiley, 5th Edition.
6. Biotechnology-BD Singh, Kalyani Publishers.
7. Biotechnology-U Satyanarayana, Books and Allied Ltd.
8. Gene cloning and DNA Analysis: An Introduction-T.A. Brown. Wiley-Blackwell; Seventh Edition.
9. Principles of gene Manipulation and Genomics-Sandy B.Primrose, Richard Twyman, Oxford, Seventh Edition
10. Molecular Biotechnology: Principles and Applications of Recombinant DNA-Bernard R. Glick, Jack J. Pasternak

B.Sc. Semester–V

Discipline Specific Course (DSC)

Course Title: Molecular Biology and Recombinant DNA Technology (Practical)

Course Code: C5BIC2P 1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/ Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-10A	Practical	02	04	56hrs.	3hrs.	10	40	50

List of the Expedients, each will have 4rs / Week

1.

Expt. No.	Title: Molecular Biology and Recombinant DNA Technology (Practical)	56.hrs
1	Estimation of DNA by diphenylamine method.	4 hrs
2	Estimation of RNA by Orcinol method.	4 hrs
3	Determination of λ_{max} of nucleotides.	4 hrs
4	Extraction and estimation of protein by salt precipitation.	4 hrs
5	Isolation of DNA from green chilli, tomato, banana, onion by simple method.	4 hrs
6	Isolation of DNA from plant source(Coconut endosperm & onion).	4 hrs
7	Isolation of RNA from Baker's yeast.	4 hrs
8	Determination of purity of isolated DNA by Warburg-Christian's method.	4 hrs
9	Determination of T _m curve for isolated DNA.	4 hrs
10	Separation of DNA by agarose gel electrophoresis.	4 hrs
11	Small scale preparation of <i>E. coli</i> plasmid.	4 hrs
12	Separation of serum protein by SDS- PAGE.	4 hrs
13	Restriction digestion.	4 hrs
14	Ligation.	4 hrs

B.Sc. Semester–V

Discipline Specific Course(DSC)-

Student shall select DSC 9B & 10 B or DSC 9A & 10 A for 06 credits only

Course Title: Biological Oxidation and Metabolism of Biomolecules (Theory)

Course Code: C5BIC2T2

DSC-1	Theory	C5BIC2T2
DSC-2	Practical	C5HSC1P2

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/ Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-9B	Theory	04	04	60hrs.	3hrs.	20	80	100

Course Outcomes (COs):

On successful completion of the course, the student will be able to understand:

- CO1: Energetic and high energy compounds.
- CO2: Biological Oxidation Reduction Mitochondrial electron transport chain.
- CO3: Metabolism of (CHO)n Glycolysis, TCA cycle..
- CO4: Metabolism of Lipid, Proteins and Nucleic Acid, Glycogen metabolism-Photosynthesis.

Unit	Title: Biological Oxidation and Metabolism of Biomolecules (Theory)	60 hrs
Unit I	Bioenergetics: Concept of highenergy bond. High energy compounds, role of high energy compounds in energy transfer, energy coupling. Biological oxidation and reduction: Redox reactions, reduction potentials standard reduction potentials. Nernst equation. Universal electron carriers (NAD⁺, NADP⁺ and FAD, flavoproteins). Stepwise process of biological oxidation. Mitochondrial electron transport chain-Components, Ubiquinone, cytochromes and iron sulfur proteins, Schematic representation indicating the sites of ATP synthesis. Oxidative phosphorylation-Chemiosmotic theory (an outline), Uncouplers and inhibitors of oxidative phosphorylation. Respiratory control (P/O ratio) and its significance.	15 hrs
Unit II	Introduction: Catabolism, anabolism, general modes of regulation of metabolism. Carbohydrate metabolism: Glycolysis: Reactions of glycolysis, oxidation of pyruvate, fates of pyruvate, entry of other carbohydrates into glycolysis. TCA cycle: Reactions of TCA cycle, Amphibolic and integrating role of TCA cycle. Substrate level phosphorylation. Anapleurosis, energetic of glucose metabolism, Cori's cycle, pentose phosphate pathway and its significance. Gluconeogenesis. Glycogen metabolism: Glycogen synthesis, glycogenolysis.	15 hrs

Unit III	Metabolism of lipids: β oxidation of even numbered fatty acids-palmitic acid. Energetics of β-oxidation. Biosynthesis of even numbered fatty acids-palmitic acid. Outlines of cholesterol biosynthesis(structures not required). Protein and Amino acid metabolism: Protein turnover, Nitrogen cycle, incorporation of ammonia into biomolecules. Transamination, deamination, non- oxidative deamination, decarboxylation of amino acids, importance of glutamic acid, aspartic acid, asparagine and glutamine, urea cycle, glucogenic and ketogenic amino acids.	15 hrs
Unit IV	Nucleic acid metabolism: Role of Ribonucleotide reductase, Biosynthesis of purine and pyrimidine—<i>denovo</i> and salvage pathway, end products of purine and pyrimidine metabolism. Photosynthesis: Structure of chloroplast, molecular architecture of Photosystem I and Photosystem II, Light and dark reactions. Cyclic photophosphorylation and its significance. Non cyclic photophosphorylation. Outline of Calvin cycle, C4 cycle and Crassulacean acid metabolism (CAM), Photorespiration and action of herbicides.	15hrs

Recommended books:

1. Harper's Illustrated Biochemistry-Rodwell, Bender, Botham, Kennelly and Weil, Lange Publishing, 31st Edition.
2. Text book of Biochemistry-Vasudevan, Shree Kumari, JAYPEE Brothers Medical Publishers, 2016.
3. Biochemistry-U Satyanarayana and U Chakrapani, Elsevier India, 2016.
4. Text book of Medical Biochemistry-M.N. Chatterjee, Rana Shinde, Jaypee Brothers, 2011.
5. Text Book of Medical Biochemistry-Dinesh Puri, Elsevier India, 4th Edition.
6. Lehninger Principles of Biochemistry-David L. Nelson and Michael M. Cox, W.H. Freeman, seventh Edition
7. Text Book of Biochemistry-Edward S West, Wilbert R Todd, Howard S Mason, John T Van Bruggen, Macmillan.
8. Principles of Biochemistry- Donald Voet, Charlotte W Pratt, Judith G Voet, Wiley, International Student Version Edition (2012).

B.Sc. Semester– V
Discipline Specific Course (DSC)

Course Title: Biological Oxidation and Metabolism Of Biomolecules (Practical)

Course Code: C5BIC2P2

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/ Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-10B	Practical	02	04	56hrs.	3hrs.	10	40	50

List of the Experiments, each will have 4rs / Week

Expt. No.	Title: Biological Oxidation and Metabolism Of Biomolecules	56.hrs
1	Estimation of reducing sugar by DNS method.	4 hrs
2	Estimation of reducing sugar by Nelson- Somogyi's method.	4 hrs
3	Estimation of total soluble sugar by Anthrone method.	6 hrs
4	Estimation of protein by Biuret method.	4 hrs
5	Estimation of protein by Lowry's method.	6 hrs
6	Estimation of sugar by Folin –Wu method.	4 hrs
7	Estimation of Tyrosine by Millon's method.	6 hrs
8	Estimation of Tyrosine by Nitrosonaphthol method.	8 hrs
9	Estimation of sugar by Hagedorn Jensen's method.	4 hrs
10	Estimation of amino acids by Ninhydrin method	4 hrs
11	Estimation of proteins by Bradford's method.	6 hrs

B.Sc. Semester–VI

Discipline Specific Course(DSC)-

Student shall select DSC 11B & 12 B or DSC 11A & 12A for 06 credits only

Course Title:- Endocrinology and Clinical Biochemistry (Theory)

Course Code: C6BIC2T1

DSC-1	Theory	C6BIC2T1
DSC-2	Practical	C6BIC1P1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/ Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-11A	Theory	04	04	60hrs.	3hrs.	20	80	100

Course Outcomes (COs):

On successful completion of the course, the student will be able to understand:

- CO1: Endocrine system, classification of hormones.
- CO2: Hormones and their mechanism of action.
- CO3: secondary messengers and GI, Adrenal, Reproductive Hormones and there.
- CO4: Clinical Biochemistry, Disorders and organs function test.

Unit	Title: Endocrinology and Clinical Biochemistry (Theory)	60 hrs
Unit I	Introduction to endocrinology: Brief account of endocrine glands and hormones secreted by them. Organisation of endocrine system, location and interrelationship of endocrine glands. Classification of hormones based on their chemical nature and mode of action. Transport of hormones. Mechanism of hormone action: Hormone receptors-extracellular and intracellular. G protein coupled receptors. Effector systems-Adenyl cyclase, Guanylyl cyclase and phospholipase C. Second messengers-cAMP, cGMP, IP₃, DAG, Ca²⁺, Protein kinases(PKA,PKB,PKC AND PKG). Steroid hormone/ thyroid hormone receptor mediated gene regulation.	15 hrs
Unit II	Hypothalamic and pituitary hormones: Study of the physiological and biochemical actions of hypothalamic hormones and pituitary hormones-GH, TSH,FSH, LH, Prolactin, Oxytocin and vasopressin. Endocrine disorders-gigantism, acromegaly, dwarfism, diabetes insipidus. Hormones regulating calcium homeostasis:Biochemical and physiological actions of calcitonin and parathyroid hormone. Pancreatic and gastrointestinal hormones: Insulin, glucagon, gastrin, secretin, CCK GIP- biochemical and physiological actions. Diabetes-type I andII. Hormones of adrenals: Mineralocorticoids-aldosterone, glucocorticoids-cortisol, epinephrine and norepinephrine. Pathophysiology-Addison's disease, Cushing's syndrome and Conn's syndrome. Reproductive hormones: Male and female sex hormones.	15 hrs

Unit III	Introduction: Basic concept of clinical biochemistry Definition and scope of clinical biochemistry in diagnosis, Quality control-external and internal quality control programs. Accuracy, precision, specificity. Collection and preservation of blood and urine. Disorders: Composition of blood and disorders of blood, Thalassemia. Disorders of carbohydrate metabolism: Blood sugar level and its clinical significance- Hypo and hyperglycemia. Diabetes mellitus-definition, clinical features, biochemical and metabolic changes (in brief). Glucose tolerance test- definition, types (Oral GTT to be discussed in brief). Glycogen storage diseases. Disorders of lipid metabolism: Hypercholesterolemia Atherosclerosis. Disorder of amino acid metabolism- Alkaptonuria and phenylketonuria.	15 hrs
Unit IV	Organ function tests: Kidney: Renal function tests-types (in brief). Clearance test-Definition, urea clearance test, creatinine clearance test (in brief). Liver: Jaundice, hemolytic, hepatic and obstructive jaundice. Differential diagnosis of jaundice-Van den Berg test. Conjugated and unconjugated bilirubin, bile pigment levels in blood and urine. Clinical Enzymology: Functional and non-functional plasma enzymes, isozymes and diagnostic tests. Enzyme pattern in health and diseases with special reference to plasma lipase, amylase, alkaline and acid phosphatase, cholinesterase, LDH, CPK, SGOT & SGPT.	15hrs

Recommended books:

1. Manipal Manual of Clinical Biochemistry-Shivanand B. Naik, S. Naik, Jaypee Brothers Medical Publishers.
2. Guyton and Hall Text Book of Medical Physiology-John.E. Hall, Elsevier
3. Concise medical Physiology-Sujith K. Chaudhury, New Central Book Agency, 6th Edition.
4. Human Physiology- CC Chatterjee, CBS Publisher, 12th Edition.
5. Medical Biochemistry-Praful Godkar, Bhalani Publishers, 1st Edition.
6. Concepts of Biochemistry With Clinical Approach-poonam Agarwal, CBS Publisher, 2020
7. Text Book of Biochemistry: With Clinical Correlations, Thomas M Devlin, John Wiley and Sons, 6th Edition.
8. Biochemistry Review With clinical Correlations- Kahrb.S, Thieme, 2019.

B.Sc. Semester–VI

Discipline Specific Course (DSC)

Course Title: Clinical Biochemistry and Endocrinology (Practical)

Course Code: C6BIC2P1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/ Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-12A	Practical	02	04	56hrs.	3hrs.	10	40	50

List of the Expedients, each will have 4rs / Week

Expt. No.	Title: Clinical Biochemistry and Endocrinology (Practical)	56.hrs
1	Determination of blood glucose by O- Toluidine method.	3 hrs
2	Determination of serum bilirubin by Powell method.	3 hrs
3	Determination of serum bilirubin by Malloy and Evelyn method.	3 hrs
4	Determination of total serum protein and Albumin- Globulin ratio.	3 hrs
5	Determination of Cholesterol by Zak's method.	4 hrs
6	Estimation of Creatinine by Jaffe's method.	4 hrs
7	Estimation of Urea by DAMO method.	4 hrs
8	Estimation of Ketoacid by DNPH method.	3 hrs
9	Determination of uric acid by Caraway method.	4 hrs
10	Estimation of phosphate by Fiske-Subbarao method.	3 hrs
11	Qualitative analysis of saliva.	4 hrs
12	Determination of activity of SGOT	3 hrs
13	Assessment of cell membrane permeability alteration.	4 hrs
14	Determination of activity of SGPT.	4 hrs
15	Qualitative tests of urine for normal constituents	3 hrs
16	16.Qualitative tests of urine for abnormal constituents.	4 hrs

B.Sc. Semester–VI

Discipline Specific Course (DSC)

Student shall select DSC 11B & 12 B or DSC 11A & 12A for 06 credits only

Course Title:- Immunology (Theory)

Course Code: C6BIC2T2

DSC-1	Theory	C6BIC2T2
DSC-2	Practical	C6BIC1P2

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/ Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-11B	Theory	04	04	60hrs.	3hrs.	20	80	100

Course Outcomes (COs):

On successful completion of the course, the student will able to understand:

- CO1: Hematopoiesis, Immunity, Antigen and Antibodies.
- CO2: T and B lymphocytes, Major Histocompatibility complex(MHC) and Complement system.
- CO3: Immunological techniques.
- CO4: Transplantation, Hypersensitivity, Auto immunity, Allergic reaction and vaccination.

Unit	Title: Immunology (Theory)	60 hrs
Unit I	Introduction: Hematopoiesis, Cells and Organs of immune system- Primary and secondary lymphoid organs, lymphoid cells, stem cells B and T lymphocytes, null cells, Mononuclear cells and Granulocytic cells. Immunity: Innate immunity (non-specific),- Anatomic, physical, phagocytic and inflammatory barriers. Adaptive(specific) immunity. Humoral and cell mediated immunity. Antigens: Types, characteristics, antigenicity, immunogenicity, Immunogens and factors influencing immunogenicity, epitopes, haptens and adjuvants	15 hrs
Unit II	Immunoglobulins: Structure, classes and functions of immunoglobulins, Theories of antibody production, clonal expansion theory .Monoclonal antibodies and its production. Abzymes. T and B lymphocytes:T and B lymphocytes, maturation, activation and differentiation. Recognition of antigens by T and B lymphocytes. Processing and presentation of antigens. Clonal selection of lymphocyte. Cellular interaction for generation of humoral and cell mediated response. Cytokines-importance and functions, antagonists.	15 hrs

Unit III	Major Histocompatibility complex (MHC): Definition, types and their structure- Antigen processing and presentation by MHC. Complement system: Complement activation by classical, alternate and lectin pathway. Formation of membrane attack complex. Immunological techniques: Antigen antibody reactions-precipitation and agglutination reactions, immune diffusion, immune electrophoresis. ELISA, RIA, complement fixation test.	15 hrs
Unit IV	Transplantation: Types of graft, graft rejection mechanism (in brief). ABO blood group compatibility and immunosuppressive drugs. Hypersensitivity reactions, Vaccines: Types, importance of rDNA vaccines. Auto immunity: Factors contributing and brief mechanism of development. Rheumatoid arthritis. Immune response to bacterial(tuberculosis), parasite(Malaria), Virus(HIV) infections. Immunodeficiency-congenital and acquired.	15hrs

Recommended books:

1. Basic Immunology: Functions and disorders of Immune System-Abul .K .Abbas. Elsevier India, 1st Edition.
2. Lippincott's Illustrated Reviews Immunology-Thao Doan, Roger Melvoid, Susan Viselli, Carl Waltenbaugh, WoltersKluver India Pvt Ltd, 2nd Edition.
3. Elements of Immunology-Fahimhalim Khan, Pearson Education India, 1st Edition.
4. Kuby's Immunology-Thomas J Kindt, WH Freeman,
5. Immunology-IM Roitt, J. Brostoff, D Male, WH Freeman and Publishing Company.

B.Sc. Semester–VI

Discipline Specific Course (DSC)

Course Title: Immunology (Practical)

Course Code: C6BIC2P2

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/ Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-12B	Practical	02	04	56hrs.	3hrs.	10	40	50

List of the Expedients, each will have 4rs / Week

Expt. No.	Title: Immunology (Practical)	56.hrs
1	Determination of blood group.	4 hrs
2	Determination of Rh factor.	4 hrs
3	Estimation of Haemoglobin content in blood by Sahli's method.	4 hrs
4	Erythrocyte sedimentation rate.	4 hrs
5	Packed cell volume.	4 hrs
6	Enumeration of RBC by Haemocytometer.	4 hrs
7	Enumeration of WBC by Haemocytometer.	4 hrs
8	Observation of different types of blood cells by smear technique.	4 hrs
9	WIDAL test.	4 hrs
10	VDRL test.	4 hrs
11	Study of Precipitation reaction (pregnancy test/ Radial immune diffusion/ Ouchterlony double diffusion).	4 hrs
12	Study of Rocket immune electrophoresis.	4 hrs
13	ELISA	8 hrs

B.Sc. Semester– III
Elective Course (EC)
It is for other combination students

Course Title:- General Biochemistry and Biochemical Techniques
Course Code:C5BIC5T1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/ Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
EC-1	Theory	03	04	45hrs.	3hrs.	20	80	100

Course Outcomes (COs):

On successful completion of the course, the student will be able to understand:

- CO1: Scope, history of Biochemistry, Carbohydrates, Proteins and Nucleic acids.
- CO2: Types of cells, Cell fraction and Centrifugation.
- CO3: Spectroscopy, chromatography and Electrophoresis.

Unit	Title: General Biochemistry and Biochemical Techniques	45 hrs
Unit I	Introduction: Scope, history and development of Biochemistry. Milestones in Biochemistry Carbohydrates: Classification and biological importance. Stereochemistry of monosaccharides, Enantiomers, Epimers, anomers and diastereomers. Structure and biological importance of Monosaccharides: Structure and biological importance of Glucose, fructose, Galactose, Mannose and Ribose. Oxidation, Reduction and reaction with phenyl hydrazine. Proteins: Classification based on structure and functions, elementary studies of primary, secondary, tertiary and quaternary structure of protein. Tertiary structure of myoglobin and quaternary structure of Hemoglobin. Denaturation of proteins. Nucleic acids: Components of nucleic acids, structure of common purine and pyrimidine bases, tautomeric forms of bases, structure of nucleoside, nucleotide and polynucleotides. DNA: Watson and Crick model of DNA, forms of DNA, physical properties of DNA, Tm curve of DNA. RNA: types of RNA (t- RNA, m-RNA, r-RNA) unusual bases of nucleic acids.	15 hrs
Unit II	Types of cells: Prokaryotic and eukaryotic cell, differences between animal and plant cell. Cell fractionation: Scope of isolation and purification of biomolecules, sample selection, methods of tissue homogenisation, salt and organic solvent extraction, fractionation, dialysis and reverse dialysis, ultrafiltration and lyophilisation. Centrifugation: Principle of sedimentation technique, different types of centrifuges, types of rotors, Preparative centrifugation: Principle, procedure and application of differential and density gradient centrifugation.	15 hrs

Unit III	Spectroscopy: Electromagnetic spectrum, Laws of light absorption, Beer – Lambert's law, molar extinction coefficient, principle and applications of colorimeter, UV- Vis spectrophotometer. Principles of light microscopy. Chromatography: Basic principle of chromatography, adsorption and partition chromatography- Ascending, descending and circular paper chromatography. Principle, procedure and applications of TLC. Principle and applications of Gel permeation chromatography, Ion exchange chromatography, affinity chromatography. Electrophoresis: Paper and gel electrophoresis. Principle and applications of SDS-PAGE, Agarose gel electrophoresis.	15 hrs
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Recommended books:

1. Harper's Illustrated Biochemistry-Rodwell, Bender, Botham, Kennelly and Weil, Lange Publishing, 31st Edition.
1. Text book of Biochemistry-Vasudevan, Shree Kumari, JAYPEE Brothers Medical Publishers, 2016.
2. Biochemistry-U Satyanarayana and U Chakrapani, Elsevier India, 2016
3. Hand book of food and nutrition-Dr.M.Swaminathan, Bappco Publisher (2010)
4. Food Science-Srilakshmi, New Age International Publisher 7th Edition.
5. Nutritional Biochemistry-DC Sharma, CBS Publisher (2014).
6. Text Book of Nutrition and Biochemistry-Prasad R Manjeshwar, Sheetal Distributors (2019)
7. Text Book of human Nutrition –Anjana Agarwal and Shobhaudipi, Jaypee Brothers Medical Publisher, 1st Edition (2014)
8. Human Nutrition and Dietetics-Sir Stanely Davidson, Reginald Passmore, martin A Eastwood, Churchi Living stone, 10th Edition, 1999.
9. Biophysical Chemistry-Dr.Avinash Upadhyay, Dr.Kakoli Upadhyay and Dr.Nirmalendu Nath, Himalaya Publishing House, Fourth Edition.
10. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, 8th Edition.

B.Sc. Semester– IV

Elective Course(EC)

Course Title:- Clinical Biochemistry
Course Code:C6BIC5P1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/ Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
EC-2	Theory	03	04	45hrs.	3hrs.	20	80	100

Course Outcomes (COs):

On successful completion of the course, the student will able to understand:

- CO1: Basic concept of clinical biochemistry, Disorders of carbohydrate metabolism and lipid metabolism.
- CO2: Organ function tests of Kidney, liver and clinical Enzymology.
- CO3: Hormones, Pancreatic and gastrointestinal hormones, Hormones of adrenals and Reproductive hormones.

Unit	Title: Clinical Biochemistry	45 hrs
Unit I	Introduction: Basic concept of clinical biochemistry Definition and scope of clinical biochemistry in diagnosis, Quality control-external and internal quality control programs. Accuracy, precision, specificity. Collection and preservation of blood and urine. Disorders: Composition of blood and disorders of blood, Thalasemia. Disorders of carbohydrate metabolism: Blood sugar level and its clinical significance- Hypo and hyperglycemia. Diabetes mellitus-definition, clinical features, biochemical and metabolic changes(in brief). Glucose tolerance test- definition, types(Oral GTT to be discussed in brief).Glycogen storage diseases. Disorders of lipid metabolism: Hypercholesterolemia Atherosclerosis. Disorder of amino acid metabolism-Alkaptonuria and phenylketonuria.	15 hrs
Unit II	Organ function tests: Kidney:Renal function tests-types(in brief). Clearance test-Definition, urea clearance test, creatinine clearance test (in brief). Liver:Jaundice, hemolytic, hepatic and obstructive jaundice. Differential diagnosis of jaundice-Van den Berg test. Conjugated and unconjugated bilirubin,bile pigment levels in blood and urine. Clinical Enzymology: Functional and non-functional plasma enzymes, isozymes and diagnostic tests. Enzyme pattern in health and diseases with special reference to plasma lipase, amylase, alkaline and acid phosphatase, cholinesterase, LDH, CPK, SGOT & SGPT.	15 hrs

Unit III	Hormones regulating calcium homeostasis: Biochemical and physiological actions of calcitonin and parathyroid hormone. Pancreatic and gastrointestinal hormones: Insulin, glucagon, gastrin, secretin, CCK GIP- biochemical and physiological actions. Diabetes-type I and II. Hormones of adrenals: Mineralocorticoids-aldosterone, glucocorticoids-cortisol, epinephrine and norepinephrine. Pathophysiology-Addison's disease, Cushing's syndrome and Conn's syndrome. Reproductive hormones: Male and female sex hormones.	15 hrs
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Recommended books:

1. Manipal Manual of Clinical Biochemistry-Shivanand B. Naik, S. Naik, Jaypee Brothers Medical Publishers.
2. Guyton and Hall Text Book of Medical Physiology-John E. Hall, Elsevier
3. Concise medical Physiology-Sujith K. Chaudhury, New Central Book Agency, 6th Edition.
4. Human Physiology- CC Chatterjee, CBS Publisher, 12th Edition.
5. Medical Biochemistry-Praful Godkar, Bhalani Publishers, 1st Edition.
6. Concepts of Biochemistry With Clinical Approach-poonam Agarwal, CBS Publisher, 2020
7. Text Book of Biochemistry: With Clinical Correlations, Thomas M Devlin, John Wiley and Sons, 6th Edition.
8. Biochemistry Review With clinical Correlations- Kahrb.S, Thieme, 2019

B.Sc. Biochemistry
03-Year UG programme: 2024-25

GENERAL PATTERN OF PRACTICAL QUESTION PAPER FOR DSC/ SEC

General instructions:

Scheme of Practical Examination (distribution of marks): 40 marks for Semester end examination

Q1. Major Experiment -20 Marks

Q2. Minor Experiment -10 Marks

Q3. Journal/Record – 5 Marks

Q4. Viva-Voce -5 Marks

Formative Assessment for Practical	
Assessment Occasion/type	Marks
First Internal Assessment	05
Second Internal Assessment	05
Assignment	10
Total	20 Marks
<i>Formative Assessment as per guidelines.</i>	

B.Sc. programme: 2024-25

GENERAL PATTERN OF **THEORY** QUESTION COURSE FOR DSC/ EC
(80 marks for semester end Examination with 3 hrs duration)

Part-A

1. Question number 1-10 carries 2 marks each. : 20 marks

Part-B

2. Question number 11- 18 carries 05Marks each. Answer any 06 questions : 30 marks

Part-C

3. Question number 19-22 carries 10 Marks each. Answer any 03 questions : 30 marks
(Minimum 1 question from each unit and 10 marks question may have
sub questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 80 Marks

**Note: Proportionate weight age shall be given to each unit based on number of hours
Prescribed**