

VIVEKANANDHA

COLLEGE OF ARTS AND SCIENCES FOR WOMEN

ELAYAMPALAYAM, TIRUCHENGODE (Tk.), NAMAKKAL (Dt.).

An ISO 9001: 2015 Certified Institution
(Affiliated to Periyar University, Approved by AICTE, recognized u/s 2 (f) & 12 (B) & Re-accredited with 'A+' by NAAC)



DEPARTMENT OF BIOCHEMISTRY

M.Sc., BIOCHEMISTRY

SYLLABUS AND REGULATIONS

FOR CANDIDATES ADMITTED FROM 2022-23
ONWARDS UNDER AUTONOMOUS OBE AND CBCS
PATTERN

VIVEKANANDHA EDUCATIONAL INSTITUTIONS
Angammal Educational Trust
Elayampalayam, Tiruchengode (Tk.), Namakkal (Dt.)

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COLLEGE VISION AND MISSION

Vision

- To evolve into a center of excellence in higher education through creative and innovative practices to social equity for women.

Mission

- To provide sufficient learning infrastructure to the students to pursue their studies.
- To provide good opportunity for higher education and conducive environment to the students to acquire education.
- To provide quality academic programs training activities and research facilities.
- To facilitate industry-institute interaction.

DEPARTMENT

Vision

To be recognized as a centre for excellence in Biochemistry that provides an atmosphere to acquire skills in identifying the link between biological and human resources and transform it to enhance the quality of life.

Mission

- To help the students to gain more knowledge through visit to research Institutions, Industries, and hospitals through Job training and project work.
- To give an opportunity to students to meet eminent scientists working in various fields of Biochemistry by way of invited lectures, seminars & workshops
- Designing strategies and catalysts for making chemical bonds in new ways
- To provide opportunities to get hands on experience in –
 - Research oriented education in Biochemistry
 - Programming and application skills in Bioinformatics and Drug Designing
 - Molecular Biology and Biotechnology
 - Apprenticeship in industries and service agencies
 - Entrepreneurship in Biochemistry-related areas.
- Promote research based projects/activities in the emerging areas of technology convergence.

PROGRAMME EDUCATIONAL OBJECTIVES

1. To make the graduates to afford fundamentals and applications of current biochemical concepts at an advanced level.
2. To promote research in the thrust areas of Biochemistry ranging in wide areas like structural biology, gene regulation and to connect various field through Biochemistry
3. To equip with the up-to-date skills of evolving technologies as per industrial forecast

PROGRAMME SPECIFIC OBJECTIVES (PSO)

1. To provide students with learning experiences that help instill deep interests in learning Biochemistry; develop broad and balanced knowledge and understanding of biomolecules, like biochemical concepts, principles and theories related to Biochemistry and equip students with appropriate tools of analysis and with theoretical technical and analytical skills to tackle issues and problems in the field of Biochemistry.

2. To equip the graduates with the ability to prepare to a fast changing situations by gaining strength to learn and apply the new skills with competency and to provide students with the knowledge and skill base that make them undertake further studies in Biochemistry and related areas or I multidisciplinary areas that help develop a range of generic skills that are relevant to wage employment, self-employment and entrepreneurship.

3. To expose the students to a wide range of careers that combine biology, plants and medicine and render graduates with some work experience, as summer internship and a research project in a research laboratory to further boost the career prospects.

PO and Knowledge level

PO No	PROGRAMME OUTCOME	Knowledge Level
PO1	Disciplinary knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate programme of study.	K2
PO2	Communication Skills: Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.	K1
PO3	Critical thinking: Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.	K4
PO4	Problem solving: Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations.	K3
PO5	Analytical reasoning: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyse and synthesise data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.	K5
PO6	Research-related skills: A sense of inquiry and capability for asking relevant/appropriate questions, problematising, synthesising and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation.	K6
PO7	Cooperation/Team work: Ability to work effectively and respectfully with diverse teams, facilitate cooperative or coordinated effort on the part of a group and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team.	K6
PO8	Scientific reasoning: Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective.	K4
PO9	Reflective thinking: Critical sensibility to lived experiences, with self awareness and reflexivity of both self and society.	K2
PO10	Information/digital literacy: Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data.	K3
PO11	Self-directed learning: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.	K6
PO12	Multicultural competence: Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to	K5

	effectively engage in a multicultural society and interact respectfully with diverse groups.	
PO13	Moral and ethical awareness/reasoning: Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one's work, avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work.	K3
PO14	Leadership readiness/qualities: Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way.	K6
PO15	Lifelong learning: Ability to acquire knowledge and skills, including "learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.	K6

ELIGIBILITY FOR ADMISSION

- Candidates seeking admission to the first year M.Sc., Degree Course could have a Bachelors Degree in Science with Biochemistry, Chemistry, Botany, Zoology, Nutrition and dietetics or Food and Nutrition or Food Sciences as the main subject or a Bachelors Degree in Agriculture and Life sciences as main subject of this University or any other qualification accepted as equivalent there to are eligible for admission to M.Sc., Degree course.

DURATION OF THE COURSE

The duration of the course is for two academic years consisting of four semesters.

EXAMINATIONS

There shall be four semester examinations: first semester examinations at the middle of the first academic year and the second semester examination at the end of the first academic year. Similarly, the third and fourth semester examinations shall be held at the middle and the end of the second academic year, respectively.

SCHEME OF EXAMINATIONS

The scheme of examinations for different semesters shall be as follows:

Theory External marks	=	75
Part A	=	20 Marks (01 x 20)
Part B	=	25 Marks (05 x 05)
Part C	=	30 Marks (03 x 10)
Internal marks	=	25
Total Marks	=	100
Time	=	3 Hrs.

The following procedure will be followed for Internal Marks**Theory - Internal Marks**

Theory best average of two tests	10 Marks
Attendance	5 Marks
Seminar	5 Marks
Assignment	5 Marks
Total	25 Marks

Practical - Internal Marks

Practical best average of two tests	25 Marks
Attendance	10 Marks
Observation Note	5 Marks
Total	40 Marks

Project- Internal Marks

Presentations [Two reviews 25+25]	50 Marks
Project Report	100 Marks
Viva - Voce	50 Marks
Total	200 Marks

Break-up Details for Attendance

Below 75%	No Marks
76 to 80%	01 Marks
81 to 85%	02 Marks
86 to 90%	03 Marks
91 to 95%	04 Marks
96 to 100%	05 Marks

REQUIREMENTS FOR PROCEEDING TO SUBSEQUENT SEMESTERS

- (i) Candidates shall register their names for the first semester examination after the admission in the PG courses.
- (ii) Candidates shall be permitted to proceed from the first semester up to the final semester irrespective of their failure in any of the semester examination subject to the condition that the candidates should register for all the arrear subjects of earlier semesters along with current (subject) semester subjects.
- (iii) Candidates shall be eligible to proceed to the subsequent semester, only if they earn sufficient attendance as prescribed therefore by the Syndicate from time to time. Provided in case of

candidate earning less than 50% of attendance in any one of the semester due to any extraordinary circumstance such as medical grounds, such candidates who shall produce Medical Certificate issued by the Authorized Medical Attendant (AMA), duly certified by the Principal of the College, shall be permitted to proceed to the next semester and to complete the course of study. Such candidate shall have to repeat the missed semester by rejoining after completion of final semester of the course, after paying the fee for the break of study as prescribed by the college from time to time.

PASSING MINIMUM

- There shall be no Passing Minimum for Internal.
- For External Examination, Passing Minimum shall be of 50% (Fifty Percentage) of the maximum marks prescribed for the paper.
- In the aggregate (External + Internal) the passing minimum shall be of 50% for each Paper/Practical/Project and Viva-voce.
- Grading shall be based on overall marks obtained (Internal + External)

CLASSIFICATION OF SUCCESSFUL CANDIDATES

Candidates who secured not less than 60% of aggregate marks (Internal + External) in the whole examination shall be declared to have passed the examination in the first class. All other successful candidates shall be declared to have passed in second class. Candidates who obtain 75% of the marks in the aggregate (Internal + External) shall be deemed to have passed the examination in first class with distinction, provided they pass all the examinations (theory papers, practical, project and viva-voce) prescribed for the course in the first appearance.

GRADING SYSTEM

The term grading system indicates a 7 point scale of evaluation of the performances of students in terms of marks obtained in the Internal and External examination, grade points and letter grade.

SEVEN POINT SCALE (As per UGC notification, 1998)

GRADE	GRADE POINT	PERCENTAGE EQUIVALENT
'O'= Outstanding	5.50 – 6.00	75 – 100
'A'= Very Good	4.50 – 5.49	65 – 74
'B' = Good	3.50 – 4.49	55 – 64
'C'= Average	3.00 – 3.49	50 – 54
'D'= Below Average	1.50 – 2.99	35 – 49
'E'= Poor	0.50 – 1.49	25 – 34
'F'= Fail	0.00 – 0.49	00 – 24

RANKING

Candidates who pass all the examinations prescribed for the course in the first appearance itself alone are eligible for Ranking / Distinction. Provided in the case of candidates who pass all the examinations prescribed for the course with a break in the first appearance will not be eligible for ranking.

PATTERN OF QUESTION PAPER

PART A (Objective): Answer All the Questions **01 x 20 = 20 Marks**

PART B (200 words): Answer All the Questions (Internal choice) **05 x 05 = 25 Marks**

PART C (500 words): Answer All the Questions (Internal choice) **03 x 10 = 30 Marks**

PROCEDURE IN THE EVENT OF FAILURE

If a candidate fails in particular subjects, she may reappear for the examination in the concerned subject in subsequent semester and shall pass the examination.

COMMENCEMENT OF THESE REGULATIONS

These regulations shall take effect from the academic year 2021-22 (i.e.,) for the students who are to be admitted to the first year of the course during the academic year 2021-22 and thereafter.

TRANSITORY PROVISION

Candidates who were admitted to the PG course of Biochemistry before 2021 – 2022 shall be permitted to appear for the examinations under those regulations for a period of two years i.e., upto and inclusive of the examination of Apr/May 2022. Thereafter, they will be permitted to appear for the examination only under the regulations then in force.

DEPARTMENT OF BIOCHEMISTRY
SCHEME OF CURRICULUM – M.Sc. BIOCHEMISTRY
(For the candidates admitted during the academic year 2022-2023 onwards)

Sem	Subject code	Course	Subject title	Hrs/week	Credit	Int. marks	Ext. marks	Tot. marks
I	21P1BC01	Core – I	Biopolymers	6	5	25	75	100
	21P1BC02	Core – II	Cellular Biochemistry	5	5	25	75	100
	21P1BC03	Core – III	Enzymology and Enzyme technology	5	5	25	75	100
	21P1BCP01	Practical - I	Core Practical - I	5	3	40	60	100
	21P1BCP02	Practical - II	Core Practical - II	5	3	40	60	100
	21P1BCE01/ 21P1BCE02	Elective – I	Analytical Biochemistry Plant Biochemistry and Plant Biotechnology	4	4	25	75	100
Total				30	25	180	420	600
II	21P2BC04	Core – IV	Intermediary Metabolism and Regulation	6	5	25	75	100
	21P2BC05	Core – V	Molecular Biology	5	5	25	75	100
	21P2BC06	Core – VI	Immunology and Immunotechnology	5	5	25	75	100
	21P2BCP03	Practical III	Core Practical- III	5	3	40	60	100
	21P2BCP04	Practical IV	Core Practical- IV	5	3	40	60	100
	21P2BCE03/ 21P2BCE04	Elective – II	Pharmaceutical Biochemistry and toxicology Endocrinology	4	4	25	75	100
Total				30	25	180	420	600
III	21P3BC07	Core – VII	Advanced Clinical Biochemistry	4	4	25	75	100
	21P3BC08	Core – VIII	Research Methodology	4	4	25	75	100
	21P3BC09	Core – IX	Genetic Engineering and Fermentation Technology	5	5	25	75	100
	21P3BCP05	Practical- V	Core Practical-V	5	4	40	60	100
	21P3BCP06	Practical- VI	Core Practical-VI	5	3	40	60	100
	21P3BCE05/ 21P3BCE06	Elective –III	Neuroscience Microbial Biochemistry	4	4	25	75	100
	21P3BCED01	EDC	Diagnostic Biochemistry	2	1	25	75	100
	21P3HR01		Human rights	1	1	25	75	100
Total				30	26	230	570	800

IV	21P4BC10	Core – X	Human Physiology	6	5	25	75	100
	21P4BC11	Core XI	Bioinformatics and Nanotechnology	6	5	25	75	100
	21P4BCPR01	Core – VII	Project work	18	5	40	60	100
Total				30	15	90	210	300
Overall Total				120	91	680	1620	2400

ELECTIVE COURSES:**SEMESTER I:**

1. Analytical Biochemistry (21P1BCE01)
2. Plant Biochemistry and Plant Biotechnology (21P1BCE01)

SEMESTER II:

1. Pharmaceutical Biochemistry and toxicology (21P2BCE03)
2. Endocrinology (21P2BCE04)

SEMESTER III:

1. Neuroscience (21P3BCE05)
2. Microbial Biochemistry (21P3BCE06)

EXTRA DISCIPLINARY COURSE

1. Diagnostic Biochemistry (21P3BCED01)

**I YEAR I SEMESTER
BIOPOLYMERS**

Paper : Core I
Hours/Week : 6
Credit : 5
Paper Code : 21P1BC01

Total Hours : 75
Exam Hours : 03
Internal : 25
External : 75

SUBJECT DESCRIPTION:

Biopolymers deal with the brief information on the structure, functions and behavioral properties of biomolecules.

OBJECTIVES:

The main objective of the course is to study about carbohydrates, proteins, lipids, and nucleic acids and their structure and properties in advanced level.

COURSE OUTCOME:

Course No	Course Outcome	Knowledge Level
CO1	Familiarize about the definition, occurrence, and types of various biomolecules	K2
CO2	Recall and understand the classification, chemistry and functions of macro and micro nutrients.	K2
CO3	Imbibe and interpret the chemical reactions of monosaccharides, amino acids and structural organization of various biomolecules.	K3
CO4	Evolve the physiological functions and significance of macro and micro nutrients.	K4
CO5	Correlate the need of macro and micronutrients with the metabolic and physiological functions of the human body.	K4

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	S	S	S	S	S	M	M	M	S	S	S	M	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	M	S	S	M	M	S	M	M	M	S
CO4	S	S	S	M	S	S	S	S	S	M	S	S	S	S	S
CO5	S	M	M	S	M	M	S	M	S	M	S	S	M	M	S

S- Strong; M-Medium; L-Low

CONTENT:

Unit I – (15 Hrs.): Carbohydrates: Introduction, Classification, and Properties of carbohydrates, Bacterial cell wall Polysaccharides, Amino sugars and Deoxy sugars, Glycosaminoglycans-Structure and biological role of Hyaluronic acid, Chondroitin sulphate and Heparin, Sialic acid - Structure and Significance, Biological importance of Proteoglycans and Glycoproteins.

Unit II – (15 Hrs.): Proteins and Amino Acids: Classification, Structure, Function, Properties of Amino acids and Proteins, Amino acid sequencing, biological importance of selenocysteine and desmosine, Ramachandran plot, Structure and Function of Hb, myoglobin, Actin, Myosin, Keratin, Collagen and Elastin, DNA binding proteins - helix-turn-helix, zinc-finger motif, leucine zipper – direct interactions, Protein denaturation.

Unit III – (15 Hrs.): Lipids: Classification, Structure, Properties and Functions of lipids, Transport and hydrolysis of triglycerol, Plant and animal sterols, Fatty acids - Types and significance, Structure and functions of cholesterol, Lipid peroxidation and antioxidants, Lipoproteins - Classification, composition and functions

Unit IV – (15 Hrs.): Nucleic Acids: Structure and properties of nitrogenous bases and nucleotides, Cot value and Cot curve, Chemical synthesis of DNA, Major classes of RNA-Structure and biological functions of mRNA, rRNA, tRNA, snRNA, hnRNA, DNA histone proteins, chromatin, non-histone proteins, Methylated bases of DNA and DNA super coiling, Properties of DNA- buoyant density, viscosity, denaturation and renaturation.

Unit V – (15 Hrs.): Vitamins and Minerals - Definition, Classification of Fat soluble vitamins (A,D,E,K) and Water soluble vitamins (B complex vitamins & Vitamin C) - Sources, Chemical nature, functions and deficiency symptoms. Minerals: Requirements, macro and micro minerals (sources and functions).

TEXT BOOKS:

1. Deb, A.C (2004) **Fundamentals of Biochemistry**. 8th Edition, New Central Book Agency,
2. Jain, J.L & Jain, (2005) **Fundamentals of Biochemistry**. Sixth Edition, S.Chand & Company, New Delhi.
3. U.Sathayanarayana,(2009). **Biochemistry**. 5th Edition by Books and Allied (P) Ltd., India.

REFERENCE BOOKS

1. Murray, K.R. Granner, K.D.Mayes, P.A. and Rodwell W.V. (2016). **Harper's Biochemistry**. 31st Edition, Prentice Hall International Inc., New Jersey.
2. Nelson, D.L. and Cox, M.M (2017). **Lehninger Principles of Biochemistry**. 8th Edition, W.H.Freeman and Company, New York.
3. Bery J.M., Tymoezko J.L. and Stryer L. (2008) **Biochemistry**, 5th Edition, W.H. Freeman and Company, New York.

WEB OF RESOURCES

1. <http://ull.chemistry.uakron.edu/genobc/>.
2. <http://www.biology.arizona.edu/biochemistry/biochemistry.html>.
3. <https://www.sciencedirect.com/topics/neuroscience/dna-binding-protein>
4. <https://biologydictionary.net/nucleic-acid/>
5. <https://www.helpguide.org/harvard/vitamins-and-minerals.htm>

PEDOGOGY: CHALK and Talk , PPT

YEAR I – SEMESTER I
CELLULAR BIOCHEMISTRY

Paper : Core II
Hours/Week : 5
Credit : 4
Paper Code : 21P1BC02

Total Hours : 75
Exam Hours : 03
Internal : 25
External : 75

SUBJECT DESCRIPTION:

This course presents to focus on the different cellular signaling pathways, cellular organelles and organization its biochemistry.

OBJECTIVES:

The objective of the course is to understand the relationship between cellular organelles and cellular signaling in research.

OUTCOME:

Course No	Course Outcome	Knowledge Level
CO1	Discuss the structure, differentiation of eukaryotes and prokaryotes and also cell cycle, check point interpretation, differentiation between mitosis and meiosis	K2
CO2	Illustrate the cell organelles structure and functions such as nucleus, chloroplast, mitochondria, endoplasmic reticulum, ribosome and lysosome etc.	K3
CO3	Apply the knowledge cell signaling of oncology markers such as P ⁵³ , Bcl2, Bax, AFP and IL-1 e and their clinical interpretation	K4
CO4	Describes the critical based knowledge of membrane architecture and their types of models, and membrane transporters- like ion channels, symporters, and antiporters etc.	K5
CO5	Evaluate and hypothesis of extra cellular matrix, gap junction and cell to cell communication and also signal transtrduction pathways such as G protein-coupled receptor and TrkA receptor etc.,.	K6

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	S	S	S	L	M	L	L	M	L	S	S	M	L	L	M
CO2	M	M	M	M	S	M	M	S	L	M	M	M	L	L	M
CO3	S	S	L	M	L	M	L	S	L	M	L	M	S	S	S
CO4	S	S	L	M	M	M	S	L	M	L	M	S	M	L	L
CO5	L	M	L	S	M	M	M	M	M	L	M	M	M	S	S

S- Strong; M-Medium; L-Low

CONTENT:**Unit I – Cell organelles and Protein trafficking****13 hour**

Prokaryotes and eukaryotes cell, Structure of cytoplasm, endoplasmic reticulum, ribosomes, golgi apparatus, lysosomes, mitochondria, nucleus, chromosomes, chromatin, chloroplasts, peroxisomes, glyoxysomes and their function. Selective transport of proteins to and from nucleus, Intracellular compartments and protein sorting, Intracellular vesicular traffic.

Unit II – Cell cycle and Cytoskeleton**10 hour**

Cell cycle and regulation of cell check point, Cell division - mitosis and meiosis- significance. Cytoskeleton - microfilaments and microtubules, actin and myosin filament, cell behavior.

Unit III – Cellular matrix and cell signaling**13 hour**

Cell-cell interaction- laminin, integrins and fibronectins, Cell-Cell adhesion – tight junctions, desmosomes, hemidesmosomes, gap junctions, focal adhesions, and adhesion junctions-cadherins. Signaling – G protein coupled receptors, cell surface receptors- steroid hormone, receptor tyrosine kinases- EGF receptor, RAS-MAP kinas, JAK- STAT pathway. Second messengers- cAMP, cGMP and IP₃

Unit IV – Cancer Biology and Tools of Cancer Markers**12 hour**

Oncogenes, causes, properties, tumor suppressor genes, malignant non-malignant tumour, human chorionic gonadotropin, carcinoembryonic antigen (CEA), alpha-fetoprotein, Carcinogenic -chemicals and radiation. Methods -fluorescence , confocal microscopy and flow cytometry

Unit V – Membrane structure and Transport**12 hour**

Membrane models, fluid mosaic model, membrane proteins -Bacteriorhodopsin, aquaporin, red blood cell ghosts, proteins carbohydrates and cell surface carbohydrates-Lectins, Membrane transport - ion channels, symporters and antiporters, Passive transport-glucose, anion transports and porins.

TEXT BOOKS:

1. Rastogi,S.C. (2003), 2nd Edition, **Cell and Molecular Biology**. New Age International Publishers,New York.
2. Harvey Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore, and James Darnell. (2000) **Molecular Cell Biology**, New York: W. H. Freeman
3. Gerald Karp, (2008).**Cell and Molecular Biology**. 5thEdition, John Wiley and Sons New Jersey.
- 4.Ajay Paul, (2009).**Text Book of Cell and Molecular Biology**. 2th Edition, Books and Allied (P) Ltd, Kolkata.
- 5.VK Agarwal and PS Varma , (2000). Cell Biology and Molecular Biology, Chand & Company, New Delhi.

REFERENCE BOOKS

- 1.Lodish, H. Baltimore, and *et al.*, (2008).**Molecular Cell Biology**. 6th Edition. W.H.Freeman and Co, NY.
2. Garrette, Grisham (1994) **Principles of Biochemistry**, Saunders College Publishing Co. USA.
- 3.Geoffrey, M. Cooper, Robert E. Hausman, **The Cell:A Molecular Approach**.4th Edition,Asm Press,USA.
4. **Bruce Albert et al.**, *Molecular biology of the cell*, Garland publications, New York & London, 3rd edition, 1994.
5. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin C. Raff, Keith Roberts, Peter Walter (2007), **Molecular Biology of the Cell**, Garland Science, Taylor & Francis Group.

WEB SOURCES:

1. <https://www2.estrellamountain.edu/faculty/farabee/biobk/BioBookCELL2.html>
2. <https://www.physics.uoguelph.ca/~dutcher/download/.../1.pdf>
3. <https://www.khanacademy.org/.../cells/cell-cell-interactions/.../cell-cell-interactions-ho...>
4. https://en.wikipedia.org/wiki/Programmed_cell_death
5. <https://www.cellsignal.com/contents/science/key-signaling-networks-in-cancer/cancer-research>

PEDOGOGY: CHALK and Talk , PPT

YEAR I – SEMESTER I
ENZYMOLGY AND ENZYME TECHNOLOGY

Paper	: Core III	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 5	Internal	: 25
Paper Code	: 21P1BC03	External	: 75

SUBJECT DESCRIPTION:

Enzymology and Enzyme Technology deal with the knowledge on enzymes, classification structure kinetics and applications.

OBJECTIVES

The Students should update their knowledge about the enzyme and its role in all stages of metabolism and biochemical reaction. This course will describe a clear idea about an isolation of enzyme, characteristic properties, production on bench scale to pilot scale and their application in bio-industries.

COURSE OUTCOMES

Course No	Course Outcome	Knowledge Level
CO1	Know about the key structural and energetic factors which increase enzyme stability	K2
CO2	Understand about the role of enzyme as a catalyst in biological process	K2
CO3	Interpret the optimum pH, Temperature , Concentration of enzyme for certain enzyme catalysed reaction	K3
CO4	Learn about the logistic and sensible entrapment technique to improve the state of enzyme immobilization	K3
CO5	Familiarize about the application of enzyme technology in industrial sector	K4

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	S	M	L	M	L	M	S	L	S	S	M	M	S	L	L
CO2	M	L	M	S	S	S	L	M	M	M	S	L	M	S	M
CO3	L	M	L	M	L	L	S	L	S	S	M	M	L	L	L
CO4	S	L	M	S	S	L	L	S	L	L	S	L	M	S	S
CO5	M	M	L	M	L	M	S	L	S	S	M	M	L	L	L

S- Strong; M-Medium; L-Low

CONTENT:

Unit I – (15 Hrs.): Enzymology: Introduction, Nomenclature and classification of enzymes by IUB system, enzyme characteristics, monomeric, oligomeric and multienzyme complex. Active site, models of enzyme action – lock and key and Koshland induced fit model. Investigations of active site structure. Isoenzymes, abzymes and ribozymes. Multienzyme systems. Enzyme units and enzyme turnover.

Unit II – (15 Hrs.): Enzyme Kinetics: MM Kinetics, LB plot, Eadie - Hofstee plot and Hanes-woolf plot. Factors affecting enzyme activity (pH, temperature, substrate and enzyme concentration and activators) - Bisubstrate reactions - Enzyme inhibition- Reversible and irreversible. Feedback inhibition -Allosteric inhibition and regulation, concerted and sequential models for allosteric enzymes, positive and negative co-operativity with special reference to aspartate transcarbamoylase.

Unit III – (15 Hrs.): Enzyme Catalysis & Coenzymes: Acid-base catalysis, covalent catalysis and metal ion catalysis. Mechanisms of action of lysozyme, chymotrypsin, ribonuclease and carboxypeptidase. Metal activated enzymes and metalloenzymes. Coenzymes – TPP, PLP, FMN, FAD, NAD, NADP, CoA, Biotin and tetrahydrofolate.

Unit IV – (15 Hrs.): Enzyme Technology: Immobilization – Types, adsorption, covalent binding, entrapment, liposomes, cross linking and microencapsulation. Effect of immobilization on enzyme activity and application of immobilized enzyme. Biosensors- calorimetric biosensors, potentiometric biosensors, Amperometric biosensors, optical biosensors, Piezo-electric biosensors and thermometric biosensor. Enzyme engineering – Artificial enzymes and antioxidant enzymes.

Unit V – (15 Hrs.): Enzyme Purification and Applications: Objectives and strategies of enzyme purification – source – methods of homogenization and separation based on size, polarity and binding sites – purification (Adenylate kinase from pig muscle). Enzymes as analytical agent, therapeutic agents and diagnostic reagents, Industry Enzymes- textile & leather industries and food industries. medical application of enzymes

TEXT BOOKS**TEXT BOOKS**

1. Cornish-Bowden A. (2012) Fundamentals of Enzyme Kinetics, Wiley-VCH GmbH, Germany.
2. Price n.C. and Steven, V. (2002) Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins, 3rd Edition, Oxford University Press.
3. Khan, M Y nad khan, F (2015) Principles of Enzyme Technology, PHI learning

REFERENCE BOOKS

1. Buchholz, K., Kasche, V. and Bornscheur, L.T. (2012) Bioatalyst and Enzyme Technology, Wiley-VCH VerlagGmnH, Gerany.
2. Paler, T. (1995) Understanding of Enzymes, 4th Edition, prentice Hall.
3. Nelson, D.L. and Cox, M.M (2013). Lehninger Principles of Biochemistry. 7th Ed. W.H. Freema and Company, New York.
4. Voet, D and Voet, G, Fundamentals of Biochemistry, John Wiley and Sons, New York.

WEB SOURCES

www.ebi.ac.uk/enzymeportal

<http://expasy.org/enzyme/>.

<http://www.ncbi.nlm.nih.gov/entrez/query.fcgi>.

www1.lsbu.ac.uk/water/enztech/inhibition.html

<https://www.khanacademy.org/...enzymes/enzyme.../basics-of-enzyme-kinetics-graphs>

PEDOGOGY: CHALK and Talk , PPT

YEAR I – SEMESTER I
ANALYTICAL BIOCHEMISTRY

Paper : ELECTIVE
Hours/Week : 4
Credit : 4
Paper Code : 21P1BCE01

Total Hours : 75
Exam Hours : 03
Internal : 25
External : 75

SUBJECT DESCRIPTION:

Analytical Biochemistry deal with the principles, instrumentation, working and application of the instruments commonly used in the laboratories.

OBJECTIVES:

To make the students learn about buffers, centrifugation techniques, chromatography, electrophoresis and spectroscopy studies.

COURSE OUTCOMES:

Course No	Course Outcome	Knowledge Level
CO1	Obtain knowledge about pH, buffers , difference between invivo and invitro studies and types of centrifugation techniques	K2
CO2	Apply the knowledge about the separation and analysis of macromolecules and their fragments, based on their size and charge.	K3
CO3	Implement chromatography techniques for the separation of the individual compound from the mixture of compound.	K3
CO4	Explore the various spectroscopic techniques for studying the structures of atoms and molecules	K4
CO5	Appraise the attributes of naturally decaying atoms and their multiple applications across many aspects of modern day life	K5

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	S	M	M	M	L	L	L	M	S	M	L	L	M	L	L
CO2	M	M	M	S	M	M	L	M	M	S	L	L	S	L	L
CO3	M	M	M	S	M	M	L	M	M	S	L	L	S	L	L
CO4	M	L	S	M	M	L	L	S	M	M	L	M	M	L	L
CO5	L	L	M	M	S	S	S	M	L	L	S	S	L	M	M

S- Strong; M-Medium; L-Low

CONTENT:

Unit I – (15 Hrs.): pH, Buffers and centrifugation: Definition and determination of pH, Henderson-Hasselbalch equation, Measurement of pH, pH electrode, Biological buffers, types of buffer system, In vivo and in vitro studies, organ and tissue slice techniques, tissue homogenization, Methods of cell disruption. Basic principles of sedimentation, types of centrifuges and rotors, Preparative ultracentrifugation, differential centrifugation, density-gradient and analytical ultracentrifugation and its applications in determination of molecular weight.

Unit II – (15 hrs) Electrophoresis and blotting techniques : Electrophoresis techniques – Principle, technique and applications of paper, Native PAGE gels, SDS-PAGE, Isoelectric focusing, Pulse field electrophoresis, Capillary electrophoresis, Immunoelectrophoresis. Separation of cell organelles 2D gel electrophoresis. Hybridization probes - Southern, western and Northern blotting techniques.

Unit III – (15 Hrs.): Chromatography: Definitions, General principles, Instrumentation and application of Chromatography – Paper, Column, Thin layer chromatography, Ion- Exchange, Molecular sieve (gel filtration), Affinity, High-performance liquid chromatography (HPLC), Gas-liquid chromatography (GLC), FPLC, HPTLC, FTIR.

Unit IV – (15 Hrs.): Spectroscopic Technique: Basic principles, wave number, wave laws of absorption, absorption spectrum, instrumentation and applications of UV, visible and IR spectrophotometers, Electron spin resonance, Nuclear Magnetic Resonance, Mass Spectrometry, Molecular analysis using light scattering and Atomic absorption spectroscopy, Flame Photometry – principle, instrumentation and applications, Electron microscope – principle, instrumentation and application of SEM and TEM. Colorimetry, fluorimetry.

Unit V – (15 Hrs.): Radioisotopes and Microscopy: X-ray diffraction - Principle, theory of operation and application, Circular dichroism (CD) – principles, theory of operation and applications, Radioisotopic techniques- Principle and applications of GM Counter, Liquid and Solid Scintillation Counter and autoradiography, applications of radioactive isotopes in biological research, radiation hazards. Microscopy: basic principles, light, brightfield, phasecontrast, fluorescent, electron microscopy-TEM, SEM, preparation of specimen, microtomy fixation and staining, flow cytometry and FACS.

TEXT BOOKS

1. Wilson. K and Walker. J. (2010), Practical Biochemistry – Principles and techniques of Biochemistry and Molecular Biology, 7th Edition, Cambridge University Press, New York, USA.
2. Upadhyay, A., Upadhyay, K., and Nath, N., (2014), Biophysical chemistry – principle & techniques, Himalaya publishing House, Mumbai.
3. Gurdeep, R. Chatwal and Anand. S.K. (2009). Instrumental Methods of Chemical Analysis, Himalaya publishing House, New Delhi.

REFERENCE BOOKS

1. Foster, L.E. (2007), Nanotechnology Science, Innovation and opportunity (First edition), Pearson Education, Inc, New York.
2. Pattabhi, V and Gautham, (2015), Biophysics, Narosa Publishing House PVT Ltd, New Delhi.
3. Rathi, R. (2007), Core Concept of Nanotechnology with application spectrum (First Edition), SBS Publishers and Distribution Pvt Ltd, New Delhi.
4. Sharma. P.K. (2008), Origin and Development of Nanotechnology (first edition), Vista

International publishing House Mumbai, New Delhi.

5. Wilson, K and Goulding, KH (1987). A Biologist Guide to Principles and Tecchniques of Practrical Biochemistry, 3rd edition, Edward Arnold Publishers. Londen, UK.

WEB OF RESOURCE:

1. www.centrifugebybeckman.com

2. www.axis-shield-density-gradient-media.com/training-1new.

3. <http://hyperphysics.phy-astr.gsu.edu/hbase/nuclear/radact.html>

4. www.austincc.edu/.../

5. <https://www.dnalc.org/resources/animations/gelectrophoresis.html>

PEDOGOGY: CHALK and Talk , PPT

PLANT BIOCHEMISTRY AND PLANT BIOTECHNOLOGY

Paper	: Elective – II	Total Hours	: 60
Hours/Week	: 4	Exam Hours	: 03
Credit	: 4	Internal	: 25
Paper Code	: 21P1BCE02	External	: 75

SUBJECT DESCRIPTION:

Plant biochemistry and Plant biotechnology deal with the plant and animal tissue culture methods, and mechanism of gene transfer, Methods of selection, Production of novel proteins and their applications.

Course No	Course Outcome	Knowledge Level
CO1	To obtain the knowledge of the state the importance of photosynthesis, factors affecting photosynthesis, the photosynthetic pigment, and describe the biochemistry of photosynthesis.	K1 & K2
CO2	To make the students understand the components of culture media and various tissue culture techniques. Learnt about the technique of genetic	K1 & K2
CO3	Define respiration and itemize detailed processes of cell respiration and gaseous exchange in flowering plants;	K1, K2 & k3
CO4	Clear about the list and describe the features of phloem translocation	K3 & K4
CO5	To obtain the knowledge about plant and animal tissue culture methods, mechanism of gene transfer Methods of selection, Production of novel proteins and their applications.	K3 & K4

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	S	M	L	M	L	M	S	L	S	S	M	M	S	L	L
CO2	M	L	M	S	S	S	L	M	M	M	S	L	M	S	M
CO3	L	M	L	M	L	L	S	L	S	S	M	M	L	L	L
CO4	S	L	M	S	S	L	L	S	L	L	S	L	M	S	S
CO5	M	M	L	M	L	M	S	L	S	S	M	M	L	L	L

S- Strong; M-Medium; L-Low

CONTENT:

Unit I – (12 Hrs.): Photosynthesis: Photosynthetic apparatus, organisation of thylakoid, role of chlorophylls, carotenoids and other photosynthetic pigments, light absorption and energy conservation, Light – properties of both particle and wave, light absorption by pigment molecules, Photosystems I and II, Electron transport pathways in chloroplast membranes, ATP synthesis in chloroplasts, cyclic and noncyclic photophosphorylation

Unit II – (12 Hrs.): Carbon Reactions & Transpiration: C3, C4 and CAM plants - Calvin cycle; Hatch-Slack pathway, Photorespiration in plants, biochemical basis of PR pathway – C2 cycle, Pathways of glucose oxidation in plants, starch biosynthesis and degradation, metabolic transport between organelles, Overview of lipid and protein metabolism in plants, Transpiration-Types, theories of transpiration, mechanism and factors affecting transpiration.

Unit III – (12 Hrs.): Nitrogen Fixation: Nitrogen fixation and its types. Biochemistry of symbiotic and non symbiotic nitrogen fixation, Physiological of nodule formation, Enzymology of nitrogen fixation, regulation of *nif* and *nod* genes of nitrogen fixation, Interaction between nitrate assimilation and carbon metabolism, Synthesis and functions of glutathione and its derivatives, Interrelationship between photosynthesis and nitrogen metabolism.

Unit IV – (12 Hrs.): Structure of Plant Genes: Structure, transport, distribution, mechanism of action and physiological effects of Auxin, gibberellins, cytokinins, abscisic acid, ethylene, Phytochrome, Biological clock, Fruit ripening.

Unit V – (12 Hrs.): Plant Cell Culture: Tissue culture media – composition and preparation, Micropropagation, somoclonal variation, Callus, Protoplast culture - isolation and purification of protoplasts, Protoplast fusion, genetic modification of protoplasts, Anther, pollen and ovary culture for production of haploid plants and homozygous lines, Uses of haploids in plant breeding. Secondary metabolites

TEXT BOOKS

- 1.Heldt, HW. (2005), **Plant Biochemistry**. 3rd Edition, Elsevier Academic PressPublication, USA.
- 2.Lea, P.J. and Leegood, R.C.(1999). **Plant Biochemistry and Molecular Biology**. 2nd Edition, Wiley and Sons, New York.
- 3.Harborne, J.B. (1989). **Methods in Plant Biochemistry in Plant Phenolics**. Academic Press, London, Uk.
- 4.Goodwin Ane Mercer,(2003).**Introduction to Plant Biochemistry**.2nd Edition,CBS Publishers, New Delhi.

REFERENCE BOOKS

- 1.Hans,Walter-Heldt,(1997).**Plant Biochemistry and Molecular Biology**. 3rd Edition Academic Press, California.
- 2.Narayanaswamy, S. (1999). **Plant Cell and Tissue Culture**. 2nd Edition,Tata McGraw Hill Publishing Company Ltd, New York.

WEB REFERENCES:

1. www.biology4kids.com/files/plants_photosynthesis.html
2. www.slideshare.net/BiologyIB/photosynthesis-powerpoint-3983595
3. http://www.slideshare.net/shivam_hayabusa/production-of-secondary-metabolites
4. www.slideshare.net/JonathanOLEary/photosynthesis-power-point
5. <https://en.wikipedia.org/wiki/Photophosphorylation>

PEDOGOGY: CHALK and Talk , PPT

YEAR I – SEMESTER I
CORE PRACTICAL - I

Paper	: Core Practical I	Total Hours	: 45
Hours/Week	: 5	Exam Hours	: 06
Credit	: 3	Internal	: 40
Paper Code	: 21P1BCP01	External	: 60

COURSE OUTCOMES:

Course No	Course Outcome	Knowledge Level
CO1	Learn and understand the concepts of separation of amini acids and carbohydrates	K1 & K2
CO2	Demonstrate the level of glucose, Ascorbic acid, Lecithine	K1 & K2
CO3	Learn the isolation of compounds like starch, Glycogen etc	K1, K2 & k3

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	S	M	M	S	S	S	S	M	M	L	M	M	M	M	M
CO2	S	M	M	S	M	S	M	M	L	L	M	L	L	S	S
CO3	S	S	M	M	S	M	M	M	L	L	M	L	L	S	M

S- Strong; M-Medium; L-Low

1. Isolation and estimation of Starch from Potato by Anthrone method
2. Isolation and estimation of glycogen from liver by Anthrone method
3. Isolation and estimation of fructose from fruits by selivanoffs method
4. Estimation of DNA from liver
5. Estimation of RNA by orcinol method
6. Isolation of lecithin from egg yolk.
7. Estimation of lactose from milk
8. Estimation of Calcium from milk by titrimetry
9. Separation of Amino acids, Sugars by Paper Chromatography (Ascending, Descending and Circular).

REFERENCE BOOKS:

1. Harold Varley, (1980). **Practical Clinical Biochemistry, Volume I and II**. 5th Edition. CBS Publishers. New Delhi.
2. Jayaraman, S. (2003). **Laboratory Manual in Biochemistry**. 2nd Edition .New Age International (P) Limited. New Delhi
3. Sadasivam S and Manickam P. (2005) **Biochemical Methods**. 2nd Edition. New Age International (P) Limited. New Delhi.

**YEAR I – SEMESTER I
CORE PRACTICAL - II**

Paper : Core Practical II
Hours/Week : 5
Credit : 3
Paper Code : 21P2BCP02

Total Hours : 45
Exam Hours : 06
Internal : 40
External : 60

COURSE OUTCOMES:

Course No	Course Outcome	Knowledge Level
CO1	Learn and understand the concepts of buffer, separation techniques of biomolecules.	K1 & K2
CO2	Demonstrate marker enzyme by kit method	K1 & K2
CO3	Optimize the enzyme activity in terms of pH, substrate, temperature, and enzyme concentration.	K1, K2 & K3

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	S	M	M	S	S	S	S	M	M	L	M	M	M	M	M
CO2	S	M	M	S	M	S	M	M	L	L	M	L	L	S	S
CO3	S	S	M	M	S	M	M	M	L	L	M	L	L	S	M

S- Strong; M-Medium; L-Low

Enzyme Studies:

I. Sub cellular fractionation of organelles from liver cells

II. Kinetic studies of

Effect of pH, Temperature and Substrate concentration-MM Plot, V_{max})

1. Peroxidase
2. Amylase
3. Acid Phosphatase (Effect of pH and Temp)

III. Immobilised Enzyme Reactions

1. Immobilisation of peroxidase by matrix entrapment method

IV. Separation of Isoenzymes

Separation of LDH by SDS-PAGE

REFERENCE BOOKS:

1. Harold Varley, (1980). **Practical Clinical Biochemistry, Volume I and II.** 5th Edition. CBS Publishers. New Delhi.
2. Jayaraman, S. (2003). **Laboratory Manual in Biochemistry.** 2nd Edition .New Age International (P) Limited. New Delhi
3. Sadasivam S and Manickam P. (2005) **Biochemical Methods.** 2nd Edition. New Age International (P) Limited. New Delhi.

M.Sc., BIOCHEMISTRY
QUESTION PAPER PATTERN
MAXIMUM MARKS – 75 marks
DURATION – 3 hours

PART – A (20X 1=20 marks)

Multiple Choice Question From each unit 4 Questions

PART – B (5 X 5 = 25 marks)
Answer All Questions

One Question from each unit with internal choice

PART-C (3x10=30 marks)

Answer any three Questions

One question from each unit

YEAR I – SEMESTER II
INTERMEDIARY METABOLISM AND REGULATION

Paper	: Core IV	Total Hours	: 75
Hours/Week	: 6	Exam Hours	: 03
Credit	: 5	Internal	: 25
Paper Code	: 21P2BC04	External	: 75

SUBJECT DESCRIPTION:

Intermediary metabolism and regulation deals with the metabolic reactions of biomolecules, energy production through different mechanism and various regulatory mechanisms that control metabolic reactions under normal condition.

OBJECTIVE:

The objective of the paper is to make the students to study about bioenergetics of important metabolic pathways and metabolic changes of molecules in the body. Also to know about the Interrelationship between carbohydrate, fat and protein metabolism. To analyse the fate of nucleic acids and porphyrins in the biological system.

COURSE OUTCOME:

Course No	Course Outcome	Knowledge Level
CO1	Explore knowledge on biological oxidation, redox potential, ETC and mitochondrial shuttle mechanism.	K1 & K2
CO2	Demonstrate the important carbohydrate metabolic pathways and understand alternate pathways for glucose oxidation, anaerobic	K1 & K2
CO3	Highlight about types of fatty acid oxidation, biosynthesis of TGs, Phospholipids and prostaglandins and various regulatory mechanism involved. Understand the concepts of metabolism of	K1, K2 & K3
CO4	Describe the types and significance of anabolic and catabolic reactions of amino acids, interrelationship between carbohydrate, lipid & protein metabolism and understand the specialized products from amino acids.	K3 & K4
CO5	Demonstrate the fate of nucleic acids and porphyrins in the biological system.	K3 & K4

Mapping with Programme Outcomes

CoS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	S	L	L	S	M	M	M	M	L	S	L	M	S	M	L
CO2	L	M	M	S	L	L	L	M	M	S	S	M	L	S	M
CO3	S	M	M	M	M	S	L	M	S	L	L	M	L	S	M
CO4	S	M	L	M	S	M	L	M	S	S	L	M	L	M	M
CO5	S	L	M	M	M	S	S	L	S	M	L	L	S	M	S

S- Strong; M-Medium; L-Low

CONTENT:

Unit I – (15 Hrs.): Bioenergetics and Biological Oxidation: Introduction, Free energy, laws of

thermodynamics, Enzymes involved in redox reactions, Electron transport chain - organization and role in electron capture, Mechanism of Electron transport chain and oxidative phosphorylation, Chemiosmotic theory, Inhibitors of respiratory chain and oxidative phosphorylation, Uncouplers and Ionophores, Regulation of oxidative Phosphorylation, Mitochondrial transport systems - ATP/ADP exchange, malate / glycerophosphate shuttle.

Unit II – (15 Hrs.): Carbohydrate Metabolism: An overview of carbohydrate metabolism - glycolysis and gluconeogenesis, energetic - Regulation of glycolysis and gluconeogenesis, Metabolism of glycogen and its regulation, HMP shunt, TCA cycle steps and its regulation, glyoxalate pathway, Cori cycle, Anaplerotic reactions, Metabolism of fructose, galactose and mannose, Lactose and glycoprotein synthesis.

Unit III – (15 Hrs.): Lipid Metabolism: An overview of fatty acid metabolism - fatty acid synthesis and Regulation control of cetyl CoA carboxylase, Oxidation of saturated and unsaturated fatty acids, Oxidation of fatty acids with even and odd numbered carbon atoms, Alpha, beta and omega oxidation, biosynthesis and regulation of triacylglycerols, cholesterol, phosphatidyl choline, sphingomyelin, Biosynthesis and regulation of prostaglandins, Eicosanoids, thromboxanes and leucotrienes, Ketogenesis and its control.

Unit IV – (15 Hrs.): Amino acid Metabolism: An overview of gamma glutamyl cycle, An overview- Methionine methyl donor (SMP pathway), Urea cycle and its regulation, Degradation of amino acids- transamination, decarboxylation, oxidative and non-oxidative deamination, Catabolism of amino acids- carbon skeleton of amino acids to amphibolic intermediates, Inter relationship between carbohydrates, proteins and fat metabolism, Conversion of amino acids to specialized products: Serotonin, GABA, dopamine, epinephrine, nor-epinephrine, melanin, creatinine and creatine.

Unit V – (15 Hrs.): Porphyrin Metabolism: Regulation, biosynthesis and degradation of Hb, chlorophyll and cytochrome, Nucleic acid metabolism - Biosynthesis and degradation of purine and pyrimidines (De novo and Salvage pathway), Regulation of Pyrimidine biosynthesis - aspartate carbomoyl transferase, Biosynthesis and degradation of porphyrin, formation, transport and excretion of bile pigment.

TEXT BOOKS

1. Nelson, David, L. and Cox, (2008). **Lehninger principles of Biochemistry**. 5th Edition, W.H. Freeman and Co., New York.
2. Donald Voet, Judith, G. Voet, and Charlotte, W Pratt, (2008). **Fundamentals of Biochemistry**, 3rd Edition. John Wiley & Sons, New Jersey.
3. Lubert Stryer, (1995). **Biochemistry**. 4th Edition .WH freeman and co, Sanfrancisco.
4. Thomas, M. Devlin, (1997). **Text book of Biochemistry**. 4th Edition A John Wiley, Inc Publication, New York.

REFERENCE BOOKS

1. Devlin, T.M. (2002) **Textbook of Biochemistry with Clinical Correlations**. John Wileysons, INC. New York.
2. Robert Murray, Bender, (2012) **Harper's Illustrated Biochemistry**. McGraw Hill.

WEB SOURCES

- www.britannica.com/science/glyoxylate-cycle
<https://www.uic.edu/classes/phar/.../transaminationofaminoacid.htm>
www.slideshare.net/YESANNA/transamination-deamination

MOLECULAR BIOLOGY

Paper : Core V
 Hours/Week : 5
 Credit : 5
 Paper Code : 21P2BC05

Total Hours : 75
 Exam Hours : 03
 Internal : 25
 External : 75

SUBJECT DESCRIPTION:

Molecular Biology deal with the central dogma of life and its regulation.

OBJECTIVE:

To make the students understood the synthesis of genetic material, RNA and proteins, gene repair mechanism and gene mutation. To make the students learn about the techniques used in identifying gene mutation.

COURSE OUTCOME:

Course No	Course Outcome	Knowledge Level
CO1	Illustrate the molecular mechanism of DNA replication in prokaryotes and eukaryotes and DNA repair mechanisms	K2
CO2	Explain the stages of transcription and post transcriptional processing	K3
CO3	Analyze the decoding process of mRNA for protein designing principle	K4
CO4	Formulate the protein targeting, transport, translocation and regulation of gene expression	K6
CO5	Categorize the different types of DNA recombination and mutation	K5

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	S	M	L	M	L	M	S	L	S	S	M	M	S	L	L
CO2	M	L	M	S	S	S	L	M	M	M	S	L	M	S	M
CO3	L	M	L	M	L	L	S	L	S	S	M	M	L	L	L
CO4	S	L	M	S	S	L	L	S	L	L	S	L	M	S	S
CO5	M	M	L	M	L	M	S	L	S	S	M	M	L	L	L

S- Strong; M-Medium; L-Low

CONTENT:

Unit I – (15 Hrs.): DNA Replication and DNA damage & repair mechanisms: Types of replication, evidence for semi conservative replication, Meselson and Stahl experiment, replications in circular chromosomes - Cairns model, rolling circle model, Enzymology of Replication, Replication in prokaryotes and eukaryotes- inhibitors of replication. DNA damage - different types, DNA repair - direct reversal repair, direct repair of nicks, excision repair, nucleotide excision repair, mismatch repair, recombination error and SOS repair.

Unit II – (15 Hrs.): Transcription: Prokaryotic RNA polymerase, Initiation of transcription, chain elongation, chain termination, Eukaryotic RNA polymerases, Conserved sequences of

eukaryotic promoters, Transcriptional factors and basal eukaryotic transcription complex, Enhancers, Transcriptional termination in eukaryotes, Post transcriptional processing of Pre-mRNA – addition of Cap to the 5' end, Polyadenylation of the 3' end, RNA splicing and processing of Pre-mRNA, Inhibitors of transcription, Reverse transcription.

Unit III – (15 Hrs.): Translation: Genetic code - salient features of genetic code, structure of tRNA, activation of enzymes, binding of amino acids to tRNA, wobble mechanism and its significance, composition of prokaryotic and eukaryotic ribosomes, prokaryotic and eukaryotic protein biosynthesis - initiation, elongation, translocation and termination, Inhibitors of protein synthesis, Post translational modification of proteins.

Unit IV – (15 Hrs.): Protein Transport and Regulation of Gene Expression: Protein targeting, translocation, heat shock proteins, glycosylation, SNAPS and SNAREs, bacterial signal sequences, mitochondrial, chloroplast and nuclear protein transport, endocytosis-viral entry, ubiquitin TAG protein destruction, gene expression and regulations, molecular mechanism of regulation, prokaryotes - operon model, lac, trp, arabinose operons, repression and attenuation, eukaryotes - C value paradox, repetitive DNA, gene dosage and gene amplifications.

Unit V – (15 Hrs.): DNA Recombination and Mutation: Homologous recombination, Site specific recombination and DNA transposition. Types of mutation- Base substitution, insertion, deletion, inversion, duplication, translocation, mutagens.

TEXT BOOKS

1. Ajoy Paul, Text book of Cell and Molecular Biology 4th Edition, Books and Allied (P) Ltd, Kolkata, 2015.
2. Rastogi.S.C. Cell and Molecular Biology, India Binding House, U.P., 2nd edi. 2010.

REFERENCE BOOKS

1. David L. Nelson and Michael Cox, Lehninger Principles of Biochemistry, WH Freeman Publisher, 7th ed., 2017
2. Freifelder. D., Essentials of Molecular Biology, Jones and Bartlett Publications Inc., London 3rd Edition, 1998.
3. De Robertis E.D.P and E.M.F. De Robertis, Cell And Molecular Biology, Walters Kluwer Publisher, 8th ed., 2010.
4. Gerald Karp, Janet Iwasa and Wallace Marshall, Karp's Cell and Molecular Biology, Wiley Publisher, 9th ed., 2019.
5. Jocelyn E. Krebs, Elliott S. Goldstein and Stephen T. Kilpatrick, Lewin's GENES XII, Jones and Bartlett Publishers, 12th Revised edition, 2017.

WEB SOURCES

1. <https://microbenotes.com/prokaryotic-dna-replication-enzymes-steps-and-significance/>
2. <https://microbenotes.com/rna-splicing/>
3. <https://www.sparknotes.com/biology/molecular/translation/section3/>
4. <https://www.khanacademy.org/science/biology/gene-regulation/gene-regulation-in-bacteria/a/the-trp-operon>
5. <https://www.nature.com/articles/nrm2008>

PEDOGOGY: CHALK and Talk , PPT

ENDOCRINOLOGY

Paper	: Elective IV	Total Hours	: 75
Hours/Week	: 4	Exam Hours	: 03
Credit	: 4	Internal	: 25
Paper Code	: 21P2BCE04	External	: 75

SUBJECT DESCRIPTION:

Endocrinology deal with the endocrine system of human body, mechanism of action on endocrine system and hormonal actions

OBJECTIVE:

To make the students understand clearly on various alimentary parts of human body. Learnt more the endocrinal activities, learn about the mechanisms and actions of vital organs.

COURSE OUTCOME:

Course No	Course Outcome	Knowledge Level
CO1	Explain the hormones, neuroendocrine, hormone secretion, mechanism of hormone action I and II and also communication between the chemical messenger and endocrine system	K2
CO2	Illustrate the pituitary gland, hormones, pathology and their feedback mechanism	K3
CO3	Apply the knowledge of hormonal disease like thyroids hormones and their medication	K4
CO4	Describes the critical knowledge of synthesis, chemistry and action of	K5
CO5	Evaluate the male and female reproductive system, synthesis of hormones, pathology and also treated with infertility	K6

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	S	M	L	M	L	M	S	L	S	S	M	M	S	L	L
CO2	M	L	M	S	S	S	L	M	M	M	S	L	M	S	M
CO3	L	M	L	M	L	L	S	L	S	S	M	M	L	L	L
CO4	S	L	M	S	S	L	L	S	L	L	S	L	M	S	S
CO5	M	M	L	M	L	M	S	L	S	S	M	M	L	L	L

S- Strong; M-Medium; L-Low

CONTENT:

Unit I – (15 Hrs.): Hormones-Introduction, hormones and homeostasis, neuroendocrine integration in homeostasis, Classes of chemical messengers, hormone secretion, transport and clearance, Feed back control of secretion, Mechanism of hormone action-Type I and II, Second messengers -postoglandine, Cytosolic hormone receptors, Eicosonoids and hormone action.

Unit II – (15 Hrs.): Pituitary Hormones-Anatomy of pituitary gland, hormones of the pituitary, pathophysiology, Endocrine hypothalamus- structure, hypophysiotropic hormones, control of hypothalamic hormone secretion, feedback mechanisms, mechanism of action, Neurohypophysis - Synthesis, chemistry and control of neurohypophyseal hormone secretion, mechanism of action and pathophysiology of oxytocin, vasopressin, Somatotropins and somatomedins, Growth factors- neurotropic growth factors, hematopoietic growth factors.

Unit III – (15 Hrs.): Thyroid and Parathyroid Gland- Synthesis and chemistry of hormones, control of thyroid hormone secretion, circulation and metabolism, physiological function, mechanism of action, Physiological function of vitamin D, Pathophysiology, Mechanism of action of calcium homeostasis and pathophysiology. Melanotropic hormones- chemistry, functions of MSH, mechanism of action and pathophysiology, Pineal gland - melatonin, melatonin secretion and circulation, functions of pineal gland and mechanism of action.

Unit IV – (15 Hrs.):Pancreas- Endocrine pancreas, insulin, glucagons and somatostatin, Pancreatic peptide – chemistry, physiological function and mechanism of action, Pathophysiology, Catecholamines - synthesis, chemistry and metabolism, Neurohormones- endorphins-source, chemistry, control of secretion, physiological function, mechanism of action and pathophysiology.

Unit V – (15 Hrs.): Reproductive Endocrinology- Male and female reproductive system- source, chemistry, synthesis, metabolism of hormones, physiological function, mechanism of action and pathophysiology. Sex differentiation and development, endocrinology of pregnancy, parturition and lactation, puberty and hormone control, human infertility-reasons, therapy and treatment.

TEXT BOOKS

1. Murray, K.R., Granner, K.D., Mayes, P.A. and Rodwell, W.V. (2009) **Harper's Biochemistry**, 28th Ed, Appleton & Lange Stamford, Connecticut.
2. Guyton, A.C. and Hall, J.E (2006), **Textbook of Medical Physiology**, 11th Edition, Saunders Co. Pennsylvania.

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1. Foye, O.W., Lemke, J.L. and William D.A. (1995), **Medicinal Chemistry**, B.I. Waverly Pvt. Ltd., New Delhi.
2. West, E.S., Todd, W.R., Mason, H.S. and Van Brugge, T.J. (1966), **Biochemistry**. 4th Edition, The Macmillan Company, London.

WEB OF RESOURCE:

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www.medicinenet.com > ... > thyroid az list > medterms medical dictionary az list
www.btf-thyroid.org > Info
www.healthline.com/human-body-maps/pituitary-gland

PEDOGOGY: CHALK and Talk , PPT

YEAR I – SEMESTER II
IMMUNOLOGY AND IMMUNOTECHNOLOGY

Paper : Core VI
Hours/Week : 5
Credit : 5
Paper Code : 21P2BC06

Total Hours : 75
Exam Hours : 03
Internal : 25
External : 75

SUBJECT DESCRIPTION:

Immunology and Immunotechnology deal with the immunity, cells and organs of immune system, mechanism of how immune cells act, to understand infectious diseases and interaction with the host's immune system.

OBJECTIVE:

To understand about immunity and its types, cells and organs, MHC and its significances and disorders and techniques in immune biology.

Course No	Course Outcome	Knowledge Level
CO1	To obtain the knowledge of the immune system is a host defense system comprising many biological structures and processes within an organism that protects against disease.	K1 & K2
CO2	To concentrate on the antigen and antibody reactions and immunological techniques.	K1 & K2
CO3	Understanding about the two branches of immune system such as humoral immunity and cellular immunity, cytokines and complement system.	K1, K2 & K3
CO4	Clear about the hypersensitivity reaction or intolerance with undesirable reactions produced by the normal immune system, including allergies and	K3 & K4
CO5	To obtain the knowledge about the hybridoma technology is to produce large numbers of identical antibodies (also called monoclonal antibodies) and a recombinant DNA technology that involves inserting the DNA encoding an antigen that stimulates an immune response.	K3 & K4

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	S	S	M	M	M	S	S	M	S	M	M	M	S	S	S
CO2	S	S	M	M	M	S	S	S	S	S	S	M	M	S	S
CO3	S	M	M	M	S	S	S	S	S	M	S	M	S	S	L
CO4	S	S	S	M	S	S	S	S	M	M	M	M	S	M	L
CO5	S	S	M	S	M	S	S	S	M	M	M	M	S	S	M

S- Strong; M-Medium; L-Low

CONTENT:

Unit I – (15 Hrs.): Overview of Immunology and Cells and Organs of Immune system: Historical perspective, Basic concepts of immunology-types of immunity-Innate and Adaptive Immunity, components of immune system, Cells of the Immune System, Hematopoiesis, Organs of Immune system –Primary and Secondary lymphoid organs. Phagocytosis

Unit II – (15 Hrs.): Antigen and Antibodies: Antigens, Haptens, Epitopes Cross-Reactivity, Properties of the immunogen, Adjuvants, Antibodies- Structure, theories of antibody formation, side chain and clonal selection theory, Antibody classification and Biological activities, MHC Antigen processing and presentation, Monoclonal Antibodies- Production and Application, cytokines, complement system

Unit III – (15 Hrs.): Antigen –Antibody interactions: Principles and Applications - Strength of Antigen-Antibody interactions, Cross-Reactivity, Precipitation reactions, Agglutination reactions, Radiimmunoassay, ELISA, Western Blotting, Immunofluorescence, Humoral immune response- B Cell maturation, activation, differentiation and proliferation, Cell mediated immune response - T-cell maturation, activation and differentiation, Hypersensitivity Types and clinical manifestations, Immunotolerance, autoimmune disorders - type I DM.

Unit IV – (15 Hrs.): Pathophysiology of Immune System: Immunology disorders- B cell deficiencies, T cell deficiencies, secondary immunodeficiency diseases – AIDS, HIV lifecycle, pathogenesis, immunological abnormalities, diagnosis and treatment, Transplantation immunology- allograft, typing – HLA typing and GVH reaction, organ transplantation and immune suppressive therapy

Unit V – (15 Hrs.): Immune System in Disease: Vaccines, Quantification of Antibody and Tumor Immunology, Isolation and characterization of immune cells, Macrophage culture and assay of macrophage activation, Tumor immunology - immune surveillance, tumor antigens, immune response to tumors, immunotherapy of tumors. Sars, mars, covid Benefits and adverse effects of vaccination, Recombinant Vaccines

TEXT BOOKS

1. Tizard (1984). **An Introduction Immunology:** Tizard K, Saunders college Publishing
2. Immunology Roitt. Brostoff and David (1998). **Immunology**, 4th Edition, Mosby Times Mirror Int Pub Ltd.
3. Kuby Richard, (2000). **Immunology**, 4th Edition, W.H. Freeman and Company, New York.
4. Janeway Jr. Paul., (2001). **The Immune System in Health and Disease.** Travels and Co.,

REFERENCE BOOKS

1. Kuby Richard, (2000). **Immunology**, 4th Edition, W.H. Freeman and Company, New York.
2. Stites D.P. Stobo, J.D. Fundanberg. H.A and Wells. J.V. (1990) **Basic and Clinical Immunology.** 6th Edition Los Atlas Lange.

WEB OF REFERENCE:

www.microbiologybook.org/mayer/ab-ag-rx.htm

www.ebi.ac.uk/interpro/potm/2005_2/Page1.htm

www.quickhack.net/

<https://www.sciencebasedmedicine.org/>

PEDOGOGY: CHALK and Talk , PPT

PHARMACETICAL BIOCHEMISTRY AND TOXICOLOGY

Paper	: Elective II	Total Hours	: 75
Hours/Week	: 4	Exam Hours	: 03
Credit	: 4	Internal	: 25
Paper Code	: 21P2BCE03	External	: 75

SUBJECT DESCRIPTION:

This course presents to focus on the bioactive principles used for drug discovery and it also covers human biology where ever relevant.

OBJECTIVE:

This course deals with the study of fundamental concepts of pharmacology about the physicochemical properties of the drug, their origin, classification and nomenclature of drugs, how do they act etc., It also enables the students to gain the complete knowledge about drug designing and also know about the principles of toxicology.

COURSE OUTCOME:

Course No	Course Outcome	Knowledge Level
CO1	To understand the development of the traditional and modern methods used for drug discovery; of how molecules interact.	K2
CO2	Explain the pharmaceutical industry is by far the largest employer of medicine	K3
CO3	Analyze the skills in the use of reaction mechanisms and how knowledge of reaction mechanisms can aid in understanding the mode of action of a drug, and the method by which it can be synthesized, and developed	K4
CO4	Knowledge of reaction mechanisms can aid in understanding the mode of action of a drug	K6
CO5	Categorize the learnt method by which it can be synthesized, and developed.	K5

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	S	M	L	M	L	M	S	L	S	S	M	M	S	L	L
CO2	M	L	M	S	S	S	L	M	M	M	S	L	M	S	M
CO3	L	M	L	M	L	L	S	L	S	S	M	M	L	L	L
CO4	S	L	M	S	S	L	L	S	L	L	S	L	M	S	S
CO5	M	M	L	M	L	M	S	L	S	S	M	M	L	L	L

S- Strong; M-Medium; L-Low

UNIT-1 - (15 Hrs) General Pharmacology Introduction to pharmacology, Sources of drugs, Classification and Nomenclature of drugs, Dosage forms, Routes of Drug administration, Factors influencing dosage and drug action, Absorption of drugs and factors affecting absorption, Distribution of drugs, Factors affecting distribution, Bioavailability, Dose response relationship,

ED50 and LD50. Combined effect of drugs.

UNIT-II: - (15 Hrs) Pharmacodynamics: Mechanism of drug action: Theories of Receptors. Types of Receptors: Enzyme linked receptors, G-Protein coupled receptors, Ion-channel receptors, Nuclear receptors. Drug metabolism: pathway of drug metabolism, phase I and phase II reactions, Adverse drug reactions, Drug Interactions. Cytochrome P450 cycle, non- microsomal reactions of drug metabolism, drug metabolizing enzymes. Elimination of Drugs. Role of isomerism in drugs and its clinical significance.

UNIT-III - (15 Hrs) Drug design and Discovery: Physicochemical factors in relation to biological activity of drugs: Hydrogen bonding, Ferguson principle, Ionisation and pKa value, steric features of drug, bioisosterism, Lipinski's rule of five, Concepts of drug designing and marketing, Molecular modeling, QSAR-Quantitative structure Activity Relationship, Drug targets.

UNIT-IV - (15 Hrs) Systemic Pharmacology: Anticholinergic drugs, Diuretics and anti diuretics, Antiarrhythmic drugs, Anti hypertensive drugs, Antibacterial agents, Antiviral agents, anticancer agents, Antiulcer agents, Anaesthetics-General and Local, Tranquillizers, Anti histamines, Non steroidal Anti inflammatory drugs-NSAIDS, Sedatives ,Analgesics, Anti tussives.

UNIT-V - (15 Hrs) Toxicology: Basic Principles of Toxicology: Toxicants and its types, Classification of Poisons, Sources of Poisoning, Factors affecting toxicity, Chemical food poisoning, Toxic effects of metals (Arsenic Lead, Mercury, Copper, Iron) and nonmetals (Phosphorus, Chlorine, Bromine, Iodine, Formaldehyde) Toxic effects of Poisonous plants (Abrus precatorius, Ricinus communis, Calotropis) Toxic effects of Cardiac poison (Oleanders, Nicotine, Aconite) Toxic Effects Caustics, Treatment and management of poisoning, Antidotes.

TEXT BOOKS

1. Willam.O.Foye, (1995) **Principles of Medicinal Chemistry** 4thEdition Waverks Pvt. Ltd. New Delhi
2. Nirmala, N., Rege, R.S., Santoskar, S.D. and Bhandarkar (2011), Pharmacology and Pharmacotherapeutics, 23rd edition, CBS Publishers and Distributors Pvt. Ltd.
- 3.Padamaja udayakumar(2017) **Medical pharmacology** 5TH Edition .,CBS publishers and distributors pvt.ltd(Textbook),Newdelhi.

REFERENCE BOOKS.

- 1.Burger's **Medicinal Chemistry and Drug Discovery:** principles and practice – Wolf, John Wiley
- 2.Glick, Pasternak, (2002) **Molecular Biotechnology** 2nd Edition ak, Panima Publishers,
- 3.R.S.Satoskar.,S.D.Bhandhakar.,Nirmala.N.Rege(2015)**Pharmacologyand pharmacotherapeutics.**

4. Tripathi, K.D. (2013) 'Essentials of Medical Pharmacology' 7th edition, Jaypee Brothers, Medical Publishers, New Delhi

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1. <https://www.msmanuals.com/professional/clinical-pharmacology/adverse-drug-reactions/adverse-drug-reactions>
2. <https://en.wikipedia.org/wiki/Pharmacodynamics>
3. <https://www.healthline.com/health/chemotherapy>
4. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3560124/>

**YEAR I – SEMESTER II
CORE PRACTICAL – III**

Paper	: Core Practical III	Total Hours	: 45
Hours/Week	: 5	Exam Hours	: 06
Credit	: 3	Internal	: 40
Paper Code	: 21P3BCP03	External	: 60

COURSE OUTCOMES:

Course No	Course Outcome	Knowledge Level
CO1	Get an insight into estimation of chlorophyll, alkaloid, flavonoid from leaves results interpretation	K1 & K2
CO2	Get an insight into isolation of solanine, caffeine and its results identification	K1 & K2
CO3	Get an insight into plant tissue culture and its methods, Get an insight into extraction of pectin from orange peel and its results identifications	K1, K2 & K3

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	S	M	M	S	S	S	S	M	M	L	M	M	M	M	M
CO2	S	M	M	S	M	S	M	M	L	L	M	L	L	S	S
CO3	S	S	M	M	S	M	M	M	L	L	M	L	L	S	M

S- Strong; M-Medium; L-Low

I. PHYTOCHEMICAL ANALYSIS

1. Qualitative analysis of secondary phytochemicals in medicinal plants
2. Estimation of chlorophyll in leaves
3. Extraction and confirmation
 - a. Pectin from orange peel
 - b. Caffeine from tea
 - c. Solanine from potato

II. PLANT TISSUE CULTURE

1. Sterilization and media preparation
2. Callus Induction and micro propagation
3. Isolation of protoplasts
4. Protoplast Culture
5. Anther culture

III QUANTITATIVE ANALYSIS

1. Estimation of total alkaloids
2. Estimation of total flavonoids

REFERENCES

1. David, T. Plummer, (1988). **An Introduction to Practical Biochemistry**. 3rd Edition. Tata McGraw Hill Publishing Company Ltd. New Delhi.
2. Pattabiraman, T.N. (1998). **Laboratory Manual in Biochemistry**. 3rd Edition. All India Publishers and Distributors. Chennai.
3. Jayaraman, S. (2003). **Laboratory Manual in Biochemistry**. 2nd Edition. New Age International (P) Limited. New Delhi
4. Sadasivam S and Manickam P. (2004) **Biochemical Methods**. 2nd Edition. New Age International (P) Limited. New Delhi.

**YEAR I – SEMESTER II
CORE PRACTICAL – IV**

Paper	: Core Practical IV	Total Hours	: 45
Hours/Week	: 5	Exam Hours	: 06
Credit	: 3	Internal	: 40
Paper Code	: 21P2BCP04	External	: 60

COURSE OUTCOME:

Course No	Course Outcome	Knowledge Level
CO1	Learn and understand the methods of bleeding-Tail vein puncture, Intravenous, Retro orbital, cardiac vein puncture	K1 & K2
CO2	Demonstrate Rh typing and Identification of blood group	K1 & K2
CO3	Learn the Immunodiffusion –Single radial and double diffusion and Immuno electrophoresis – Counter Current immunoelectrophoresis	K1,K2 & k3

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	S	M	M	S	S	S	S	M	M	L	M	M	M	M	M
CO2	S	M	M	S	M	S	M	M	L	L	M	L	L	S	S
CO3	S	S	M	M	S	M	M	M	L	L	M	L	L	S	M

S- Strong; M-Medium; L-Low

1. Preparation of serum and plasma from Blood
2. Identification of blood cells
3. Isolation of blood mononuclear cells.
4. Identification of blood group & Rh typing
5. Preparation of Blood antigens
6. Testing: Widal slide test and Pregnancy Test (Slide Test)
7. Immunodiffusion –Single radial and double diffusion
8. Immunoelectrophoresis – Counter Current immunoelectrophoresis
9. C reactive protein

REFERENCES

1. David, T. Plummer, (1988). **An Introduction to Practical Biochemistry**. 3rd Edition. Tata McGraw Hill Publishing Company Ltd. New Delhi.
2. Pattabiraman, T.N. (1998). **Laboratory Manual in Biochemistry**. 3rd Edition. All India Publishers and Distributors. Chennai.
3. Jayaraman, S. (2003). **Laboratory Manual in Biochemistry**. 2nd Edition. New Age International (P) Limited. New Delhi

4. Sadasivam S and Manickam P. (2004) **Biochemical Methods**. 2nd Edition. New Age International (P) Limited. New Delhi.

YEAR II – SEMESTER III
ADVANCED CLINICAL BIOCHEMISTRY

Paper : Core VII
Hours/Week : 4
Credit : 4
Paper Code : 21P3BC07

Total Hours : 75
Exam Hours : 03
Internal : 25
External : 75

SUBJECT DESCRIPTION:

Advanced Clinical Biochemistry deal with the diagnostic importance of various metabolic disorders and to know the clinical aspects of various metabolic disorders.

Course No	Course Outcome	Knowledge Level
CO1	Recognize the basic principles and practices of clinical laboratory-Automation, Laboratory safety	K1 & K2
CO2	Execute disorders of carbohydrate metabolism and lipid metabolism	K3
CO3	Distinguish about disorders of aminoacids and nucleic acid metabolism	K4
CO4	Interpret the Renal function test, Liver function test, Gastric function test, Cerebrospinal fluid	K3 & K4
CO5	Categorize Porphyria, porphyrinuria and Disorders of erythrocyte metabolism	K4 & K6

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	S	M	L	M	L	M	S	L	S	S	M	M	S	L	L
CO2	S	L	M	S	S	S	L	M	M	M	S	L	M	S	M
CO3	S	M	L	M	L	L	S	L	S	S	M	M	L	L	L
CO4	S	L	M	S	S	L	L	S	L	L	S	L	M	S	S
CO5	S	M	L	M	L	M	S	L	S	S	M	M	L	L	L

S- Strong; M-Medium; L-Low

CONTENT:

Unit I – (15 Hrs.): Basic principles and practices of clinical laboratory: Collection of specimens – Blood, Urine, CSF, Amniotic fluids. Laboratory safety –first aid in laboratory accident, Toxic chemicals and biohazards, Automation in clinical laboratory – Precision, Quality assurance, clinical validation.

Unit II – (15 Hrs.): Disorders of carbohydrate and lipid metabolism (Hyperglycemia and Hypoglycemia): Diabetes Mellitus, Diabetes incipitus, Renal Threshold Value, Glycogen storage disease, Mucopolysaccharidosis, Lipids and lipoprotein abnormalities - Atherosclerosis, hypercholesterolemia, albuminuria, Tayssach's and Niemann picks diseases.

Unit III – (15 Hrs.): Disorders of aminoacids metabolism: Inborn errors of Branched chain amino acids- Maple Syrup Disease, Aromatic amino acids-Alkaptunuria, Tyrosinaemia, Aliphatic amino acids, Disorders of Purine and Pyrimidine metabolism-Gout.

Unit IV – (15 Hrs.): Clinical Tests: Renal function test, Acute and chronic renal failure, nephritic syndrome, dialysis, Liver function test - Clinical significance of AST, ALT, ALP and Gamma glutamyl transpeptidase, Jaundice, Gastric function test- Peptic Ulcer, Cerebrospinal fluid – Blood-brain barrier, composition of CSF and chemical changes in CSF.

Unit V – (15 Hrs.): Haematological Tests: Disorders of mineral metabolism- phosphorus, Potassium, Iron, Copper, Calcium, Sodium - Porphyria, porphyrinuria. Disorders of erythrocyte metabolism- hemoglobinopathies, thalassemia and anemia, Classification of anemia.

TEXT BOOKS

1. N.W. Teitz, (1994). *Textbook of Clinical Chemistry and Molecular Diagnostics*, Fifth Edition W.B. Saunders company
2. Harold Varley (1988). **Practical Clinical Biochemistry**, volume I and II 4th Edition, CBS Publishers New Delhi
3. Foye, O.W., Lemke, J.L. and William D.A. (1995). **Medicinal Chemistry**, B.I. Waverly Pvt.Ltd., New Delhi.

REFERENCE BOOKS

1. Philip. D. Mayne (1994). **Clinical Biochemistry in Diagnosis and Treatment** 6th Edition ELBS Publication
2. A.C. Guyton & J.E. Hall, (2006). **Text Book of Medical Physiology** 11th Edition Harcourt Asia.
3. Medical laboratory technology by Kanai L mukherjee and Swarajit gosh. 2ND EDITION 2014 PUBLISHED BY mc.Graw hill education (India) Pvt ltd, New Delhi.

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2. www.mayoclinic.org/diseases-conditions/diabetes/basics/.../con-2003309...
3. www.niams.nih.gov ›
4. www.nios.ac.in/media/documents/dmlt/Biochemistry/Lesson-25.pdf
5. www.arup.utah.edu/education/automation.php

PEDOGOGY: CHALK and Talk , PPT

YEAR II – SEMESTER III
GENETIC ENGINEERING AND FERMENTATION TECHNOLOGY

Paper	: Core IX	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 5	Internal	: 25
Paper Code	: 21P3BC09	External	: 75

SUBJECT DESCRIPTION:

Genetic Engineering and Fermentation technology deal with the basis of gene cloning, vectors, genetic engineering techniques and large scale production of biochemical by fermentation technology.

OBJECTIVE:

The objective of the course is to learn about the basics of genetic engineering, vectors, methods of gene cloning. Techniques and application of gene technology, Fermentation technology and its application in fermented food preparation.

COURSE OUTCOMES:

Course No	Course Outcome	Knowledge Level
CO1	Define the basics of gene cloning, enzymes involved in genetic engineering techniques and genomic DNA libraries.	K2
CO2	Outline the techniques involved in sequencing, molecular markers and gene transfer techniques	K2
CO3	Applications of genetic engineering and genome editing techniques	K3
CO4	Perceive fermentation screening, media preparation and knowledge about fermentors	K4
CO5	Production of products like antibiotics, enzymes and fermented foods	K4

Mapping with Programme Outcomes

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	S	M	S	S	M	S	S	M	L	S	M	L	L	L	L
CO2	S	L	M	S	S	S	L	M	M	M	S	L	M	S	M
CO3	S	M	S	M	L	L	S	S	S	S	M	M	L	L	L
CO4	S	L	M	S	S	L	L	S	L	S	S	L	M	S	S
CO5	S	M	L	M	L	M	S	L	S	S	M	M	L	L	L

S- Strong; M-Medium; L-Low

CONTENT:**Unit I****15 Hours**

Introduction to Genetic Engineering: Molecular tools of GE – Restriction endonucleases its types, and applications, DNA ligases, Alkaline phosphatase, reverse transcriptase and Topoisomerase. Vectors – plasmids, bacteriophage lambda, M13, cosmids, phagemids, bacterial and yeast artificial chromosome, plant viral vector – CaMV, animal viral vector – retroviral vector, shuttle vector, expression vector, Strategies and steps involved in Gene Cloning, cDNA and Genomic DNA library.

Unit II**15 Hours**

Techniques in Genetic engineering: DNA sequencing – DNA/RNA labelling, Maxam and Gilbert method, Dideoxynucleotide method, next generation sequencing, Chromosome walking, Automated DNA sequencing, DNA fingerprinting, Molecular markers - RFLP, RAPD, AFLP, STR and SNP. *In-situ* hybridization, Site-directed mutagenesis, PCR. Methods of gene transfer – transformation, conjugation, electroporation, liposome-mediated gene transfer, transduction, direct transfer of DNA.

Unit III**15 Hours**

Applications of Genetic engineering: Production of recombinant therapeutic proteins – recombinant insulin, growth hormone, interferons, vaccine – hepatitis B surface antigen, GE of *B.thuringiensis* toxin genes and GE for improved biocontrol agent - baculovirus. Concept of gene therapy – types, applications – gene therapy for SCID, ADA, CF, Anti-sense therapy, Genome editing- CRISPR-Cas, gene targeting.

Unit IV**15 Hours**

Zymology: Pasteur and fermentation, Strain - screening, development, preservation, storage. Inoculum preparation, production medium, sterilization -equipment, media and air. Fermentor - factors, configuration – batch, semi continuous, continuous stirred – tank, tubular, fluidised bed, computer application in fermentation technology. Downstream processing – stages.

Unit V**15 Hours**

Application of fermentation technology: Production of antibiotics - penicillin, streptomycin, tetracyclin, organic acids – citric acid, lactic acid and vinegar, enzymes - extracellular amylase, proteases, pectinase, solvents – ethanol, glycerol, aminoacids - glutamic acid and lysine, vitamins - vitamin B12 and vitamin C, SCP, fermented food - Sauerkraut, yoghurt.

TEXT BOOKS

1. Brown T.A., (2012), Gene cloning and DNA Analysis: An Introduction, 7th edition, Wiley-Blackwell.
2. Watson, W.H.Freeman(1992).**Recombianant DNA** 2nd Edition.Freeman and Co., NY
3. A.H.Patel (2008). Industrial Microbiology 11th Edition. Macmillan India Ltd, New Delhi

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1. Peter J.Russell., (2013) Genetics, 5th Edition, person Benjamin Cummings, New york
2. S.B. primrose and R.m.Twyman (2006) **Principles of Gene Manipulation and Genomics (2006)** 7th Edition. Blackwell pub., NY.
3. SmitaRastogi and neelamPathak (2014) Genetic Engineering 6th Edition Oxford University Press, New Delhi.

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2. <https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/chromosome-walking>
3. <https://www.yourgenome.org/facts/what-is-crispr-cas9>
4. <https://www.biologydiscussion.com/industrial-microbiology-2/fermentor-bioreactor-history-design-and-its-construction/55756>
5. <https://www.sciencedirect.com/topics/food-science/sauerkraut>

PEDOGOGY: CHALK and Talk , PPT

**YEAR II – SEMESTER III
RESEARCH METHODOLOGY**

Paper : Core VIII
Hours/Week : 4
Credit : 4
Paper Code : 21P3BC08

Total Hours : 75
Exam Hours : 03
Internal : 25
External : 75

SUBJECT DESCRIPTION:

Research Methodology deal with the knowledge on the basic concepts of research and its methodologies and identify appropriate research topics.

OBJECTIVE:

To understand basic concepts of research and its methodologies and identify appropriate research topics. Select and define appropriate research problem and parameters and prepare a project proposals.

COURSE OUTCOME:

Course No	Course Outcome	Knowledge Level
CO1	Understood about basic concepts of research and its methodologies and identify appropriate research topics	K2
CO2	Provide the importance and need for research.	K2
CO3	Understood about basic concepts of research designs, ethics in scientific research.	K3
CO4	Understood about basic concepts of data collection and analysis of scientific data using software along with ethical issues in human gene therapy and human cloning.	K4
CO5	Select and define appropriate research problem and parameters	K5

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	S	S	S	S	M	S	S	S	M	S	S	S	S	M	S
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	S	M
CO3	S	S	M	M	M	S	M	S	M	M	S	S	M	S	S
CO4	S	S	M	M	M	S	M	S	M	M	S	M	S	S	M
CO5	S	S	M	S	S	S	S	S	S	S	M	S	S	S	M

S- Strong; M-Medium; L-Low

CONTENT:

Unit I – (15 Hrs.): Scientific Research and Writing: Importance and need for research, Ethics and scientific research, Plagiarism- Types of Plagiarism, Types and characteristic designing a research work, Formulation of hypothesis, Scientific writing – Characteristics, Logical format for writing thesis and papers, Essential features of abstract, introduction, review of literature, materials and methods, and discussion, Effective illustration - tables and figures, Reference styles - Harvard and Vancouver systems, citations and h-index

Unit II – (15 Hrs.): Measures of central tendency: Arithmetic mean, median, mode, quartiles, deciles and percentiles, Measures of variation - range, quartile and Quartile deviation, mean deviation, standard deviation, Correlation analysis - Scatter diagram, Karl Peason's coefficient of correlation and Spearman's rank method, Regression analysis- Regression line, Regression equation.

Unit III – (15 Hrs.): Probability- Definition, concepts, Addition and Multiplication theorems (proof of the theorems not necessary) and calculations of probability, Theoretical, distributions, Binomial, Poisson, Fit a Poisson distribution, Normal distribution - importance, properties, conditions and constants of the distribution (proof not necessary), Simple problems. Analysis of variance

Unit IV – (15 Hrs.): Sampling distribution and test of significance: Testing of hypothesis, errors in hypothesis testing, standard error and sampling distribution, sampling of variables (large samples and small samples), Student's 't' distribution and its applications, Chi - square test & goodness of fit.

Unit V – (15 Hrs.): Bioethics and Patenting: The Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA) guidelines - Animal care and technical personnel environment-Animal husbandry, feed, bedding, water, sanitation and cleanliness, waste disposal, anesthesia and euthanasia, Institutional Ethical Committee (IEC) - General ethical issues of human- Drugs, herbal remedies , Food and drug safety and human genetic research- Gnen Therapy and Cloning. Definition- Patent, Intellectual Property, Intellectual Property rights - Patents, Copy rights, Design, Trademark and Trade secrets, Geographical indication (GI), criteria for patentability, Declaration of Bologna.

TEXT BOOKS

1. R.A. Day, **How to Write a Scientific Paper**. Cambridge University Press.
2. Alley, Michael (1987). **The Craft of Scientific Writing**. Englewood Cliffs. N.N. Prentice
3. M.C. Sharma (1997). Desk Top Publishing on PC, BPB Publications,

REFERENCE BOOKS

1. Contemporary issues in Bioethics, Beauchamp & Leroy, 1999. Wardsworth Pub. Co. Belmont, California.
2. Ethical Guidelines for Biomedical Research on Human Subjects (2000). ICMR, New Delhi.
3. Biostatistics – A foundation for analysis in health Science Danien.

WEB RESOURCES

1. www.newagepublishers.com/samplechapter/000896.pdf
2. www.wipo.int/wipo_magazine/en/2006/04/article_0003.html
3. www.ijme.in/182ar82.html
4. <https://en.wikipedia.org/wiki/Database>
5. www.tutorialspoint.com/database_tutorials.htm

PEDOGOGY: CHALK and Talk , PPT

**YEAR II – SEMESTER III
CORE PRACTICAL V**

Paper : Core Practical - V
Hours/Week : 5
Credit : 4
Paper Code : 21P3BCP05

Total Hours : 45
Exam Hours : 06
Internal : 40
External : 60

COURSE OUTCOME:

Course No	Course Outcome	Knowledge Level
CO1	Learn and understand the collection and storage of blood	K1 & K2
CO2	Estimate the amount of Glucose, Serum protein, urea, uric acid, Creatinine, Bilirubin	K1 & K2
CO3	Learn the qualitative analysis of normal and pathological constituents in urine.	K1, K2 & k3

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	S	M	M	S	S	S	S	M	M	L	M	M	M	M	M
CO2	S	M	M	S	M	S	M	M	L	L	M	L	L	S	S
CO3	S	S	M	M	S	M	M	M	L	L	M	L	L	S	M

S- Strong; M-Medium; L-Low

Analysis of Blood and Urine samples

1. Estimation of glucose by O-Toluidine Method.
2. Estimation of proteins by Lowry and Biuret Method.
3. Estimation of A/Gratio in serum.
4. Estimation of urea by DAM method.
5. Estimation of uric acid by Phosphotungstate Method.
6. Estimation of creatinine by Alkaline Picrate Method.
7. Estimation of cholesterol by Zlatkis, Zak and Boyle method.
8. Estimation of bilirubin by Evelyn Malloy method.
9. Qualitative analysis of normal and pathological constituents in urine.
10. Estimation of Calcium in urine by Clark Method
11. Estimation of Chloride in urine by Schales & Schales Method

REFERENCES

1. David, T. Plummer, (1988). **An Introduction to Practical Biochemistry**. 3rd Edition. Tata McGraw Hill Publishing Company Ltd. New Delhi.
2. Pattabiraman, T.N. (1998). **Laboratory Manual in Biochemistry**. 3rd Edition. All India Publishers and Distributors. Chennai.
3. Jayaraman, S. (2003). **Laboratory Manual in Biochemistry**. 2nd Edition. New Age International (P) Limited. New Delhi
4. Sadasivam S and Manickam P. (2004) **Biochemical Methods**. 2nd Edition. New Age International (P) Limited. New Delhi.

REFERENCES

1. David, T. Plummer, (1988). **An Introduction to Practical Biochemistry**. 3rd Edition. Tata McGraw Hill Publishing Company Ltd. New Delhi.
2. Pattabiraman, T.N. (1998). **Laboratory Manual in Biochemistry**. 3rd Edition. All India Publishers and Distributors. Chennai.
3. Jayaraman, S. (2003). **Laboratory Manual in Biochemistry**. 2nd Edition. New Age International (P) Limited. New Delhi
4. Sadasivam S and Manickam P. (2004) **Biochemical Methods**. 2nd Edition. New Age International (P) Limited. New Delhi.

**YEAR II – SEMESTER III
CORE PRACTICAL VI**

Paper : Core Practical - VI
Hours/Week : 5
Credit : 3
Paper Code : 21P3BCP06

Total Hours : 45
Exam Hours : 06
Internal : 40
External : 60

COURSE OUTCOME:

Course No	Course Outcome	Knowledge Level
CO1	Learn and understand the genetic material	K1 & K2
CO2	Isolation and Estimation of DNA, RNA	K1 & K2
CO3	Learn the restriction digestion, PCR techniques	K1, K2 & k3

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	S	M	M	S	S	S	S	M	M	L	M	M	M	M	M
CO2	S	M	M	S	M	S	M	M	L	L	M	L	L	S	S
CO3	S	S	M	M	S	M	M	M	L	L	M	L	L	S	M

S- Strong; M-Medium; L-Low

1. Estimation of DNA a) Diphenylamine method b) UV method
2. Estimation of RNA a) Orcinol method b) UV method
3. Comet Assay
4. Agarose Gel Electrophoresis
5. Isolation of plasmid DNA
6. Isolation of Genomic DNA
7. Isolation of RNA
8. Restriction digestion of DNA
9. Preparation of competent cell and Transformation
10. PCR – Demonstration
11. Southern Blotting – Demonstration

REFERENCES

1. David, T. Plummer, (1988). **An Introduction to Practical Biochemistry**. 3rd Edition. Tata McGraw Hill Publishing Company Ltd. New Delhi.
2. Pattabiraman, T.N. (1998). **Laboratory Manual in Biochemistry**. 3rd Edition. All India Publishers and Distributors. Chennai.
3. Jayaraman, S. (2003). **Laboratory Manual in Biochemistry**. 2nd Edition. New Age International (P) Limited. New Delhi
4. Sadasivam S and Manickam P. (2004) **Biochemical Methods**. 2nd Edition. New Age International (P) Limited. New Delhi.

NEUROSCIENCE

Paper	: Elective III	Total Hours	: 60
Hours/Week	: 4	Exam Hours	: 03
Credit	: 4	Internal	: 25
Paper Code	: 21P3BCE05	External	: 75

SUBJECT DESCRIPTION:

Neuroscience deal with the understanding of the functions of various sensory organs in human system, biochemical aspects behind diseases associated with the nervous system and effect of drug therapy.

OBJECTIVE:

To enable the students to gain knowledge about the structure and functions of the nervous system and have basic understanding of the nervous system and effect of drug therapy

COURSE OUTCOME:

Course No	Course Outcome	Knowledge Level
CO1	Discuss the structure of nervous system, neurons and neurotransmitters receptors like cholinergic, exhibitory and inhibitory nerve impulse	K2
CO2	Understand a broad fundamentals neurohormones, neurotransmitters and neuronal behavior such as cognitive, movement and sleeping	K3
CO3	Analyses critical knowledge skills by a analyzing and evaluation of neuronal sensory and visual sensation	K4
CO4	Explain the knowledge of treated drugs action for neurological disease	K5
CO5	Hypothesis and evaluate the neurological diseases such as Dementia, Schizopherenia, Parkinson disease and Alzheimer's disease etc. and their clinical interpretation	K6

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	S	M	L	M	L	M	S	L	S	S	M	M	S	L	L
CO2	M	L	M	S	S	S	L	M	M	M	S	L	M	S	M
CO3	L	M	L	M	L	L	S	L	S	S	M	M	L	L	L
CO4	S	L	M	S	S	L	L	S	L	L	S	L	M	S	S
CO5	M	M	L	M	L	M	S	L	S	S	M	M	L	L	L

S- Strong; M-Medium; L-Low

CONTENT:**Unit I – Introduction Nervous system****11 hour**

Classification, Structure of autonomic and somatic nervous system, spinal cord and their functions. Somatic sensation -perception of pain, visual cycle- Color vision- rod cell and cone cell.

Unit II – Neurophysiology**14 hour**

Excitation and conduction, generation and conduction of action potential, ion channels and transport of ions, excitatory and inhibitory transmission, conduction of nerve impulse, Neurohormones, neuromodulators, neurotransmitters, synaptic transmission, cholinergic, adrenergic, nicotinic and muscarinic receptor, Biochemistry of vision.

Unit III-Neuromorphology**10 hour**

Organization of neuron, dendrites and axons, Glial cells –astrocytes, oligodendrocytes, ependymal cells, Schwann cells. Nerve fiber types and functions.

Unit IV – Neurological disorder**13 hour**

Headache, facial pain, Dementia, Schizophrenia, Huntington's disease, amyotrophic lateral sclerosis, Motor neuron disease, Parkinsonism disease and Alzheimer's disease, Neuromuscular diseases - Muscular dystrophy, tetanus and botulism. Magnetic resonance imaging, electroencephalogram, Positron emission tomography,

Unit V- Pharmaceutical Biochemistry**12 hour**

CNS depressants (sedative, hypnotics), CNS stimulants, analgesics, antipsychotics and mood stabilizing drugs, Drug action- huntington's disease, Parkinsonism and Alzheimer's disease. Dosage forms and routes of administration, Principles of basic and clinical pharmacokinetics, Discovery and development of new drugs.

TEXT BOOKS:

1. Arthur C. Guyton and John E. Hall. 2007. **Text Book of Medical Physiology**. [Eleventh Edition]. Elsevier Publications, New Delhi. .
2. Gerald. J. Tortora and Sandra Reynolds. 2003. **Principles of Anatomy and Physiology**. [Tenth Edition]. John Wiley and Sons. Inc. Pub. **New York..**
3. Tripathi, K. D. 1999. **Essentials of Medical Pharmacology**. [Fourth Edition]. Jaypee Brothers Medical Publishers. New Delhi
4. Gerard J Tortora and Bryan derrickson **Principles of anatomy and physiology**, 14 th Edition.

REFERENCE BOOKS:

1. George I. Siegel, 2000. **Basic Neurochemistry**. [Seventh Edition]. Academic Press, New Delhi.
2. Kathleen J. W. Wilson and Anne Waugh. 1998. **Anatomy and Physiology in Health and Illness**. [Eighth Edition]. Churchill Livingstone, New York.

WEB SOURCES

<https://www.myvmc.com/anatomy/blood-function-and-composition/>
<https://en.wikipedia.org/wiki/Blood>
<https://www.pjms.com.pk/issues/aprjun107/article/article4.html>
www.drive5.com/muscle/

PEDOGOGY: CHALK and Talk , PPT

YEAR II – SEMESTER IV
BIOINFORMATICS & NANOTECHNOLOGY

Paper	: Core XI	Total Hours	: 75
Hours/Week	: 6	Exam Hours	: 03
Credit	: 5	Internal	: 25
Paper Code	:21P4BC11	External	: 75

SUBJECT DESCRIPTION:

Bioinformatics and Nanotechnology deal with the understanding of Biological databases, Tools for database search, Protein structure analyses and prediction and drug design.

OBJECTIVE:

Analysis of gene and protein sequences to reveal protein evolution and alternative splicing, the development of computational approaches to study and predict protein structure to further understanding of function, the analysis of mass spectrometry data to understand the connection between phosphorylation and cancer, the development of computational methods to utilize expression data to reverse engineer gene networks in order to more completely model cellular biology, and the study of population genetics and its connection to human disease.

COURSE OUTCOME:

Course No	Course Outcome	Knowledge Level
CO1	Students learn about Biological databases	K1 & K2
CO2	Tools for database search system.	K1 & K2
CO3	Protein structure analyses and prediction and drug design and nanoparticles	K1, K2 & K3
CO4	An ability to design and conduct experiments, as well as to analyze and interpret data	K3 & K4
CO5	Characterization methods for nanomaterials, understanding and critiquing nanomaterial safety and handling methods required during characterization	K4 & K5

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	S	S	M	S	L	S	M	S	S	M	S	L	M	M	S
CO2	S	S	S	S	S	S	S	S	M	S	S	M	M	M	S
CO3	S	S	S	S	S	S	S	S	M	S	S	M	M	M	S
CO4	S	S	M	M	S	M	M	S	M	M	M	M	M	M	S
CO5	S	S	S	S	M	S	M	S	S	L	M	M	S	M	S

S- Strong; M-Medium; L-Low

CONTENT:

Unit I – (15 Hrs.): Nucleotide sequence database – GenBank, EMBL, Protein Sequence databae – SWISS-PROT, UNiPROT – PIR, Genome Sequence database – GOLD, TIGR, Structural databae – PDB, MMDB, protein structure visualisation tools, RasMol, Swiss-PDB Viewer

Unit II (15 Hrs.): Sequence Alignment – local, global alignment, pairwise, multiple sequence alignment, BLAST, FASTA, Phylogenetic Analysis

UNIT III(15 Hours) : Homology modelling, Tertiary structure prediction – Energy based predict, modelling software-design of ligands, drug receptor interactions, automated structure construction method – Autodock, ORFs and Primer designing.

UNIT IV (15 Hours) : Introductin, opportunities, nanoparticles, properties, synthesis of nps – solid state synthesis, vapour phase synthesis, plasma based synthesis, characterisation -dippinlithograpy micro nano electrochemical devices, diagnostic imaging techniques

UNIT V (15 Hours): Drug delivery systems, microcapsules, microspheres, EPR effect, PEG-protein conjugates, polymer therapeutics, nanomedicine in cancer therapy, dendrimers as drug carriers, hydrogel, nanomaterial in medicine, orthopaedic biomaterial, environmental implication of nanoparticles and its toxicological health effects.

TEXT BOOKS

1.Functional and computational Aspects **Genomic and proteomics** – sandarsunai

Bioinformatics-concepts,Skill and Application-S,C Rastogi ,Namitamendritta,Paragrastogi (2000).

2. **Protein Biochemistry and Proteomics**(2006).Hubert Rehn, Academic press

3. Harshawaedhan .P.Bal **Bioinformatics** Principles and Application

4. JanuszM.Bujnicki (2008) **Practical Bioinformatics** Springer Berlin.

REFERENCE BOOK

1. Nanotechnology –**Fundamentals and Application** –MansiKarKare

2. Liebler,Humana(2002) **Introduction to proteomics**:Tools for new biologyLiebler,Humana W.CBS pub.,

WEB REFERENCE

<https://en.wikipedia.org/wiki/Nanomaterials>

<https://gmwgroup.harvard.edu/pubs/pdf/936.pdf>

www.crnano.org/whatis.html

www.metabolomicdiscoveries.com/

PEDOGOGY: CHALK and Talk , PPT

YEAR II – SEMESTER IV
HUMAN PHYSIOLOGY

Paper : Core X
Hours/Week : 6
Credit : 5
Paper Code :21P4BC10

Total Hours : 75
Exam Hours : 03
Internal : 25
External : 75

SUBJECT DESCRIPTION:

Human Physiology deal with the understanding of biological, physiological activities along with the mechanism of action of various organs and its anatomy.

OBJECTIVE:

The objective of the subject is to make the students learn about various parts of alimentary parts of human body. Learnt more specific on the nervous activities.

COURSE OUTCOME:

Course No	Course Outcome	Knowledge Level
CO1	Distinguish the anatomy, biological, physiological activities along with the mechanism of action of eyes and muscles.	K1 & K2
CO2	Demonstrate about digestive system and its regulation alimentary parts of human and body fluids body.	K3
CO3	Discriminate respiratory system and excretory system.	K5
CO4	Assess the Sympathetic parasympathetic nervous system and synaptic transmission	K4
CO5	Interpret about male and female reproductive system and its physiological function, hormonal regulation	K5

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	S	M	L	M	L	M	S	L	S	S	M	M	S	L	L
CO2	M	L	M	S	S	S	L	M	M	M	S	L	M	S	M
CO3	L	M	L	M	L	L	S	L	S	S	M	M	L	L	L
CO4	S	L	M	S	S	L	L	S	L	L	S	L	M	S	S
CO5	M	M	L	M	L	M	S	L	S	S	M	M	L	L	L

S- Strong; M-Medium; L-Low

CONTENT:

Unit I – (15 Hrs.): Physiology of vision: Structure of eye, image formation and defects of the eye, Receptor mechanism of the eye, photopigments, Visual cycle and colour adaptation. Muscle- Types of muscle, Structure of skeletal muscle. Mechanism and regulation of contraction and relaxation of skeletal muscle Muscle proteins - myosin, actin, troponin, tropomyosin and other proteins.

Unit II – (15 Hrs.): Digestive and cardiovascular system: Overview of the digestive system, secretions of digestive tract, process of digestion, absorption, assimilation of carbohydrates, proteins, fats, nucleic acids. Circulatory system – structure and functions of heart, ECG, Cardiac Cycle

Unit III – (15 Hrs.): Respiratory system: Diffusion of gases in lungs, transport of oxygen from lungs to tissues through blood, factors influencing the transport of oxygen, Transport of CO₂ from tissues to lungs through blood, factors influencing the transport of CO₂. Excretory System - Structure and functions of kidney, Nephron, Mechanism of urine formation, Renal Transplantation, Dialysis.

UNIT IV-(15 Hrs.): Nervous system: Structure of neuron, resting potential and action potential, Propagation of nerve – impulses, Structure of synapse, synaptic transmission (electrical and chemical theory), Structure of Neuro muscular junction and mechanism of neuro muscular transmission, neurotransmitters.

Unit V – (15 Hrs.): Reproductive biology: Structure of testis, Spermatogenesis, functions of testis, Female Reproductive system - Ovarian cycle, Structure and hormones of ovaries, menstrual cycle, menopause, pregnancy and lactation, Steroids as contraceptives.

TEXTBOOKS

1. Guyton, A.C. and Hall, J.E., **Textbook of Medical Physiology** (2020) 14th ed., Reed Elsevier India Pvt. Ltd. (New Delhi). ISBN: 978-1-4160-4574-8.
2. Chatterjee's CC (2022) **Human Physiology**,. Volume I 14th Edition CBS publishers and distributors pvt ltd
3. Vander's **Human Physiology** (2022) 16th ed., Widmaier, E.P., Raff, H. and Strang, K.T., McGraw Hill International Publications (New York), ISBN: 978-0-07-128366-3.
4. M.M.Muthiah **Text book of biochemistry**, Lecture notes on human physiology Vol II 1991.

REFERENCE

1. William. F. Ganong, (2003) **Review of Medical Physiology**, 14th Edition, A Lange Medical book.
2. Murray, R.K., Granner, D.K., Mayes and P.A., Rodwell, V.W., (2012) **Harper's Biochemistry** 29th ed., Lange Medical Books/McGraw Hill. ISBN:978-0-07-176-576-3.4

WEB SOURCES

<https://www.myvmc.com/anatomy/blood-function-and-composition/>
<https://en.wikipedia.org/wiki/Blood>
<https://www.pjms.com.pk/issues/aprjun107/article/article4.html>
www.drive5.com/muscle/

PEDOGOGY: CHALK and Talk , PPT

MICROBIAL BIOCHEMISTRY

Paper	: Elective VI	Total Hours	: 60
Hours/Week	: 4	Exam Hours	: 03
Credit	: 4	Internal	: 25
Paper Code	:21P4BCE06	External	: 75

SUBJECT DESCRIPTION:

Microbial Biochemistry deal with the basic principles of metabolic processes within the cell and how these processes can be harnessed for biotechnology.

OBJECTIVES:

Basic knowledge regarding the structure and properties of micro-organisms, including those of clinical, environmental and industrial importance. A variety of laboratory exercises where students can apply their theoretical knowledge to Practical situations and demonstrations, in the above areas.

OUTCOME:

Students will be able to demonstrate an understanding of the major mechanisms of metabolism, energy exchanges and homeostasis in cells. Recognize the linkage between the structures, chemical properties and chemical processes of certain molecules and macromolecules, and their roles in cells and biological processes, and in certain diseases.

CONTENT:

Unit I – (12 Hrs.): Microbial world: Cellular organization of bacteria with special reference to molecular organisation of cell wall, flagella and pili, Identification and classification of bacteria, Handling and sterility maintenance in microbiological work, Methods of isolation and pure culture techniques, culture media preparation, enrichment culture, Microbial nutrition, bacterial growth and its kinetics, Cyanobacteria, Archeabacteria, Viruses - Structure, classification.

Unit II – (12 Hrs.): Microbial metabolism: Photosynthesis in microbes- Role of chlorophylls, carotenoids and phycobilins, Photosynthesis in microalgae, Chemolithotrophy, methanogenesis and acetogenesis, fermentations - diversity, syntrophy - role of anoxic decomposition, Entner - Doudoroff pathway, stickland reaction, pectin and aldo-hexuronate pathway, hydrocarbon transformation, Anaphlerotic reactions, Autotrophic metabolism, Amino acid synthesis in microbes.

Unit III – (12 Hrs.): Bioprocess Technology: Fermentation technology - Primary and secondary metabolites, Continuous and batch type culture techniques, Types and design of fermentors, fermentation processes, brewing, manufacture of penicillin, production of other antibiotics and organic compounds, single cell proteins, Isolation and screening of industrially important microbes, Inoculum preparation - primary and secondary strain improvement, Detection of Downstream processing.

Unit IV – (12 Hrs.): Industrial Production: Microbes in mineral recovery and petroleum recovery, Bioleaching and Biosorption, Production of Biomass, Production of Single cell protein and Mushrooms, Organic acids - Acetic acid, lactic acid, citric acid and gluconic acid, Solvent production - Ethanol and Butanol, Antibiotics - Penicillin and streptomycin, Vitamins - B12 and riboflavin, Amino acid – Glutamic acid , Threonine and Phenylalanine, Fermented foods- Yoghurt, cheese, Production of beer, wine and vinegar.

Unit V – (12 Hrs.): Industrial Application: Wastewater treatment - physical, chemical and biological treatment processes, Effluent treatment, Bioremediation, oil spill clean-up, Microbial mining, Bio fertilizers - bacteria and blue-green algae, Biopesticides in integrated pest management - *Bascillus* and *Pseudomonas* as biocontrol agents, Soil microbiota, Biogeochemical role of soil microorganisms, Microbial degradation of xenobiotics in the environment.

TEXT BOOKS:

1. Microbial biotechnology – Alexander *et al.*, -W.H. Freeman Publishers, 1995
2. Biology of microorganisms – Madigan *et al.*, - Printice Hall, 2002
3. Biochemistry of bacterial growth – Mandelstram, Blackwell Scientific Publishers
4. Principles of fermentation technology, 2nd edition – Stanbury *et al.*, Pergamon Publishers, 1995
5. Basic Biotechnology, 2nd edition – Ratledge, Kristiansen Cambridge University Press, 2001

REFERENCES BOOKS:

1. Elements of Biotechnology – Gupta, Rastogi Publication, 1998
2. Bioprocess Engineering – basic concepts 2nd editon – Schuler, Karg, Printice Hall, 2001
3. Concepts in Biotechnology – Balasubramanian *et al.*, Universities Press (India) Ltd., 2004
4. Animal Tissue Culture – Freshney, IRL press
5. Culture of animal cells: a manual of basic techniques, 4th edition – Freshney, Wiley Liss, 2000

WEB SOURCES:

<http://www.sigc.edu/department/microbiology/studymet/10markQuestionsonBioprocess.pdf>
https://en.wikipedia.org/wiki/Entner%E2%80%93Doudoroff_pathway

DIAGNOSTIC BIOCHEMISTRY

Paper	: EDC	Total Hours	: 60
Hours/Week	: 2	Exam Hours	: 03
Credit	: 1	Internal	: 25
Paper Code	:21P3BCED01	External	: 75

SUBJECT DESCRIPTION:

This course presents about the techniques, diagnostic values and significance and the interpretation of various enzymes, bio-chemical parameters, hormones and immunoglobulins.

COURSE OUTCOME:

Course No	Course Outcome	Knowledge Level
CO1	Remember the approaches to clinical quality control, accuracy, collection and preservation of biological samples such as blood, urine and fluids	K1 & K2
CO2	Understand the blood cell and explain the different cell count such as PVC, ESR, RBC and WBC	K1 & K2
CO3	Apply the knowledge on abnormal constituents of urine such as protein, keton bodies, bile pigments and their clinical interpretation	K1, K2 & k3
CO4	Analyse and describe the to know about the critical based stool collection, preservation, and analyse the abnormal constituent of stools and microscopy studies.	K1 & K2
CO5	Evaluate and discuss clinical significance of the biochemical GTT, SGOT, SGPT and LDH etc	K1 & K2

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	S	L	L	S	M	M	M	M	L	S	L	M	S	M	L
CO2	L	M	M	S	L	L	L	M	M	S	S	M	L	S	M
CO3	S	M	M	M	M	S	L	M	S	L	L	M	L	S	M
CO4	S	M	L	M	S	M	L	M	S	S	L	M	L	M	M
CO5	S	L	M	M	M	S	S	L	S	M	L	L	S	M	S

S- Strong; M-Medium; L-Low

UNIT – I**12 Hours**

Approaches to clinical biochemistry: Quality control: Concepts of accuracy, precision, sensitivity and reproducibility, Collection of clinical specimens, preservatives for blood and urine, transport of biological samples. First aid equipment in laboratory accident- Precautions and first aid equipment sensitivity, linearity, calibration, Biomedical waste disposals

UNIT – II**12 Hours**

Hematology: Composition and functions of blood, Haemoglobin, Differential count-PCV, ESR, RBC, WBC and Platelet count. Fully automated and semi automated analysers.

UNIT – III**12 Hours**

Physical examination of urine: Volume, colour, odour, appearance, specific gravity and pH. Chemical examination of urine: Qualitative tests for Reducing sugar, protein, ketone bodies, Bile pigment, bile salt, Urobilinogen, and mucin. Microscopic Examination of urine.

UNIT – IV**12 Hours**

Stool examination: Collection of fecal specimen, preservation, physical examination:- volume, colour, odour and appearance. Chemical examination:- reducing sugar, occult blood test, detection of steatorrhea. Microscopic examination of stool.

UNIT – V**12 Hours**

Estimation of Biochemical components in Blood: Glucose, GTT, Glycosylated haemoglobin, Protein, cholesterol, Urea, Uric acid and Creatinine. Determination of enzyme activity: SGOT, SGPT and LDH.

TEXT BOOK

1. Practical Clinical Biochemistry, Harold Varley, 4th edition, CBS Publication and Distributors, New Delhi.
2. Medical Biochemistry by MN Chatterjee, Rana Shinde, 8th edition, 2013, Jaypee publications.
3. Sabitri Sanyal, Clinical pathology, B.I.Churchill Livingstone(P)Ltd, New Delhi.2000.
3. Tietz Fundamentals of Clinical Chemistry- (5th edition) C.A. Burtis, E.R. Ashwood (eds) Saunders WB Co.

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