M. Sc. BIOCHEMISTRY

Syllabus

Programme Code : 2PSBIC

2023-2025

SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE (AUTONOMOUS)

(Affiliated to Bharathidasan University, Tiruchirappalli)

(Accredited by NAAC) | (An ISO 9001:2015 Certified Institution)

Sundarakkottai, Mannargudi–614 016,

Thiruvarur (Dt.), Tamil Nadu, India.

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SUNDARAKKOTTAI, MANNARGUDI–614016.

TAMILNADU, INDIA.

M.Sc., BIOCHEMISTRY

CHOICE BASED CREDIT SYSTEM– LEARNING OUTCOMES BASED CURRICULUM FRAME WORK (CBCS–LOCF)

(For the candidates admitted in the academic year 2023–2024)

CHOICE BASED CREDIT SYSTEM

The credit based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The choice based credit system provides a 'cafeteria' type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning. Our College hasmoved to CBCS and implemented the grading system.

OUTCOME-BASED EDUCATION (OBE)
LEARNING OUTCOME-BASED CURRICULUM FRAMEWORK (LOCF)

The fundamental premise underlying the learning outcomes-based approach to curriculum planning and development is that higher education qualifications are awarded on the basis of demonstrated achievement of outcomes (expressed in terms of knowledge, understanding, skills, attitudes and values) and academic standards expected of graduates of a programme of study. Learning outcomes specify what graduates completing a particular programme of study are expected to know, understand and be able to do at the end of their programme of study. The expected learning outcomes are used as reference points that would help to formulate graduate attributes, qualification descriptors, programme learning outcomes and course learning outcomes which in turn will help in curriculum planning and development, and in the design, delivery and review of academic programmes. They provide general guidance for articulating the essential learnings associated with programmes of study and courses with in a programme, maintain national standards and international comparability of learning outcomes and academic standards to ensure global competitiveness, and to facilitate student/graduate mobility and provide higher education institutions an important point of reference for designing teaching-learning strategies, assessing student learning levels, and periodic review of programmes and academic standards.

Some important aspects of the Outcome Based Education

Course: is defined as a theory, practical or theory cum practical subject studied in a semester.

Course Outcomes (COs): are statements that describe significant and essential learning that learners have

achieved, and can reliably demonstrate at the end of a course. Generally three or more course outcomes may be specified for each course based on its weightage.

Programme: is defined as the specialization or discipline of a Degree.

Programme Outcomes (POs): Programme outcomes are narrower statements that describe what students are expected to be able to do by the time of graduation. POs are expected to be aligned closely with Graduate Attributes.

Programme Specific Outcomes (PSOs): PSOs are what the students should be able to do at the time of graduation with reference to a specific discipline.

Some important terminologies repeatedly used in LOCF.

Core Courses (CC): A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course. These are the courses which provide basic understanding of their main discipline. In order to maintain a requisite standard certain core courses must be included in an academic program. This helps in providing a universal recognition to the said academic program.

Discipline Specific Elective Courses (DSE): Elective course may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective (DSE). These courses offer the flexibility of selection of options from a pool of courses. These are considered specialized or advanced to that particular programme and provide extensive exposure in the area chosen; these are also more applied in nature.

Generic Elective Courses: An elective course chosen generally from an **unrelated discipline/subject,** with an intention to seek exposure is called a Generic Elective. Generic Elective courses are designed for the students of other disciplines. Thus, as per the CBCS policy, the students pursuing particular disciplines would have to optGeneric Elective courses offered by other disciplines, as per the basket of courses offered by the college. The scope of the Generic Elective (GE) Courses is positively related to the diversity of disciplines in which programmes are being offered by the college.

Non Major Elective (NME): A student shall choose at least two Non-major Elective Courses (NME) from outside his/her department.

Skill Enhancement Courses (SECs): These courses focus on developing skills or proficiencies in the student, and aim at providing hands-on training. Skill enhancement courses can be opted by the students of any other discipline, but are highly suitable for students pursuing their academic programme. These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge**.**

Field Study/Industrial Visit/Case Study: It has to be completed during the fifth semester of the degree programme. Credit for this course will be entered in the fifth semester's marks statement.

Internship: Students must complete internship during summer holidays after the fourth semester. They have to submit a report of internship training with the necessary documents and have to appear for a viva-voce examination during fifth semester. Credit for internship will be entered in the fifth semester's mark statement.

Extra Credit Courses: In order to facilitate the students, gaining knowledge/skills by attending online courses MOOC, credits are awarded as extra credits, the extra credit are at three semesters after verifying the course

completion certificates. According to the guidelines of UGC, the students are encouraged to avail this option of enriching their knowledge by enrolling themselves in the Massive Open Online Courses (MOOC) provided by various portals such as SWAYAM, NPTEL etc.

Postgraduate Programme:

Programme Pattern: The Post Graduate degree programme consists of **FIVE** vital components. They are as follows:

Part –A	:	Core Course (Theory, Practical) Core Industry Module, Core Project
Part-B (i)	:	Elective courses
Part-B (ii)	:	Non Major Elective, Skill Enhancement course, Professional Competency course
Part-B (iii)	:	Internship
Part –C	:	Extension activity

EXAMINATION

Continuous Internal Assessment (CIA):

PG - Distribution of CIA Marks

Passing Minimum: 50 %

Assignments – 3 = 30%
Tests- 3(Best 2 out of 3) = 50%
Seminar=10 %
Attendance= 10 %

Question Paper Pattern

Part A: includes two subsections

Part A 1 (10X1=10 marks)
One word question/ Fill in/ Match the following/True or False/ Multiple Choice Questions
Two Questions from Each unit

Part A 2(5X2=10 marks)
Short Answers
One question from Each unit
Total Marks - 20

Part B: (5X5=25 marks)
Paragraph Answers
Either/ or type, One Question from each unit

Part C: (10X3=30)
Essay Type Answers
Answer 3 out of 5 Questions
One Question from each unit

Part A: K1 Level
Part B: K2, K3 and K4 Level
Part C: K5 and K6 Level

Knowledge levels for assessment of Outcomes based on Blooms Taxonomy

S.No.	Level	Parameter	Description
1	K1	Knowledge/Remembering	It is the ability to remember the previously learned
2	K2	Comprehension/ Understanding	The learner explains ideas or concepts
3	K3	Application/Applying	The learner uses information in a new way
4	K4	Analysis/Analysing	The learner distinguishes among different parts
5	K5	Evaluation/Evaluating	The learner justifies and or decision
6	K6	Synthesis/Creating	The learner creates a new product or point of view

WEIGHTAGE of K –LEVELS IN QUESTION PAPER

(Cognitive Level) K-LEVELS →	Lower Order Thinking			Higher Order Thinking			Total
	K1	K2	K3	K4	K5	K6	
END SEMESTER EXAMINATIONS (ESE)	20	25			30		**75**
Continuous Internal Assessment (CIA)	20	25			30		**75**

QUESTION PATTERN FOR END SEMESTER EXAMINATION/ Continuous Internal Assessment		
PART		**MARKS**
PART –A I. (No choice, One Mark) **TWO** questions from each unit **II.** (No choice, Two Mark) **ONE** question from each unit	**(**10x1=10) **(**5x2=10)	**20**
PART –B (Either/ or type, 5-Marks) **ONE** question from each unit	(5x5=25)	**25**
PART –C (3 out of 5) (10 Marks) **ONE** question from each unit	(3x10=30)	**30**
	Total	**75**

BLUE PRINT OF QUESTION PAPER FOR END SEMESTER EXAMINATION							
DURATION: 3.00 Hours.							**Max Mark :75**
K-LEVELS	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**	**Total**
PART							**Marks**
PART –A (One Mark, No choice) (10x1=10)	10						**10**
(2-Marks, No choice) (10x2=20)	10						**10**
PART –B (5-Marks) (Either/or type) (5x5=25)		5	10	10			**25**
PART –C (10 Marks) (3 out of 5) (3x10=30) Courses having only **K5, K6** levels, K5 level- 3 Questions, K6 level - 2 Questions **(One K6 level question is compulsory)**					20	10	**30**
Total	**20**	**05**	**10**	**10**	20	10	**75**

EVALUATION

GRADING SYSTEM

Once the marks of the CIA and the end-semester examination for each of the courses are available, they will be added and converted as final mark. The marks thus obtained will then be graded as per the scheme provided in Table-1.

Grade Point Average (GPA) will be calculated from the first semester onwards for all semester. From the second semester onwards, the total performance with in a semester and the continuous performance starting from the first semester are indicated by semester Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA), respectively. These two are calculated by the following formulae:

$GPA = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{I=1}^{n} C_i}$	$WAM(\text{Weighted Average Marks}) = \frac{\sum_{i=1}^{n} C_i M_i}{\sum_{I=1}^{n} C_i}$
Where, C_i is the Credit earned for the Course i G_i is the Grade Point obtained by the student for the Course i M_i is the marks obtained for the course i and N is the number of Courses **Passed** in that semester.	

CGPA: Average GPA of all the Courses starting from the first semester to the current semester.

CLASSIFICATION OF FINAL RESULTS:

i. The classification of final results shall be based on the CGPA, as indicated in Table-2.

ii. For the purpose of Classification of Final Results, the candidates who earn the CGPA 9.00 and above shall be declared to have qualified for the Degree as 'Outstanding'. Similarly the candidates who earn the CGPA between 8.00 and 8.99, 7.00 and 7.99, 6.00 and 6.99 and 5.00 and 5.99 shall be declared to have qualified for their Degree in the respective programmes as 'Excellent', 'Very Good', 'Good', and 'Above Average' respectively.

iii. Absence from an examination shall not be taken an attempt.

Table- 1: Grading of the Courses

Marks Range	Grade Point	Corresponding Grade
90 and above	**10**	**O**
80 and above and below 90	**9**	A+
70 and above and below 80	**8**	**A**
60 and above and below 70	**7**	**B+**
50 and above and below 60	**6**	**B**
Below 50	**NA**	**RA**

NA- Not Applicable, RA- Reappearance

The candidates performance in every current semester is indicated by **Semester Grade Point Average (SGPA)** and from the second semester onwards, the continuous performance including previous semester/s is indicated by **Cumulative Grade Point Average (CGPA)**

Table-2: Final Result

CGPA	Corresponding Grade	Classification of Final Result
9.00 and above	**O**	**Outstanding**
8.00 to 8.99	A+	**Excellent**
7.00 to 7.99	**A**	**VeryGood**
6.00 to 6.99	**B+**	**Good**
5.00 to 5.99	**B**	**AboveAverage**

*****The candidates who have passed in the first appearance and within the prescribed duration of the PG Programme are eligible. If the candidate's Grade is O/A+ with more than one attempt, the performance is fixed as "Very Good"

VISION

Imparting quality education in Biochemistry to make the students to document the biological resources with scientific validation so as to enhance the quality of life.

MISSION

- To provide a learning environment to the students to understand, analyze and augment the basic analytical skills in Biochemistry.
- To expose the students and make them well versed in the various biochemical processes and update their knowledge and skills in advanced biochemical techniques.

PROGRAMME OUTCOMES FOR M.Sc., DEGREE PROGRAMMES

PO. No	Programme Outcomes (*Upon completion of the M.Sc., Degree Programme, the Post graduate will be able to)*
PO-1	**Disciplinary Knowledge**: Demonstrate in-depth knowledge and understanding of theories, policies, and practices in one or more disciplines that form a part of a Post Graduate program of study in Master of Science.
PO-2	**Critical Thinking and Problem Solving**: 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: solve problems and extrapolate the same to real life situation.
PO-3	**Information/digital literacy and Communication Skills:** 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: communicate thoughts and ideas analytically and effectively in writing and orally using appropriate media, and present complex information in a clear and concise manner to different groups.
PO-4	**Research-related skills:** Conduct independent inquiry in a chosen scientific discipline, demonstrate sense of inquiry and capability for asking relevant/appropriate questions, problematising, synthesizing and articulating; recognize cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; plan, execute and report the results of an experiment or investigation.
PO-5	**Scientific reasoning and Reflective Thinking:** Analyse, interpret and draw conclusions from quantitative/qualitative data and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective; critically and sensibly evaluate life experiences, with self-awareness and reflexivity of both self and society.
PO-6	**Multidisciplinary Approach, Innovation and Entrepreneurship:** Propose novel ideas of interdisciplinary approach in providing better solutions and new ideas for the sustainable developments; identify opportunities, entrepreneurship vision and use of innovative ideas to create value and wealth for the betterment of the individual and society.
PO-7	**Moral and ethical awareness/reasoning:** 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, demonstrate the ability to identify ethical issues related to one's work, avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights, appreciate environmental and sustainability issues, and adopt objective, unbiased and truthful actions in all aspects of work.
PO-8	**Self directed Learning:** Work independently, identify appropriate resources required for a project, and manage a project till completion.
PO-9	**Lifelong Learning:** Engage in continuous learning for professional growth and development, acquire knowledge and skills, adapt to changing environment and to changing trades and demands of work place through knowledge / skill Development /reskilling.

PO-10	**Multicultural Competence, Social Interaction and Effective Citizenship:** Understand the values and beliefs of multiple cultures, global perspectives, engage and interact respectfully with diverse groups and elicit views of others, mediate disagreements and help reach conclusions in group settings, and demonstrate empathetic social concern and equity centred national development

PROGRAM SPECIFIC OUTCOMES

PSO1: Understand the principles and methods of various techniques in Biochemistry, Immunology, Microbiology, Enzyme kinetics and Molecular Cell Biology. Based on their understanding, the students may would be able to design and execute experiments during their final semester project, and further research programs.

PSO2: Insight on the structure-function relationship of biomolecules, their synthesis and breakdown, the regulation of these pathways, and their importance in terms of clinical correlation. Students will also acquire knowledge of the principles of nutritional biochemistry and understand diseases and their prevention.

PSO3: To understand the concepts of cellular signal transduction pathways and the association of aberrant signal processes with various diseases. Acquire insight into the immune system and its responses, and use this knowledge in the processes of immunization, vaccine development, transplantation and organ rejection.

PSO4: To visualize and appreciate the central dogma of molecular biology, regulation of gene expression, molecular techniques used in rDNA technology, gene knock-out and knock-in techniques.

PSO5: To create awareness in students about the importance of good laboratory practices and the importance of ethical and social responsibilities of a researcher. Teach them how to review literature and the art of designing and executing experiments independently and work as a part of a team.

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TAMIL NADU, INDIA.

M.Sc., BIOCHEMISTRY COURSE STRUCTURE UNDER CHOICE BASED CREDIT SYSTEM – LEARNING OUTCOMES BASED CURRICULUM (CBCS-LOCF)

(For the candidates admitted from the academic year 2023-2024)

ELIGIBILITY: A Candidates who have passed bachelor level examination in Botany / Zoology / Biochemistry / Biotechnology / Microbiology / Genetics / Medicine / Agriculture / Life Sciences / Chemistry / Pharmacy from any recognized university in India or abroad

Sem	Part	Course	Course Code	Title of the Paper	Ins. Hours/ Week	Ins. Hours/ Week				Credit	Exam Hours	Marks		Total
						L	T	P	S			CIA	ESE	
I	Part A	Core Course –I	P23BC101	Basics of Biochemistry	6	5	1	0	0	5	3	25	75	100
		Core Course –II	P23BC102	Biochemical and Molecular Biology Techniques	6	5	1	0	0	5	3	25	75	100
		Core Practical-I	P23BC103P	Biomolecules and Biochemical Techniques	6	0	0	6	0	3	3	25	75	100
	Part B (i)	Elective Course–I	P23BCE11A/ P23BCE11B	Microbiology and Immunology/ Nanotechnology	5	4	1	0	0	3	3	25	75	100
		Elective Course–II	P23BCE12A/ P23BCE12B	Energy and Drug Metabolism/ Genetics	5	4	1	0	0	3	3	25	75	100
	Part B (ii)	Non Major Elective - I	P23NMEBC11	Nutritional Biochemistry	2	2	0	0	0	2	3	25	75	100
		TOTAL			**30**	**20**	**4**	**6**	**0**	**21**	-	-	-	**600**
II	Part A	Core Course –III	P23BC204	Physiology and Cell Biology	6	5	1	0	0	5	3	25	75	100
		Core Course-IV	P23BC205	Enzymology	6	5	1	0	0	5	3	25	75	100
		Core Practical-II	P23BC206P	Enzymology, Microbiology and Cell Biology	6	0	0	6	0	3	3	25	75	100
	Part B (i)	Elective Course –III	P23BCE23A/ P23BCE23B	Ecology and Environmental Sciences/Industrial Microbiology	5	4	1	0	0	3	3	25	75	100
		Elective Course-IV	P23BCE24A/ P23BCE24B	Biosafety, Lab Safety and IPR / Genomics and Proteomics	5	4	1	0	0	3	3	25	75	100
	Part B (ii)	Non Major Elective - II	P23NMEBC22	Molecular Basis of Disease and Therapeutic Strategies	2	2	0	0	0	2	3	25	75	100
	Part B (iii)	Internship/Industrial Activity			0	0	0	0	0	0		-	-	-
		TOTAL			**30**	**20**	**4**	**6**	**0**	**21**	-	-	-	**600**
III	Part A	Core Course –V		Cellular Metabolism	6	5	1	0	0	5	3	25	75	100
		Core Course –VI		Clinical Biochemistry	6	5	1	0	0	5	3	25	75	100
		Core Practical-III		Clinical Biochemistry	6	0	0	6	0	3	3	25	75	100

Sem	Part	Course	Course Code	Title of the Paper	Ins. Hours/ Week	Ins. Hours/ Week				Credit	Exam Hours	Marks		Total
						L	T	P	S			CIA	ESE	
				Practical										
		Core Industry Module		Pharmaceutical Biochemistry	5	4	1	0	0	3	3	25	75	100
	Part B (i)	Elective Course – V		Research Methodology/ Biostatistics and data sciences	5	3	1	1	0	3	3	25	75	100
	Part B (ii)	Skill Enhancement Course		Developmental Biology	2	2	0	0	0	2	3	25	75	100
	Part B (iii)	Internship/Industrial Activity			0	0	0	0	0	2		-	-	-
				TOTAL	**30**	**19**	**4**	**7**	**0**	**23**	**-**	**-**	-	**600**
IV	Part A	Core Course – VII		Molecular Biology	5	4	1	0	0	5	3	25	75	100
		Core Course-VIII		Gene Editing, Cell and Gene therapy	5	4	1	0	0	5	3	25	75	100
		Core Practical-IV		Molecular Biology Techniques	6	0	0	6	0	3	3	25	75	100
		Core Project		Project with Viva Voce	8	0	2	6	0	7	3	25	75	100
	Part B (i)	Elective Course – VI (Industry/ Entrepreneurship)		Clinical Lab Technology/ Phytotherapeutics	4	3	1	0	0	3	3	25	75	100
	Part B (ii)	Professional Competency Course		Professional Competency Course	2	2	0	0	0	2	3	25	75	100
	Part C	Extension Activity			0	0	0	0	0	1	-	-	-	-
	TOTAL				**30**	**13**	**5**	**12**	**0**	**26**	**-**	-	-	**600**
GRAND TOTAL					**120**	**72**	**17**	**31**	**0**	**91**				**2400**
Extra Credit				MOOC/ SWAYAM/ NPTEL (At least One Per Year)	**-**	**2**	-	-	-	**-**				
				Value Added Courses (At least One Per Year)	**-**	**2**	-	-	-	**-**				

CREDIT DISTRIBUTION FOR PG PROGRAMME

S.No.	Subject	Total Credits
Part A	Core Course (8 courses x 5 credits)	40
	Core Practical (4 courses x 3 credits)	12
	Project Work with Viva Voce	7
	Core Industry Module (1 course x 3 credits)	3
Part B (i)	Elective Course (6 Courses x 3 Credits)	18
Part B (ii)	Non Major Elective (2 courses x 2 credits)	4
	Skill Enhancement Course (1 course x 2 credits)	2
	Professional Competency Course (1 course x 2 credits)	2
Part B (iii)	Internship	2
Part C	Extension Activity	1
	Total	**91**

L-Lecture T-Tutorial P-Practical S-Seminar

Part A component and Part B (i) will be taken into account for CGPA calculation for the postgraduate programme and the other components of Part B and Part C have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the PG degree.

NON MAJOR ELECTIVE (NME) OFFERED BY THE DEPARTMENT

Semester	Part	Course	Course Code	Title of the Paper
I	Part B (ii)	NME-I	P23NMEBC11	Nutritional Biochemistry
II		NME-II	P23NMEBC22	Molecular Basis of Disease and Therapeutic Strategies

SEMESTER I

Semester: I-CC-I: Basics of Biochemistry

Ins. Hrs./Week: 6 **Course Credit**: 5 **Course Code**: P23BC101

UNIT- I: Carbohydrates (18 Hours)

Classification, structure (configurations and conformations, anomeric forms), function and properties of monosaccharide, mutarotation, Disaccharides and oligosaccharides with suitable examples. Polysaccharides – Homo polysaccharides (starch, glycogen, cellulose, inulin, dextrin, agar, pectin, dextran). Hetero polysaccharides - Glycosaminoglycans– source, structure, functions of hyaluronic acid, chondroitin sulphates, heparin, keratan sulphate. Glycoproteins - proteoglycans. O- Linked and N-linked glycoprotein. Biological significance of glycan. Blood group polysaccharides. Bacterial cell wall (peptidoglycans, teichoic acid) and plant cell wall carbohydrates.

UNIT-II: Lipids (18 Hours)

Classification of lipids, structure, properties and functions of fatty acids, triacylglycerols, phospholipids, glycolipids, sphingolipids and steroids – Biological importance. Eicosanoids- classification, structure and functions of prostaglandins, thromboxanes, leukotrienes. Lipoproteins– Classification, structure, transport (endogenous and exogenous Pathway) and their biological significance.

UNIT-III: Amino acids (18 Hours)

Overview of Amino acids - classification, structure and properties of amino acids, Biological role. Non Protein amino acids and their biological significance .Proteins – classification based on composition, structure and functions. Primary, secondary, super secondary (motifs) (Helix-turn–helix, helix-loop-helix, Beta-alpha-beta motif, Rosemann fold, Greek key), tertiary and quaternary structure of proteins. Structural characteristics of collagen and hemoglobin. Determination of amino acid sequence. Chemical synthesis of a peptide, Forces involved in stabilization of protein structure. Ramachandran plot. Folding of proteins. Molecular chaperons – Hsp 70 and Hsp 90 - biological role.

UNIT-IV: Membrane Proteins (18 Hours)

Types and significance of Membrane Proteins. Cytoskeleton proteins - actin, tubulin, intermediate filaments. Biological role of cytoskeletal proteins. Membrane structure-fluid mosaic model.

UNIT-V: Nucleic acids (18 Hours)

Types and forms (A, B, C and Z) of DNA. Watson-Crick model- Primary, secondary

and tertiary structures of DNA. Triple helix and quadruplex DNA. Mitochondrial and chloroplast DNA. DNA supercoiling (calculation of Writhe, linking and twist number). Determination of nucleic acid sequences by Maxam Gilbert and Sanger's methods. Forces stabilizing nucleic acid structure. Properties of DNA and RNA. C-value, C-value paradox, Cot curve. Structure and role of nucleotides in cellular communications. Major and minor classes of RNA, their structure and biological functions.

Total Lecture Hours - 90

COURSE OUTCOME

Students are able to,

1. Explain the chemical structure and functions of carbohydrates.
2. Using the knowledge of lipid structure and function, explain how it plays a role in signaling pathways.
3. Describe the various levels of structural organization of proteins and the role of proteins in biological system.
4. Apply the knowledge of proteins in cell-cell interactions.
5. Applying the knowledge of nucleic acid sequencing in research and diagnosis.

TEXT BOOK(S)

1. David L. Nelson and Michael M.Cox (2012) Lehninger Principles of Biochemistry (6th ed) W.H.Freeman.
2. Voet. D & Voet. J.G (2010) Biochemistry, (4th ed), John Wiley & Sons, Inc.
3. Metzler D.E (2003). The chemical reactions of living cells (2nd ed), Academic Press.
4. Zubay G.L (1999) Biochemistry, (4th ed),Mc Grew-Hill.
5. Lubert Stryer (2010) Biochemistry,(7th ed), W.H.Freeman
6. Satyanarayan,U (2014) Biochemistry (4th ed), ArunabhaSen Books & Allied (P) Ltd, Kolkata.

REFERENCE BOOK(S)

1. Anders Liljas. 2019. Textbook of Structural Biology, 2nd Edition, World Scientific Publishers, Singapore.
2. Berg JM, Tymoczko JL and Stryer L. 2019. Biochemistry, 9th Edition, WH. Freeman Publishers, New York, USA.
3. David L. Nelson and Michael M. Cox. 2017. Lehninger Principles of Biochemistry, 7th Edition, WH Freeman Publishers, New York, USA.
4. Lehninger AL, Nelson DL and Cox MM. 2020. Principles of Biochemistry, 8th Edition, WH Freeman Publishers, New York, USA.
5. Satyanarayana U and Chakrapani U. 2020. Biochemistry, 5th Updated edition, Elsevier Publishers, India.

E-RESOURCES

1. https://bio.libretexts.org/Bookshelves/Biochemistry/Book%3A_Biochemistry_Online_(Jakubowski)

2. https://www.thermofisher.com/in/en/home/life-science/protein-biology/protein-biology-learning-
3. center/protein-biology-resource-library/pierce-protein-methods/protein-glycosylation.html
4. https://ocw.mit.edu/courses/biology/7-88j-protein-folding-and- human-disease-
5. spring-2015/study-materials/
6. https://www.open.edu/openlearn/science-maths-technology/science/biology/nucleic-acids-and- chromatin/content-section- 3.4.2
7. https://www.genome.gov/genetics-glossary/Cell-Membrane
8. https://nptel.ac.in/content/storage2/courses/102103012/pdf/mod3.pdf.

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Semester: I-CC-II: **Biochemical and Molecular Biology Techniques**
Ins. Hrs./Week: 6 **Course Credit**: 5 **Course Code**: P23BC102

UNIT- I: Cellular Investigation **(18 Hours)**

General approaches to biochemical investigation, cell culture techniques and microscopic techniques. Organ and tissue slice technique, cell distribution and homogenization techniques, cell sorting, and cell counting, tissue Culture techniques. Cryopreservation, Biosensors- principle and applications. Principle, working and applications of light microscope, dark field, phase contrast and fluorescent microscope. Electron microscope- Principle, instrumentation of TEM and SEM, Specimen preparation and applications-shadow casting, negative staining and freeze fracturing.

UNIT-II: Chromatographic Techniques **(18 Hours)**

Basic principles of chromatography- adsorption and partition techniques. Chiral Chromatography and counter current Chromatography. Adsorption Chromatography – Hydroxy apatite chromatography and hydrophobic interaction Chromatography. Affinity chromatography. Gas liquid chromatography- principle, instrumentation, column development, detectors and applications. Low pressure column chromatography – principle, instrumentation, column packing, detection, quantitation and column efficiency, High pressure liquid chromatography- principle, instrumentation, delivery pump, sample injection unit, column packing, development, detection and application. Reverse HPLC, capillary electro chromatography and perfusion chromatography.

UNIT-III: Electrophoretic Techniques **(18 Hours)**

General principles of electrophoresis, supporting medium, factors affecting electrophoresis, Isoelectric focusing-principle, ampholyte, development of pH gradient and application. PAGE-gel casting-horizontal, vertical, slab gels, sample application, detection-staining using CBB, silver, fluorescent stains. SDS PAGE-principle and application in molecular weight determination principle of disc gel electrophoresis, 2D PAGE. Electrophoresis of nucleic acids-agarose gel electrophoresis of DNA, pulsed field gel electrophoresis- principle, apparatus, application. Electrophoresis of RNA, curve. Microchip electrophoresis and 2D electrophoresis, Capillary electrophoresis.

UNIT-IV: Spectroscopic techniques **(18 Hours)**

Basic laws of light absorption- principle, instrumentation and applications of UV-Visible, IR, ESR, NMR, Mass spectroscopy, Turbidimetry and Nephelometry. Luminometry (Luciferase system, chemiluminescence). X - ray diffraction. Atomic absorption spectroscopy - principle and applications - Determination of trace elements.

UNIT-V: Radio labeling Techniques and Centrifugation (18 Hours)

Nature of radioactivity-detection and measurement of radioactivity, methods based upon ionization (GM counter) and excitation (scintillation counter), autoradiography and applications of radioactive isotopes, Biological hazards of radiation and safety measures in handling radioactive isotopes. Basic principles of Centrifugation. Preparative ultracentrifugation- Differential centrifugation, Density gradient centrifugation. Analytical ultracentrifugation - Molecular weight determination.

Total Lecture Hours - 90

COURSE OUTCOME

Students are able to,

1. Attain good knowledge in modern used in biochemical investigation and microscopy and apply the experimental protocols to plan and carry out simple investigations in biological research.
2. Demonstrate knowledge to implement the theoretical basis of chromatography in upcoming practical course work.
3. Demonstrate knowledge to implement the theoretical basis of electrophoretic techniques in research work.
4. Tackle more advanced and specialized spectroscopic techniques that are pertinent to research.
5. Tackle more advanced and specialized radioisotope and centrifugation techniques that are pertinent to research work.

TEXT BOOK(S)

1. Keith Wilson, John Walker (2010) Principles and Techniques of Biochemistry and Molecular Biology (7^{th} ed) Cambridge University Press.
2. David Sheehan (2009), Physical Biochemistry: Principles and Applications (2nd ed), Wiley-Blackwell
3. David M. Freifelder (1982) Physical Biochemistry: Applications to Biochemistry and Molecular Biology, W.H.Freeman.
4. Rodney F. Boyer (2012), Biochemistry Laboratory: Modern Theory and techniques, (2nd ed), Prentice Hall.
5. Kaloch Rajan (2011), Analytical techniques in Biochemistry and Molecular Biology, Springer
6. Segel I.H (1976) Biochemical Calculations (2nd ed),John Wiley and Sons
7. Robyt JF (2015) Biochemical techniques: Theory and Practice (1st ed), CBS Publishers & Distributors.

REFERENCE BOOK(S)

1. Avinash Upadhyay, Kakoli Upadhyay and Nirmalendu Nath. 2014. Biophysical Chemistry (Principles and Techniques), 4^{th} Edition, Himalaya Publishers, Hyderabad.
2. Ghosal Sabari and Srivastava A. 2009. Fundamentals of Bio Analytical Techniques and Instrumentation, 2^{nd} Edition, PHI Learning Pvt. Ltd. India.
3. Kothari CR. 2004. Research Methodology, Methods and Techniques, 2^{nd} Edition, New Age International Publishers, India.

4. Rajan Katoch. 2011. Analytical Techniques in Biochemistry and Molecular Biology. 1st Edition, Springer New York Dordrecht Heidelberg London Publishers, United Kingdom.
5. Rodney Boyer. 2012. Biochemistry Laboratory: Modern Theory and Techniques, 2nd Edition, Prentice Hall Publishers, United Kingdom.
6. Seader JD. Henley J and Keith Roper D. 2011. Separation process principles - Chemical and Biochemical Operations, 3rd Edition, John Wiley & Sons Publishers, United Kingdom.
7. Wilson and Walkers. 2018. Principles and Techniques of Biochemistry and Molecular Biology, 8th Edition, Cambridge University Press Publishers, England.

E-RESOURCES

1. https://www.kau.edu.sa/Files/0017514/Subjects/principals%20and%20techiniques%20of%20biochemistry%20and %20molecular%20biology%207th%20ed%

Semester: I-CP-I: **Biomolecules and Biochemical Techniques**
Ins. Hrs. /Week: 6 **Course Credit**: 3 **Course Code**: P23BC103P

I. Biochemical studies and estimation of macromolecules

1. Isolation and estimation of glycogen from liver.
2. Isolation and estimation of DNA from animal tissue.
3. Isolation and estimation of RNA from yeast.
4. Purification of Polysaccharides –Starch and assessment of its purity

II. UV absorption

1. Denaturation of DNA and absorption studies at 260nm.
2. Denaturation of Protein and absorption studies at 280nm.

III. Colorimetric estimations

1. Estimation of Pyruvate
2. Estimation of tryptophan.

IV. Estimation of minerals

1. Estimation of calcium
2. Estimation of iron

V. Plant Biochemistry

1. Qualitative analysis phytochemical screening
2. Estimation of Flavonoids -Quantitative analysis

VI. Group Experiments

1. Fractionation of sub-cellular organelles by differential centrifugation-Mitochondria and nucleus
2. Identification of the separated sub-cellular fractions using marker enzymes (any one)
3. Separation of identification of lipids by thin layer chromatography
4. Separation of plant pigments from leaves by column chromatography
5. Identification of Sugars by Paper Chromatography
6. Identification of Amino acids by Paper Chromatography

Total Hours- 90

COURSE OUTCOME

Students are able to,

1. Instill skill in students enabling them to apprehend the wider knowledge about principles and techniques to be employed for the biomolecules under investigation.

2. Inculcate the knowledge of various isolation and purification techniques of macromolecules like DNA, RNA, Glycogen and Starch,
3. Perform colorimetric estimations to quantify important metabolites like lactate and tryptophan and minerals like calcium and iron from various sources.
4. Achieve training in subcellular fractionation and to identify them by markers.
5. Achieve training in various chromatographic techniques.
6. Perform the isolation and identification of the organelles of a cell using differential centrifugation.
7. Perform phytochemical screening and quantification enabling them to give an insight on phytochemicals this will be useful for future research.

TEXT BOOK(S)

1. Jayaraman, J (2011),laboratory Manual in Biochemistry, New age publishers

REFERENCE BOOK(S)

1. David Plummer (2001) An Introduction to Practical Biochemistry (3rd ed) McGraw Hill Education (India) Private Ltd
2. Varley H (2006) Practical Clinical Biochemistry (6th ed) , CBS Publishers
3. O. Debiyi and F. A. Sofowora, (1978)"Phytochemical screening of medical plants," Iloyidia, vol. 3, pp. 234–246,
4. Sarin A. Chavhan, Prof. Sushilkumar A. Shinde (2019) A Guide to Chromatography Techniques Edition:1
5. Analytical techniques in Biochemistry and Molecular Biology; Katoch, Rajan. Springer (2011)

E-RESOURCES

1. https://www.researchgate.net/publication/313745155_Practical_Bio chemistry A_Student_Companion
2. https://doi.org/10.1186/s13020-018-0177-x
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5368116/
4. https://www.life.illinois.edu/biochem/455/Lab%20exercises/2Photometry/spectrophotometry.pdf
5. https://ijpsr.com/bft-article/determination-of-total-flavonoid-and-phenol-content-in-mimusops-elengi-linn/?view=fulltext
6. https://skyfox.co/wp-content/uploads/2020/12/Practical-Manual-of-Biochemistry.pdf

Semester: I-EC-I Microbiology and Immunology

Ins. Hrs. /Week: 5 **Course Credit**: 3 **Course Code**: **P23BCE11A**

UNIT-I: Taxonomical classification (10 Hours)

Bacteria, viruses (DNA, RNA), algae, fungi and protozoa. Distribution and role of microorganisms in soil, water and air. Charaka's classification of microbes, lytic cycle and lysogeny. Types of culture media, isolation of pure culture, growth curve and the measurement of microbial growth.

UNIT-II: Food Contamination (11 Hours)

Contamination and spoilage of foods – cereals, cereal products, fruits, vegetables, meat, fish, poultry, eggs, milk and milk products. General principles of traditional and modern methods of food preservation - Removal or inactivation of microorganisms, boiling, steaming, curing, pasteurization, cold processing, freeze drying, irradiation, vacuum packing, control of oxygen and enzymes. Microbes involved in preparation of fermented foods - cheese, yoghurt, curd, pickles, rice pan cake, appam, ragi porridge and bread.

UNIT-III: Food poisoning (12 Hours)

Bacterial food poisoning, *Salmonella*, *Clostridium blotulinum* (botulism), *Staphylococcus aureus*, fungal food poisoning – aflatoxin, food infection – *Clostridium, Staphylococcus* and *Salmonella*. Pathogenic microorganisms, *E. coli, Pseudomonas, Klebsilla, Streptococcus, Haemophilus, & Mycobacterium*, causes, control, prevention, cure and safety. Food microbiological screening- Real time PCR, ELISA, Aerobic and anaerobic Plate Count, dye reduction method, anaerobic lactic acid bacteria, anaerobic sporeformers, Hazard analysis critical control point (HACCP).

UNIT-IV: Antimicrobial chemotherapy (12 Hours)

General characteristics of antimicrobial agents. Mechanism of action – sulfonamides, sulphones and PAS. Penicillin, streptomycin- spectra of activity, mode of administration, mode of action, adverse effects and sensitivity test., Antiviral and antiretroviral agents, Antiviral RNA interference, natural intervention (Natural immunomodulators routinely usedin Indian medical philosophy).

UNIT-V: Immune system (15 Hours)

Definition and properties. Cells of the immune system – neutrophils, eosinophils, basophils, mast cells, monocytes, macrophages, dendritic cells, natural killer cells, and lymphocytes (B cells and T cells). Lymphoid organs- Primary and Secondary; structure and functions. Antigens and Complement System: definition, properties- antigenicity and immunogenicity, antigenic determinants and haptens. Antigen - antibody interactions - molecular mechanism of binding. Affinity, avidity, valency, cross reactivity and

multivalent binding. Immunoglobulins & Immune Response: Structure, classes and distribution of antibodies. Antibody diversity. Immune system in health & disease, Transplantation immunology- graft rejection and HLA antigens. Immunological techniques, Flow cytometry and its application.

Total Instruction Hours-60

COURSE OUTCOME

Students are able to,

1. Classify (by both ancient and modern modes) different types of microorganisms and explain life cycle of the microbes
2. Recognize the microorganisms involved in decay of foods and will be able to apply various counteracting measures. The students also will be able to relate the role of certain beneficial microbes in day-to- day's food consumption.
3. Understand the common pathogenic bacterial and fungi that cause toxic effects and also will be able to employ curative measures.
4. Analyse various features of wide variety of antimicrobial agents along with their mode of action, in addition, being able to apprehend the valuable potentials of traditional and easily available herbs.
5. Apply knowledge gained in production of industrially important products as both pharmaceutical and nutraceutical.

TEXT BOOK(S)

1. Michael J.Pelczar Jr.(2001) Microbiology (5th ed), McGraw Hill Education (India) Private Limited
2. Willey J and Sherwood L (2011) ,Prescott's Microbiology (8^{th} ed) McGraw Hill Education (India)
3. Ananthanarayanan , Paniker and Arti Kapil (2013) Textbook of Microbiology (9^{th} ed) Orient BlackSwan
4. Judy Owen , Jenni Punt Kuby (2013) ,Immunology (Kindt, Kuby Immunology) (7th ed) W. H. Freeman & Co
5. Brooks GF and Carroll KC (2013) Jawetz Melnick&Adelbergs Medical Microbiology,(26^{th} ed) McGraw Hill Education
6. Greenwood D (2012) ,Medical Microbiology, Elsevier Health

REFERENCE BOOK(S)

1. Abul K. Abbas, Andrew H. Lichtman, and Shiv Pillai. 2020. Cellular and Molecular Immunology, 10th Edition, Elsevier Publishers, India.
2. Ashim K. Chakravarty. 2016. Immunology and Immunotechnology, 1st Edition, Oxford Publishers, England.
3. Jenni Punt, Sharon A Stranford, Patricia P Jones and Judith A Owen. 2019. Kuby Immunology, 8th Edition, Macmillan Education Publishers, London. 45
4. Peter J. Delves, Seamus J. Martin, Dennis R. Burton and Ivan M. Roitt. 2016. Roitt's Essential Immunology, 13th Edition, Wiley-Blackwell Publishers, New Jersey.
5. Frazier WC , Westhoff DC, Vanitha NM (2010) Food Microbiology (5^{th} ed), McGraw Hill Education (India) Private Limited
6. Richard A. Goldsby, Thomas J. Kindt, Barbara A. Osborne, Janis Kuby. 2002. Immunology, 5th Edition, W.H.Freeman Publishers, New York.

E-RESOURCES

1. https://www.nature.com/ni/video
2. https://www.cell.com/immunity/home
3. https://www.wpunj.edu/sec/vsec/science_courses/bio/BIOimmuANIM.html
4. https://www.youtube.com/watch?v=K09xzIQ8zsg
5. https://nptel.ac.in/content/syllabus_pdf/102105083.pdf

Semester: I-EC-I: Nanotechnology

Ins. Hrs. /Week: 5 **Course Credit**: 3 **Course Code**: **P23BCE11B**

UNIT-I: Importance of Nanotechnology **(12 Hours)**

History of Nanotechnology-Opportunity at the nano scale-length and time scale in structures-energy landscapes-Interdynamic aspects of inter molecular forces - classification based on the dimensionality- nanoparticles nanoclusters-nanotubes-nanowires and nanodots- Semiconductor nanocrystals carbon nanotubes- Influence of Nano structuring on Mechanical, optical, electronic, magnetic and chemical properties

UNIT-II: Self-assembly **(12 Hours)**

Self-assembled monolayers (SAMs). Langmuir-Blodgett (LB) films, clusters, colloids, zeolites, organic block copolymers, emulsion polymerization, templated synthesis, and confined nucleation and/or growth. Biomimetic Approaches: polymer matrix isolation, and surface-templated nucleation and/or crystallization. Vapor (or solution) – liquid – solid (VLS or SLS) growth -Electrochemical Approaches: anodic oxidation of alumina films, porous silicon, and pulsed electrochemical deposition.

UNIT-III: Spectroscopy **(12 Hours)**

X-ray Diffraction - Thermal Analysis Methods, Differential Thermal Analysis and Differential scanning calorimetry - Spectroscopic techniques, UV-Visible Spectroscopy – IR Spectroscopy – Microwave Spectroscopy - Raman Spectroscopy - Electron Spin Resonance Spectroscopy- - NMR Spectroscopy- Particle size characterization: Zeta Potential Measurement – Particle size Analysis – X-ray Photoelectron spectroscopy

UNIT-IV: Microscopy **(12 Hours)**

Fundamentals of the techniques – experimental approaches and data interpretation – applications/limitations of Optical microscopy - Scanning Electron Microscopy – Transmission Electron Microscopy – Atomic Force Microscopy – Scanning Tunneling Microscopy

UNIT-V: Applications of Nanoparticles **(12 Hours)**

Semiconductor (metal) nanoparticles and nucleic acid and protein based recognition groups– Application in optical detection methods – Nanoparticles as carrier for genetic material– Nanotechnology in agriculture – Fertilizer and pesticides. Designer proteins, Peptide nucleic acids, Nanomedicine, Drug delivery, DNA computing, Molecular design using biological selection, Harnessing molecular motors, Artificial life, Hybrid materials, Biosensors - Future directions

Total Lecture Hours-60

COURSE OUTCOME:

The Students are able to,

1. Acquire the knowledge of basic sciences required to understand the fundamentals of Nanomaterials.
2. Acquire the knowledge of electronic, optical and magnetic properties of nanomaterials.
3. Make the students understand about the functional principles of nanotechnology.
4. Provide the knowledge in basics of nanotechnology in biotechnology.
5. Understand the application of Nanomaterials in biotechnology and acquire the knowledge about the DNA, proteins, amino acids, drug delivery, biomedicine etc.,

TEXT BOOK(S):

1. Pradeep. T, 2007, Nano: The Essentials, McGraw – Hill education.
2. Challa. S.S.R, Kumar, Josef Hormes, Carola Leuschaer, Nanofabrication Towards.
3. Biomedical Applications, Techniques, Tools, Applications and Impact", Wiley – VCH, 2005.

REFERENCE BOOK(S):

1. Rao. C. N. R, Mu¨ller. A, Cheetham. A. K, 2006, The Chemistry of Nanomaterials: Synthesis, Properties and Applications, Wiley-VCH.
2. Breachignac. C, Houdy. P, Lahmani. M, 2006, Nanomaterials and Nanochemistry, Springer.
3. Guozhong Cao, 2011, Nanostructures and Nanomaterials: Synthesis, Properties, and Applications, World Scientific Publishing Private, Ltd.,
4. Niemeyer.C.M. Mirkin C, 2004, A Nanobiotechnology: Concepts, Applications and Perspectives, Wiley – VCH.

E-RESOURCES:

https://www.pdfdrive.com/nanotechnology-books.html

Semester: I-EC-II: Energy and Drug Metabolism

Ins. Hrs. /Week: 5 **Course Credit**: 3 **Course Code**: **P23BCE12A**

UNIT-I: Thermodynamics (10 Hours)

Principles in biology- Concept of entropy, enthalpy and free energy change. Redox systems. Redox potential and calculation of free energy. Biological oxidation – Oxidases, dehydrogenases, hydroperoxidases, oxygenases. Energy rich compounds – phosphorylated and non-phosphorylated. High energy linkages.

UNIT-II: Oxidative phosphorylation (12 Hours)

Electron transport chain-various complexes of ETC, Q-cycle. Inhibitors of ETC. Oxidative phosphorylation-P/O ratio, chemiosmotic theory. Mechanism of ATP synthesis - role of F0-F1 ATPase, ATP-ADP cycle. Inhibitors of oxidative phosphorylation ionophores, protonophores . Regulation of oxidative phosphorylation.

UNIT-III: Photosynthesis (13 Hours)

Light reaction-Hills reaction, absorption of light, photochemical event. Photo ETC-cyclic and non-cyclic electron flow. Photophosphorylation-role of CF0-CF1 ATPase. Dark reaction- Calvin cycle, control of C3 pathway, and Hatch-Slack pathway (C4 pathway), Photorespiration. Synthesis and degradation of starch.

UNIT-IV: Bioenergetics (14 Hours)

Interconversion of major food stuffs. Energy sources of brain, muscle, liver, kidney and adipose tissue. Amphibolic nature of Citric acid cycle. Anaplerotic reaction. Krebs cycle, Inhibitors and regulation of TCA cycle. Transport of extra mitochondrial NADH – Glycerophosphate shuttle, malate aspartate shuttle. Energetics of metabolic pathways – glycolysis, (aerobic and anaerobic), citric acid cycle, beta oxidation.

UNIT-V: Drug metabolism (11 Hours)

Activation of sulphate ions – PAPS, APS, SAM and their biological role. Metabolism of xenobiotics – Phase I reactions – hydroxylation, oxidation and reduction. Phase II reactions – glucuronidation, sulphation, glutathione conjugation, acetylation and methylation. Mode of action and factors affecting the activities of xenobiotic enzymes

Total Lecture Hours-60

COURSE OUTCOME

Students are able to,

1. Appreciate the relationship between free energy and redox potential and will be able to justify the role of biological oxidation and energy rich compounds in maintaining the energy level of the system

2. Gain knowledge on role of mitochondria in the production of energy currency of the cell
3. Acquaint with the process of photosynthesis
4. Comprehend on the diverse role of TCA cycle and the energy obtained on complete oxidation of glucose and fatty acid
5. Correlate the avenues available to metabolize the xenobiotics.

TEXT BOOK(S)

1. Ajit Pandya. 2015. A Text book of Metabolism - Lipids, Proteins and Carbohydrates, Kindle Edition, Amazon Asia-Pacific Holdings Private Limited, Singapore.
2. Denise R Ferrier. 2013. Biochemistry (Lippincott's Illustrated Reviews), 6th Edition, Lippincott Williams and Wilkins Publishers, New York, USA.
3. Keith N Frayn and Rhys D. Evans. 2019. Human Metabolism A Regulatory Perspective, 4 th Edition, John Wiley Publishers, United Kingdom.
4. Reginald H. Garrett, Charles M. Grisham. 2010. Biochemistry, 4th Edition, Mary Finch Publishers.
5. Voet D, and Voet JG. 2010. Biochemistry, 4th Edition, John Wiley & Sons, Inc. Publishers, New York.
6. Goodwin TW and Mercer EI. 1983. Introduction of Plant Biochemistry 2nd Edition, Pergamon Press, Oxford.
7. Harbone JB. 1997. Plant Biochemistry, 5th Edition. Harcourt Asia (P) Ltd., India and Academic Press, Singapore

REFERENCE BOOK(S)

1. David L.Nelson and Michael M.Cox (2012) Lehninger Principles of Biochemistry (6th ed), W.H.Freeman
2. Robert K. Murray, Darryl K. Granner, Peter A. Mayes, and Victor W. Rodwell (2012), Harper's Illustrated Biochemistry, (29th ed), McGraw-Hill Medical
3. Metzler D.E (2003). The chemical reactions of living cells (2nd ed), Academic Press.
4. Zubay G.L (1999) Biochemistry, (4th ed), Mc Grew-Hill.
5. Devlin RM (1983) Plant Physiology (4th ed), PWS publishers
6. Taiz L, Zeiger E (2010), Plant Physiology (5th ed), Sinauer Associates, Inc

E-RESOURCES

1. https://chemed.chem.purdue.edu/genchem/topicreview/bp/ch21/gibbs.php
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7767752/#:~:text=The%20mitochondrial%20electron%20transport%20chain,cellular%20ATP%20through%20oxidative%20phosphorylation
3. https://www.researchgate.net/figure/Oxidative-phosphorylation-in-mitochondrial-electron-transport-chain-ETC-and-proton_fig1_230798915
4. https://www.lyndhurstschools.net/userfiles/84/Classes/851/photosynthesis%20light%20&%20dark%20reactions%20ppt.pdf?id=560837
5. https://bajan.files.wordpress.com/2010/05/amphibolic-nature-of-krebs-cycle.pdf
6. https://www.sciencedirect.com/topics/medicine-and-dentistry/xenobiotic-metabolism#:~:text=Xenobiotic%20metabolism%20can 20be% 20 defined, more% 20 readily%20excreted%20hydrophilic%20metabolites

7. https://byjus.com/biology/plant-growth-regulators
8. https://icar.org.in/files/mAgMicro.pdfv

Semester: I-EC-II: Genetics

Ins. Hrs. /Week: 5 **Course Credit**: 3 **Course Code**: **P23BCE12B**

UNIT-I: Introduction to Genetics **(12 Hours)**

Brief history/basic concepts of genetics, Cell division and chromosomes. Mendelian genetics/monohybrid, dihybrid cross. Mendelian genetics/trihybrid cross, probability. Modification of Mendelian ratios/incomplete and codominance. Modification of Mendelian ratios/incomplete and codominance. Structure of Gene - Interaction of Gene - Commentary Factors, Supplementary Factors, Inhibitory and Lethal Factors - Atavism.

UNIT-II: Chromosome abnormalities **(12 Hours)**

Diploid chromosomes number- Sex differentiation and sex determination.The X chromosomes, Barr bodies, the Lyon hypothesis. Aneuploidy and polyploidy: Gene deletion, duplication, inversions and translocation. Sex Linkage in Drosopohila and Man, Sex Influenced and Sex Limited Genes - Non-Disjunction and Gynandromorphs - Cytoplasmic Inheritance - Maternal Effect OnLimnaea (Shell Coiling), Male Sterility (Rode's Experiment).CO2 sensitivity In Drosophila, Kappa particles in Paramecium, Milk Factor in Mice.

UNIT-III: Blood groups and Crossing over **(12 Hours)**

Blood Groups and their Inheritance in Human - Linkage and Crossing Over:- Drosophila - Morgans' Experiments - Complete and Incomplete Linkage, Linkage Groups, Crossing Over types, Mechanisms - Cytological Evidence for Crossing Over, Mapping of Chromosomes - Interference and Coincidence.

UNIT-IV: Nature and Function of Genetic Material **(12 Hours)**

Fine Structure of the Gene - Cistron, Recon, Muton - Mutation - Molecular Basis of Mutation, Types of Mutation, Mutagens, Mutable and Mutator Genes. Chromosomal Aberrations - Numerical and Structural Examples from Human.

UNIT-V: Applied Genetics **(12 Hours)**

Animal Breeding - Heterosis, Inbreeding, Out Breeding, Out Crossing, Hybrid Vigour. Population Genetics, Evolutionary genetics, Hardy Weinberg Law - Gene Frequency, Factors Affecting Gene Frequency, Eugenics, Euphenics and Euthenics, Bioethics.

Total Lecture Hours-60

COURSE OUTCOME

The students are able to,

1. Identify and describe the process and purposes of the cell cycle, meiosis, and mitosis, as well as predict the outcomes of these processes.

2. Analyse genetics problems, make accurate predictions about inheritance of genetic traits, and map the locations of genes.
3. Identify the parts, structure, and dimensions of DNA molecules, RNA molecules, and chromosomes, and be able to categorize DNA as well as describe how DNA is stored.
4. Describe what causes and consequences of DNA sequence changes and how cells prevent these changes, as well as make predictions about the causes and effects of changes in DNA.
5. Describe applications and techniques of modern genetic technology, as well as select the correct techniques to solve practical genetic problems.

TEXT BOOK(S)

1. The Biology of Cancer, R.A. Weinberg, Garland Science, Taylor and Francis Group, 2007.
2. Cancer Biology, 3rd ed., R.J.B. King and M.W. Robbins, Pearson Education Ltd., 2006.
3. Cancer cytogenetics, chromosomal and molecular genetic aberrations of tumor cells, 3rd ed., S. Heim and F. Mitelman, Wiley, Blackwell Inc., 2009
4. Human cytogenetics: malignancy and acquired abnormalities, a practical approach,3rd ed., D.E. Rooney, Oxford University Press, 2001.
5. Introduction to the Cellular and Molecular Biology of Cancer,4th ed., M.A. Knowles and P.J. Selby, Oxford University Press, 2005.

REFERENCE BOOK(S)

1. Genetics by Verma, P.S. and V. K.Aggarwal.
2. Genetics by Russell P.J.
3. Genetics analysis and principles by Brooker R.J and McGraw Hill.
4. Basic Genetics my Miglani G.S.
5. Genetics: Analysis of genes and genomes by Hartl D.L and Jones E.W.

E-RESOURCES

1. https://www.slideshare.net/vanessaceline/intorduction-to-genetics
2. www.goldiesroom.org/

Semester: I-NME-I: Nutritional Biochemistry

Ins. Hrs. /Week: 2 **Course Credit**: 2 **Course Code**: **P23NMEBC11**

UNIT I: Basic concepts of Nutrition (6 Hours)

Food groups and balanced diet. Novel Foods. Calorific value of foods: Direct and indirect calorimetry. Empty calories. Basal metabolic rate: Factors affecting BMR. SDA and physical activity. Calculation of day's energy requirement. Assessment of nutritional status. Lactose intolerance. Nutritional requirement and biochemical changes in different physiological states -infancy, childhood, pregnancy, lactation, and ageing. Sports nutrition.

UNIT II: Elements of nutrition (6 Hours)

Plant and animal sources of simple and complex carbohydrates, fats and proteins and their requirement. Biological significance, deficiency and toxicity of macronutrients and micronutrients. Role of dietary fibre. Protein sparing action of carbohydrates and fats. Essential amino acids. Essential fatty acids. Effects of naturally occurring food toxins, preservatives, additives, alcohol and tobacco on health.

UNIT III: Vitamins and Minerals (6 Hours)

Dietary sources, classification, biochemical functions, requirements, absorption, metabolism and excretion. Vitamin B complex as coenzyme. Nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper.

UNIT IV: Malnutrition (6 Hours)

Diseases arising due to Protein - Calorie Malnutrition and undernutrition (Kwashiorkor and Marasmus), Prevention of malnutrition. Deficiency diseases associated with vitamin B complex, vitamin C and A, D, E & K vitamins - Mineral deficiency diseases - aetiology, sign and symptoms and dietary supplementation. Enrichment and fortification (vitamins and minerals)

UNIT V: Nutrition in diseases (6 Hours)

Aetiology, signs and symptoms , treatment and dietary management during fever (Typhoid and Malaria) and infectious diseases(COVID-19), Jaundice, hyper acidity (Ulcer), Atherosclerosis, Hypertension, kidney diseases and diabetes in adults. Starvation and Obesity. Inter-relationship of nutrition, infection, immunity and poverty

COURSE OUTCOME

The students are able to,

1. Plan a balanced diet based on an individual's energy requirement, Assess nutritional status of an individual
2. Describe the biochemical, physiological and nutritional functions of macronutrients and their integrated role. Understand the role played by antinutritional factors
3. Evaluate the functions of vitamins and minerals ,and fluids and electrolyte balance in different physiological states and in sports persons
4. Identify nutritional deficiency conditions , its prevention and dietary management
5. Acquire knowledge about the importance of balanced diet and diet therapy

TEXT BOOK(S):

1. Principles of Nutrition & Dietetics.Dr. M. Swaminathan, 2018, The Bangalore printing & publishing Company limited.88, Mysore Road, Bangalore- 560018.
2. Srilakshmi. E .(2016) Nutrition Science, New Age International Publishers.
3. Mahan, Kathleen L. (2004) Krause's Food, Nutrition and Diet Therapy, W.B.Saunder's 11th Edition
4. Andreas M. Papas (1998). Antioxidant Status, Diet, Nutrition, and Health (1st ed) CRC Press.
5. M. Swaminathan (1995) Principles of Nutrition and Dietetics. Bappco
6. Margaret Mc Williams (2012). Food Fundamentals (10th ed) Prentice Hall Tom Brody (1998) Nutritional Biochemistry (2nd ed). Academic Press, USA

REFERENCE BOOK(S):

1. Dr.M.Swaminathan, 2000, Advanced Text Book on Food & Nutrition –Vol. I. 2nd edition.
2. Dr. M. Swaminathan, 2015, Advanced Text Book on Food & Nutrition volume-II. 2nd edition.
3. Corine Rohinson, 1982, Normal and Therapeutic Nutrition.

E-RESOURCE:

- https://libguides.ug.edu.gh/c.php

SEMESTER II

Semester: II-CC-III: Physiology and Cell Biology

Ins. Hrs. /Week: 6 **Course Credit**: 5 **Course Code**: **P23BC204**

UNIT-I: Cell Junction, Cell cycle and Cell death (10 Hours)

Major classes of cell junctions- anchoring, tight and gap junctions. Major families of cell adhesion molecules (CAMs)- cadherins, integrins. Types of tissues. Epithelium-organisation and types. The basement membrane. Cell cycle- mitosis and meiosis, Cell cycle-phases and regulation. Cell death mechanisms- an overview-apoptosis, necrosis.

UNIT-II: Digestive system (13 Hours)

Structure and functions of different components of digestive system, digestion and absorption of carbohydrates, lipids and proteins, role of bile salts in digestion and absorption, mechanism of HCl formation in stomach, role of various enzymes and hormones involved in digestive system. Composition of blood, lymph and CSF. Blood cells - WBC, RBC and energy metabolism of RBC, Blood clotting mechanism and blood groups- ABO and Rhesus system.

UNIT-III: Respiratory system (12 Hours)

Gaseous transport and acid-base homeostasis. Mechanism of the movement of O2 and CO2 through lungs, arterial and venous circulation. Bohr Effect, oxygen and carbon dioxide binding haemoglobin. pH maintenance by cellular and intracellular proteins. Phosphate and bicarbonate buffers, metabolic acidosis and alkalosis. Respiratory acidosis and alkalosis. Regulation of fluid and electrolyte balance.

UNIT IV: Sensory transduction (13 Hours)

Nerve impulse transmission- nerve cells, synapses, reflex arc structure, resting membrane potential, Nernst equation, action potential, voltage gated ion-channels, impulse transmission, neurotransmission, neurotransmitter receptors, synaptosomes, synaptotagmin, rod and cone cells in the retina, changes in the visual cycle, photochemical reaction and regulation of rhodopsin, odour receptors, learning and memory. Chemistry of muscle contraction – actin and myosin filaments, theories involved in muscle contraction, mechanism of muscle contraction, energy sources for muscle contraction.

UNIT-V: Hormones (12 Hours)

Classification, Biosynthesis, circulation in blood, modification and degradation. Mechanism of hormone action, Target cell concept. Hormones of Hypothalamus,

pituitary, Pancreatic, thyroid & parathyroid, adrenal and gonadal hormones. Synthesis, secretion, physiological actions and feedback regulation of synthesis.

Total lecture hours- 60

COURSE OUTCOME

The students are able to

1. Specifically understand the biological and chemical processes within a human cell
2. Identify and prevent diseases
3. Understand defects in digestion, nutritional deficiencies and intolerances, and gastrointestinal pathologies
4. Identify general characteristics in individuals with imbalances of acid- base, fluid and electrolytes.
5. Process the mechanism: the transmission of biochemical information between cell membrane and nucleus.

TEXT BOOK(S)

1. Cooper M. 2000. The cell molecular approach. 2nd Edition. ASM Press, Washington, USA.
2. Kim E. Barrett, Susan M. Barman, Heddwen L. Brooks and Jason XJ. Yuan. 2019, Ganong's Review of Medical Physiology, 26th Edition. Mcgraw-Hill Publishers, New York.
3. Nitin Ashok John, Chatterjee CC. 2019. Human Physiology Volume – 1, 13th Edition. CBS Publishers, New Delhi.
4. Nitin Ashok John, Chatterjee CC. 2019. Human Physiology Volume – II, 13th Edition. CBS Publishers, New Delhi.
5. West ES, Todd WR, Mason HS. 2011. Textbook of Biochemistry, 4th Edition. Bruggen Oxford IBH Publishers, USA.

REFERENCE BOOK(S)

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments (6th ed). John Wiley & Sons. Inc.
2. Bruce Alberts and Dennis Bray (2013), Essential Cell Biology,(4th ed),Garland Science.
3. De Robertis, E.D.P. and De Robertis, E.M.F. (2010). Cell and Molecular Biology.(8th ed). Lippincott Williams and Wilkins, Philadelphia.
4. Wayne M. Baker (2008) the World of the Cell. (7th ed). Pearson Benjamin Cummings Publishing, San Francisco. Cell Biology
5. John E. Hall (2010). Guyton and Hall Textbook of Medical Physiology (12th ed), Saunders
6. Harrison's Endocrinology by J. Larry Jameson Series: Harrison's Specialty, 19th Edition Publisher: McGraw-Hill, Year: 2016.

E-RESOURCES

1. https://www.genome.gov/genetics-glossary/Cell-Cycle
2. https://my.clevelandclinic.org/health/diseases/16083-infertility-causes
3. https://www.webmd.com/heartburn-gerd/reflux-disease
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5760509/
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3249628/

Semester: II-CC-III: Enzymology

Ins. Hrs. /Week: 6 **Course Credit**: 5 **Course Code**: **P23BC205**

UNIT-I: Introduction to enzymes and features of catalysis (18 Hours)

A short history of the discovery of enzymes and how they became powerful biochemical tools. Holoenzyme, apoenzyme, cofactors, coenzyme, prosthetic groups, Classification and Nomenclature, Specificity of enzyme action-group specificity, absolute specificity, substrate specificity, stereochemical specificity. Active site, Identification of amino acids at the active site-trapping of ES complex, identification using chemical modification of amino acid side chains and by site-directed mutagenesis. Mechanisms of enzyme catalysis: acid-base catalysis, covalent catalysis, electrostatic catalysis, metal ion catalysis, proximity and orientation effects, Low barrier H-bonds, Structural flexibility Mechanism of action of chymotrypsin.

UNIT – II: Enzyme techniques (18 Hours)

Isolation and purification of enzymes - Importance of enzyme purification, methods of purification- choice of source , extraction, fractionation methods-based on size or mass (centrifugation, gel filtration); based on polarity (ion-exchange chromatography, electrophoresis, isoelectric focusing, hydrophobic interaction chromatography); based on solubility (change in pH, change in ionic strength); based on specific binding sites (affinity chromatography) ,choice of methods, Criteria of purity of enzymes. Enzyme units - Katal, IU. Measurement of enzyme activity - discontinuous, continuous, coupled assays; stopped flow method and its applications. Isoenzymes and their separation by electrophoresis with special reference to LDH.

UNIT-III: Enzyme kinetics I (18 Hours)

Thermodynamics of enzyme action, Activation energy, transition-state theory, and steady-state kinetics & pre-steady-state kinetics.Single substrate enzyme catalyzed reactions -assumptions, Michaelis-Menten and Briggs-Haldane kinetics, derivation of Michaelis-Menten equation. Double reciprocal (Lineweaver-Burk) and single reciprocal (Eadie -Hofstee) linear plots, their advantages and limitations. Analysis of kinetic data- determination of Km, Vmax, kcat, and their physiological significance, Importance of kcat/Km. Enzyme inhibition: Irreversible inhibition. Reversible inhibition-Competitive, uncompetitive, noncompetitive, mixed and substrate inhibition. Michaelis -Menten equation in the presence of competitive, uncompetitive and non-competitive inhibitors. Graphical analysis - Diagnostic plots for the determination of inhibition type. Therapeutic use of enzyme inhibitors-Aspirin, statins (irreversible inhibitors), Methotrexate (competitive inhibitor), Etoposide (non-competitive inhibitor), camptothecin (uncompetitive inhibitor).

Demonstration: Using Microsoft Excel to Plot and Analyze Kinetic Data

UNIT – IV: Enzyme kinetics II **(18 Hours)**

Allosteric enzymes: Cooperativity, MWC and KNF models of allosteric enzymes, sigmoidal kinetics taking ATCase as an example. Regulation of amount and catalytic activity by - extracellular signal, transcription, stability of mRNA, rate of translation and degradation, compartmentation, pH, temperature, substrate concentration, allosteric effectors, covalent modification. Regulation of glycogen synthase and glycogen phosphorylase. Feedback inhibition-sequential, concerted, cumulative, enzyme-multiplicity with examples. Bi - Substrate reactions: Single Displacement reactions (SDR) (Ordered and Random bi bi mechanisms), Double Displacement reactions (DDR) (Ping pong mechanism), Examples, Cleland's representation of bisubstrate reactions, Graphical analysis (diagnostic plots) to differentiate SDR from DDR.

UNIT – V: Enzyme technology **(18 Hours)**

Immobilization of enzymes – methods - Reversible immobilization (Adsorption, Affinity binding), Irreversible immobilization (Covalent coupling, Entrapment and Microencapsulation, Crosslinking, Advantages and Disadvantages of each method, Properties of immobilized enzymes,. Designer enzymes- ribozymes and deoxyribozymes, abzymes, synzymes. Enzymes as therapeutic agents-therapeutic use of asparaginase and streptokinase. Application of enzymes in industry- Industrial application of rennin, lipases, lactases, invertase, pectinases, papain.

Total lecture hours- 90

COURSE OUTCOME

The students are able to

1. Describe the catalytic mechanisms employed by enzymes
2. Choose and use the appropriate methods to isolate and purify enzymes and check the purity of the enzyme
3. Analyse enzyme kinetic data graphically, calculate kinetic parameters, determine the mechanism of inhibition by a drug/chemical and analyze options for applying enzymes and their inhibitors in medicine
4. Explain allosterism and cooperativity and differentiate Michaelis-Menten kinetics from sigmoidal kinetics. The role played by enzymes in the regulation of vital cellular processes will be appreciated.
5. Highlight the use of enzymes in industries and biomedicine

TEXT BOOK(S)

1. Alan J. Barrett J. Fred Woessner, and Neil D. 2012. Handbook of Proteolytic Enzymes, 3rd Edition, Rawlings Publishers.

2. Jain JL. 2005. Fundamentals of biochemistry, 6th Edition, S.Chand Publishers, New Delhi.

3. Nicholas C. 1989. Fundamentals of Enzymology, 2nd Edition, Oxford Science Publishers,

4. Palmer T. and Bonner P. 2007. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry, 2 nd Edition, Horwood Publishers, United Kingdom.

5. Satyanarayana U. 2019. Fundamentals of Biochemistry, Allied & Books Pvt Ltd, Calcutta, India.

REFERENCE BOOK(S)

1. Enzymes: Biochemistry, Biotechnology and Clinical chemistry, 2nd edition, 2007, Palmer T and Bonner P; Affiliated- East West press private Ltd, New Delhi
2. Fundamentals of Enzymology, 3rd edition, 2003, Price NC and Stevens L; Oxford University Press, New York
3. Voet's Biochemistry, Adapted ed, 2011,Voet,D and Voet JG; Wiley, India
4. Lehninger Principles of Biochemistry, 8th edition, 2021, .Nelson DL and Cox MM; WH Freeman & Co, New York
5. Biochemistry, Berg JM, Stryer L, Gatto,G, 8th ed, 2015;WH Freeman & Co., New York.
6. Enzyme Kinetics and Mechanism; Cook PF, Cleland W, ;2007; Garland Science, London

E-RESOURCES

1. https://ocw.mit.edu/high-school/biology/exam-prep/chemistry-of-life/enzymes/
2. https://onlinecourses.swayam2.ac.in/cec20_bt20/preview
3. https://mooc.es/course/enzymology/
4. https://dth.ac.in/medical/courses/biochemistry/block-1/1/index.php
5. https://www.lecturio.com/medical-courses/enzymes-and-enzyme kinetics.course#/
6. https://www.nature.com/articles/nrd.2017.219
7. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4934206/

Semester: II-CP-II: Enzymology, Microbiology and Cell Biology

Ins. Hrs. /Week: 6 **Course Credit**: 3 **Course Code**: **P23BC206P**

I. Enzymology

Alkaline Phosphatase

a. Isolation of Alkaline Phophatase from goat kidney.
b. Purification of alkaline phosphatase
c. Checking the purity using SDS-PAGE
d. Determination of optimum pH and temperature of alkaline phosphatase.
e. Determination of specific activity and Km of alkaline phosphatase.
f. Effect of activators and inhibitors on the activity of alkaline phosphatase.

Assay of enzymes

a. Salivary Amylase
b. Acid Phosphatase

II. Microbiology

a. Safety measures and Good Laboratory Practices in microbiology laboratory
b. Sterilization, Culture and inoculum preparation
c. Staining of bacteria – Gram Staining

III. Physiology & Cell Biology

a. Test for blood grouping (Haemagglutination)
b. Peripheral Blood smear –Staining and Interpretation

IV. Group Experiments

a. Separation of proteins based on molecular weight by SDS PAGE
b. Agarose gel electrophoresis of genomic DNA

V. Industrial visit can be organized to students through Academia –Industry Collaborative Programme

Total Hours-90

COURSE OUTCOME

The students are able to

1. Employ the relevant techniques forisolation and purification of enzymes and gain skill in kinetic studies which is essential for research activity
2. Acquire ability in performing enzyme assay, and explicate the methods that form the basis of enzyme characterization
3. Learn the Basic concepts in microbiology and cell biology which will be helpful for interdisciplinary research work
4. Trained in separation techniques used in molecular Biology which will be supportive in their future research
5. Learn practically through interaction, working methods and employment practices through Industrial visits

TEXT BOOK(S)

1. David Plummer (2001) An Introduction to Practical Biochemistry (3rd ed) McGraw Hill Education (India) Private Ltd
2. Jayaraman, J (2011), laboratory Manual in Biochemistry, New age publishers

REFERENCE BOOK(S)

1. Fundamentals of Enzymology; 3rd Edn. Nicholas C. Price and Lewis Stevens, Oxford University Press (2012).
2. Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis; Robert A. Copeland, Wiley-VCH Publishers (2000).
3. Cappuccino JG & Sherman N (2005). Microbiology-A Laboratory Manual, Pearson Education Inc
4. Practical Enzymology, Second Revised Edtion: Hans Bisswanger, Wiley – Blackwell; 2 edition (2011)

E-RESOURCES

1. https://www.researchgate.net/publication/337146254_Kinetic_studies_with_alkaline_phosphatase
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4846332/
3. https://www.ijsr.net/archive/v3i8/MDIwMTU0MDk=.pdf
4. https://www.researchgate.net/publication/349318898_ABC_of_ Periheral_smear
5. https://ncdc.gov.in/WriteReadData/l892s/File608.pdf
6. https://www.ncbi.nlm.nih.gov/books/NBK562156/

Semester: II-EC-III: Ecology and Environmental Sciences
Ins. Hrs. /Week: 5 Course Credit: 3 Course Code: P23BCE23A

UNIT I: Environment (15 Hours)

Physical environment: atmosphere (air), hydrosphere, lithosphere properties, interrelationship with living organisms. Abiotic and biotic environment and their interactions. Species interactions; types, interspecific competition, herbivory, carnivory, pollination, symbiosis. Population ecology – Population characteristics, population growth curve, population regulation, life history strategies (r and K selection); concept of meta population demes and dispersal, interdemic extinctions, age structured populations.

UNIT II: Community ecology (15 Hours)

Nature of communities, community structure and attributes, levels of species diversity and its measurement, edges and ecotones. Concept of habitat and niche, types of niche, niche width and overlap, fundamental and realized niche, resource partitioning, character displacement.

UNIT III: Ecological succession and Ecosystem Ecology (15 Hours)

Ecological succession types, mechanisms, concept of climax. Structure and function of ecosystem (terrestrial, forest, grassland and aquatic). ecosystem connections: food chain, food web; detritus pathway of energy flow and decomposition processes; ecological pyramids: pyramids of number, biomass, and energy, mineral cycling (C,N,P,S).

UNIT IV: Pollution (15 Hours)

Definition, Causes, Effects and Control measures of Air, Water, Soil, Marine, Noise and thermal pollution, Nuclear hazards, Solid Waste Management: Causes, Effects and Control measures of Urban and Industrial Waste, major drivers of biodiversity change, biodiversity management approaches.

UNIT V: Biogeography and Conservation Biology (15 Hours)

Major terrestrial biomes, theory of island biogeography, biogeographically zones of India. Principles of conservation, major approaches to management, Indian case studies on conservation/management stratergy (Project Tiger, Biosphere reserves).

Total lecture hours- 75

COURSE OUTCOME

The students are able to,

1. Understand core concepts of physical environment and species interactions.
2. Knowledge of the environment and the role of human beings in shaping the environment.

3. Ability to correlate ecological dynamics and regulation of vital processes on earth as biogeochemical cycles.
4. Analytical ability to link cause and effect of pollution.
5. Understand the Indian constitutional provisions with respect to the environmental protection, division of powers, and fundamental rights.

TEXT BOOK (S):

1. Edward J.Kormondy, 1996, Concepts of Ecology, 4th edition.
2. Aulay Mackenzine, Andy S.Ball, 1998, Instant Notes Ecology, 2nd edition.
3. PK Yadav Shubhrata R.Mishra. Environmental Biology, Discovery Publishing House. New Delhi.
4. Fundamentals of Ecology, MCDASH , 1993, Second Edition, TATA Mcgow Hill Publishing Company Limited, New Delhi
5. H.D.Kumar, 2008, Modern concepts of Ecology, Vikas Publishing House Pvt Ltd, 8th edition,

REFERENCE BOOKS:

1. P.S. Verma and V.K.Agarwal, 2005, Cell Biology, Genetics, Molecular Biology, Evolution And Ecology, S. Chand Company Ltd.
2. T.K.Saha, 2011, Ecology and Environmental Biology, Books and Allied (P) Ltd, Kolkata.
3. Dr. Biswarup Mukherjee, 2008, Fundamentals of Environment Biology, Silverline publications.
4. S S Negi, 2008, A Hand Book of Environmental Science.
5. P.Panday, 2010, A Text Book of Environmental Pollution.

E-RESOURCES:

http:// www.pdfdrive.com › ecology-and-environment-books
http:// www.freebookcentre.net › Biology › Ecology-Books

Semester: II-EC-III: Industrial Microbiology
Ins. Hrs. /Week: 5 Course Credit: 3 Course Code: P23BCE23B

UNIT I: Structure of bacteria, fungi and viruses and their classification (13 Hours)
Types and characteristics of microorganisms used in Industry (a) Food Industry (b) Chemical Industry (c) Pharmaceutical Industry.

UNIT II: Fundamentals and principles of microbial fermentation techniques (16 Hours)
Application in industry and pharmaceutical Biochemistry. Fermentation – types, techniques, design and operation of fermenters including addition of medium. Types and characteristics of microorganisms, environmental conditions required for the growth and metabolism of industrially and pharmaceutically important microbes. Sterilization methods in fermentation techniques, air, gas, culture medium sterilization. Steam-filtration and chemicals. Types and constituents of fermentative culture medium and conditions of fermentations, Antifoaming devices.

UNIT III: Recovery and estimation of products of fermentation (15 Hours)
Production of ethanol, acetic acid, glycerol, acetone, butanol and citric acid by fermentation. Production of Enzymes- amylase, protease, lipase,Production of pharmaceuticals by fermentation– penicillin, streptomycin, tetracycline, riboflavin, vitamin B12.Beverages-wine, beer and malt beverages.

UNIT IV: Food Microbiology (16 Hours)
Production of dairy products-bread, cheese and yoghurt (preparation and their types). Food borne diseases- Bacterial and Non- Bacterial. Food preservation - Principles–Physical methods: temperature (low, high, canning, drying), irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging, Chemical methods - salt, sugar, organic acids, SO_2, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins.

UNIT V: Agricultural Microbiology (15 Hours)
General Properties of soil, microorganisms in soil – decomposition of organic matter in soil. Biogeochemical cycles, nitrogen fixation, Production of bio fertilizers and its field applications – Rhizobium, azotobacter, blue green algae, mycorrhizae, azospirilium, Production of biofuels (biogas- methane), soil inoculants.

Total lecture hours- 75

COURSE OUTCOME
The students are able to,

1. Understand the structure and classification of microorganisms
2. Gain knowledge of the uses of microorganisms in various industrial applications
3. Understand the concepts of fermentation process, harvest and recovery.
4. Know the types of microbial fermentation processes and their applications in pharmaceutical industry.
5. Learn about the use of microorganisms in beverages, diary and food industries.

TEXT BOOK (S):

1. Food Microbiology: An Introduction: 4th edition,Matthews KR, Kniel KE, Montville TJ; American Society for Microbiology
2. Food, Fermentation and Micro-Organisms,2nd edition, Charles, BW; Blackwell Science Ltd
3. Microbiology. 5th edition , Pelczar MJ, Chan ECS and Krieg NR; McGraw Hill Book Company.

REFERENCE BOOKS:

1. Text book of Microbiology:11th edition, Ananthanarayanan R and Paniker CKJ; Universities Press (India) Pvt. Ltd.
2. Food Microbiology, 3rd edition, Frazier WC and Westhoff DC; Tata McGraw Hill Publishing Company Ltd, New Delhi
3. New Methods of Food Preservation:1st edition, Gould GW; Springer Manual of Industrial Microbiology and Biotechnology: 3rd edition, Baltz

E-RESOURCES:

Industrial biotechnology:
https://nptel.ac.in/courses/102/105/102105058/
Bioreactors:
https://nptel.ac.in/courses/102/106/102106053/
Food Microbiology:
https://nptel.ac.in/courses/126/103/126103017/
Agriculture Microbiology:
https://www.youtube.com/watch?v=f7UXyVImZ_c

Semester: II-EC-IV: Biosafety, Lab Safety and IPR
Ins. Hrs. /Week: 5 Course Credit: 3 Course Code: P23BCE24A

UNIT-I: Biosafety (15 Hours)

Historical background; introduction to biological safety cabinets; primary containment for biohazards; biosafety levels; recommended biosafety levels for infectious agents and infected animals; biosafety guidelines - government of India, roles of IBSC, RCGM, GEAC etc. for GMO applications in food and agriculture; environmental release of GMOs; risk assessment; risk management and communication; national regulations and international agreements.

UNIT-II: Laboratory safety (15 Hours)

Chemical, electrical and fire hazards; handling and manipulating human or animal cells and tissues, toxic, corrosive or mutagenic solvents and reagents; mouth pipetting, and inhalation exposures to infectious aerosols, Safe handling of syringe needles or other contaminated sharps, spills and splashes onto skin and mucous membranes. Health aspects; toxicology, allergenicity, antibiotic resistance. History of biosafety microbiology and molecular biology, Risk assessment, Personal protective equipment, Laboratory facilities and safety equipment, Disinfection, decontamination, and sterilization, Regulatory compliance, Laboratory security and emergency response and administrative controls.

UNIT-III: Intellectual Property Rights (IPR) (15 Hours)

Introduction to patents, types of patents, process involved in patenting in India, trademarks, copyright, industrial design, trade secrets, traditional knowledge, geographical indications, history of national and international treaties and conventions on patents, WTO, GATT, WIPO, Budapest Treaty, Patent Cooperation Treaty (PCT) and TRIPS. Patent databases: Searching international databases; analysis and report formation. Indian Patent Act 1970; recent amendments; filing of a patent application; precautions before patenting disclosure/non-disclosure; procedure for filing a PCT application. The patentability of microorganisms-claims, Characterization and repeatability disposition in the culture collections, legal protection for plants and other higher organisms, new plant varieties by rights, tissue culture protocols.

UNIT-IV: Patent filing and infringement (15 Hours)

Patent application- forms and guidelines, fee structure, time frames; types of patent applications: provisional and complete specifications; PCT and convention patent applications, International patenting-requirement, financial assistance for patenting-introduction to existing schemes; Publication of patents-gazette of India, status in Europe

and US. Research Patenting: Patenting by researchers and scientists-University/organizational rules in India and abroad. Detailed information on patenting biological products, Case studies on patents (basmati rice, turmeric, neem etc.), and patent infringement.

UNIT-V: Bioethics **(15 Hours)**

Introduction to bioethics, human genome project and its ethical issues, genetic manipulations and their ethical issues, ethical issues in GMOs, foods and crops in developed and developing countries, environmental release of GMOs, ethical issues involved in stem cell research and use, use of animals in research experiments, animal cloning, human cloning and their ethical aspects, testing of drugs on human volunteers.

Total Lecture Hours-60

COURSE OUTCOME

The students are able to,

1. Understand and implement various aspects of biosafety and carry out risk assessment of products in biological research
2. Understand the basic concepts of ethics and safety that are essential for different disciplines of science and procedures involved and protection of intellectual property and related rights.
3. Appreciate the intellectual property rights and its implementation of on the invention related to biological research.
4. Understand the statutory bodies that regulate the property rights and its validity in various countries.
5. Critique the ethical concerns associated with modern biotechnology processes and plan accordingly.

TEXT BOOK(S)

1. V. Shree Krishna, (2007). Bioethics and Biosafety in Biotechnology, New Age International Pvt. Ltd. Publishers. (Unit III, Unit IV and Unit V)
2. Deepa Goel, Shomini Parashar, (2013). IPR, Biosafety and Bioethics, Pearson. (Unit II)
3. R. Ian Freshney, 2016. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 6th Ed, John Wiley & Blackwell.
4. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007. (Unit I)

REFERENCE BOOK(S)

1. Biosafety in Microbiological and Biomedical Laboratories, (2020) 6th Ed. (https://www.cdc.gov/labs/pdf/SF 19_308133-A_BMBL6_00-BOOK-WEB-final3.pdf)
2. Kankanala C., (2007), Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd.,

E-RESOURCES

1. http://books.cambridge.org/0521384737.html

2. http://online.sfsu.edu/%7Erone/GEessays/gedanger.htm
3. http://www.actahort.org/members/showpdf?booknrarnr=447_125
4. http://www.cordis.lu/elsa/src/about.htm
5. http://www.csmt.ewu.edu/csmt/chem/jcorkill/bioch480/bioLN98.html
6. http://www.accessexcellence.org/AE/AEPC/BE02/ethics/ethintro.html

Semester: II-EC-IV: Genomics and Proteomics

Ins. Hrs. /Week: 5 **Course Credit**: 4 **Course Code**: **P23BCE24B**

UNIT-I: Basics of genomics and proteomics **(15 Hours)**

Brief overview of prokaryotic and eukaryotic genome organization; extra-chromosomal DNA: bacterial plasmids, mitochondria and chloroplast. **Genome sequencing projects:** Human Genome Project, genome sequencing projects for microbes, plants and animals, accessing and retrieving genome project information from the web.

UNIT-II: Genome mapping **(15 Hours)**

Genetic and physical maps; markers for genetic mapping; methods and techniques used for gene mapping, physical mapping, linkage analysis, cytogenetic techniques, FISH technique in gene mapping, somatic cell hybridization, radiation hybrid maps, *in situ* hybridization, comparative gene mapping.

UNIT-III: Genome sequencing projects **(15 Hours)**

Human Genome Project, genome sequencing projects for microbes, plants and animals, accessing and retrieving genome project information from the web

UNIT-IV: Comparative Genomics **(15 Hours)**

Identification and classification of organisms using molecular markers- 16S rRNA typing/sequencing, SNPs; use of genomes to understand evolution of eukaryotes, track emerging diseases and design new drugs; determining gene location in genome sequence.

UNIT-V: Proteomics **(15 Hours)**

Aims, strategies and challenges in proteomics; proteomics technologies: 2D-PAGE, isoelectric focusing, mass spectrometry, MALDI-TOF, yeast 2-hybrid system, proteome databases.

Total Lecture Hours-75

COURSE OUTCOME

Students are able to

1. Understand the fundamentals of genomics and proteomics
2. Analyse the applications of transcriptomics and metabolomics in various applied areas of biology.
3. Acquire knowledge about genome mapping
4. Illustrate genome sequencing projects
5. Gain knowledge on proteomics technologies and its challenges

TEXT BOOK(S)

1. Primrose, S. B., Twyman, R. M., Primrose, S. B., &Primrose, S. B. (2006).
2. Principles of Gene Manipulation and Genomics. Malden, MA: Blackwell Pub.
3. Liebler, D. C. (2002). Introduction to Proteomics: Tools for the New Biology. Totowa, NJ: Humana Press.
4. Campbell, A. M., &Heyer, L. J. (2003). Discovering Genomics, Proteomics, and Bioinformatics. San Francisco: Benjamin Cummings

REFERENCE BOOK(S)

1. Alberts B. 2002. Developmental Biology. 3rd Edition. Garland Science, USA.
2. Balinsky, 2012. An Introduction to Embryology, 6th Edition, Cenage Learning India, Uttar Pradesh.
3. Brain K Hall, Wendy M Olson, 2006. Keywords and Concepts in Evolutionary Developmental Biology, New Edition. Hardward University Press, Cambridge,USA.
4. Diwan AP, Dhakad NK. 1996. Animal Regeneration, 3rd Edition, Anmol Publications Ltd, India.
5. Gilbert SF. 2010. Developmental Biology, 9th Edition, Sinauer Associates Inc. Massachusetts, USA.

E-RESOURCES

1. https://www.freebookcentre.net/Biology/Developmental-Biology-Books.html
   https://lib-ebooks.com/developmental-biology-12th-edition-pdf/
2. https://www.worldcat.org/title/developmental-biology/oclc/698642961
3. http://www.freebookcentre.net/Biology/Plant-Biology-Books.html

SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE
(AUTONOMOUS)
SUNDARAKKOTTAI, MANNARGUDI- 614016
(For the Candidates admitted in the academic year 2023 – 2024)
DEPARTMENT OF BIOCHEMISTRY
M.Sc., BIOCHEMISTRY

Semester: II-NME II: **Molecular Basis of Disease and Therapeutic Strategies**
Ins. Hrs./Week:2 **Course Credit**:2 **Course Code**: **P23NMEBC22**

UNIT- I: Mechanism of blood sugar regulation in human body (6 Hours)
Pathophysiology of Type I and II diabetes, Diabetes – investigation methods for the diagnosis of diabetes. Nutritional care. Complications related to diabetes – Diabetic cardiovascular disease, retinopathy, neuropathy and nephropathy. Cellular and molecular mechanism of development of diabetes- Management of Type I and Type II diabetes, drugs for the treatment of diabetes.

UNIT-II: Biology of cancer (6 Hours)
Overview of hallmarks of cancer. Tumorigenesis, Tumor progression and mechanism of Metastasis. Proto-oncogene to oncogene. Oncogene- myc and src family. Tumor suppressor gene-Rb and p53 pathway in cancer. Diagnosis- Non-invasive imaging techniques, Tumor diagnosis, Interventional radiology, New imaging technique, Molecular techniques in cancer diagnosis.- treatment of cancer- surgery, radiotherapy, chemotherapy, hormonal treatment, and biological therapy. Introduction to personalized medicine.

UNIT-III: Brain (6 Hours)
Brain- neuronal network- memory- Neurogenerative diseases- Parkinson and Alzheimer Disease- molecular understanding of the neurodegenerative diseases- treatment modalities.

UNIT-IV: Kidney Disease (6 Hours)
Acute and chronic renal failure, glomerular diseases–glomerulonephritis, nephritic syndrome, diabetes insipidus, diagnosis of kidney disease.

UNIT-V: Introduction to cardiovascular diseases (6 Hours)
Lipids and lipoproteins in coronary heart disease-cardiac enzymes, Molecular changes during cardiac remodeling – hypertrophy of hearts – heart failure- treatment modalities.

Total Lecture Hours - 30

COURSE OUTCOME
The students are able to,
1. Overall view about the complications of diabetes mellitus and its management.
2. Comprehensive understanding of the concepts of cancer biology and implicating the theoretical concepts for further research
3. Understand and appreciate the pathophysiology of conditions affecting the nervous system.

4. A thorough knowledge of renal and cardiac diseases with emphasis related to mechanistic aspects and therapeutic interventions.
5. A thorough knowledge on the experimental models of non-communicable diseases that will be applied for future research or project dissertation. An in-depth knowledge on development of drugs against non-communicable diseases.

TEXT BOOK(S)

1. The Biochemical basis of disease:2018, Barr AJ; Portland Press

REFERENCE BOOK(S)

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