

**MOTHER TERESA WOMEN'S UNIVERSITY
KODAIKANAL**

DEPARTMENT OF BIOTECHNOLOGY

B.Sc. BIOCHEMISTRY



**SYLLABUS TO BE IMPLEMENTED FROM THE
ACADEMIC YEAR
2021-2022**

(CHOICE BASED CREDIT SYSTEM)

Mother Teresa Women's University, Kodaikanal
Department of Biotechnology
Choice Based Credit System (CBCS)
(2021-2022 onwards)
B.Sc. BIOCHEMISTRY

1. About the Programme

B.Sc. Biochemistry is a 3-year Undergraduate Programme and the duration of the Programme divided into six semesters. Biochemistry deals with the study of structure and function of cellular components such as proteins, carbohydrates, lipids, nucleic acids and other bio-molecules involved in biological processes such as growth, metabolism, reproduction as well as laboratory-based science that unite Biology along with Chemistry using chemical knowledge and bio-techniques. The Programme is career oriented and opens up many bright job prospects for them. After completing the Programme, the graduates can join medical industries, research labs, agriculture, pharmaceutical companies, or any academic institutions as well.

2. Programme Educational Objectives (PEOs)

PEO1	To encourage the students to take up and shape a successful career in Biochemistry.
PEO2	To equip the students with fundamental knowledge to solve socio-economic challenges in the field of biochemistry.
PEO3	To emphasize the need for responsible and eminent biochemists in the society.
PEO4	To develop skills to meet the ever-evolving professional demands in the field of biochemistry.
PEO5	To motivate the students to pursue higher studies and research to contribute scientifically to the society.

3. Eligibility

- i. Candidate should have passed the Higher Secondary Examination conducted by the Board of Higher Secondary Examination, Govt. of Tamil Nadu or any other Examination accepted by the syndicate as equivalent there to with at least one of the following subject Biology/Botany/Zoology
- ii. Candidate should have secured at least 55% in the above subject and above in the aggregate.
- iii. A relaxation of 10% in the total percentage will be given to SC, ST candidates.

4. General Guidelines for UG Programme

- i. **Duration:** The programme shall extend through a period of 6 consecutive semesters and the duration of a semester shall normally be 90 days or 450 hours. Examinations shall be conducted at the end of each semester for the respective subjects.
- ii. **Medium of Instruction:** English
- iii. **Evaluation:** Evaluation of the candidates shall be through Internal Assessment and External Examination.

- **Evaluation Pattern**

Evaluation Pattern	Theory		Practical	
	Min	Max	Min	Max
Internal	10	25	10	25
External	30	75	30	75

- **Internal (Theory): Test (15) + Assignment (5) + Seminar/Quiz(5) = 25**
- **External Theory: 75**

- **Question Paper Pattern for External examination for all course papers.**

Max. Marks: 75

Time: 3 Hrs.

S.No.	Part	Type	Marks
1	A	10*1 Marks=10 Multiple Choice Questions (MCQs): 2 questions from each Unit	10
2	B	5*4=20 Two questions from each Unit with Internal Choice (either / or)	20
3	C	3*15=45 Open Choice: Any three questions out of 5: one question from each unit	45
Total Marks			75

*** Minimum credits required to pass: 156**

- **Project Report**

A student should select a topic for the Project Work at the end of the third semester itself and submit the Project Report at the end of the fourth semester. The Project Report shall not exceed 75 typed pages in Times New Roman font with 1.5 line space.

- **Project Evaluation**

There is a Viva Voce Examination for Project Work. The Guide and an External Examiner shall evaluate and conduct the Viva Voce Examination. The Project Work carries 100 marks (Internal: 25 Marks; External (Viva): 75 Marks).

5. Conversion of Marks to Grade Points and Letter Grade (Performance in a Course/ Paper)

Range of Marks	Grade Points	Letter Grade	Description
90 – 100	9.0 – 10.0	O	Outstanding
80-89	8.0 – 8.9	D+	Excellent
75-79	7.5 – 7.9	D	Distinction
70-74	7.0 – 7.4	A+	Very Good
60-69	6.0 – 6.9	A	Good
50-59	5.0 – 5.9	B	Average
40-49	4.0 – 4.9	C	Satisfactory
00-39	0.0	U	Re-appear
ABSENT	0.0	AAA	ABSENT

6. Attendance

Students must have earned 75% of attendance in each course for appearing for the examination. Students with 71% to 74% of attendance must apply for condonation in the Prescribed Form with prescribed fee. Students with 65% to 70% of attendance must apply for condonation in the Prescribed Form with the prescribed fee along with the Medical Certificate. Students with attendance lesser than 65% are not eligible to appear for the examination and they shall re-do the course with the prior permission of the Head of the Department, Principal and the Registrar of the University.

7. Maternity Leave

The student who avails maternity leave may be considered to appear for the examination with the approval of Staff i/c, Head of the Department, Controller of Examination and the Registrar.

8. Any Other Information

In addition to the above-mentioned regulations, any other common regulations pertaining to the UG Programmes are also applicable for this Programme.

PROGRAMME OUTCOMES (PO)

On completion of B.Sc. Biochemistry Programme, students will be able to

PO1	comprehend the fundamental concepts and principles of Biochemistry.
PO2	utilize the knowledge of bio-techniques to make scientific queries and understand recent advancements in biochemistry.
PO3	ascertain extensive knowledge about molecular mechanisms, diagnostic tools and techniques.
PO4	gain expertise in different areas of basic biochemistry.
PO5	study principles of biochemistry and enhance the knowledge about the reactions within a living system.
PO6	apply the theoretical and practical knowledge in securing a successful career.
PO7	utilize the scientific skills acquired to develop a sustainable environment.
PO8	use the scientific knowledge obtained to develop and support the Indian economy.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

On completion of B.Sc. Biochemistry Programme, the students will be able to

PSO1	acquire knowledge in the basic concepts and principles of Biochemistry.
PSO2	enrich the theoretical and practical knowledge for securing successful careers.
PSO3	develop the knowledge attained from the programme to work as biochemists in emerging modern clinical laboratories
PSO4	interact appropriately and effectively with people in the field of Biochemistry and other allied backgrounds.
PSO5	get hands on experience through practical sessions which will enable them to pursue higher studies and research.

**MOTHER TERESA WOMEN'S UNIVERSITY,
KODAIKANAL
B.Sc. BIOCHEMISTRY SYLLABUS
2021-2022**

Paper No.	Paper Code	Course Title	Credits	Hours		(CIA)	(ESE)	Total
				T	P			
Semester I								
1	U21LTA11	Tamil I- Part – I	3	6	-	25	75	100
2	U21LEN11	English I-Part- II	3	6	-	25	75	100
3	U21BCT11	Core I- Bio-molecules	4	5	-	25	75	100
4	U21BCP11	Core II- Practical- Bio-molecules	4	-	6	25	75	100
5	U21PHA11	Allied I- Physics for Biology	4	5	-	25	75	100
6	U21EVS11	Environmental Studies	2	2	-	25	75	100
7	U21PELS11	Professional English - I	4	6	-	25	75	100
		Total	24	36				700
Semester II								
8	U21LTA22	Tamil II -Part- I	3	6	-	25	75	100
9	U21LEN22	English II-Part- II	3	6	-	25	75	100
10	U21BCT21	Core III- Fundamentals of Cell Biology	4	5	-	25	75	100
11	U21BCT22	Core IV - Nutritional Biochemistry	4	5	-	25	75	100
12	U21BCA22	Allied II – Statistics for Biology	4	5	-	25	75	100
13	U21VAE21	Value Education	3	3	-	25	75	100
14	U21PELS22	Professional English - II	4	6	-	25	75	100
		Total	25	36				700
Semester III								
15	U21LTA33	Tamil III- Part I	3	6	-	25	75	100
16	U21LEN33	English III -Part –II	3	6	-	25	75	100
17	U21BCT31	Core V- Plant Physiology and Biochemistry	4	5	-	25	75	100
18	U21CHA33	Allied III- Chemistry	4	5	-	25	75	100
19	U21BCE311/ U21BCE312	Elective I- Human Physiology / Bio-molecules and Diseases	3	4	-	25	75	100
20	U21MSS311	Skill Based Elective I- Managerial Skills	2	2	-	25	75	100
21		Non-Major Elective I	2	2	-	25	75	100
		Total	21	31				700

Semester IV								
22	U21LTA44	Tamil IV-Part –I	3	6	-	25	75	100
23	U21LEN44	English IV-Part –II	3	6	-	25	75	100
24	U21BCT41	Core VI - Intermediary Metabolism	4	4	-	25	75	100
25	U21BCP42	Core VII - Practical - Biochemical Techniques	4	-	4	25	75	100
26	U21CHA44	Allied IV – Practical Chemistry	4	-	4	25	75	100
27	U21BCE421/ U21BCE422	Elective II: Nano-materials / Plant Therapeutics	3	3	-	25	75	100
28	U21CSS42	Skill Based Elective II- Computer Skills for Office Management	2	2	-	25	75	100
29		Non Major Elective course II	2	2	-	25	75	100
		Total	25	31				800
Semester V								
30	U21BCT51	Core VIII- General Microbiology	4	5	-	25	75	100
31	U21BCT52	Core IX - Immunology	4	5	-	25	75	100
32	U21BCT53	Core X- Pharmacology	4	5	-	25	75	100
33	U21BCT54	Core XI – Fundamentals of Molecular Biology	4	5	-	25	75	100
34	U21BCP53	Core XII - Practical - General Microbiology & Immunology	4	-	5	25	75	100
35	U21BCE531/ U21BCE532	Elective III –Bioinformatics / Cancer Biology	3	3	-	25	75	100
36	U21BCS531/ U21BCS532	Skill Based Elective III- Food Processing Technology/Molecular modeling & Drug discovery	2	2	-	25	75	100
		Total	25	30				700
Semester VI								
37	U21BCT61	Core XIII – Principles of Enzyme Technology	4	5	-	25	75	100
38	U21BCT62	Core XIV - Medical Biochemistry	4	5	-	25	75	100
39	U21BCT63	Core XV – Bioprocess Technology	4	5	-	25	75	100

40	U21BCT64	Core XVI - Bioinstrumentation	4	5	-	25	75	100
41	U21BCP64	Core XVII- Practical- Principles of Enzyme Technology & Medical Biochemistry	4	-	5	25	75	100
42	U21BCE641/ U21BCE642	Elective IV – Hormones & Neurochemistry/Plant Pathology	3	3	-	25	75	100
43	U21BCS641/ U21BCS642	Skill Based Elective IV- Medical Coding / Bio-safety & IPR	2	2	-	25	75	100
44	U21EAS61	Extension Activity (NSS/NCC/YRC/Physical Education)	3	-	-	100		100
		Total	28	30				800
		Grand Total	148	193				4400

Extra Credit Course:U21BCO31 - Online Course – 3rd SemesterU21BCI41- Internship – 4th SemesterU21BCV51 - Value added course – 5th Semester (Single Cell Protein)

Each carries 2 Credits to be included as additional credit courses

Non-Major Elective

U21BCN311	NME I – First Aid and Emergency Care
U21BCN421	NME II - Phyto chemistry

SEMESTER I

Course Code	U21BCT11	BIOMOLECULES			
Core	I	L	T	P	C
Cognitive Level	K1: Recall	K2: Understand	K3: Apply		
Learning objective	<ul style="list-style-type: none"> To understand the basic fundamentals of biochemistry. To learn about the general properties of carbohydrates, proteins and lipids its role in the living beings. To understand the major role of nucleic acids in life processes. To understand the chemistry of biomolecules and its significance 				
Unit I	Cellular and chemical foundations of life				
Historical background of the origin and development of Biochemistry. Carbohydrates - basic structure, properties and biological importance of monosaccharide (Structure of Glucose), Disaccharides (Lactose, Sucrose), Trisaccharides (Raffinose). Polysaccharides – structural polysaccharide (Cellulose) and storage polysaccharides (Starch and Glycogen) - other polysaccharides (Insulin and Chitin).					
Unit II	Amino acids and Proteins				
Classification amino acids, physical properties of amino acids - Solubility, electrochemical properties, fundamental role of proteins in life - Composition of proteins - General properties of proteins - Rudimentary treatment of structure, classification of the proteins on the basis of their biological functions- Criteria for the purity of proteins.					
Unit III	Lipids				
Fatty acids - Classification, Hydroxy and keto derivatives and cyclic fatty acids - physical properties of fatty Acids - solubility, boiling point, absorption, spectro chemical properties of fatty acids - Salts, detergents and wetting agents, esters - reactions of unsaturated fatty acids - hydrogenation, halogenations and oxidation. Fats - Fatty acids esters of glycerol - Chemical structures. Physical and chemical properties of fats – Waxes, phospholipids, non-phosphorylated lipids and steroids.					
Unit IV	Nucleic Acids				
Fundamental role of nucleic acids in life processes- DNA and its types, RNA – types, functions. Structure of bases, nucleosides and nucleotides - bond linking the various bases. Isolation, separation and purification of DNA and RNA.					
Unit V	Vitamins				
Discovery and Physico- chemical properties of vitamins, fat-soluble vitamins, vitamin A, D, E and K - Water soluble vitamins, vitamin B complex, vitamin C – Brief mention of source and physiological role.					
Text Books	<ol style="list-style-type: none"> T. Devasena, Biomolecules by MJP Publishers,2011 Arihant, Experts Handbook of Chemistry, Arihant Publications,2020 P.K.Gupta , Biomolecules and cell Biology, Rastogi Publication, 2018 				
References	1. Lehninger, A.L , Biochemistry, 6 th edition, Kalyani publisher, 2012.				

	2. Lubert Stryer, Biochemistry, 7 th edition, W.H. Freeman and Company, New York, 2012 3. J.M. Berg, J.L. Tymoczko and L. Stryer, Biochemistry, W.H. Freeman, 2015 4. Mohan P Arora, Biomolecules, Himalaya publishing House, 2012 5. S. Azhagu Madhavan, P. Vinotha, V. Uma, Chemistry of Biomolecules, Notion Press, 2020													
E-References Link	1. https://www.mdpi.com/journal/biomolecules 2. https://ncert.nic.in/textbook/pdf/lech205.pdf 3. https://www2.nau.edu/lrm22/lessons/biomolecules/biomolecules.html 4. https://opentextbc.ca/biology/chapter/2-3-biological-molecules/													
Course outcome	Upon completion of this course, the students will be able to													
	CO	Course Outcomes								Knowledge Level				
	CO1	understand the foundation of life and structure and functions of carbohydrates								K1, K2				
	CO2	attain knowledge in structure, properties, role and classification of amino acids and proteins								K1, K2, K3				
	CO3	know the structure, properties, role and classification of Lipids and fatty acids								K1, K2, K3				
	CO4	learn the types of nucleic acids and its structure and biological importance.								K1, K2, K3				
CO5	gain knowledge on various types, functions, requirements and deficiency diseases of vitamins								K1, K2, K3					
Mapping of CO with PO & PSO:														
CO	PO								PSO					
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	M	M	S	S	S	M	M	S	S	S	M	S	
CO2	S	M	S	S	S	S	M	S	S	S	S	S	S	
CO3	S	S	S	S	M	S	S	S	S	M	S	S	S	
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	
CO5	S	S	S	S	S	S	S	S	S	S	S	M	S	

Strongly Correlating (S) - 3 marks
 Moderately Correlating (M) - 2 marks

Weakly Correlating (W) - 1 mark
 No Correlation (N) - 0 mark

Course Code	U21BCP11	BIOMOLECULES (Practical)			
Core	II	L	T	P	C
		-	-	6	4
Cognitive Level	K1: Recall K2: Understand K3: Apply				
Learning Objective	<ul style="list-style-type: none"> To qualitatively identify carbohydrates, amino acids, proteins, lipids and nucleic acids To quantitatively identify carbohydrates, amino acids, proteins, lipids and nucleic acids To learn the principles and operation of basic instruments in the laboratory To learn to operate the pH meter and colorimeter 				
Experiments in Biomolecules	<ol style="list-style-type: none"> Qualitative analysis of Bio-organic Compounds <ol style="list-style-type: none"> Carbohydrates Amino acids Proteins Lipids and cholesterol Nucleic acids Quantitative analysis of Bio-organic Compounds <ol style="list-style-type: none"> Starch(potato) Lactose(milk) Casein(milk) pH meter- preparation of Buffer. Verification of Beer Lamberts law using colorimeter. <ol style="list-style-type: none"> Determination of the extinction co-efficient of given colored compound. Determination of the concentration of given colored compound using a standard graph. 				
Text Books	1. J. Jayaraman, Practical bio-chemistry, Jaypee Brothers medical, 2013.				
References	<ol style="list-style-type: none"> Keith Wilson and John Walker, Principle and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, 2011. Shivaraja Shankara. Y. M, Laboratory Manual for Practical Biochemistry, Jaypee Brothers Medical Publishers, 2nd Edition, 2013. Pattabiraman, Laboratory manual in bio-chemistry, Pineapple research station, 2015. S. Rajan, R. Selvi christy, Experimental Procedures in Life sciences, CBS, 2019 Soundravally Rajendiran, Pooja Dhiman, Biochemistry Practical Manual, Elsevier, 2019. 				
E-	1. http://www.chem.boun.edu.tr/wp-content/uploads/2014/04/Chem-415-				

References Link	Experiment-1.pdf 2. http://www.chem.boun.edu.tr/wp-content/uploads/2014/04/Chem-415-Experiment-2.pdf 3. https://drinc.ucdavis.edu/dairy-food-sciences/procedures-oxidized-milk-problems													
Course outcomes	Upon completion of this course, the students will be able to													
	CO	Course Outcomes								Knowledge Level				
	CO1	identify qualitatively both carbohydrates and amino acids								K1, K2				
	CO2	understand about the analysis of lipids and nucleic acids								K1, K2, K3				
	CO3	gain knowledge on quantitative analysis of biomolecules								K1, K2, K3				
	CO4	use the pH meter and understand the Beer Lamert's Law								K1, K2, K3				
	CO5	analyze the Beer – Lambert's Law by experiments								K1, K2, K3				
Mapping of CO with PO & PSO														
CO	PO								PSO					
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	M	S	S	S	S	M	S	S	S	S	M	S	
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	
CO3	S	S	S	S	M	S	S	M	S	S	S	S	M	
CO4	S	M	S	S	S	S	S	S	S	S	S	S	S	
CO5	M	S	S	S	S	M	S	S	S	S	M	S	S	
Strongly Correlating (S) - 3 marks Weakly Correlating (W) - 1 mark Moderately Correlating (M) - 2 marks No Correlation (N) - 0 mark														

Course Code	U21PHA11	PHYSICS FOR BIOLOGY			
Allied	I	L	T	P	C
Cognitive Level	K1: Recall	K2: Understand	K3: Apply		
Learning Objective	<ul style="list-style-type: none"> To understand the principles and applications of Spectroscopy To learn the principles of thermodynamics and their applications. To attain knowledge on types of radioisotopes used in biology 				
Unit I	Spectroscopy				
Absorption spectroscopy – principle, instrumentation and applications of atomic absorption, UV visible spectroscopy, Infrared spectroscopy, Nuclear Magnetic Resonance Spectroscopy, NOSY, COSY and ROSY techniques. Electron Spin resonance.					
Unit II	Emission spectroscopy				
Principle, method and application of Flame photometry. Fluorimetry – principle, instrumentation and application. Mass spectroscopy – principle, instrumentation and application. Light scattering Raman Spectroscopy; principles, method, application with reference to biological macromolecules such as proteins and nucleic acids.					
Unit III	Principles of thermodynamics and their applications				
Introduction, thermodynamics system, thermodynamic state functions, first and second laws of thermodynamics, concept of free energy, standard free energy, determination of ΔG for a reaction, relation between equilibrium constant and standard free energy change, biological standard state and standard free energy change in coupled reactions.					
Unit IV	Radioisotopes				
Types of radioisotopes used in biology, units of radioactivity measurements, techniques used to measure radioactivity (gas ionization and liquid scintillation counting), nuclear emulsions used in biological studies (pre-mounted liquid and stripping).					
Unit V	Isotopes				
Isotopes commonly used in biochemical studies – ^{32}P , ^{35}S , ^{14}C and ^3H . Autoradiography, Biological hazards of radiation and safety measures in handling radioisotopes – Biological applications.					
Text Books	<ol style="list-style-type: none"> L. Veerakumari, Bioinstrumentation, MJP Publisher, 2019. John G. Webster, Bioinstrumentation, Wiley, 2018. 				
References	<ol style="list-style-type: none"> M. J. Reilly, Bioinstrumentation, CBS Publishers & Distributors, 2016. Keith Wilson and John Wilson, Practical Biochemistry, Cambridge University Press, 2018. M.H. Fulekar & Bhawana Pandey, Bioinstrumentation, I. K. International Publishing House Pvt. Ltd., 2014. 				
E-References Link	<ol style="list-style-type: none"> https://is.muni.cz/www/384/30618506/koncepty/PhysicsinBiologyandMedicine3rdEdition.pdf https://ibsen.com/applications/spectroscopy/absorption-spectroscopy/ https://education.seattlepi.com/examples-radioisotopes-biology-6678.html https://www.cpp.edu/~pbsiegel/bio431/texnotes/sep1.pdf 				

Course outcomes	Upon completion of this course, the students will be able to												
CO	Course Outcomes								Knowledge Level				
CO1	analyze and understand the techniques of spectroscopy.								K1, K2				
CO2	understand the basic principle of emission spectroscopy and mass spectroscopy.								K1, K2, K3				
CO3	recognize the principles of thermodynamics.								K1, K2, K3				
CO4	realize and learn the various types of radioisotopes								K1, K2, K3				
CO5	gather the knowledge on biological hazards of radiation and safety.								K1, K2, K3				
Mapping of CO with PO & PSO													
CO	POs								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	S	S	M	S	S	M	S	S	M	S	M	S
CO2	S	M	S	S	S	S	S	S	S	S	S	S	S
CO3	S	S	M	S	M	M	S	M	S	S	S	S	M
CO4	M	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	M	S	S	M	S	S	S	S	M	S
Strongly Correlating (S) - 3 marks Weakly Correlating (W) - 1 mark Moderately Correlating (M) - 2 marks No Correlation (N) - 0 mark													

SEMESTER II

Course Code	U21BCT21	FUNDAMENTALS OF CELL BIOLOGY			
Core	III	L	T	P	C
Cognitive Level	K1: Recall	K2: Understand	K3: Apply		
Learning Objective	<ul style="list-style-type: none"> To know about the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles To understand how the cellular components are used to generate and utilize energy in cells To understand the cellular components underlying mitotic cell division. 				
Unit I	Cell Structure				
Prokaryotic and Eukaryotic (Plant and animal cells: structural features and a brief comparative account). Plasma Membrane: Chemistry and Structure, Fluid mosaic model and functions of plasma membrane. Protoplasm: Chemistry and organization, microtubules and microfilaments.					
Unit II	Membrane Bound Organelles				
Structure and Function, Golgi complex, chloroplast, endoplasmic reticulum, mitochondria and ribosomes. Nucleus: Structure, Chromatin: Eu and heterochromatin, nucleic acids, nucleosomes. Chromosomes: Kinds, structure, Polytene chromosomes, bacterial chromosomes. Nucleolus: structure and function.					
Unit III	Cell cycle				
Mitosis and meiosis. Cell growth: normal and cancerous. Oncology: formation of cancer, malignant and non-malignant tumors, carcinogenic substances.					
Unit IV	Cell Communication				
Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junction, extracellular matrix, integrins, neurotransmission and its regulation.					
Unit V	Cancer				
Oncogens, tumor suppressor genes, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis.					
Text Books	<ol style="list-style-type: none"> Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter P. Molecular Biology of the Cell. Garland Science, 2014 De Robertis, E.D.P. and De Robertis, Jr.E.M.E. 2009. Essentials of cell Karp, G. Cell Biology. Wiley, 2013. 				
References	<ol style="list-style-type: none"> Gerald Karp, Cell and Molecular Biology, John Wiley and Sons, 2013. Bruce Alberts, Essential Cell Biology, Taylor and Francis Group, 2014. George Plopper, Principles Cell Biology, Jones & Bartlett publishers, 2016. 				
E-References link	<ol style="list-style-type: none"> www.sc.chula.ac.th/courseware/2303101j/VIII-Cell.pdf http://www.frontiersin.org/Cellular_Biochemistry 				

	3. https://www.omicsonline.org/scholarly/cellular-biochemistry-journals-articles-ppts-list.php													
Course outcomes	Upon completion of this course, the students will be													
	CO	Course Outcomes								Knowledge Level				
	CO1	acquire knowledge on structure and functions of cell organelles								K1, K2				
	CO2	understands membrane organelles, nucleus and chromosomes								K1, K2, K3				
	CO3	gain knowledge on cell cycle								K1, K2, K3				
	CO4	understand the cell communication and its regulation								K1, K2, K3				
	CO5	understand the stages in cancer and learn about apoptosis								K1, K2, K3				
Mapping of CO with PO & PSO:														
CO	PO								PSO					
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	S	M	S	S	M	S	S	M	S	M	S	
CO2	S	M	S	S	S	S	S	S	S	S	S	S	S	
CO3	S	S	M	S	M	S	S	M	S	S	S	S	M	
CO4	M	S	S	S	S	S	S	S	S	S	S	S	S	
CO5	S	S	S	M	S	S	M	S	S	S	S	M	S	
Strongly Correlating (S) - 3 marks Weakly Correlating (W) - 1 mark Moderately Correlating (M) - 2 marks No Correlation (N) - 0 mark														

Course Code	U21BCT22	NUTRITIONAL BIOCHEMISTRY			
Core	IV	L	T	P	C
Cognitive Level	K1: Recall K2: Understand K3: Apply				
Learning Objective	<ul style="list-style-type: none"> To know the value and nutritional components of food. To understand the sources of nutrients such as carbohydrates, proteins, fibers and fats for good health. To know about the disorders caused due to deficiency of protein, vitamin deficiency and minerals 				
Unit I	Introduction of nutrition				
Functions of food and its relation to nutritional and clinical health, essential nutrients, analysis of food composition, food groups, ICMR five-food groups, food pyramids					
Unit II	Carbohydrates				
Types, functions, food sources. Fat - types, functions, food sources, essential fatty acids, and cholesterol. Proteins - types, Function, food source, complete and incomplete protein. Nitrogen balance, quality of food proteins and requirements, protein deficiency disorders					
Unit III	Vitamins				
Definition, Classification, Sources, distribution, function, abnormalities, minimum requirements and optimum allowances. Mineral Nutrition: Essential-micro and macro mineral nutrients, distribution, sources, function and abnormalities					
Unit IV	Energy				
Basal metabolism, measurement of BMR,RDA,BMI, factors affecting BMR, regulation of body temperature, energy needs, and total energy requirement estimation of energy requirements and energy value of foods, Obesity- Definition, Causes, Risk factors and Precautions. Balanced diet formulation- Assessment of nutritional status. Nutrition at various stages of growth and development, diets of infants, children, adolescents, pregnant women, lactating mothers and old age.					
Unit V	Nutritional Challenges of the future				
Food production and food storages, future foods, new protein foods, new fat foods and changing food habits Food adulterations.					
Text Books	<ol style="list-style-type: none"> M. Raheena Begum, A Textbook Of Foods, Nutrition And Dietetics, 2019. Sharma DC, Nutritional Biochemistry, CBS Publication, 2014. Venkatraman, Dandekar, Nutrition & Biochemistry for Nurses, Elsevier, 3rd Edition, 2020 				
References	<ol style="list-style-type: none"> B.Srilakshmi, Food science, Third edition, New age international, 2018 Sunil Natha Mhaske, Essentials of Nutrition, CBS Publication,2015 				

	3. Shantaramman juala, Biochemistry and Nutrition, Jaypee Brothers Medical Publishers, 2011. 4. Dickson JK, Food Nutrition, CBS publishers and Distributors, 2020													
E-References Link	1. https://www.omicsonline.org/biochemistry-and-analytical-biochemistry/nutritional-biochemistry-journal.php 2. https://www.routledge.com/Nutritional-Biochemistry-Current-Topics-in-Nutrition-Research/Cox/p/book/9781774635612 3. https://www.nutritionalconference.com/events-list/nutritional-biochemistry													
Course outcomes	Upon completion of this course, the students will be able to													
	CO	Course Outcomes								Knowledge Level				
	CO1	explain the functions, groups of food and its analysis								K1, K2				
	CO2	discuss the binomial classification, functions and requirements of the carbohydrates, proteins								K1, K2, K3				
	CO3	describe the classification and features of vitamins and minerals								K1, K2, K3				
	CO4	recognize the concepts of BMR, RDA, energy and its requirements, know about the balanced diet formulation.								K1, K2, K3				
	CO5	acquire knowledge on the nutritional challenges of the future and food adulterations								K1, K2, K3				
Mapping of CO with PO & PSO:														
CO	PO								PSO					
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	M	S	S	S	S	S	S	S	S	S	M	S	
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	
CO3	S	S	S	S	M	S	M	S	S	M	S	S	M	
CO4	S	M	S	S	S	S	S	S	S	S	S	S	S	
CO5	S	S	S	M	S	S	S	M	S	S	M	S	S	
Strongly Correlating (S) - 3 marks				Weakly Correlating (W) - 1 mark										
Moderately Correlating (M) - 2 marks				No Correlation (N) - 0 mark										

Course Code	U21BCA22	STATISTICS FOR BIOLOGY			L	T	P	C
Allied	II				5	-	-	4
Cognitive Level	K1: Recall K2: Understand K3: Apply							
Learning Objective	<ul style="list-style-type: none"> To understand collection and representation of data To learn measures of central tendency. To understand symmetry, correlation and regression. To acquire knowledge on tests of significance. 							
Course outcomes	Upon completion of this course, the students will be able to							
	CO	Course Outcomes					Knowledge Level	
	CO1	acquire information on collection of data and representation in diagram and graph					K1, K2	
	CO2	understand the problems in measures of central tendency and distribution					K1, K2, K3	
	CO3	recognize the measures of symmetry					K1, K2, K3	
	CO4	familiarize on correlation and regression.					K1, K2, K3	
	CO5	receive elaborate knowledge on tests of statistical significance.					K1, K2, K3	
Unit I	Statistics							
Definition. Collection and organization of data. Representation of data. Sampling and Sampling Design. Tabulation, Diagrammatic and graphical representation								
Unit II	Measures of Central Tendency							
Mean, Median, Mode. Measures of Dispersion – Range, Mean Deviation, Standard Deviation and Variance – Problems and explanation. Probability – Distribution – Binomial, Poisson and normal								
Unit III	Measures of symmetry							
Skewness; Kurtosis a brief explanation - Measures of Skewness and Kurtosis. (Problems not necessary)								
Unit IV	Correlation and regression:							
Explanation – Types of correlation – Positive and negative correlation – Methods of studying Correlation using Karl Pearsons Coefficient of correlation (Simple problems related to correlation and regression)								
Unit V	Tests of statistical significance							
Analysis of Variance (One way, Two Way Classification) – Chi square test.								
Text Books	1. Veer Bala rastogi, Biostatistics, Medtech publishers, 2015. 2. Dr.B.Annadurai, A Textbook of Biostatistics, New age international							

	publishers , 2017. 3. Belavendra Antonisamy, Prasanna S Preamkumar, Principles and practices of Biostatistics, Elsevier Publishers, 2017. 4. K.L.A.P Sarma, B,Ravindra Reddy, Biostatistics, Daya Publishing House, 2013.												
References	1.AP Kulkarni ,Basics of Biostatistics, CBS publishers,2020. 2.K. Balaji, A.V.S. Raghavaiah & K. N. Jayaveera, Biostatistics, Wiley Publishers, 2020. 3.Veer Bala rastogi, Biostatistics , Medtech publishers , 2015. 4.Wayne W. Daniel & Chad L. Cross, Biostatistics, Wiley Publishers, 2014. 5.B.Annadurai, A Textbook of Biostatistics, New Age International Publishers,2017.												
E-References Link	1. http://www.biostathandbook.com/HandbookBioStatThird.pdf 2. http://web.stanford.edu/class/bios221/book/introduction.html 3. https://www.nature.com/collections/qghhqm/												
Course outcomes	Upon completion of this course, the students will be able to												
	CO	Course Outcomes							Knowledge Level				
	CO1	acquire information on collection of data and representation in diagram and graph							K1, K2				
	CO2	understand the problems in measures of central tendency and distribution							K1, K2, K3				
	CO3	recognize the measures of symmetry							K1, K2, K3				
	CO4	familiarize on correlation and regression.							K1, K2, K3				
	CO5	receive elaborate knowledge on tests of statistical significance.							K1, K2, K3				
Mapping of CO with PO & PSO:													
CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	M	S	S	S	S	M	S
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	M	S	S	S	S	S	M	S	S
CO4	S	M	S	M	S	S	M	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S	M	S	S
Strongly Correlating (S) - 3 marks Moderately Correlating (M) - 2 marks Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark													

SEMESTER III

Course Code	U21BCT31	PLANT PHYSIOLOGY AND BIOCHEMISTRY			
Core	V	L	T	P	C
Cognitive Level	K1: Recall	K2: Understand	K3: Apply		
Learning Objective	<ul style="list-style-type: none"> To understand the photosynthesis process in plants. To gain knowledge on plant nutrition, nitrogen fixation, the function of mineral, sulphur and nitrate metabolism in the plants. To understand about the plant physiology of physiology and its secondary metabolites 				
Unit I	Photosynthesis				
Photosynthesis apparatus and photosynthesis pigments, light and dark reactions of photosynthesis, C ₃ C ₄ and CAM plants, factors affecting photosynthesis, photorespiration.					
Unit II	Plant growth regulators:				
Biosynthesis, physiological role Auxins, Gibberllin, Cytokinins, Ethylene and ABA, synthetic growth hormones.					
Unit III	Plant nutrition:				
Essential mineral nutrients, absorption, translocation and function and deficiency, N ₂ , cycle, N ₂ fixation, symbiotic and asymbioticN ₂ fixation: Mechanism of nitrogen fixation, sulphur metabolism.					
Unit IV	Physiology and reproduction:				
Brief account on physiology of Seed germination, Seed dormancy, photoperiodism, vernalization., Circadian Rhymes					
Unit V	Secondary metabolites				
Their physiological, biochemical and pharmacological properties. Terpenes, terpenoids Saponin and alkaloids (structural elucidation not necessary).					
Text Books	<ol style="list-style-type: none"> V. K. Jain, Fundamentals of Plant Physiology, S Chand Publishing, 2017. Jurgen kleine –Vehn, Plant hormones, Humana press.2017. 				
References	<ol style="list-style-type: none"> Hans- Walterheldt, Plant Biochemistry, Academic press 4th Ed, 2011. Srivastava H.S, Plant Physiology and Biochemistry, Rastogi Publication 7th Ed, 2018. Dey P.M, Plant Biochemistry, Elsevier science, 2013. Mehrotra, Fundamentals of plant pathology, MC Graw Hill,2013. 				
E-References Link	<ol style="list-style-type: none"> www.esalq.usp.br/lepse/imgs/conteudo_thumb/Plant-Biochemistry-by-Heldt-2005-.pdf http://priede.bf.lu.lv/grozs/AuguFiziologijas/Augu_biokimija/Plant%20Biochemistry%204.pdf 				

	3. https://www.internetchemistry.com/chemistry/plant-biochemistry.php	
Course outcomes	Upon completion of this course, the students will be able to	
	CO	Course Outcomes
	CO1	explain photosynthetic cycles and its factors
	CO2	understand the hormones of plant and their biological importance
	CO3	illustrate the concept of plants nutrition and it's deficiency
	CO4	recognize the physiology and reproduction of plants
	CO5	discuss the tissue culture and secondary metabolites
		Knowledge Level
		K1, K2
		K1, K2, K3
		K1, K2, K3
		K1, K2, K3
		K1, K2, K3

Mapping of CO with PO & PSO

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	S	S	M	S	M	S	M	S	M	S	M	S
CO2	S	M	S	S	S	S	S	S	S	S	S	S	S
CO3	S	S	M	S	M	S	S	S	S	S	S	S	M
CO4	M	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	M	S	S	S	M	S	S	S	M	S
Strongly Correlating (S) - 3 marks		Weakly Correlating (W) - 1 mark											
Moderately Correlating (M) - 2 marks		No Correlation (N) - 0 mark											

Course Code	U21CHA33	CHEMISTRY			
Allied	III	L	T	P	C
		5	0	0	4
Cognitive Level	K1: Recall K2: Understand K3: Apply				
Learning Objective	<ul style="list-style-type: none"> To understand the handling of chemicals and errors in chemical analysis To get knowledge in chemical bonding and hybridization To acquire knowledge in volumetric analysis To understand the basic concept of Biomolecules 				
Unit I	Handling of chemicals and Data analysis :				
	a) Storage and handling of chemicals: Handling of acids, ethers, toxic and poisonous chemicals. Antidotes, threshold vapour concentration and first aid procedure. b) Errors in chemical analysis: Accuracy, precision. Types of error-absolute and relative errors. Methods of eliminating and minimizing errors. c) Separation techniques – Solvent extraction. Principle of adsorption and partition chromatography, column chromatography, thin layer chromatography (TLC), paper chromatography and their applications.				
Unit II	Chemical bonding				
	a) Ionic Bond: Nature of Ionic bond. Structure of NaCl, KCl and CsCl. Factors influencing the formation of ionic bond. b) Covalent Bond: Nature of covalent bond. Structure of CH ₄ , NH ₃ , H ₂ O based on hybridization. c) Coordinate Bond: Nature of coordinate bond. Coordination complexes. Werner's theory. Geometrical and optical isomerism in square planar and octahedral complexes. Mention of structure and functions of chlorophyll and hemoglobin d) Hydrogen Bond: Theory and importance of hydrogen bonding. Types of hydrogen bonding. Hydrogen bonding in carboxylic acids, alcohol, amides, polyamides, DNA and RNA. e) Vander Waal's forces: Dipole – dipole and dipole - induced dipole interactions.				
Unit III	Volumetric analysis :				
	a) Methods of expressing concentration: normality, molality, ppm. b) Primary and secondary standards: preparation of standard solutions c) Principle of volumetric analysis: end point and equivalence points. d) Strong and weak acids and bases - Ionic product of water, pH, pKa, pKb. Buffer solutions - pH of buffer solutions. Mention of Henderson equation & its significance.				
Unit IV	Chemical Kinetics:				
	a) Chemical Kinetics: Rate, rate law, order and molecularity. Derivation of rate expressions for I and II order reactions. b) Catalysis-Homogeneous and heterogeneous catalysis. Enzyme catalysis, enzymes in biological system and in industry.				
Unit V	Chemistry of Biomolecules:				
	a) Fats – Occurrence and composition. Hydrolysis of fats. b) Vitamins – Source, provitamin, properties and classification. Structure and function of vitamin A, C, D, K and E c) Hormones – Thyroxin, adrenaline and sex hormones (structure and functions only)				

Text Books	1. R. Gopalan, S. Sundaram, Allied Chemistry, Sultan Chand and Sons, 1995.												
Reference	1. U. Sathyanarayana, Biochemistry, Books and allied (p) Ltd, 1999. 2. B.R.Puri and L.R.Sharma, Principles of physical chemistry, Shoban Lal Nagin Chand and Co. 33rd ed., 1992.												
Course Outcomes	Upon completion of this course, the students will be able to												
	CO	Course Outcomes							Knowledge Level				
	CO1	gain the knowledge on the handling of chemicals and errors in chemical analysis,							K1, K2				
	CO2	understand about the chemical bonding and hybridization							K1, K2				
	CO3	learn the calculations of preparing standard solutions							K1, K2				
	CO4	discuss and appreciate the advanced concepts and rate equations in chemical kinetics.							K1, K2, K3				
	CO5	know the importance of Biomolecules in chemistry							K1, K2, K3				
Mapping of CO with PO & PSO													
CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	S	S	S	S	S	M	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S
CO3	S	S	S	S	M	S	S	S	S	S	S	S	M
CO4	S	M	S	S	S	S	S	S	S	S	S	S	S
CO5	M	S	S	S	S	S	S	S	S	S	M	S	S1
Strongly Correlating (S) - 3 marks Weakly Correlating (W) - 1 mark Moderately Correlating (M) - 2 marks No Correlation (N) - 0 mark													

Course Code	U21BCE311	HUMAN PHYSIOLOGY			
Elective	I	L	T	P	C
Cognitive Level	K1: Recall	K2: Understand	K3: Apply		
Learning Objective	<ul style="list-style-type: none"> To learn fundamentals of anatomical structures and physiology of body organs. To know about the structure and functions of the blood & blood vessels To understand how the nervous system controls the body parts. To understand the structure and functions liver and pancreas, respiratory organs, urinary System, endocrine System 				
Unit I	General Anatomy				
Digestion in the mouth, stomach and intestines. Movements of the intestine; Role of Liver and Pancreas – Structure and Functions.					
Unit II	Respiratory System				
Structure of Respiratory organs; Sub – divisions of lung air; Chemistry of Respiration. Physiology of the Urinary System- Structure of kidney and nephron; Formation of urine, Skin – Structure and functions, Regulations of body temperature					
Unit III	Endocrine System				
Structure and functions of thyroid, pituitary, parathyroid, adrenals, islets of langerhans of pancreas. Reproductive System – anatomy of the male and female reproductive organs; menstrual cycle; mammary glands; Fertilization; Development of Embryo; Pregnancy and parturition					
Unit IV	Nervous System				
General classification of nervous system: Structure of nerve cell and Spinal cord; Basic Knowledge of different parts of the brain – anatomy and functions of cerebrum, cerebellum and medulla oblongata. Structure and function of eye and ear; taste, smell and cutaneous sensations.					
Unit V	Blood				
Composition and Functions of blood; White Blood Cells – Types and function; Red Blood Cells – Structure and functions; Haemoglobin –Structure and functions, Blood coagulation, Blood group – ABO, Rh. Structure of heart and blood vessels; Properties of cardiac muscle; cardiac cycle; origin and conduction of heart beat; measurement of arterial blood pressure.					
Text Books	1.Chatterjee C.C .Human Physiology Volume II.CBS publishers, 2020.				
References	1. Sembulingam, K. Essentials of Medical Physiology. 8 th ed. Jaypee Brothers Medical Publishers (P) Ltd., New Delhi; 2019. 2. Best and Taylor. The Physiological Basis for Medical Practice, Wolters Kluwer India Pvt Ltd; 2011.				
E-References Link	1. https://www.researchgate.net/publication/311934098_introduction_to_human_physiology 2. https://www.wiley.com/enn/Lecture+Notes:+Human+Physiology,+5th+Edition-p-9781405136518				

Course outcomes	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	understand the function of digestive system and the role of liver and pancreas.	K1, K2
	CO2	learn about respiratory organs and its regulation.	K1, K2, K3
	CO3	acquire knowledge on the importance of endocrine system.	K1, K2, K3
	CO4	explain structure and function of nervous system.	K1, K2, K3
	CO5	learn the composition and functions of blood.	K1, K2, K3

Mapping of CO with PO & PSO:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	S	S	S	S	S	M	S
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	M	S	S	S	S	M	S	S	M
CO4	S	M	S	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	M	S	S	S	S	S	S	S	S	S

Strongly Correlating (S) - 3 marks

Moderately Correlating (M) - 2 marks

Weakly Correlating (W) - 1 mark

No Correlation (N) - 0 mark

Course Code	U21BCE312	BIOMOLECULES AND DISEASES			
Elective	II	L	T	P	C
Cognitive Level	K1: Recall	K2: Understand	K3: Apply		
Learning Objective	<ul style="list-style-type: none"> To understand the lifestyle disease due to imbalance of metabolism To know the fundamental principles and disease causing by hormonal imbalance and nutritional deficiency 				
Unit I	Inborn errors of metabolism				
Alkaptonuria, Phenylketonuria, Glycogen and Lipid storage diseases, SCID, Clotting disorders					
Unit II	Nutritional deficiency:				
Nutritional deficiency based diseases Kwashiorkor, Marasmus, Beri-beri, Scurvy, Pellagra, Anaemia, Night blindness, Rickets, Osteomalacia, Osteoporosis, Wilson's disease.					
Unit III	Lifestyles disease:				
Obesity, Cardiovascular diseases, Atherosclerosis, Diabetes mellitus-II. Inflammatory Bowel Disease (IBD).					
Unit IV	Hormonal Imbalances:				
Outline of hormone action and imbalances leading to disease - precocious puberty, hyper and hypopituitarism. Hyper and hypothyroidism.					
Unit V	Diseases caused due to misfolded proteins:				
Alzheimer's, Huntington's disease, Kuru, Creutzfeldt-Jakob disease, Sickle cell anaemia, Thalessemia.					
Text Books	<ol style="list-style-type: none"> K. Ramadevi, Ambika Shanmugam, Fundamentals of Biochemistry for Medical students 8th Edition, Wolters kluwer India Pvt Ltd, 2016. U. Satyanarayana & U. Charapani. Essentials of Biochemistry, Books & Allied Pvt Ltd. 2019. 				
References	<ol style="list-style-type: none"> Nanda Maheswari, Clinical Biochemistry Jaypee Brothers Medical Publishers, 2016. John. E. Hall, Guyton & Hall Text book of Medical Physiology, Elsevier, Health, 2017. Rajinder Chawla, Tarek. H. E, Metwally Sucherda sahu, Text book of Medical Biochemistry Wolters Kluwer India, Pvt, Ltd, 2nd Edition, 2017. Allan Gaw, Clinical chemistry, Churchill Living Stone, 2018. Michael Murphy, Rajeer Srivastava, Kevin Deans, Clinical Biochemistry, Elsevier, 2018. 				
E-References Link	<ol style="list-style-type: none"> https://pubmed.ncbi.nlm.nih.gov/11843698/ https://www.nature.com/articles/gim200166 				

Course outcomes	Upon completion of this course, the students will be able to												
CO	Course Outcomes								Knowledge Level				
CO1	understand the inborn errors of metabolism.								K1, K2				
CO2	acquire information on nutritionally deficiency disease and its importance.								K1, K2, K3				
CO3	learn the importance of diet in lifestyle disease.								K1, K2, K3				
CO4	understand the disorders related to hormonal imbalance.								K1, K2, K3				
CO5	acquire knowledge on genetics disease and its inheritance.								K1, K2, K3				
Mapping of CO with PO & PSO													
CO	POs								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	M	S	S	S	S	S	M	S
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	M	S	S	S	S	M	S	S	M
CO4	M	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S
Strongly Correlating (S) - 3 marks Weakly Correlating (W) - 1 mark Moderately Correlating (M) - 2 marks No Correlation (N) - 0 mark													

Course Code	U21BCN311	FIRST AID AND EMERGENCY CARE			
NME		L	T	P	C
		2	-	-	2
Cognitive Level	K1:Recall	K2:Understand	K3:Apply		
Learning Objective	<ul style="list-style-type: none"> To understand the basic fundamentals of First aid To learn about the types of first aids on different emergency situations. To understand the major role of first aid in life processes. To understand the techniques of first aid and its significance 				
Unit I	First Aid: Important Rules of First Aid, First Aid Box. Injuries (Head, Spinal, Eye, Ear), Sprains and Strains. Cuts and Abrasions, Bleeding, Fractures, Dislocations of bones, Burns, Amputations, Nose bleeds, Electric Shock, Radiation burns.				
Unit II	Poisoning, bites & stings : Types of poisons, Swallowed poisons, Drug poisoning, Alcohol poisoning, Animal and human bites, Insect sting, Tick bite Other bites and stings, Snake bite, Stings from sea creatures, Marine puncture wound.				
Unit III	Techniques and Equipment: Removing clothing, Removing headgear, Casualty handling, First aid materials, Dressings, Cold compresses, Principles of bandaging, Roller bandages, Tubular gauze bandages, square knots, hand and foot cover, Arm sling, Elevation sling, improvised slings.				
Unit IV	Common medical emergencies: First aid during Chest pain, Stroke, Seizures, Breathing difficulties, Epilepsy. First aid during Diabetic emergencies, Choking, Fainting, and Heart attack, Low Blood Pressure.				
Unit V	Emergency First Aid : Action in an emergency, CPR for an adult, chest compression only CPR, CPR for an infant, child, Community emergencies such as fire explosions, earth quakes, flood and famine				
Text Books	<ol style="list-style-type: none"> Sura Arya , First Aid and Emergency Management, Atlas Publishers, 2016. Lc Gupta and Abhitabh Gupta, Manual of First Aid, Jaypee Publications, 2012 				
References	<ol style="list-style-type: none"> Paarvesh Saini , First Aid and Emergency Management , Lotus Publishers, second Edition, 2015. Paolo, Jose de Luna , Basic First Aid Management, Createspare Independent Publication, 2015. St. Andrew's , First Aid Manual, 10 th edition, DK Publishers, 2016 S N Chugh, Ashima Chugh , Emergency Medicine for Students and Practitioners, , CBS Publisher, 2019 KPP. Abhilash , Emergency Medicine, Jaypee Publishers, 2018 				
E-Reference Link	<ol style="list-style-type: none"> https://www.actualfirstaid.com/uploads/1/0/4/9/104966051/first_aid_notes_2019.pdf https://nhcps.com/lesson/cpr-first-aid-first-aid-basics/ https://www.medicalnewstoday.com/articles/153849 				

Course outcomes	Upon completion of this course, the students will be able to		
CO	Course Outcomes	Knowledge Level	
CO1	understand the important rules of First aid	K1, K2	
CO2	learn the types of poisoning and stings	K1, K2, K3	
CO3	know the techniques and equipments used for first aid process	K1, K2, K3	
CO4	understand the types of common medical emergencies	K1, K2	
CO5	know the Emergency First aid procedure	K1, K2	

Mapping of CO with PO & PSO:

CO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	M	S	S	S	S	S	S	M	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	M	S	S	M	S	S
CO4	S	M	S	M	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	M	S	S

Strongly Correlating

(S)

- 3 marks ; Moderately Correlating (M)

- 2 marks

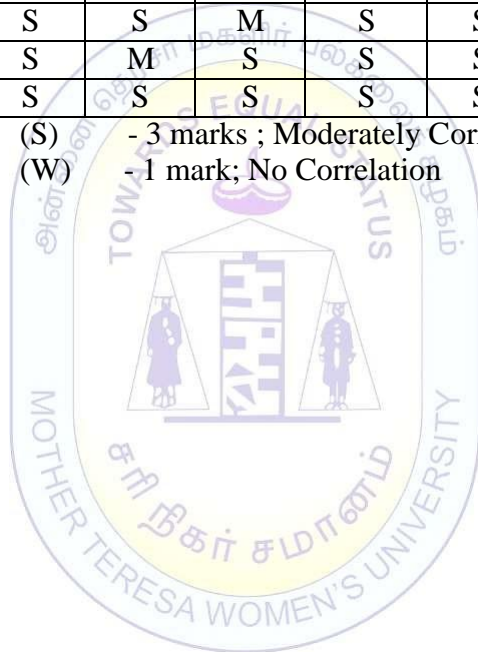
Weakly Correlating

(W)

- 1 mark; No Correlation

(N)

- 0 mark



SEMESTER IV

Course Code	U21BCT41	INTERMEDIARY METABOLISM			
Core	VI	L	T	P	C
Cognitive Level	K1: Recall	K2: Understand	K3: Apply		
Learning Objective	<ul style="list-style-type: none"> To learn the metabolic pathways involved in the physiological processes To understand the concept of bioenergetics, carbohydrate and amino acid metabolism To acquire knowledge on lipid and nucleotide metabolism 				
Unit I	Metabolism:				
	Definition, importance, Division of metabolism. Bioenergetics: high energy and low energy phosphates, Electron Transport Chain, Oxidative phosphorylation				
Unit II	Carbohydrate metabolism:				
	Glycolysis, TCA cycle, HMP Shunt, glycogenolysis, glycogenesis, gluconeogenesis				
Unit III	Amino acid metabolism:				
	A brief account of amino acid metabolism of glycine, cysteine, proline, homoserine, phenylalanine, (other amino acids excluded), urea cycle, a brief account on protein biosynthesis.				
Unit IV	Lipid metabolism:				
	Oxidation of fatty acids, energetics of oxidation, ketone body metabolism, glycerol metabolism. Biosynthesis of fatty acids, biosynthesis of triglycerides, phospholipids, cholesterol metabolism				
Unit V	Nucleotide metabolism:				
	Purine and pyrimidine bases, De novo synthesis and Salvage pathway, catabolism of nucleic acids.				
Text Books	1. Biochemistry, Victor Rodwell, David Bender, Kathleen Botham, Peter Kennelly, 2018				
Reference	1. Nelson, D. L. & Cox, M. M. Lehninger, Principles of Biochemistry. Freeman, 2013 2. Mathews, C. K. & Van Holde, K. E. & Ahern, K. G. Biochemistry. Addison Wesley, 2012. 3. Hames, B. D. et al. Instant Notes in Biochemistry. Bios, 4th edition, 2011. 4. J.M. Berg, J.L. Tymoczko and L. Stryer, Biochemistry, W.H. Freeman, 2015. 5. D. Voet and J.G. Voet, Biochemistry, Wiley, 2011.				
E-References Link	1. https://www.ncbi.nlm.nih.gov/books/NBK116085/ 2. https://link.springer.com/chapter/10.1007/978-1-4613-8081-8_22 3. http://allduniv.ac.in/old/images/course/syllabus/biochem/msc2.pdf				
Course outcomes	Upon completion of this course, the students will be able to				
	CO	Course Outcomes			Knowledge Level
	CO1	define the concepts of metabolism and energetics			K1, K2
	CO2	gain knowledge on various cycles of carbohydrate metabolism and their energetics			K1, K2, K3
	CO3	recognize the amino acid metabolism cycles and their energetic			K1, K2, K3

	CO4	know and understand Lipid metabolism cycles and their energetics.							K1, K2, K3						
	CO5	illustrate the key concepts in metabolism of Nucleic acids							K1, K2, K3						
Mapping of CO with POs & PSOs															
CO	PO								PSO						
	1	2	3	4	5	6	7	8	1	2	3	4	5		
CO1	S	S	S	M	S	S	S	S	S	S	S	S	S		
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S		
CO3	S	S	M	S	M	S	M	S	S	M	S	S	M		
CO4	M	S	S	S	S	S	S	S	S	S	S	S	S		
CO5	S	S	S	M	S	S	S	S	S	S	S	M	S		
Strongly Correlating (S) - 3 marks				Moderately Correlating (M) - 2 marks				Weakly Correlating (W) - 1 mark						No Correlation (N) - 0 mark	



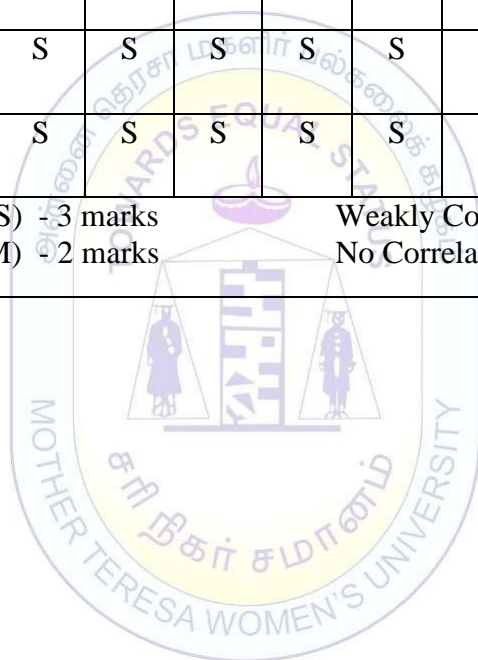
Course Code	U21BCP42	BIOCHEMICAL TECHNIQUES			
Core	VII	L	T	P	C
Cognitive Level	K1: Recall	K2: Understand	K3: Apply		
Learning Objective	<ul style="list-style-type: none"> To know the fundamental aspects in biological techniques To develop the skills in identifying the various biomolecules To develop the skills of quantifying the various biomolecules 				
Experiments in Biochemistry	<ul style="list-style-type: none"> ❖ Estimation of total sugar concentration by Anthrone method ❖ Estimation of reducing sugar concentration by DNSA Method. ❖ Estimation of protein concentration by <ul style="list-style-type: none"> ○ Biuret method b) Lowry method. ❖ Determination of total amino acid concentration by Ninhydrin methods ❖ Estimation of DNA and RNA ❖ Estimation of DNA by diphenyl amine methods. ❖ Estimation of RNA by orcinol method. ❖ Estimation of Iodine Number ❖ Determination of Acid Number ❖ Determination of Saponification Number 				
Text Books	<ol style="list-style-type: none"> J. Jayaraman, Practical bio-chemistry, Jaypee Brothers medical, 2013. Pattabiraman, Laboratory manual in bio-chemistry, Pineapple research station, 2015. 				
References	<ol style="list-style-type: none"> Keith Wilson and John Walker, Principle and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, 2011. Shivaraja Shankara. Y.M, Laboratory Manual for Practical Biochemistry, Jaypee Brothers Medical Publishers, 2nd Edition, 2013. S. Rajan, R. Selvi christy, Experimental Procedures in Lifesciences, CBS, 2019. Soundravally Rajendiran, Pooja Dhiman, Biochemistry Practical Manual, Elsevier, 2019. 				
E-References Link	<ol style="list-style-type: none"> https://www.britannica.com/science/biochemistry/Methods-in-biochemistry https://link.springer.com/book/10.1007/978-1-4939-9861-6 https://www4.unifr.ch/biochem/assets/files/dreyer/cours/BC_0009-ModMethods-JLD-part_2.pdf 				
Course outcomes	Upon completion of this course, the students will be able to				
	CO	Course Outcomes			Knowledge Level
	CO1	explain the procedure for estimating carbohydrates			K1, K2
	CO2	learn the estimation of protein and amino acid			K1, K2, K3
	CO3	illustrate the protocol for the identification of nucleic acids			K1, K2, K3
	CO4	perform the estimation of Iodine number			K1, K2, K3
	CO5	determine acid number and saponification number			K1, K2, K3

Mapping of CO with PO & PSO													
CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	M	M	S	S	M	M	S	S
CO2	S	S	S	M	M	S	M	M	S	M	M	S	S
CO3	M	M	S	M	S	S	M	S	S	S	S	S	M
CO4	M	M	S	S	S	S	S	S	M	S	S	M	M
CO5	S	S	S	S	S	S	S	S	M	S	S	M	S
Strongly Correlating (S) - 3 marks					Weakly Correlating (W) - 1 mark								
Moderately Correlating (M) - 2 marks					No Correlation (N) - 0 mark								



Course Code	U21CHA44		PRACTICAL- CHEMISTRY	L	T	P	C
Allied	IV			-	-	4	4
Cognitive Level	K1: Recall		K2: Understand	K3: Apply			
Learning Objective	<ul style="list-style-type: none"> To understand basics and gain knowledge on laboratory reagents and their uses in volumetric analysis. To enable the students to acquire knowledge in Organic Estimation To understand basics and gain knowledge in organic analysis At the end of the course, the students should be able to plan experimental projects and execute them. 						
Experiments in Chemistry	<p>Acidimetry and alkalimetry: Titration acids used: hydrochloric acid, sulphuric Standard solutions prepared: sodium carbonate, sodium bicarbonate, oxalic acid.</p> <p>Oxidation and reduction titration: Oxidising agents: Potassium permanganate (permanganimetry) Reducing agents: Ferrous sulphate, ferrous ammonium Sulphate, oxalic acid</p> <p>Standard solutions prepared: Ferrous Sulphate, ferrous ammonium Sulphate and oxalic acid.</p> <p>Iodometry titrations: Titrations of liberated iodine against sodium thiosulphate using acidified potassium permanganate, potassium dichromate and copper Sulphate solutions. Standard solutions: potassium dichromate, copper sulphate.</p>						
Text Books	<ol style="list-style-type: none"> Sundaram, Krishnan, Raghavan, Practical Chemistry (Part II), S. Viswanathan Co. Pvt., 1996. B.S. Furniss, A.J. Hannaford, P.W. G. Smith, A.R. Tatchell, Vogel's Text Book of Practical Organic Chemistry. 5th Edn., Pearson Education, 2005. 						
References	<ol style="list-style-type: none"> N.S. Gnanapragasam and G. Ramamurthy, Organic Chemistry – Lab manual, S. Viswanathan Co. Pvt., 1998. Practical Chemistry by A.O. Thomas, Scientific Book Centre, Cannanore, 2003. Basic Principles of Practical Chemistry, V. Venkateswaran, R. Veeraswamy, A. R. Kulandaivelu, Sultan Chand & Sons, New Delhi, 2nd Edn., 2004. 						
Course outcomes	Upon completion of this course, the students will be able to						
	CO	Course Outcomes				Knowledge Level	
	CO1	understand the basic concepts in titration				K1, K2	
	CO2	understand the acidimetry and alkalimetry titrations				K1, K2, K3	
	CO3	explain the preparation of standard solutions				K1, K2, K3	

	CO4	learn the calculations of molarity, molality and normality of the solutions							K1, K2, K3				
	CO5	discuss the concept of Iodometry titrations							K1, K2, K3				
Mapping of CO with PO & PSO													
CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	S	S	S	S	S	M	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S
CO3	S	S	S	S	M	S	S	S	S	S	S	S	M
CO4	S	M	S	S	S	S	S	S	S	S	S	S	S
CO5	M	S	S	S	S	S	S	S	S	S	M	S	S
Strongly Correlating (S) -3 marks									Weakly Correlating (W) - 1 mark				
Moderately Correlating (M) -2 marks									No Correlation (N) - 0 mark				



Course Code	U21BCE421	NANOMATERIALS			
Elective	II	L	T	P	C
Cognitive Level	K1: Recall	K2: Understand	K3: Apply		
Learning Objective	<ul style="list-style-type: none"> To gain knowledge on nanobiotechnology To understand the basics of nanomaterials To acquire knowledge about the structure and bonding in nanomaterials To learn the different methods to synthesize nanomaterials 				
Unit I	Nanotechnology				
Introduction to nanotechnology, scope and definitions of nanotechnology, Historical development of nanomaterials, Classification of nanomaterials. Fundamentals of nanomaterials: Size & Scale Units Scaling Atoms, Molecules, Clusters and Supramolecules					
Unit II	Structure and Bonding in Nanomaterials				
Chemical Bonds (types and strength), Intermolecular Forces, Molecular and Crystalline Structures, Hierarchical Structures, Bulk to Surface transition, surface reconstruction. Properties and Size dependence of properties: Chemical Optical, vibrational, thermal, Electrical, Magnetic, Mechanical.					
Unit III	Nanomaterial Synthesis				
Chemical routes Electrochemical methods Vapor growth Thin films methods: chemical vapor deposition, physical vapor deposition (sputtering, laser ablation), Langmuir-Blodgett growth Mechanical methods: ball milling, mechanical attrition Sol-gel methods Special nanomaterials: carbon nanotubes, fullerenes, nanowires, porous silicon Bio-inspired synthesis Nanocomposite fabrication Nanolithography					
Unit IV	Nanomaterial characterization techniques				
Scanning and Transmission Electron Microscopy Scanning Probe Microscopies: Atomic Force, scanning tunneling microscopy Diffraction and scattering techniques Vibrational spectroscopy Surface techniques					
Unit V	Applications of Nanotechnology:				
Nano-electronics Nano optics Nanoscale chemical- and bio-sensing Biological/bio-medical applications Photovoltaic, fuel cells, batteries and energy-related applications High strength nanocomposites Nanoenergetic materials					
Text Books	<ol style="list-style-type: none"> Sunipa Roy, Chandan Kumar Ghosh, Chandan Kumar Sarkar, Nanotechnology: Synthesis to Applications, Publisher CRC Press, 2018 Ann-Marie Broome, Cancer Nanotechnology, Academic Press. 2018 				
References	<ol style="list-style-type: none"> Sanyog Jain Kaiser Raza Ashish Kumar Agrawal Ankur Vaidya 1st Ed, Nanotechnology Applications for Cancer Chemotherapy, Elsevier. 2020 Sulabha K. Kulkarni, Nanotechnology: Principles and Practices, Publisher Springer Nature, 2014 				

E-Reference Link	<ol style="list-style-type: none"> http://home.iitk.ac.in/~anandh/MSE694/Introduction_to_Nanomaterials-3.pdf https://onlinelibrary.wiley.com/doi/pdf/10.1002/9783527673919.oth1 https://application.wiley-vch.de/books/sample/3527340998_c01.pdf https://arxiv.org/ftp/arxiv/papers/0801/0801.3280.pdf https://www.centropiaggio.unipi.it/sites/default/files/course/material/nanomaterials.pdf 													
Course outcomes	Upon completion of this course, the students will be able to													
	CO	Course Outcomes								Knowledge Level				
	CO1	learn the fundamentals and classifications of nanomaterials								K1				
	CO2	understand the structure and bonding in nanomaterials								K2				
	CO3	gain knowledge on the synthesis of nanomaterials from different sources								K1,K2				
	CO4	learn the techniques to characterize nanomaterials								K3				
	CO5	acquire knowledge on the applications of nanomaterials								K2				
Mapping of COs with POs & PSOs:														
CO	PO								PSO					
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	M	M	M	M	M	S	S	S	M	M	M	
CO2	S	S	M	M	M	M	M	S	S	S	M	M	S	
CO3	S	S	M	S	M	S	S	S	S	S	S	S	M	
CO4	S	S	M	M	S	M	M	S	S	S	M	S	S	
CO5	S	S	S	S	S	S	S	S	S	S	S	M	S	
Strongly Correlating (S) - 3 marks Weakly Correlating (W) - 1 mark Moderately Correlating (M) - 2 marks No Correlation (N) - 0 mark														

Course Code	U21BCE422	PLANT THERAPEUTICS			
Elective	II	L	T	P	C
Cognitive Level	K1: Recall	K2: Understand	K3: Apply		
Learning Objective	<ul style="list-style-type: none"> To learn about the bioactive compounds in plants and their therapeutic properties To gain knowledge on plant metabolites and their importance To acquire knowledge on different medicinal plants and their composition To understand the scope of plant therapeutics in medical industry To gain knowledge on development of plant therapeutic products 				
Unit I	Plant therapeutics				
Introduction to plant therapeutics, Bioactive principles in herbs, plants with hepatoprotective , nephroprotective, hypoglycemic, anticancer, antibacterial, antiviral and antimalarial ,anti-inflammatory properties.					
Unit II	Free radicals:				
Types, sources, importance, production, free radicals induced damages, lipidperoxidation, measurement of free radicals, disease caused by radicals, reactive oxygen species, antioxidant defence system, enzymic and non-enzymic antioxidants, role of antioxidants in prevention of diseases, phytochemicals as antioxidants.					
Unit III	Metabolites:				
Alkaloids, flavanoids, terpenoids, phenols-Occurrence, distribution & functions, Production of secondary metabolite in plants, stages of secondary metabolite production, uses of tissue culture techniques, elicitation, biotransformation- production of pharmaceutical compounds.					
Unit IV	Herbal extracts and their standardization:				
Physical, chemical, spectral and toxicologicals standardization, qualitative and quantitative estimations exemplified by the methods of preparation of at least two standardized extracts. Stability studies for extracts. Predictable chemical and galenical changes					
Unit V	Development of plant therapeutics:				
Preparation of liquid orals, tablets, capsules , ointments ,creams and cosmetics. Methods involved in monoherbal and polyherbal formulation with their merits and demerits. Excipients used in herbal formulation. Compatibility studies. Stability studies. Bioavailability & Pharmacokinetic aspects for herbal drugs with examples of well-known documented, clinically used herbal drugs.					
Text Books	1. Khan,I.A and Khanum.A 2004. Role of Biotechnology in medicinal & aromatic plants,Vol 1and Vol 10, Ukkaz Publications ,Hyderabad. 2. Singh.M.P and Panda .H 2005.Medicinal Herbs with their formulations, Daya Publishing House,Delhi				
					Page 38

References	<ol style="list-style-type: none"> Swamy M.K, Patra J.K, Rudramurthy G.R. 2019, Medicinal Plants Chemistry, Pharmacology, and Therapeutic Applications, 1 st edition, CRC Press Marta C.T. D, Rai. M. 2016, Therapeutic medicinal plants, 1 tt edition, CRC Press Alamgir, A.N.M. 2017. Therapeutic Use of Medicinal Plants and Their Extracts: Volume 1, Springer International Publishing 												
E-Reference Link	<ol style="list-style-type: none"> http://informahealthcare.com/doi/pdf/10.1517/13543776.13.4.489 https://www.longdom.org/open-access/free-radicals-and-oxidative-stress-jbb.10000e13.pdf https://www.weizmann.ac.il/plants/aharoni/sites/plants.aharoni/files/uploads/may022007.pdf https://media.neliti.com/media/publications/278981-standardization-and-evaluation-of-herbal-ce0e9f33.pdf https://sustainabledevelopment.un.org/content/documents/6544118_Pesic_Development%20of%20natural%20product%20drugs%20in%20a%20sustainable%20manner.pdf 												
Course outcomes	Upon completion of this course, the students will be able to												
	CO	Course Outcomes							Knowledge Level				
	CO1	attain knowledge on the therapeutics properties of bioactive compounds in plants							K1				
	CO2	understand the mechanism behind free radical scavenging and the antioxidant properties of plants							K1,K2				
	CO3	gain knowledge on plant secondary metabolites and their functions							K2				
	CO4	learn how to standardize and stabilize herbal preparations							K3				
	CO5	acquire knowledge on development of plant therapeutics for commercial use							K2				
Mapping of CO with PO & PSO													
CO	POs								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	M	M	S	M	S	S	S	S	M	S
CO2	S	M	S	S	S	M	M	S	S	S	M	M	S
CO3	S	M	M	S	M	S	S	M	S	M	S	S	M
CO4	S	M	S	S	M	M	S	S	M	S	M	M	S
CO5	S	S	S	M	M	S	S	S	M	M	S	S	S
Strongly Correlating (S) - 3 marks Moderately Correlating (M) - 2 marks Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark													

Course Code	U21BCN421	PHYTOCHEMISTRY			L	T	P	C
NME	II				2	-	-	2
Cognitive Level	K1:Recall	K2:Understand	K3:Apply					
Learning Objective	<ul style="list-style-type: none"> To learn about the phyto chemicals in plants To learn the biological and toxicological properties of plant. To know about the separation techniques and structure elucidation To provide knowledge on secondary metabolites 							
Unit I	Herbal drugs							
Phyto chemicals and their Classification–Qualitative and Quantitative Screening of Phyto compounds. (Carbohydrate, Tannin, Saponin, Alkaloids, Flavonoids, Glycosides, Quinones, Phenols, Terpenoids, Anthocyanin)								
Unit II	Phytochemicals							
Plant extract used to Bacterial, Fungal and Parasitic infection - Biological and Toxicology Properties of plant extract –Anti-MRSA (Methicillin -resistant <i>Staphylococcus aureus</i>) and Anti- VRE (vancomycin- resistant entero cocci) activities of Phytoalexins and Phytoncides–Anti microbial and targeted screening of Plantextract–Plant derived compound against drug resistant microorganisms– Anti oxidant and antitumor Plant metabolites (fruits and vegetables) – Bioactive compounds as Food.								
Unit III	Medicinal Plants and its Use							
Medicinal Plants and Their Use in Primary Health Care– immune stimulants and adaptation from Plants– Poly phenols for Atherosclerosis and Ischemic Heart disease– Cancer Chemo preventive agents –Lipid oxidation nitrogen Radicals– Phyto chemicals in oil seeds– Flavonoids in Cardio vascular disease– Bio engineering and Breeding approaches in improving phyto chemical content of plants.								
Unit IV	Separation techniques and structure elucidation							
Thin layer chromatography–HPLC – Column chromatography – GC – MS – LC – MS – Partition chromatography – Gas chromatography – FTIR – UV – NMR – X-ray diffraction QSAR (Quantitative structure–activity relationship).								
Unit V	Secondary metabolites and their Production							
Hairy root induction– Methods of gene transfer – Chemical methods– PEG– dextran – Physical method -Electroporation– Microinjection – Lipofection delivery for herbal therapeutics – Quality Control– Germplasm improvement								
Text books	1. Neeru Mathur, Medicinal Plants of India, RBSA Publisher, 2010. 2. M.C.Joshi, Handbook of Indian Medicinal Plants, Scientific publishers ,2019.							

References	1.Joshi SG, Medicinal Plants, Oxford and IBH publishing, 2018. 2.L.D Kapoor, Handbook of Ayurvedic Medicinal Plants, CRC Press ,2011.													
E-references	1. http://6e.plantphys.net/PlantPhys6e-appendix04.pdf 2. https://www.intechopen.com/books/secondary-metabolites-sources-and-applications/an-introductory-chapter-secondary-metabolites 3. https://edu.rsc.org/resources/chromatography-techniques/4010255.article 4. https://www.weizmann.ac.il/plants/aharoni/sites/plants.aharoni/files/uploads/may022007.p													
Course outcomes	Up on completion of this course, the students will be able to													
	CO	Course Outcomes								Knowledge Level				
	CO1	learn about the classification and phytochemical analysis of herbs								K1, K2, K3				
	CO2	explain about phytochemicals and their uses in microbial infection								K1, K2,				
	CO3	describe role of phyto medicine in various diseases								K1, K2,				
	CO4	learn about the separation techniques and structure elucidation of phyto compounds								K1, K2, K3				
	CO5	know about the production of Secondary metabolites								K1, K2, K3				
Mapping of CO with PO & PSO														
CO	Pos								PSOs					
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	M	S	S	S	S	M	S	S	S	S	M	S	
CO2	S	S	S	S	S	S	M	S	S	S	S	M	S	
CO3	S	S	S	S	M	S	S	M	S	M	S	S	M	
CO4	S	M	S	S	S	M	S	S	S	S	M	S	S	
CO5	S	S	S	M	S	S	S	S	S	S	S	S	S	
Strongly Correlating (S) - 3 marks					Weakly Correlating (W) - 1 mark									
Moderately Correlating (M) - 2 marks					No Correlation (N) - 0 mark									

SEMESTER V

Course Code	U21BCT51	GENERAL MICROBIOLOGY			
Core	VIII	L	T	P	C
		5	-	-	4
Cognitive Level	K1: Recall K2: Understand K3: Apply				
Learning Objective	<ul style="list-style-type: none"> To understand the basics of microbiology, classification and general characteristics of microbes. To gain knowledge on structural organization and morphological features of microorganisms. To know the growth, reproduction and metabolism of bacteria. 				
Unit I	Introduction to Microbiology				
	History of microbiology, Microscopes (light & electron), natural distribution of microorganism, general classification of microorganisms (Bacteria, Yeast, Fungi) and their characteristics				
Unit II	Organization and structure of Microorganisms				
	Prokaryotic organization, cytoplasm membranes and their function, mesosomes, cell wall – gram positive and gram negative reactions, capsule and slime layers, flagella and cilia, bacterial chromosome, plasmids, ribosomes, reserved food and endospore.				
Unit III	Bacterial nutrition				
	Growth and reproduction, autotrophic and heterotrophic nutrition, bacterial photosynthesis, chemolithotrophy, bacterial metabolism, fermentation, homo fermentative and hetero conjugation, transformation, transduction, speculation, kinetics of bacterial growth, normal growth curve				
Unit IV	Food Microbiology				
	Food spoilage, food poisoning, food borne infections and disease causing microorganisms, Medical Microbiology: Pathogenesis and prevention of air and water borne diseases – Typhoid, Cholera, Dysentery, Diarrhea, hepatitis, amoebiosis, tuberculosis, pox diseases, diphtheria and poliomyelitis.				
Unit V	Industrial Microbiology				
	Use of microbes in industries, ethanol production, organic acid (penicillin and streptomycin) production. Microorganisms and milk: Sources of microorganisms, fermentation of milk and characteristic, Transmission of disease through milk, determining the wholesomeness of mild, frozen dairy products				
Text Books	<ol style="list-style-type: none"> C. P. Baveja, Textbook of Microbiology 6 th Edition, Arya Publications, 2021. N. Arumugam, A. Mani, A. M. Selvaraj, L. M. Narayanan, Microbiology, Saras Publication, 2014. R. C. Dubey, D. K. Maheshwari, A Text book of Microbiology, S. Chand, 2013. 				
References	<ol style="list-style-type: none"> Ananthanarayan and Paniker's, Microbiology, University press, 2020. Harsh Mohan, f Pathology with Pathology Quick Review and MCQs- 				

	English, jaypee brothers, medical publishers 2018 . 3. Subhash Chandra Parija, Microbiology and Immunology, Elsevier India Publication, 2016 . 4. Jeffrey C, Pommerville, Fundamentals of Microbiology Jones and Bartlett publisher, 2017. 5. D.K.Sharma, Microbiology, Alpha science International limited, 2013.													
E-References Link	1. https://open.oregonstate.edu/generalmicrobiology/ 2. https://fac.ksu.edu.sa/sites/default/files/140_mbio-final_notes.pdf 3. https://www.classcentral.com/course/swayam-general-microbiology-14088													
Course outcomes	Upon completion of this course, the students will be able to													
	CO	Course Outcomes								Knowledge Level				
	CO1	explain basics of microorganisms and microscope and its types								K1, K2				
	CO2	gain knowledge on various cell organelles of micro-organisms and its structure								K1, K2, K3				
	CO3	describe the nutrition, photosynthesis, metabolism of bacteria								K1, K2, K3				
	CO4	illustrate the factors involved in spoilage, poisoning of food and food borne diseases								K1, K2, K3				
	CO5	know the methods of fermentation and applications of microbes in industry								K1, K2, K3				
Mapping of CO with PO & PSO														
CO	PO								PSO					
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	M	S	S	S	S	M	S	S	S	S	M	S	
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	
CO3	S	S	S	S	M	S	S	S	S	M	S	S	M	
CO4	M	S	S	S	S	M	S	S	S	S	S	S	S	
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S	
Strongly Correlating (S) - 3 marks					Weakly Correlating (W) - 1 mark									
Moderately Correlating (M) - 2 marks					No Correlation (N) - 0 mark									

Course Code	U21BCT52	IMMUNOLOGY			
Core	VIII	L	T	P	C
Cognitive Level	K1: Recall	K2: Understand	K3: Apply		
Learning Objective	<ul style="list-style-type: none"> To learn the basics of immunology and function of immune system against infections. To know the properties and functions of antigens and antibody types. To acquire knowledge about hypersensitivity caused by immunological action and autoimmune disorders. 				
Unit I	Development of immunology				
Immunity – types –Organs of immune system – Hematopoiesis – Cells of immune system – blood grouping ABO and Rh systems – Blood transfusion.					
Unit II	Antigens				
Properties and types – Haptens and adjuvants. Antibodies: structure, classes and biological functions- Generation of antibody diversity, Immunogenicity, Hybridoma and monoclonal					
Unit III	Antigen antibody reaction				
Host response – humoral and cell mediated immunity – complement pathways of complement activation, MHC.					
Unit IV	Hypersensitivity				
Types (Immediate &Delayed), immune tolerance – transplantation immunity – auto immune diseases. Immunological techniques (RIA, Immunodiffusion (Single and Double)Immunoblotting- ELISA					
Unit V	Immunodeficiency:				
Immunology of infectious diseases –microbial infection bacterial, protozoan, viral infection – toxoid. Vaccines – types and vaccine development.					
Text Books	<ol style="list-style-type: none"> Jenny Punt, Sharon stranford, Patrica jones, Judith A Owen, Immunology, WH Freeman publisher , 2010. Abul Abbas and Andrew H Lichtman and Shiv Pillai, Basic immunology Elsevier Publication, 2019. 				
References	<ol style="list-style-type: none"> Dr. S. K. Gupta, Essentials of Immunology ,Publisher APC Books,2011. Peter J Delves, Roitts Essential Immunology , John Wiley publishers,2017. C. V. Rao, Immunology, Good reads,2020. 				
E-References Link	<ol style="list-style-type: none"> http://www.sacema.org/uploads/Introduction-to-Medical-Immunology.pdf http://dl.mehrsys.ir/pdfbooks/Roitt_s%20Essential%20Immunology%20Thirteenth%20Edition(www.myuptodate.com).pdf 				

Course outcomes	Upon completion of this course, the students will be able to													
	CO	Course Outcomes								Knowledge Level				
	CO1	understand the history and development of immunology and contributions of various scientist								K1, K2				
	CO2	define antigens and antibodies								K1, K2, K3				
	CO3	illustrate antigen-antibody reaction								K1, K2, K3				
	CO4	define hypersensitivity and explain its types.								K1, K2, K3				
	CO5	explain the concepts of immunodeficiency								K1, K2, K3				
Mapping of CO with POs & PSOs														
CO	POs								PSOs					
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	S	M	S	S	M	S	S	M	S	M	S	
CO2	S	M	S	S	S	S	S	S	S	S	S	S	S	
CO3	S	S	M	S	M	S	S	S	S	S	S	S	M	
CO4	M	S	S	S	S	S	S	S	S	S	S	S	S	
CO5	S	S	S	M	S	S	S	S	S	S	S	M	S	
Strongly Correlating (S) - 3 marks Weakly Correlating (W) - 1 mark Moderately Correlating (M) - 2 marks No Correlation (N) - 0 mark														

Course Code	U21BCT53	PHARMACOLOGY			
Core	VIII	L	T	P	C
		5	-	-	4
Cognitive Level	K1: Recall K2: Understand K3: Apply				
Learning Objective	<ul style="list-style-type: none"> To understand the drug receptors, principles and phases of drug metabolism and pharmacological activity. To learn the principles and methods of chemotherapy for cancer and mode of anticancer drugs. To acquire knowledge about the adverse effect of drugs and metabolism of Xenobiotics. 				
Unit I	Drugs				
Definition, classification of drugs, routes of drug administration, absorption of drugs, factors influencing absorption of drugs. Drug distribution: role of kidney in drug interaction with biomolecules, binding of drugs to plasma proteins.					
Unit II	Drug receptors				
Drug receptor interaction G-protein coupled receptors, Transmembrane Receptors, Intracellular receptors.					
Unit III	Drug metabolism				
Effects of drug metabolism, principles of phase I& II reactions, microsomal metabolism of drugs, role of cytochrome p450, enzyme induction and pharmacological activity.					
Unit IV	Chemotherapy				
Principles of cancer chemotherapy, target sites for cancer chemotherapeutic agents. Mode of action of anticancer drugs: antibiotics, antimetabolites, alkylating agents, hormones and other agents. Mode of action of sulphonamides, antiviral substances, antimalarials and cancer chemotherapy.					
Unit V	Drug tolerance				
Unusual, adverse response to drugs, drug tolerance and intolerance, drug induced diseases, commonly abused drugs and their biological effects. Metabolism of xenobiotics and their biomedical importance					
Textbooks	<ol style="list-style-type: none"> Arthur.J, Principles of clinical pharmacology, Academic press,2011. Satoskar R.S , Pharmacology and Pharmaco Therapeutics, Popular Prakashan Bombay, 2015. 				
References	<ol style="list-style-type: none"> Shargel.L, Applied Biopharmaceutics and pharmacokinetics Mc Gram- Hill Medical, 2015. Eric .J. Nestler, molecular Neuropharmacology, Access Biomedical science, 2015. Karen Whalen, Pharmacology, LWW Health Library, 2019. 				

E-References Link	1. https://www.osmosis.org/library/foundational-sciences/pharmacology 2. https://www.karger.com/Journal/Home/224274												
Course outcomes	Upon completion of this course, the students will be able to												
	CO	Course Outcomes							Knowledge Level				
	CO1	know about the basics of pharmacology							K1, K2				
	CO2	understand the drug receptors and its mechanisms							K1, K2, K3				
	CO3	acquire knowledge on the metabolism of drugs							K1, K2, K3				
	CO4	understand chemotherapy and drug's mechanism							K1, K2, K3				
	CO5	discuss drug abuse and its adverse effects							K1, K2, K3				
Mapping of CO with PO & PSO													
CO	POs								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	S	M	S	S	S	M	S
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	M	M	S	S	S	M	S	S	M
CO4	M	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S
Strongly Correlating (S) - 3 marks Moderately Correlating (M) - 2 marks Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark													

Course Code	U21BCT54	FUNDAMENTALS OF MOLECULAR BIOLOGY			
Core	XI	L	T	P	C
Cognitive Level	K1: Recall	K2: Understand	K3: Apply		
Learning Objective	<ul style="list-style-type: none"> To study about the genetic material, mutation, and DNA repair mechanism. To understand the mechanism and types of DNA replication in prokaryote and eukaryote. To obtain knowledge of bacterial genetic exchange, genetic maps and linkage. 				
Unit I	Structure of nucleic acids:				
Watson and Crick's double helix structure, types of DNA, Structure of mRNA, t-RNA and r-RNA – Nucleic acid as genetic material, Experimental evidence, mutation – types, introns, exons, probes, complementation of gene function. Genetic code: codon, Wobble hypothesis.					
Unit II	Replication:				
Types and mechanism of replication, difference between prokaryotic and eukaryotic replication, DNA polymerases. Transcription: mechanism, RNA polymerase. Translation					
Unit III	Genetic exchange in bacteria:				
Transformation, transduction, and conjugation. genetic maps, linkages, Hfr strain					
Unit IV	Regulation of Gene expression:				
Organization of operon, positive and negative operon, lac and Ara operon. Chemical mutagen: NTG, HNO ₂ , physical mutagen: UV and biological mutagen.					
Unit V	Extra chromosomal inheritance:				
Plasmids, types; Transposons: structure and functions; DNA damage and repair mechanism					
Text Books	<ol style="list-style-type: none"> S.C.Rastogi, Cell and Molecular Biology – New Age International Publishers, 2012. Pragya Khanna, Cell and Molecular Biology, I.K.International Pvt. Ltd., 2010. 				
References	<ol style="list-style-type: none"> Wilson, K. & Walker, J. Principles and Techniques of Biochemistry and Molecular Biology. 7th Edition, Publisher CUP, 2010. H. Lodish, Molecular Cell Biology, W.H. Freeman, 2012. Watson, J. D, Molecular Biology of the Gene, Benjamin Cummings, 2013. B. Alberts, Molecular Biology of the Cell, Garland, 2014. 				
E-References Link	<ol style="list-style-type: none"> https://www.news-medical.net/life-sciences/What-is-Molecular-Biology.aspx 				

	2. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/molecular-biology													
Course outcomes	Upon completion of this course, the students will be able to													
	CO	Course Outcomes								Knowledge Level				
	CO1	know and understand the structure of nucleic acids, genetic code, wobble hypothesis and mutation and their types								K1, K2				
	CO2	describe about the central dogma of life								K1, K2, K3				
	CO3	explain the gene exchange methods								K1, K2, K3				
	CO4	discuss about operon and its types								K1, K2, K3				
	CO5	gain knowledge on transposons as mutagenic agent, DNA damage and repair mechanisms.								K1, K2, K3				
Mapping of CO with PO & PSO														
CO	PO								PSO					
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	M	S	S	S	S	S	S	S	S	S	M	S	
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	
CO3	S	S	S	S	M	S	M	S	S	M	S	S	M	
CO4	S	M	S	S	S	S	S	M	S	S	M	S	S	
CO5	S	S	S	M	S	S	S	S	S	S	S	S	S	
Strongly Correlating (S) - 3 marks					Weakly Correlating (W) - 1 mark									
Moderately Correlating (M) - 2 marks					No Correlation (N) - 0 mark									

Course Code	U21BCP53	GENERAL MICROBIOLOGY AND IMMUNOLOGY			
Core	XII	L	T	P	C
		-	-	5	4
Cognitive Level	K1: Recall K2: Understand K3: Apply				
Learning Objective	<ul style="list-style-type: none"> To learn the blood grouping and method to estimate haemoglobin level in blood. To know the diagnostic methods in laboratory level. To know the isolation and identification of microbes from various samples. 				
	<ol style="list-style-type: none"> Blood grouping Estimation of Hemoglobin Precipitation method <ol style="list-style-type: none"> Immuno-diffusion Immuno-electrophoresis WIDAL test ELISA VDRL test CRP test RA test ASO test Aseptic Techniques – Sterilization Serial Dilution, Pour Plate and Spread Plate & streak plate method Staining – Simple and Gram's Staining Antibiotic sensitivity test (Disc diffusion method) 				
Text Books	<ol style="list-style-type: none"> Atlas, M. Ronald, Alfred E. Brown. And Lawrence C. Parks, Gram stain, Experimental Microbiology, 2010 Handbook of Microbiological Media – HI Media. 2012 				
References	<ol style="list-style-type: none"> Cappuccino, G. James and Natalie Sherman, Gram stain, Microbiology A Lab. Manual, 2014. Atlas, M. Ronald, Alfred E. Brown and Lawrence C. Parks, Gram stain, Experimental Microbiology. Practical Immunology A Laboratory Manual, 2017 Weir, Hand book of experimental Immunology. Vol I & II. Blackwell scientific publishing. 2011 Hudson L & Hay H.C. Techniques in clinical immunology –Blackwell scientific publishing. 2015 				
E-References Link	<ol style="list-style-type: none"> https://www.healthline.com/health/elisa https://www.mybiosource.com/learn/ELISA https://microbenotes.com/spread-plate-technique/ https://asm.org/getattachment/2594ce26-bd44-47f6-8287-0657aa9185ad/Kirby-Bauer-Disk-Diffusion-Susceptibility-Test-Protocol-pdf.pdf https://vlab.amrita.edu/?sub=3&brch=73&sim=1628&cnt=1 				
Course outcomes	Upon completion of this course, the students will be able to				

CO	Course Outcomes	Knowledge Level
CO1	understand hematology and blood grouping methods.	K1, K2
CO2	empathize on various immunological techniques	K1, K2, K3
CO3	gain expertise in aseptic technique	K1, K2, K3
CO4	learn different staining techniques	K1, K2, K3
CO5	acquire knowledge in various plating techniques	K1, K2, K3

Mapping of CO with PO & PSO

CO	POs								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	S	S	S	S	S	M	S
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	M	S	M	S	S	M	S	S	M
CO4	S	M	S	S	S	S	S	M	S	S	M	S	S
CO5	S	S	S	M	S	S	S	S	S	S	S	S	S

Strongly Correlating (S) - 3 marks

Moderately Correlating (M) - 2 marks

Weakly Correlating (W) - 1 mark

No Correlation (N) - 0 mark

Course Code	U21BCE531	BIOINFORMATICS			
Elective	III	L	T	P	C
Cognitive Level	K1: Recall	K2: Understand	K3: Apply		
Learning Objective	<ul style="list-style-type: none"> To learn the concepts and applications of bioinformatics To learn basic tools on bioinformatics and biological databases To understand the construction Phylogenetic trees for evolutionary analysis and apply theoretical skill to practical application 				
Unit I	Bioinformatics				
Definition, application and significance of bioinformatics in life sciences. Database-introduction, types and classification, internet, World Wide Web.					
Unit II	Nucleic acid sequence database				
Genbank, EMBL, DDBJ - Protein sequence database - PIR, SWISS PROT, protein structural database – PDB.					
Unit III	Sequence analysis				
Need and importance – pairwise alignment – dynamic programming – Global (Needleman – Wunsch) and Local (Smith Waterman) Alignment concepts – Database searching tools – Entrez, BLAST, FASTA – multiple alignment – Clustal – Construction of Phylogenetic trees.					
Unit IV	Use of nucleic acid and protein data banks				
NCBI, EMBL, DDBJ, SWISSPORT. 3D structural analysis of biomolecules – molecular visualization tools – RasMol.					
Unit V	Evolutionary analysis				
Distance – Clustering methods – Rooted and Unrooted tree representation – phylogenetic tree. Bootstrapping strategies. Neural Networks					
Textbooks	<ol style="list-style-type: none"> S.C.Rastogi, N.Meniratta, “Bioinformatics Methods and Applications”, Prentice Hall India Learning Private Limited, 2013. Harsha, “Fundamentals of Bioinformatics”, S. Wiley Publishers ,2019. Jeremy Ramdass, “Bioinformatics, An Introduction”, Springer publishers ,2015. T.K.Atwood, “Introduction to Bioinformatics”, Pearson Publishers, 2017. 				
References	<ol style="list-style-type: none"> Zhumur Ghosh & Bibekanand Mallick, Bioinformatics Principles and applications , OUP Publishers ,2018. Ruchi Singh, “Bioinformatics, Proteomics and Genomics”,Vikas publishing House, 2014. 				
E-References Link	<ol style="list-style-type: none"> https://www.bioinformatics.org/ https://pubmed.ncbi.nlm.nih.gov/11552348/ https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1122955/ 				

Course outcomes	Upon completion of this course, the students will be able to												
CO	Course Outcomes								Knowledge Level				
CO1	acquire knowledge on the application of bioinformatics in life sciences.								K1, K2				
CO2	realize the importance and application of database.								K1, K2, K3				
CO3	determine the sequence of unknown sample through various e- resources.								K1, K2, K3				
CO4	explain the importance of data banks and visualization tools.								K1, K2, K3				
CO5	gain knowledge on evolutionary analysis.								K1, K2, K3				
Mapping of CO with PO & PSO													
CO	POs								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	M	S	S	S	S	S	S
CO2	S	S	S	M	S	S	S	S	S	S	S	S	S
CO3	S	M	S	S	M	S	M	S	S	M	S	S	M
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S	M	S	S
Strongly Correlating (S) - 3 marks				Weakly Correlating (W) - 1 mark									
Moderately Correlating (M) - 2 marks				No Correlation (N) - 0 mark									

Course Code	U21BCE532	CANCER BIOLOGY					
Elective	III	L	T	P	C		
Cognitive Level	K1:Recall	K2:Understand	K3:Apply	3	-	-	3
Learning objective	<ul style="list-style-type: none"> ➤ To distinguish normal cell and cancer cell. ➤ To understand the various methods of diagnosis of cancer ➤ To obtain the knowledge of staging the cancer cells ➤ To know about different types of cancer ➤ To obtain the knowledge about treatments for cancer. 						
UNIT – I	Normal and Cancer cell						
Properties of normal cell and cancer cell, benign tumor and malignant tumor. Type of cancer common symptoms, causative factors, Definition of primary and secondary cancer							
UNIT – II	Classification and diagnosis of cancer:						
Classification and diagnosis of cancer by tissue type - Solid tumor, Histopathological diagnosis. Immunohistochemistry Hematological malignancies, morphological diagnosis Biopsy its types. Clinical examinations.							
UNIT – III	Cancer classification						
TNM classification Purpose types of staging. TNM System, Stage grouping. Factors affecting the stage and staging system.							
UNIT – IV							
Sporadic cancers, hereditary cancers, examples of cancer susceptibility syndromes, Immune suppression related malignancies, transplantation related malignancies.							
UNIT –V	Cancer treatments						
Surgery and its types, Radiation, Chemotherapy, Biological therapy, Hormone therapy, transplantation. Targeted therapy, Gene therapy and other treatment methods							
Text Books	<ol style="list-style-type: none"> 1. Robert A. Weinberg, Robert A Weinberg .The Biology of Cancer, Publisher Garland Science,2013 2. Robin Hesketh,Introduction to Cancer Biology, Publisher Cambridge University Press,2015 						
Reference Books	<ol style="list-style-type: none"> 1. Francesco Pezzella, Mahvash Tavassoli, David J. Kerr.Cancer Biology, Publisher OUP Oxford,2019 2. Kleinsmith, Principles of Cancer Biology, Publisher Pearson Education,2016 3. Lewis Kleinsmith, Principles of Cancer Biology, Publisher Pearson,2017 						
E-References	<ol style="list-style-type: none"> 1. http://csbl.bmb.uga.edu/mirrors/JLU/DragonStar2017/download/introduction-to-cancer-biology.pdf 2. https://sphweb.bumc.bu.edu/otlt/MPH- 						

	Modules/PH/PH709_Cancer/A10-Cancer.pdf													
Course out come	Upon completion of this course, the students will be able to													
	CO	Course Outcomes								Knowledge Level				
	CO1	differentiate between normal cell and cancer cell.								K3				
	CO2	understand the classification and diagnosis of cancer by tissue type								K2				
	CO3	gain the knowledge of classification of cancer								K1				
	CO4	understand the sporadic cancers, hereditary cancers and examples of cancer susceptibility syndromes								K2				
	CO5	acquire the knowledge of cancer treatments like radiation, chemotherapy, biological therapy, hormone therapy and transplantation								K2				
Mapping of COs with POs & PSOs														
CO	PO								PSO					
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	S	M	S	M	S	S	M	S	S	S	M	
CO2	S	S	S	S	S	M	S	S	M	S	S	M	S	
CO3	S	S	S	S	S	M	S	S	S	S	S	S	S	
CO4	S	M	S	S	S	S	S	S	S	S	S	S	S	
CO5	S	S	S	S	M	S	S	S	S	S	S	M	S	
Strongly Correlating (S) - 3 marks Weakly Correlating (W) - 1 mark														
Moderately Correlating (M) - 2 marks No Correlation (N) - 0 mark														

Course Code	U21BCS531	FOOD PROCESSING TECHNOLOGY			
SBE	III	L	T	P	C
Cognitive Level	K1: Recall	K2: Understand	K3: Apply		
Learning objective	<ul style="list-style-type: none"> To understand the functional groups of food To acquire the knowledge on principle of food spoilage and food preservation. To learn the techniques of food packaging 				
Unit I	Food preservation				
Food Irradiation, microwave heating & cosmic heating preparation of cakes-methods. Assessment of Quality Factors in foods: - Appearance factors, Textural factors, flavor factors, quality standards.					
Unit II	Food deterioration and its control				
Shelf life & dating of foods, principles of food preservation, control of microorganisms. Beverages: Carbonated non-alcoholic beverages, beer, wine, coffee, tea. Causes of spoiling and their control methods.					
Unit III	Food Safety, Risks Hazards				
Food processing & the environment, principles of food packaging. Governmental regulation of food & nutrition labelling for jam, jelly, squash, pickle. General characteristic of milk, milk products.					
Unit IV	Food Preparation:				
Preparation of fermented foods – Idli, Dosa, Wine Preparation of preserved food – JAM, Pickle					
Unit V	Food preservation:				
<ul style="list-style-type: none"> Preparation of product by using salt as preservative Preparation of product by using sugar as preservative Preparation of product by using oil as preservative 					
Text Books	<ol style="list-style-type: none"> Sukumar De, Outlines of Dairy Technology, Oxford university press ,2011. W.Hartel, Principles of Food Processing, Springer,2019. Shubhangini A.Joshi, Nutrition & Dietetics , Mc Graw hill, 2017. 				
References	<ol style="list-style-type: none"> Normal N.Potter, Joseph H. Hotchkiss, Food Science, Shafifur, 2017. P.J Fellows, Food processing technology, Wood Head publishing, 2017. 				
E-References Link	<ol style="list-style-type: none"> https://application.wiley-vch.de/books/sample/3527338802_c01.pdf https://bioeng.berkeley.edu/research/bioinstrumentation https://worldwidescience.org/topicpages/b/bioinstrumentation.html 				

Course outcomes	Upon completion of this course, the students will be able to												
CO	Course Outcomes								Knowledge Level				
CO1	gain knowledge and understanding about the nature of food and human nutrition and an appreciation of the importance of food to health								K1, K2				
CO2	understand the sources of food spoilage and control								K1, K2, K3				
CO3	gain knowledge on food safety								K1, K2, K3				
CO4	explain the preparation of fermented foods								K1, K2, K3				
CO5	gain knowledge about the food preservation methods								K1, K2, K3				
Mapping of CO with POs & PSOs													
CO	POs								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	S	S	S	S	S	M	S	S	S	M	S	S
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S
CO3	S	S	M	S	M	S	S	S	S	S	S	S	M
CO4	M	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	M	S	S	S	M	S	S	S	M	S
Strongly Correlating (S) - 3 marks Weakly Correlating (W) - 1 mark Moderately Correlating (M) - 2 marks No Correlation (N) - 0 mark													

Course Code	U21BCS532	MOLECULAR MODELLING AND DRUG DESIGNING			
SBE	III	L	T	P	C
Cognitive Level	K2: Understand	K3: Apply	K4: Analyze		
Learning Objective	<ul style="list-style-type: none"> To know the concepts in Quantum mechanics, molecular modelling and molecular dynamics To learn the basic modelling techniques to explore biological phenomena at the molecular level To attain perceive knowledge in protein-ligand interaction study by docking and visualization tools for molecular modelling. 				
Unit I	Quantum mechanics & concepts in molecular Modeling				
Coordinate systems, potential energy surfaces. Introduction to quantum mechanics. Force Fields - Bond stretching; angle bending, torsional terms; non-bonded interactions; electrostatic interactions; Vander Waals interactions					
Unit II	Molecular Dynamics and Monte Carlo simulation:				
Design Constraints, Potentials in MD simulation, Molecular dynamics algorithms.					
Unit III	Analysis and Properties:				
Geometry optimization, Vibrational frequencies: potential energy surface, harmonic vs. fundamental frequencies, zero-point vibrational energies.					
Unit IV	Modelling:				
Homology Modeling, Ab initio, Protein Threading. Drug design -Structure-based methods to identify lead compounds: finding lead compounds by searching 3D databases; de novo ligand design.					
Unit V	Molecular Docking :				
Docking - molecular Modeling in Drug Design – structure-based drug design – pharmacophores - QSAR.					
Text Books	<ol style="list-style-type: none"> Moore E A, Molecular Modelling and Bonding, C Publishing, 2002 Schneider, Molecular Design Concepts and Applications, John Wiley. 2008 Rajesh Kumar, Anju Sharma, Tiwari, Introduction To Drug Designing And Development by Kumar, Nova. 2014 Cohen Claude N. Guidebook on Molecular Modeling In Drug Design, Elsevier India. 2014 				
References	<ol style="list-style-type: none"> Leach AR, Molecular Modeling, Principles & Applications, Pearson education Ltd, UK. 2010. Arjun S, Drug Discovery, Design & Development Lambert Academic publishing. 2013. Clark T, Thurston DE, and Banting L, Drug Design Strategies: Computational Techniques & Applications Royal society of chemistry, 2012. Kukol, Andreas, Molecular Modeling of Proteins, Publisher Springer, 2015. 				

E-Reference links	<ol style="list-style-type: none"> https://www.mdpi.com/books/pdfview/book/1187 https://www.kobo.com/us/en/ebook/molecular-modelling-and-drug-design https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6539951/ https://link.springer.com/article/10.1007/BF02834015 http://www.drugdiscoverytoday.com/view/25419/molecular-modeling/ 													
Course Outcomes	Upon completion of this course the students will be able to													
	CO1	know the concepts of Molecular modelling							K2					
	CO2	employ different designs and potentials in molecular dynamics simulation							K3					
	CO3	illustrate the concept of optimization and vibrational frequencies							K3					
	CO4	understand homology modelling and the methods to identify lead compounds							K3					
	CO5	compare different drug designs for molecular modelling by docking							K4					
Mapping of COs with POs & PSOs														
CO	PO								PSO					
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	M	S	S	S	M	S	S	S	M	S	S	
CO2	S	S	S	M	M	S	M	S	S	S	M	M	S	
CO3	S	S	S	S	M	M	M	S	S	S	M	S	S	
CO4	S	S	M	M	S	S	M	S	S	S	S	S	S	
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S	
Strongly Correlating (S) - 3 marks Weakly Correlating (W) - 1 mark Moderately Correlating (M) - 2 marks No Correlation (N) - 0 mark														

SEMESTER VI

Course Code	U21BCT61	PRINCIPLES OF ENZYME TECHNOLOGY			
CORE	XIII	L	T	P	C
		5	-	-	4
Cognitive Level	K1: Recall K2: Understand K3: Apply				
Learning objective	<ul style="list-style-type: none"> To know about the enzyme reaction and enzyme kinetics through Michaelis- Menten equation and LB plot. To learn the methods of enzyme assay and the regulation mechanism of enzyme activity. To understand and know the mode of enzyme action and the industrial applications of enzymes. 				
Unit I	Enzymes:				
Introduction, Function, nomenclature, classification, isolation, purification and characterization of enzymes. Metallo enzymes and metal activated enzymes. Enzyme specificity and its reactions					
Unit II	Enzyme substrate complexes				
Michaelis – Menten kinetics: Determination of Km and V max – Line Weaver Burk plot – Factors influencing enzyme reaction and Enzyme inhibition – competitive inhibition, non - competitive inhibition, un competitive inhibition.					
Unit III	Enzyme assay				
Methods and applications, regulation of enzyme activity- allosteric regulation, covalent modification, zymogens and feedback regulation					
Unit IV	Mechanism of enzyme action				
Acid base catalysis – Ribonuclease, covalent catalysis - chymotrypsin, metal ion catalysis – carboxy peptidase A, activation energy, role of coenzymes in enzyme reaction. eg: NADH,FADH and CoASH.					
Unit V	Enzyme Applications				
A brief account of enzyme applications – Immobilized enzymes and diagnostic enzymes (Liver enzymes (SGOT,SGPT),LDH,CK, Phosphatase) – enzymes as drugs in digestive disorders, applications of enzymes in Industries.					
Text Books	<ol style="list-style-type: none"> Athel Cornish Bowden Fundamental of Enzyme kinetics, Wiley – Blackwell, 2012. T.D.H. Bugg, Introduction to Enzymes & Co-Enzyme chemistry, Wiley, 2012 				
References	<ol style="list-style-type: none"> Irwin.H. Segel, Enzyme kinetics - Wiley, 2014. A.C.Bowden, Fundamentals of Enzyme kinetics, Medtech, 2017. N.S. Punekar, Enzymes: Catalysis, kinetics and Mechanisms, Springer, 2018. 				
E-References	<ol style="list-style-type: none"> https://www.longdom.org/open-access/enzyme-technology--an-emerging-trend-in-biotechnology-2329-6674-1000163.pdf 				

Link	2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3962110/ 3. https://www.kth.se/dib/enzyme-technology-1.783173													
Course outcomes	Upon completion of this course, the students will be													
	CO	Course Outcomes								Knowledge Level				
	CO1	understand the basics and characterization and purification of enzymes.								K1, K2				
	CO2	gain knowledge on enzyme kinetics and inhibition								K1, K2, K3				
	CO3	learn about the enzyme assay and their regulation.								K1, K2, K3				
	CO4	learn the mechanism of action of enzyme with examples								K1, K2, K3				
	CO5	illustrate the applications of enzyme and its immobilization techniques								K1, K2, K3				
Mapping of CO with PO & PSO														
CO	POs								PSOs					
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	M	S	S	S	S	S	M	S	S	S	M	S	
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	
CO3	S	S	S	S	M	M	S	S	S	M	S	S	M	
CO4	S	M	S	S	S	S	S	S	S	S	S	S	S	
CO5	S	S	S	M	S	S	M	S	S	S	M	S	S	
Strongly Correlating (S) - 3 marks Weakly Correlating (W) - 1 mark Moderately Correlating (M) - 2 marks No Correlation (N) - 0 mark														

Course Code	U21BCT62	MEDICAL BIOCHEMISTRY			
CORE	XIV	L	T	P	C
Cognitive Level	K1: Recall	K2: Understand	K3: Apply		
Learning Objective	<ul style="list-style-type: none"> To understand about scope of clinical biochemistry to detect disorders. To know about disorders caused due to the error in carbohydrate, lipid, protein metabolism and regulation of blood glucose level. To learn the tissue function tests, biochemical tests and renal disorders. 				
Unit I	Clinical biochemistry				
Introduction, scope of clinical biochemistry in diagnosis and preservation of biological fluids (Blood, Urine and CSF). Disorders of carbohydrate metabolism: Regulation of blood glucose, digestion and absorption, normal blood glucose level, hypo and hyper glycemia, diabetes GTT, glucosuria GTT and galactosemia. Inborn errors of carbohydrate metabolism					
Unit II	Disorders of lipid metabolism				
Digestion and absorption of lipid, hypo and hyper lipoproteinemias, disorders of triglycerides, phospholipids and cholesterol metabolism, inborn errors of lipid metabolism.					
Unit III	Disorders of amino acid and protein metabolism				
Digestion and absorption, urea cycle, disorders of urea, uric acid, creatinine and ammonia. Hypo urecemia, hyper urecemia and porphyria, inborn errors of amino acid metabolism.					
Unit IV	Disorders of nucleic acid metabolism				
Purine and pyrimidine metabolism. Gout, oroticaciduria and xanthinuria.					
Unit V	Tissue function tests				
Biochemical tests of liver, kidney and pancreas, significance of tissue function tests. Renal and liver transport: Renal Glycosuria, cystenuria, Fanconi syndrome, Crigglar - Najjar disease, Gilbert's disease, Dubin – Johnson disease.					
Text Books	1.Nanda Maheswari, Clinical Biochemistry Jaypee Brothers Medical Publishers, 2016. 2.John. E. Hall, Guyton & Hall Text book of Medical Physiology, Elsevier, Health, 2017.				
References	1.Rajinder Chawla, Tarek. H. E, Metwally Sucherda sahu, Text book of Medical Biochemistry Wolters Kluwer India, Pvt, Ltd, 2017. 2.Allan Gaw, <i>et al.</i> , Clinical chemistry Churchill Living Stone, 2018. 3.Michael Murphy, Rajeer Srivastava, Kevin Deans, Clinical Biochemistry, Elsevier, 2018.				
E-References link	1. https://csc.ca/en/about-us/what-is-clinical-chemistry.html 2. https://journals.sagepub.com/home/acb 3. https://www.mayoclinic.org/departments-centers/laboratory-medicine-pathology/overview/specialty-groups/clinical-biochemistry-immunology				

Course outcomes	Upon completion of this course, the students will be		
CO	Course Outcomes	Knowledge Level	
CO1	describe various mechanism disorders of carbohydrates	K1, K2	
CO2	discuss about the lipid metabolism disorders	K1, K2, K3	
CO3	realize the disorders of protein and amino acid metabolism	K1, K2, K3	
CO4	know and understand about the nucleic acid metabolism	K1, K2, K3	
CO5	analyze and realize the facts of tissue function tests	K1, K2, K3	

Mapping of CO with PO & PSO

CO	POs								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	M	S	S	S	S	M	S
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	M	S	S	S	S	M	S	S	M
CO4	M	S	S	S	S	M	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S

Strongly Correlating (S) - 3 marks Weakly Correlating (W) - 1 mark
 Moderately Correlating (M) - 2 marks No Correlation (N) - 0 mark

Course Code	U21BCT63	BIOPROCESS TECHNOLOGY			
CORE	XV	L	T	P	C
Cognitive Level	K1: Recall	K2: Understand	K3: Apply		
Learning Objective	<ul style="list-style-type: none"> To learn about Industrial microorganisms To understand learn the techniques of fermentation. To learn the production of industrial products using microorganisms. 				
Unit I	Introduction to industrial microorganisms:				
Isolation, Preservation and Maintenance of Industrial Microorganisms. Kinetics of microbial growth and death. Media for industrial fermentation. Air and Media Sterilization.					
Unit II	Types of fermentation processes:				
Solid state and liquid state fermentations; batch, fed-batch and continuous fermentations. Components of bioreactor, Types of bioreactor, Measurement and control of bioprocess parameters- pH, temperature, dissolved oxygen, foaming and aeration.					
Unit III	Downstream Processing:				
Introduction, Removal of microbial cells and solid matter, foam removal, precipitation, filtration, centrifugation, cell disruption, liquid-liquid extraction chromatography, Membrane process, Drying and Crystallization.					
Unit-IV	Microbial production of Industrial Products:				
Alcohol (Ethanol), Acids (Citric), Antibiotics (Penicillin), Amino acids (lysine), Single Cell Protein (algae/fungi).					
Unit-V	Enzyme immobilization:				
Methods of immobilization, advantages and application of immobilization, large scale application of immobilized enzymes.					
Text Books	<ol style="list-style-type: none"> S.M. Reddy, Basic Fermentation Technology, New Age International Publishers, 2017. H. K. Das, Textbook of Biotechnology, 5th Edition, Wiley, 2017. Wulf Crueger, Anneliese Crueger, A Textbook of Industrial Microbiology, Wiley, 2017. U. Sathyanarayana, U. Chakrapani, Biotechnology, Books & amp; Allied Ltd, 2020. 				
References	<ol style="list-style-type: none"> Doraiswami Ramkrishna, Subhabrata Sengupta, Sudipta Dey Bandyopadhyay, Avijit Ghosh, Advances in Bioprocess Engineering and Technology, Springer, r 2020. Michael I. Shuler, Fikret Kargi Bioprocess Engineering: Basic Concepts, Pearson Education India 2015. Casida, L. E. Industrial Microbiology. New Age International (P) Ltd., New Delhi, 2013. Michael Shuler and Fikret Kargi.. Bioprocess Engineering: Basic Concepts, Prentice Hall, Englewood Cliffs, 2020 Bioprocess Engineering Principles by Pauline M. Doran, 2nd Edition, Elsevier, 2012. 				

E-References link	<ol style="list-style-type: none"> http://microbio.du.ac.in/web3/uploads/Microbiology%20Uploads/Reading%20material/MBOE-201%2002.%20strain%20improvement.pdf https://www.mpgmahavidyalaya.org/userfiles/Fermentation%20Types.pdf https://theconstructor.org/environmental-engg/difference-chemical-oxygen-demand-cod-biological-oxygen-demand-bod/34792/ https://microbiologynotes.org/downstream-processing-and-its-steps/ https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5385174/ https://www.britannica.com/topic/food-preservation/Fungi https://www.news-medical.net/health/What-are-Biosensors.aspx 													
Course outcomes	Upon completion of this course, the students will be able to													
	CO	Course Outcomes								Knowledge Level				
	CO1	gain a comprehensive understanding of media formulations, microbial growth kinetics								K1, K2				
	CO2	acquire knowledge on bioreactor selection, upstream & fermentation processes, and its role in manufacturing bio-products								K1, K2, K3				
	CO3	gain knowledge on downstream processing								K1, K2, K3				
	CO4	discuss about various products obtained from microbes								K1, K2, K3				
	CO5	illustrate the techniques of enzyme immobilization								K1, K2, K3				
Mapping of CO with PO & PSO														
CO	POs								PSOs					
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	M	S	S	S	S	S	S	S	S	S	M	S	
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	
CO3	S	S	S	S	M	S	S	S	S	M	S	S	M	
CO4	S	M	S	S	S	S	S	S	S	S	M	S	S	
CO5	S	S	S	M	S	S	S	S	S	S	S	S	S	
Strongly Correlating (S) - 3 marks				Moderately Correlating (M) - 2 marks										
Weakly Correlating (W) - 1 mark				No Correlation (N) - 0 mark										

Course Code	U21BCT64	BIO- INSTRUMENTATION	L	T	P	C
CORE	XVI		5	-	-	4
Cognitive Level	K1: Recall K2: Understand K3: Apply					
Learning objective	<ul style="list-style-type: none"> To know the fundamental principles and applications of basic instruments in biology To learn the types of electrophoresis and spectroscopy To understand, design and evaluate systems and devices that can measure, test and/or acquire biological information 					
Unit I	Microscopy					
Parts and their function, resolving power, aperture – simple, compound, light and dark field, electron and phase contrast microscopes, fluorescent– their applications.						
Unit II	Colorimetry					
Parts and their functions - Beer Lambert's Law. pH metry, Spectroscopy -NMR, IR, UV. Centrifugation techniques – principle, centrifuges and their uses, separation methods. Ultracentrifugation – applications						
Unit III	Chromatography techniques					
Principles and types – paper, TLC, Column, HPLC and GC. Electrophoretic techniques – principle, electrophoresis of proteins and nucleic acids. Capillary electrophoresis, Pulse field electrophoresis and 2 D gel electrophoresis						
Unit IV	Biochemical Techniques					
<ul style="list-style-type: none"> Estimation of carbohydrates Estimation of Proteins Preparation of Buffers Qualitative identification of Nucleic Acids 						
Unit V	1. Lipid analysis <ol style="list-style-type: none"> Determination of Saponification number Determination of Acid number Determination of Iodine number 2. Separation of lipids by TLC Separation of Amino acids by Paper chromatography.					
Text Books	<ol style="list-style-type: none"> M. J. Reilly, Bioinstrumentation , CBS Publishers & Distributers, 2016. John G. Webster ,Bioinstrumentation, Wiley,2018. M.H. Fulekar & Bhawana Pandey, I. K. Bioinstrumentation, International Publishing House Pvt. Ltd., 2014 					
References	<ol style="list-style-type: none"> L. Veerakumari, Bioinstrumentation, MJP Publisher, 2019. M. J. Reilly, Bioinstrumentation, CBS Publishers & Distributers, 2016. John G. Webster, Bioinstrumentation, Wiley, 2018. Keith Wilson and John Wilson, Practical Biochemistry, Fifth edition Cambridge University Press, 2018. M.H. Fulekar & Bhawana Pandey, Bioinstrumentation , I. K. International Publishing House Pvt. Ltd., 2014. 					

E-References Link	1. https://application.wiley-vch.de/books/sample/3527338802_c01.pdf 2. https://bioeng.berkeley.edu/research/bioinstrumentation 3. https://worldwidescience.org/topicpages/b/bioinstrumentation.html														
Course outcomes	Upon completion of this course, the students will be able to														
	CO	Course Outcomes								Knowledge Level					
	CO1	understand the fundamentals of microscope and its working principle.								K1, K2					
	CO2	realize the use of Colorimetry and spectroscopy. Acquire knowledge on centrifuge and its types								K1, K2, K3					
	CO3	recognize the importance of chromatographic techniques and Empathize on electrophoretic techniques								K1, K2, K3					
	CO4	explain the fundamentals of Biochemical techniques								K1, K2, K3					
	CO5	estimate and separate the lipid molecules								K1, K2, K3					
Mapping of CO with PO & PSO															
		PO								PSO					
CO		1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1		S	S	S	S	S	S	S	S	S	S	M	S	S	
CO2		S	S	S	S	S	S	S	S	S	S	S	S	S	
CO3		S	S	M	S	M	S	S	M	S	S	S	S	M	
CO4		M	S	S	S	S	M	S	S	S	S	S	S	S	
CO5		S	S	S	M	S	S	S	S	S	S	S	M	S	
Strongly Correlating (S)		- 3 marks				Moderately Correlating (M)					- 2 marks				
Weakly Correlating (W)		- 1 mark				No Correlation (N)					- 0 mark				

Course Code	U21BCP64	PRINCIPLES OF ENZYME TECHNOLOGY & MEDICAL BIOCHEMISTRY - PRACTICAL	L	T	P	C
CORE	XVII		5	-	-	4
Cognitive Level	K1:Recall K2:Understand K3:Apply K5:Analyze					
Learning Objective	<ul style="list-style-type: none"> ➤ To acquire the practical knowledge for the estimation of blood sugar and uric acid level estimation ➤ To know the diagnostic methods in laboratory level. ➤ To develop skill to do the test such as Blood analysis, Urine analysis 					
Enzyme & Enzyme Technology & Clinical Biochemistry						
	<p>Preparation of crude enzyme extract</p> <ol style="list-style-type: none"> a) Effect of pH b) Temperature c) Substrate concentration d) Enzyme concentration e) Determination of km. <p>Clinical Biochemistry</p> <p>Blood analysis</p> <ol style="list-style-type: none"> 1. Blood sugar– Azatoor and king’s method 2. Blood urea-Dam method 3. Blood cholesterol– Zak’s method 4. Blood uric acid– Caraway method 5. Serum Creatinine –Picric acid method 6. Estimation of protein by biuret method 7. Estimation of Calcium and phosphorous <p>Urine analysis</p> <ol style="list-style-type: none"> 1. Urine urea 2. Uric acid 3. urine sugar 					
Text Books	<ol style="list-style-type: none"> 1. Shivaraja Shankara. Y. M. Laboratory Manual for Practical Biochemistry Jaypee Brothers Medical Publishers, 2nd Edition, 2013. 2. S. Rajan, R. Selvi christy Experimental Procedures in Lifesciences CBS, 2019 					
References	<ol style="list-style-type: none"> 1. Soundravally Rajendiran, Pooja Dhiman, Biochemistry Practical Manual, Elsevier, 2019. 2. CG. Kaushik, Neha Sharma, Sabira Dabeer, Ruchi Jindal, Practical Manual of Biochemistry, CBS, 2020. 3. Rafi M. D, Manual of Practical Biochemistry Orient Black swan Pvt. Ltd, 2020. 4. Shivananda Nayak B. Manipal Manual of Clinical Biotechnology Jaypee Brothers, 2013. 5. Drew Provan, Oxford Handbook of Clinical and Laboratory Investigation OUP, Oxford, 2018. 					

E-References Link	<ol style="list-style-type: none"> https://youtu.be/-atHARq0JbQ https://youtu.be/HfubKxTjvIE https://youtu.be/B88TqQYOENU https://youtu.be/yxokk8VYfII https://www.tasmc.org.il/sites/en/Lab/Pages/Clinical-Biochemistry-Laboratory.aspx https://www.researchgate.net/publication/260182512_Practical_Manual_in_Biochemistry_and_Clinical_Biochemistry http://rajswashthya.nic.in/RHSDP%20Training%20Modules/Lab.%20Tech/Biochemistry/Dr.%20Jagarti%20Jha/Techniques%20In%20Biochemistry%20Lab.pdf 													
Course outcomes	Upon completion of this course, the students will be able to													
	CO	Course Outcomes								Knowledge Level				
	CO1	acquire knowledge on preparation of enzyme and their effect various factors								K1,K2				
	CO2	analyze the blood sugar, Protein, Cholesterol								K1,K2,K5				
	CO3	acquire knowledge on blood urea, uric acid, creatinine								K1,K2,K3				
	CO4	learn and understand the urine urea, uric acid and sugar								K1,K2,K3				
	CO5	analyze the urine component								K1,K2,K3				
Mapping of CO with PO& PSO														
CO	PO								PSO					
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	M	M	S	S	M	S	S	S	M	S	M	S	
CO2	S	M	S	S	S	S	S	S	S	S	S	M	S	
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	
CO4	S	M	S	S	S	S	S	S	S	S	S	S	S	
CO5	S	S	S	S	S	S	S	S	S	S	S	M	S	
Strongly Correlating (S) - 3 marks Moderately Correlating (M) - 2 marks														
Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark														

Course Code	U21BCE641	HORMONES AND NEUROCHEMISTRY			
Elective	IV	L	T	P	C
Cognitive Level	K1: Recall	K2: Understand	K3: Apply		
Learning objective	<ul style="list-style-type: none"> To get the deep knowledge about the classification, biosynthesis and degradation mechanism of hormones. To learn about the biosynthesis and mode of action of thyroid hormone, pancreatic and adrenal hormones. To gain the profound knowledge about the structure and function of brain, neurotransmitters with examples. 				
Unit I	Hormones				
Definition, classification, biosynthesis and degradation. Mechanism of hormone action, class I and II hormone receptors, steroids. Feedback regulation of hormones.					
Unit II	Hypothalamus and pituitary hormones:				
Hypothalamic releasing factors vasopressin, oxytocin. Biosynthesis, secretion, transport, regulation and biological effects of growth hormones, FSH, LH, TSH, ACTH and prolactin					
Unit III	Thyroid hormones				
Biosynthesis, secretion, transport, regulation and biological actions. Hypo and hyperthyroidism, antithyroid agent's role of parathyroid hormones, calcitriol, calcium and phosphorous homeostasis. Hypo and hyperparathyroidism.					
Unit IV	Pancreatic hormones				
Insulin and glucagon: biosynthesis, mechanism of action and biological effects. Adrenal hormones: biosynthesis, mechanism of action of glucocorticoids, mineralocorticoids, adrenal medullary hormones - epinephrine and nor epinephrine, steroid hormones - androgens and estrogens.					
Unit V	Neurotransmitters:				
Synthesis, storage, release, uptake, degradation and action of neurotransmitters. Acetyl choline, GABA, serotonin, dopamine, glutamate, aspartate, nitrous oxide.					
Text Books	1. C. Donnell Turner, Joseph. T. Bagnara, General Endocrinology Affiliated East – West Press Pvt. Ltd – New Delhi, 6 th edition, 2012.				
References	<ol style="list-style-type: none"> Shiomo Melmed, Kenneth S. Polonsky, P. Reed Larsen, Henry. M. Kronberg, Williams Textbook of Endocrinology Elsevier, 13th Edition, 2015. Bernhard Kleine, Winfried. G. Rossmann Hormones and the Endocrine System – Textbook of Endocrinology Springer Nature, First Edition, 2016. J.Larry. Jameson, Harrison's Endocrinology Chaukhamba Auriyantaliya, 4th Edition, 2017. David. G. Gardner & Dolores Shoback, Greenspan's Basic & Clinical Endocrinology Overruns, 2017. 				

E-References link	<ol style="list-style-type: none"> https://link.springer.com/chapter/10.1007/978-1-4757-9847-0_34 https://pubmed.ncbi.nlm.nih.gov/1363136/ https://www.visiblebody.com/blog/endocrine-system-hypothalamus-and-pituitary https://courses.lumenlearning.com/suny-ap2/chapter/the-pituitary-gland-and-hypothalamus/ 													
Course outcomes	Upon completion of this course, the students will be able to													
	CO	Course Outcomes								Knowledge Level				
	CO1	acquire the knowledge on classification and regulation of hormones								K1, K2				
	CO2	learn about the hypothalamus and pituitary hormones								K1, K2, K3				
	CO3	explain the secretion and role of thyroid and parathyroid hormones								K1, K2, K3				
	CO4	understand about pancreas and adrenal hormones								K1, K2, K3				
	CO5	know about the cells of nervous system , neurotransmitters and related drugs								K1, K2, K3				
Mapping of CO with PO & PSO														
CO	PO								PSO					
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	M	S	S	S	S	M	S	S	S	S	M	S	
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	
CO3	S	S	S	S	M	S	S	M	S	M	S	S	M	
CO4	S	M	S	S	S	M	S	S	S	S	M	S	S	
CO5	S	S	S	M	S	S	S	S	S	S	S	S	S	
Strongly Correlating (S) - 3 marks				Moderately Correlating (M) - 2 marks										
Weakly Correlating (W) - 1 mark				No Correlation (N) - 0 mark										

Course Code	U21BCE642	PLANT PATHOLOGY			
Elective	IV	L	T	P	C
		3	-	-	3
Cognitive Level	K1: Recall	K2: Understand			
Learning objective	<ul style="list-style-type: none"> • To learn plant diseases Classification and defense mechanisms in Plants • To know the methods of assessment of disease incidence and disease severity • To gain knowledge on principles and methods of plant disease control. 				
Unit I	History and development of Plant Pathology Disease concept in plants:				
Disease classification, Causal factors - biotic and abiotic, disease diagnosis, Koch's postulates. Defense Mechanism in plants: Structural and Biochemical.					
Unit II	Epidemiology:				
Traditional and modern concepts of disease triangle, Role of host, pathogen and environment in disease development. Aerobiology in relation to Epidemiology. Methods of monitoring splash borne and airborne inoculum.					
Unit III	Assessment of disease:				
Methods of assessment of disease incidence and disease severity and estimation of yield loss. Study of plant diseases of major crops in India caused by fungi, bacteria, and viruses. (with reference to symptoms, etiology and control)					
Unit IV	Plant diseases:				
Study of importance, symptoms, causal organism, disease cycle and control of diseases of crop plants. Rots diseases with special reference to fruit and stem end rot of papaya. Damping off of seedlings of crop plants. Downy mildews of cucurbits.					
Unit V	Principles and methods of plant disease control:				
Control through regulatory methods: Plant quarantine. Cultural and biological methods of control. Control through physical means. Chemical method for plant disease control: Fungicides, chemotherapy. Use of resistant varieties.					
Text Books	<ol style="list-style-type: none"> 1. P. D. Sharma, Environmental Botany and Plant Pathology, Publisher, Rastogi, 2015 2. R.S. Mehrotra, Ashok Aggarwal, John William Harshberger, Mycology and Plant pathology, Publisher McGraw Hill Education, 2015 				
References	<ol style="list-style-type: none"> 1. Chaube H.S. Introductory plant pathology, Publisher CBS, 2017 2. Stephen Burchett, Sarah Burchett, Plant Pathology, Garland Science, 2017 				
E-References link	<ol style="list-style-type: none"> 1. http://ceventura.ucanr.edu/Environmental_Horticulture/Landscape/Problems/Pathology/ 2. https://phytopath.ca/education/what-is-plant-pathology/ 				

	3. https://cropwatch.unl.edu/soybean-management/plant-disease 4. https://www.saferbrand.com/advice/plant-disease-library													
Course outcomes	Upon completion of this course, the students will be able to													
	CO	Course Outcomes								Knowledge Level				
	CO1	know the concept of plant diseases and its classification								K1				
	CO2	understand the epidemiology of plant diseases								K1, K2				
	CO3	attain knowledge on plant diseases of major crops in India								K1, K2				
	CO4	understand disease cycle and control of diseases of crop plants								K2				
	CO5	learn the Principles and methods of plant disease control								K2				
Mapping of CO with PO & PSO														
CO	PO								PSO					
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	M	S	S	S	S	M	S	S	S	S	M	S	
CO2	S	S	S	M	S	M	S	M	S	S	S	S	S	
CO3	S	S	M	S	M	S	S	M	S	M	S	M	M	
CO4	S	M	S	S	S	M	M	S	S	S	M	S	S	
CO5	S	S	M	M	S	S	S	S	M	M	S	M	S	
Strongly Correlating (S) - 3 marks Moderately Correlating (M) - 2 marks Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark														

Course Code	U21BCS641	MEDICAL CODING			
SBE	IV	L	T	P	C
Cognitive Level	K1: Recall	K2: Understand	K3: Apply		
Learning Objective	<ul style="list-style-type: none"> To understand the scope of medical coding To learn the basics in medical coding To acquire knowledge on Indian and US healthcare providers and payers To understand the coding procedures and techniques To learn the terminologies, general and specific codes 				
Unit I	Medical coding:				
Introduction to medical coding, basic structure of the medicare program, Health insurance portability and accountability act, Healthcare in India and US, Patient, Provider and Payers Relationship, Importance and significance of coding in today's world					
Unit II	Anatomy and Pathophysiology:				
Human body – Anatomical Position, Body Cavities, Important terminologies in Dermatology, Ophthalmology, Otorhinolaryngology, Pulmonology, Cardiology. Gastroenterology, Genitourinary system, Gynaecology and Obstetrics, Orthopaedics, Endocrinology, Immunology, Lymphatics, and Hematology					
Unit III	ICD-9-CM:				
History, Volumes, Conventions, General Coding Guidelines, Infections and Parasitic Diseases, Endocrine, Nutritional and metabolic diseases, and immunity disorders, Diseases of blood and blood forming organs, Mental disorders, Diseases of Circulatory System, Diseases of Respiratory system, Diseases of Digestive system					
Unit IV	Current Procedural Terminology				
Introduction to CPT, Category I to Category III, Six sections of CPT in Detail Evaluation and Management, Anesthesiology, Surgery, Radiology, Pathology and Laboratory, Medicine, Significance of Parent codes, CPT Modifiers, Symbols and significance, Alphanumeric codes overview of categories II and III					
Unit V	HCPCS (Healthcare Common Procedure Coding System):				
Introduction to HCPCS, Significance and Usage, Types of HCPCS, Modifiers Level II HCPCS					
Text Books	<ol style="list-style-type: none"> Patricia A.T, 2009, Medical coding, Jones and Bartlett Publishers, Inc Patricia A.T, 2005, Medical Coding What It Is And How It Works, Jones and Bartlett Publishers 				
References	<ol style="list-style-type: none"> Sandra, J.2018, Understanding medical coding, 4 th edition, Cengage Learning Inc. publishers Mcgrath M, 2017, Coding for beginners in easy steps, PBP publications 				

E-References Link	<ol style="list-style-type: none"> https://www.velocityhc.com/wp-content/uploads/2019/09/Step-by-Step-Medical-Coding-2017-Edition-E-Book.pdf https://aapcperfect.s3.amazonaws.com/ppdf/2011MCT_CPC_TB_Student-Press_Sample1.pdf https://www.icslearn.ca/~media/files/pdf/samplelessons/582-basic-medical-coding.pdf?la=en http://www.billing-coding.com/pdf/mbacc_ebook_full_pages.pdf 												
Course outcomes	Upon completion of this course, the students will be able to												
	CO	Course Outcomes							Knowledge Level				
	CO1	understand the basics and the importance of medical coding							K1, K2				
	CO2	gain knowledge on human anatomy and important terminologies							K1, K2, K3				
	CO3	learn about ICD-9-CM and general coding guidelines							K1, K2, K3				
	CO4	acquire knowledge on current procedural terminologies							K1, K2, K3				
	CO5	know about Healthcare Common Procedure Coding System							K1, K2, K3				
Mapping of CO with PO & PSO													
		PO							PSO				
CO	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	M	M	S	M	S	S	S	S	M	S
CO2	S	S	S	M	S	S	S	S	S	S	S	S	S
CO3	S	M	S	S	M	S	M	S	S	M	S	M	M
CO4	S	S	S	M	S	M	S	S	S	S	S	S	S
CO5	S	S	S	S	M	S	S	S	S	M	M	M	S
Strongly Correlating (S)				- 3 marks				Moderately Correlating (M)				- 2 marks	
Weakly Correlating (W)				- 1 mark				No Correlation (N)				- 0 mark	

Course Code	U21BCS642	BIOSAFETY & IPR			
SBE	IV	L	T	P	C
Cognitive Level	K1: Recall K2: Understand K3: Apply				
Learning Objective	<ul style="list-style-type: none"> To understand the key concept and historical background of biosafety and to know the importance of biosafety levels, biosafety guidelines and regulations and the function of institutional biosafety committee. To study the application of GMOs in various field and methods to release GMO's in the environment. To acquire the knowledge about IPR, patenting, trademark, copyrights and geographical indications. 				
Unit I	Biosafety				
Introduction; biosafety issues in biotechnology-historical background; Introduction to Biological Safety Cabinets; Biosafety Levels.					
Unit II	Biosafety Guidelines				
Biosafety guidelines and regulations (National and International) – operation of biosafety. Guidelines and regulations of Government of India; Roles of Institutional Biosafety Committee.					
Unit III	GMO				
Definition of GMOs, GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication.					
Unit IV	Types of Intellectual Property				
Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications. Importance of IPR					
Unit V	Patent Filing Procedures:				
National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Precautions while patenting – disclosure/nondisclosure; Financial assistance for patenting					
Text Books	1. V.K. Ahuja ,Intellectual property rights in India , Lexisnexis publishers, 2015 2. M.K.Satheesh, Bioethics and Biosafety, Wiley Publishers, 2020. 3. Deepa Goel ,IPR, Biosaftey and Bioethics ,Pearson publishers ,2013.				
References	1. M.M.S.Karki, Intellelual property rights , Basic concept, 2011. 2. Rae Scott B Willam B, Bioethics, Eerdmans publishing house,2013.				
E-References Link	1. https://www.researchgate.net/publication/329170462_IPR_Biosafety_Bioethics 2. https://biocyclopedia.com/index/biotech_biosafety_ipr_ipp.php 3. https://link.springer.com/chapter/10.1007/978-981-10-2961-5_14				

Course outcomes	Upon completion of this course, the students will be able to												
CO	Course Outcomes								Knowledge Level				
CO1	explain the basics of biosafety								K1, K2				
CO2	recognize the guideness and regulation of biosafety								K1, K2, K3				
CO3	acquire knowledge on food assessment and risks analysis								K1, K2, K3				
CO4	realize and Learn about intellectual property								K1, K2, K3				
CO5	gather information regarding patenting and its procedures								K1, K2, K3				
Mapping of CO with PO & PSO													
CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	M	S	S	S	S	S	S
CO2	S	S	S	M	S	S	S	S	S	S	S	S	S
CO3	S	M	S	S	M	S	M	S	S	M	S	S	M
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S	M	S	S
Strongly Correlating (S) - 3 marks Moderately Correlating (M) - 2 marks Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark													

Course Code	U21BCV51	SINGLE CELL PROTEIN	Total Hours	C
Value Added Programme	IV		30	2
Cognitive Level	K1: Recall K2: Understand K3: Apply			
Learning Objective	1. To understand the key concept and historical background of algal biomass as non-conventional food 2. To know about the application of SCP and mass cultivation of spirulina 3. To acquire the knowledge about the uses of spirulina and steps of mass cultivation			
Unit I	Algal biomass as non- conventional food:			
Introduction, Concept and need, Advantages, disadvantages and Sources of non-conventional food				
Unit II	Introduction to SCP production			
Historical use and rediscovery of <i>Spirulina</i> importance – morphology, taxonomy and habitat of <i>Spirulina</i> –biochemical composition including proximate composition – amino acids – unsaturated fatty acids – minerals and vitamins. Human health benefits of <i>Spirulina</i> .				
Unit III	Spirulina cultivation for single cell protein			
SCP Introduction, Systematic position, thallus structure, Merits of Spirulina cultivation, Methods of cultivation- Small scale cultivation, Mass cultivation, Harvesting of Spirulina, Flow chart of Spirulina cultivation, Limiting factors for Spirulina cultivation, Spirulina products –Powder, Biscuits, Tablets				
Unit IV	Spirulina cultivation			
Principle, Requirement, chemicals, Sample or Inoculum of Spirulina, procedure, observations, Harvesting, results and records, precautions Visit to a spirulina cultivation laboratory in nearby area (Students are expected to prepare a model of spirulina cultivation laboratory, a visit report and to submit the same at the time of practical examination.				
Unit V	Natural production			
Laboratory cultivation – small scale commercial production – commercial and mass cultivation (tank construction, culture medium, strain selection, scaling up of the process) – importance of light and pH in <i>Spirulina</i> cultivation – harvesting, drying and packing				
Text Books	1. Umar Bacha, Muhammad Nasir, Single Cell Protein: Production and Evaluation for Food Use Evaluation for Food Use, Lambert Publication, 2011 2. Amos Richmond, Qiang Hu, Handbook of Microalgal Culture: Applied Phycology and Biotechnology, Wiley, 2013			
References	1. Biswas S., Datta M. and Ngachan S.V, Mushrooms: A Manual for Cultivation, PHI, 2012. 2. Aaron Baum, Grow Your Own Spirulina Superfood: A Simple How-To Guide Kindle Edition, 2013. 3. Selvendran D, Large Scale Algal Biomass (Spirulina) Production in India. In: D. Das Algal Biorefinery: An Integrated Approach, Springer. 2015.			
E-References Link	1. https://www.researchgate.net/publication/329170462_IPR_Biosafety_Bioethics			

	2. https://biocyclopedia.com/index/biotech_biosafety_ipr_ipp.php 3. https://link.springer.com/chapter/10.1007/978-981-10-2961-5_14	
Course outcomes	Upon completion of this course, the students will be able to	
	CO	Course Outcomes
	CO1	understand the advantages and disadvantages of algal mass
	CO2	learn the production of SCP
	CO3	acquire knowledge on spirulina cultivation
	CO4	illustrate the steps of spirulina cultivation
	CO5	gather information regarding natural production, mass cultivation and process
		Knowledge Level
		K1, K2
		K1, K2, K3
		K1, K2, K3
		K1, K2, K3
		K1, K2, K3

Mapping of CO with PO & PSO

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	M	S	S	S	S	S	S
CO2	S	S	S	M	S	S	S	S	S	S	S	S	S
CO3	S	M	S	S	M	S	M	S	S	M	S	S	M
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S	M	S	S

Strongly Correlating (S)

- 3 marks

Moderately Correlating (M)

- 2 marks

Weakly Correlating (W)

- 1 mark

No Correlation (N)

- 0 mark