ST.PHILOMENA'S COLLEGE (AUTONOMOUS), MYSURU

(AFFILIATED TO UNIVERSITY OF MYSORE & REACCREDITED BY NAAC WITH B^{++} GRADE)

PROGRAMME: M.Sc in BIOCHEMISTRY

CBCS with Learning Outcome Based Curriculum

Academic years: 2020-22

{Approved in the Academic Council Meeting held on 12.01.2021}

{The Academic Year of 2020-21 was commenced on 24.01.2021 due to first wave of Covid-19 Pandemic}

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ST. PHILOMENA'S COLLEGE (AUTONOMOUS) MYSORE
PROGRAMME: M.Sc Biochemistry
(For Candidates admitted during the Academic year 2020 -2021 onwards)

PREAMBLE

M.Sc Biochemistry course was started in the year 2016. Since then, department has taken periodic revision of syllabus in 2018. At present it's going for third revision. This programme endeavours to provide students a broad based training in biochemistry with a solid background of basic concepts as well as exposing them to the exciting advancements in the field. In addition to theoretical knowledge, significant emphasis has been given to provide hands on experience to the students in the forefront areas of experimental biochemistry.

The goal of the syllabus is to make the study of Biochemistry popular, interesting and encouraging to the students for higher studies including research. The new and updated syllabus is based on a basic and applied approach with vigour and depth. At the same time precaution is taken to make the syllabus comparable to the syllabi of other universities and the needs of industries and research.

The current revision focussed on learner's centric and outcome based curriculum as per the UGC guidelines. The frame work of learning outcome based curriculum includes Vision and Mission statements of the Institute, Vision and Mission statements of the department, Programme Educational Objectives (PEOs), Programme Outcomes (POs), Programme Specific Outcomes (PSOs), Course Outcomes (COs), Evaluation and Result analysis, Teaching and learning process, technological tools, sharing of resources by industry partners with the institution and active feedback of the course outcome from the industry.

The learner centric curriculum provides and enables a continuous improvement of curriculum, teaching learning process, teaching resources, assessment methods, evaluation rubrics, validity and reliability of evaluation.

The curriculum is designed with compulsory hardcore courses and soft-core electives to equip the students with required knowledge and skills by the employers, to build learner competencies and make them self-learners.

The student can choose from a pool of electives that are offered below:

1. **Skill Enhancing Electives,**
2. **Interdisciplinary Electives,**
3. **Ability Enhancing Electives,**

4. **Generic Electives**
5. **Self-Study Electives**

The students will have flexibility, academic mobility and maximum utilization of human and material resources**.**

The following modifications are incorporated in the revised syllabus from the academic year 2020-21.

NEW PAPERS INTRODUCED TO THE EXISTING CURRICULUM

Sl No	Semester	Existing Paper replaced	New Paper	Credits	Justification	% of Changes
1.	**FIRST**	**---**	Clinical Biochemistry **SC**	**3**	To apply skill in measurement of chemicals (both natural and unnatural) in blood, urine and other body fluids as these results are useful for detecting health problems, determining prognosis and guiding the therapy of a patient.	**100**
2.		---	Pharmacology and Toxicology **SC**	**3**	To provide basic information on pharmacology and toxicology and to prepare the students to handle pharmacological experiments.	**100**
3.		**---**	Waste Management and Bioremediation **SC-Skill Enhancement**	**2**	To critically evaluate the Wastes collection, storage, segregation and disposal methods and go for biocomposting.	**100**
4.		**---**	Techniques in Forensic Science **SC-Skill Enhancement**	**2**	To Understand how a forensic investigation is initiated through preservation of evidences, as well as chemical, physical and biological methods of their analysis including analysis of DNA and other bodily fluids	**100**
5.		**---**	First Aid Management **SC-Skill Enhancement**	**2**	To learn & undertake immediate relief and rescue during emergency	**100**
6.	**Second**	**---**	Endocrinology **SC**	**3**	To facilitate students to understand the hormonal action on metabolic aspects of organs.	**100**
7.		**---**	Basics of Herbal Technology **SC-ID**	**2**	To understand the concepts, structure & pharmacological use of common plants used in Ayurveda.	**100**
8.		**---**	Functional Foods and Neutraceuticals **SC**	**2**	To Apply and understand the use of functional food for managing chronic diseases	**100**
9.		**---**	Histochemistry	**2**	To Asses the relationship	**100**
10.			Ecology & Evolution	**2**	To Analyse the diversity of evolutionary thoughts &	**100**

		---	**SC**		to Evaluate the Environmental and Community Ecology	
11.		---	Research Methodology **SC- Ability Enhancement**	**2**	To understand the concepts of research & its types and need to do the research in systematic way	**100**
12.		---	Pathological basis of diseases **SC- Ability Enhancement**	**2**	To apply the necessary inputs for the other disciplines like Pharmacology, social and preventive medicine, medicinal biochemistry etc	**100**
13.		---	Food processing and Packaging **SC- Ability Enhancement**	**2**	To Learn skills in researching, analyzing and communicating food issues, skills in experimenting with and preparing food by applying theoretical concepts	**100**
14.	**Third**	---	Introduction to Manuscript Writing & Presentation **SC- Self Study**	**2**	To Apply the knowledge & art of scientific writing	**100**
15.		---	Advanced Nutrition **SC- Self Study**	**2**	To apply and understand the fundamentals of food and its importance as nutrition	**100**
16.		---	Literature review and publication **SC- Self Study**	**2**	It is necessary to do a review of existing research in order to identify gaps in the literature, and to justify their own projects	**100**
17.		---	Plant Tissue Culture & Grafting **SC**	**2**	To understand & apply the knowledge plant tissue culture& grafting	**100**
18.		---	Advanced Endocrinology **SC**	**2**	To Understand the fundamental concepts of signal transduction & hormonal regulations	**100**
19.	**Forth**	---	Genomics, Proteomics and Bioinformatics **SC**	**2**	To understand the basic concept of Genomics, Proteomics and Bioinformatics	**100**
20.		---	Fruits and Vegetable preservation **SC- Ability Enhancement**	**2**	To assess the knowledge related to fruit and vegetable preservation	**100**
21.		---	QA, QC and GMP **SC- Skill Enhancement**	**2**	Understand the cGMP, QA & QC aspects in a pharmaceutical industry	**100**
22.		-	Biosafety, Laboratory safety and IPR **SC- Skill Enhancement**	**2**	To Assess the knowledge of Biosafety, Analyze ethical aspects, different types of intellectual property rights	**100**

TOTAL CHANGES =50%

SELF STUDY PAPERS OFFERED TO M.SC BIOCHEMISTRY STUDENTS

S. I No	Semester	Title of the Paper	Type	Credits	Percentage of Change
1.	**I II III IV**	Introduction to Manuscript Writing	SC- Self Study	2	100

		And Research Presentation			
2.		Advanced Nutrition	SC- Self Study	2	100
3.		Literature review and publication	SC- Self Study	2	100

NEW INTERDISCPLINARY COURSES OFFERED TO SISTER DEPARTMENT

Sl. No	Semester	Title of the Paper	Type	Credits	Percentage of Change
1	Second	Basics of Herbal Technology	**SC- ID**	**2**	**100**
2		Biopharmaceuticals-I	**SC- ID**	**2**	**100**
3		Clinical Diagnosis in Health and Disease-I	**SC- ID**	**2**	**100**
4	Forth	Plant tissue culture and Grafting	**SC- ID**	**2**	**100**
5		Biopharmaceuticals-II	**SC- ID**	**2**	**100**
6		Clinical Diagnosis in Health and Disease-II	**SC- ID**	**2**	**100**

NEW OPEN ELECTIVE COURSE OFFERED TO UNRELATED DEPARTMENT

Sl No	Semester	Title of the Paper	Type	Credits	Percentage of Change
1	Second	Biochemistry in Daily Life	**OE**	**2**	**100**
2		Biochemistry of Common Disorders	**OE**	**2**	**100**
4	Forth	Lifestyle Disorders	**OE**	**2**	**100**
6		Fundamentals of Biochemistry	**OE**	**2**	**100**

CERTIFCATE COURSE OFFERED

S. I No	Semester	Title of the Paper	Type	Credits	Percentage of Change
1.	I/II/III/IV	Mushroom Cultivation Technology	**Certificate Course**	**2**	**100**
2.		Vermi compost Technology	**Certificate Course**	**2**	**100**

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CHANGES IN THE EXISTING COURSES

S. I No	Semester	Module of the course	Justification	Percentage of Change
1.	**First**	Microscopic techniques ***Techniques in Biochemistry*** Module 5.0	This module has been added to give deep insight on Microscopic techniques as part of structure analysis	**25**
2.		Male & Female reproductive system of **Human Physiology** Module 6.0	To provide knowledge on reproductive system as it helps to study developmental biology in future class.	**25**
3.	**Second**	Bioenergetics & Biological Oxidation **Carbohydrate and Lipid Metabolism** Module 1.0 & 2.0	To gain knowledge on concepts of bioenergetics & Biological Oxidation	**50**
4.	**Third**	Plant Hormones & Host parasite interaction **Nitrogen Metabolism** Module 4.0 & 5.0	As it provides supporting knowledge on plant growth and development	**50**
5.		Concepts on Ecology **Ecology & Evolution** Module 1.0 & 2.0	It helps to identify the species concepts, Life history strategies; adaptive radiation	**50**
6.	**Fourth**	Development Biology **Genetics & Development Biology** Module 3.0, 4.0, 5.0	It helps to define the concepts and implications of developmental biology	**25**

VISION AND MISSION OF THE COLLEGE

VISION:

The college is guided by the visionary zeal of providing value- based education to everyone irrespective of religion, caste, creed or sex by which the character is formed, intellect is explained and one can stand on his/her feet**.**

MISSION:

To transform young men and women who come to learn not from books, but also from life and to share the experience of working and playing together, this inculcates life skills to become good citizens with integrity and discipline.

VISION AND MISSION OF THE DEPARTMENT

Vision:
To achieve academic excellence in biochemistry of imparting in-depth knowledge to the students, facilitating research activities and cater to the ever changing industrial demand & societal needs.

Mission:

1. To provide a learning environment that helps the students to enhance problem solving skills and be successful in their profession.

2. To prepare students to be lifelong learner by offering solid theoretical & practical foundation in various discipline of biochemistry and educating them about their professional and ethical responsibilities.

3. To Horne the skills and mould the students in such a way that they meet the requirements of the industry or to work independently.

4. To periodically update curriculum on par with emerging trends with inter and multi-disciplinary approach.

PO No.	Programme Educational Objectives (PEOs)
PEO-1	**CORE PROFICIENCY** To expertise the students to be able to apply fundamental knowledge related to pure sciences in an interdisciplinary manner for providing innovative solutions to need based problems for global impact.
PEO-2	**PROFESSIONAL DEVELOPMENT** To train students to critically analyze scientific data, draw objective conclusions and apply this knowledge for human welfare. Students should be able to demonstrate expertise and ethical perspective on areas related to Biochemistry.
PEO-3	**PROFESSIONALISM** To train the An ability to gain domain knowledge and know-how for successful career in academia, industry and research.
PEO-4	**LEARNING ENVIRONMENT** To Promoting lifelong learning to meet the ever evolving professional demands by developing ethical, inter personal and team skills.
PEO-5	**TECHNICAL ACCOMPLISHMENTS** To equip the students with the talent to interpret in core applications by building up a multi-disciplinary concept.

Mapping of Mission of the department with Programme Educational Objectives					
Mission	**Programme Educational Objectives (PEOs)**				
	PEOs-1	**PEOs-2**	**PEOs-3**	**PEOs-4**	**PEOs-5**
M1	✓			✓	
M2		✓			✓

M3			✓	✓	
M4	✓				✓

PO No.	Programme Outcomes (POs) Upon completion of the Programme the student will be able -
PO-1	Acquire practical skills to gather information, assess, create and execute new ideas to develop entrepreneurial skills
PO-2	Gain Proficiency in basic laboratory techniques and able to apply the scientific method on lab to land
PO-3	Inculcate a domestic and international perspective and be competent enough in the area of life sciences
PO-4	Learn to recognize potential laboratory safety and conserve nature and the environment and also To enable to get quality education in the areas of Biochemistry

PSO No.	Programme Specific Outcomes(PSOs) Upon completion of the Programme the student will acquire -
PSO-1	to use current biochemical and molecular techniques and carry out experiments
PSO-2	Develop skills in cultivation of plants& also Prepare them to do higher studies in other biological fields like Genetic, Entomology, Biological Oceanography etc
PSO-3	Monitoring the changes in modern life styles leads to modern diseases
PSO-4	Developed critical thinking skills/laboratory techniques to be capable of designing, carrying out ,interpreting scientific experiments

Mapping of Programme Educational Objectives with Program Outcomes and Programme Specific outcomes										
	Program Outcomes					**Program Specific Outcomes**				
Programme Educational Objectives	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**
PEOs-1	✓			✓	✓		✓			
PEOs-2		✓				✓		✓		
PEOs-3			✓	✓			✓		✓	
PEOs-4					✓	✓				✓

ST. PHILOMENA'S COLLEGE (AUTONOMOUS), MYSURU-570 015

CHOICE BASED CREDIT SYSTEM

M.Sc., BIOCHEMISTRY COURSE STRUCTURE & SYLLABUS

Sl. No	Subject Code No	QP Code	TITLE OF THE PAPERS	Type	L	T	P	Credits	Total Credits
FIRST SEMESTER									
1.			Techniques in Biochemistry	HC	3	0	0	3	20
2.			Chemistry of Biomolecules	HC	3	0	0	3	
3.			Cell & Membrane Biochemistry	HC	3	0	0	3	
4.			Practical- Biomolecules & Techniques	HC	0	0	6	3	
5.			Any TWO of the Soft-Core General courses to be chosen from **List-A**	SC	3	0	0	3	
6.				SC	3	0	0	3	
7.			Any one of the Skill Based Courses to be chosen from the **List-B**	SEC	2	0	0	2	
SECOND SEMESTER									
8.			Enzymology	HC	3	0	0	3	20
9.			Molecular Biology	HC	3	0	0	3	
10.			Carbohydrate & Lipid Metabolism	HC	3	0	0	3	
11.			Practical- Enzyme & Metabolism	HC	0	0	6	3	
12.			Any TWO of the Soft-Core General courses to be chosen from **List-C**	SC	2	0	0	2	
13.				SC	2	0	0	2	
14.			Any ONE of the Interdisciplinary courses from sister department to be chosen	ID	2	0	0	2	
15.			Any ONE of the Open elective courses from unrelated department to be chosen	OE	2	0	0	2	
THIRD SEMESTER									
16.			Nitrogen Metabolism	HC	3	0	0	3	20
17.			Genetic engineering & Gene Expression	HC	3	0	0	3	
18.			Immunology	HC	3	0	0	3	
19.			Practicals: Metabolism, Genetic engineering and Immunology	HC	0	0	6	3	
20.			Any ONE of the Soft-Core General courses to be chosen from **List-D**	SC	2	0	0	2	
21.			Any ONE Ability Enhancement Courses to be chosen from the **List-E**	AEC	2	0	0	2	
22.			Any ONE of the Self Study courses to be chosen from **List-F**	SS	0	2	0	2	
23.			Any ONE of the Open elective courses from unrelated department to be chosen	OE	2	0	0	2	
FOURTH SEMESTER									
24.			Industry Internship/Project Work	HC	0	2	18	10	18
25.			Any ONE of the Soft-Core General courses to be chosen from **List-G**	SC	2	0	0	2	
26.			Any ONE Ability Enhancement Courses to be chosen from the **List -H**	AEC	2	0	0	2	
27.			Any ONE of the Skill Based Courses to be chosen from the **List -I**	SEC	2	0	0	2	
28.			Any ONE of the Interdisciplinary courses from sister department to be chosen	ID	2	0	0	2	
29.			**Extra Credit Courses (MOOC)**	-	-	-	-	**4***	

Total Credits (HC-44+SC-16+ AEC-04+SEC-04+IDC-04+SS-02+OE- 04) MOOC-04*	78(4)*

HC= HARD CORE PAPER. SC= SOFT CORE PAPER. AEC= ABILITY ENHANCEMENT COURSE.
SEC = SKILL ENHANCEMENT COURSE .SS = SELF STUDY PAPER.
INTERDISCIPLINARY COURSE= IDC. OE = OPEN ELECTIVE PAPER

SEMESTER WISE SOFT- CORE ELECTIVE PAPERS OFFERED TO M. SC BIOCHEMISTRY STUDENTS

List A - Soft-Core General Courses						
S. I No	**Semester**	**Title of the paper**	**L**	**T**	**P**	**Credits**
1	**First**	Human Physiology	3	0	0	3
2		Clinical Biochemistry & Histochemistry	3	0	0	3
3		Biotechnology	3	0	0	3
4		Pharmacology and Toxicology	3	0	0	3
List B- Soft-Core Skill Enhancement Courses						
S. I No	**Semester**	**Title of the paper**	**L**	**T**	**P**	**Credits**
1	**First**	Waste Management and Bioremediation	2	0	0	2
2		Biochemical applications in Forensics	2	0	0	2
List C - Soft-Core General Courses						
S. I No	**Semester**	**Title of the paper**	**L**	**T**	**P**	**Credits**
1	**Second**	Basics of Herbal Technology	2	0	0	2
2		Endocrinology	2	0	0	2
3		Functional Foods and Neutraceuticals	2	0	0	2
List D - Soft-Core General Courses						
S. I No	**Semester**	**Title of the paper**	**L**	**T**	**P**	**Credits**
	Third	Plant Biochemistry	2	0	0	2
		Ecology & Evolution	2	0	0	2
List E - Soft-Core Ability Enhancement Courses						
S. I No	**Semester**	**Title of the paper**	**L**	**T**	**P**	**Credits**
	Third	Methods in Research	2	0	0	2
		Pathological basis of Diseases	2	0	0	2
		Food processing and Packaging	2	0	0	2
List F- Soft-Core Self Study Courses						
S. I No	**Semester**	**Title of the paper**	**L**	**T**	**P**	**Credits**
1	**Third**	Introduction to Manuscript Writing And Research Presentation	0	2	0	2
2		Advanced Nutrition	0	2	0	2
3		Literature review and publication	0	2	0	2
List G - Soft-Core General Courses						
S. I No	**Semester**	**Title of the paper**	**L**	**T**	**P**	**Credits**
1	**Forth**	Plant tissue culture and Grafting	2	0	0	2
2		Advanced Endocrinology	2	0	0	2
3		Genomics, Proteomics and Bioinformatics	2	0	0	2
List H - Soft-Core Ability Enhancement Courses						
S. I No	**Semester**	**Title of the paper**	**L**	**T**	**P**	**Credits**
1	**For th**	Genetics & Developmental Biology	2	0	0	2
2		Principles of Chemistry	2	0	0	2

3		Fruits and Vegetable preservation	2	0	0	2
List I- Soft-Core Skill Enhancement Courses						
S. I No	**Semester**	**Title of the paper**	**L**	**T**	**P**	**Credits**
1	**Third**	QA, QC and GMP	2	0	0	2
2		Microbiology	2	0	0	2
3		Biosafety, Bioethics and IPR	2	0	0	2

SEMESTER WISE INTERDISCPLINARY COURSES OFFERED TO SISTER DEPARTMENT						
S. I No	**Semester**	**Title of the paper**	**L**	**T**	**P**	**Credits**
1	**Second**	Basics of Herbal Technology	2	0	0	2
2		Biopharmaceuticals-I	2	0	0	2
3		Clinical Diagnosis in Health and Disease-I	2	0	0	2
S. I No	**Semester**	**Title of the paper**	**L**	**T**	**P**	**Credits**
1	**Forth**	Plant tissue culture and Grafting	2	0	0	2
2		Biopharmaceuticals-II	2	0	0	2
3		Clinical Diagnosis in Health and Disease-II	2	0	0	2

SEMESTER WISE OPEN ELECTIVE COURSES OFFERED TO UNRELATED DEPARTMENT						
S. I No	**Semester**	**Title of the paper**	**L**	**T**	**P**	**Credits**
1	**Second**	Biochemistry in Daily Life	2	0	0	2
2		Biochemistry of Common Disorders	2	0	0	2
S. I No	**Semester**	**Title of the paper**	**L**	**T**	**P**	**Credits**
1	**Third**	Lifestyle Disorders	2	0	0	2
2		Fundamentals of Biochemistry	2	0	0	2

CERTIFCATE COURSE OFFERED						
S. I No	**Semester**	**Title of the paper**	**L**	**T**	**P**	**Credits**
1	**I /II/III/IV**	Mushroom Cultivation Technology	2	0	2	2
2		Vermi compost Technology	2	0	2	2

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ST. PHILOMENA'S COLLEGE (AUTONOMOUS)

Programme: M.Sc Biochemistry

(For Candidates admitted during the Academic year 2020-21 onwards)

FIRST YEAR - SEMESTER – I

<table>
<tr><td>Course Title</td><td colspan="8">TECHNIQUES IN BIOCHEMISTRY</td></tr>
<tr><td>Course Type</td><td colspan="2">Hard Core- Theory</td><td>Total Hours</td><td>48</td><td>Hours/Week</td><td>03</td><td>Credits</td><td>03</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2"></td><td rowspan="2">Evaluation</td><td>Internal</td><td colspan="3">C1+C2 = 15+15</td><td colspan="2">30 Marks</td><td rowspan="2">100</td></tr>
<tr><td>External</td><td>Duration</td><td>C3</td><td>03Hrs</td><td colspan="2">70 Marks</td></tr>
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COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand theoretical and practical knowledge about various techniques used in purification, characterization
CO-2	Identify and apply the knowledge in estimation of cellular constituents
CO-3	Develop key skills like practical research required in scientific work

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Use the current biochemical and molecular technique concept to plan and carry out experiments	PSO-2	Apply
CLO-2	Understand construction, working principle and application of various techniques used in biochemistry with its limitations	PSO-3	Understand
CLO-3	Understand the usage of live models in research and techniques in extraction of cellular components	PSO-1	Understand
CLO-4	Generate and analyze data appropriately and appreciate the limitations of conclusions drawn from experimental data independently	PSO-4	Analyze

Modules	**COURSE CONTENTS**	**Duration**
1.0	**Models**: Animal Models, Choice Of Animals, Types Of Studies Mutant Organisms (Auxotroph), Cultured Animal And Plant Cells As Models.	
	Cell Fractionation Techniques: Cell Lysis, Homogenization, Extraction, Salting In & Salting Out, Dialysis And Ultra Filtrations	**4 hours**
	Keywords: live animal and plant models; isolation of cellular component	

1.1 Analytical Ultracentrifuge: Construction, Svedberg's Constant, Sedimentation Velocity And Sedimentation Equilibrium, Schleiran Optics

Preparative: Differential And Density Gradient Centrifugation, Centrifugal Elutriation, Construction and applications of Preparative Ultra Centrifuge ,Marker Enzymes **6 hours**

Keywords: construction and working principle; identification of cellular components

2.0 **Chromatographic Techniques:** Principles and Applications of Paper Chromatography, Adsorption Chromatography, TLC, Ion Exchange Chromatography, Gel Filtration Chromatography Affinity chromatography, GLC, HPLC, FPLC & Chromatofocusing **8 hours**

Keywords: Construction, working principle and application

2.1 **Electrophoretic Techniques :** Polyacrylamide Gel Electrophoresis ,SDS-PAGE,2D-Electrophoresis, Agarose Gel Electrophoresis, Isoelectric Focusing, Pulsed Field Electrophoresis, High Voltage Electrophoresis, Capillary Electrophoresis, Separation Of Proteins, Lipoproteins And Nucleic Acids **8 hours**

Keywords: Construction, working principle and application

2.2 **Blotting Techniques:** Dot blot, Western , Southern, Northern blotting , DNA finger print assay , DNA foot print assay, Gel retardation assay , Nuclease protection assay **Visualizing Separated Components- Staining:** Coomassie Blue, Silver Staining, Ethidium Bromide, PAS Staining, Zymogram And Reverse Zymogram **4 hours**

Keywords: Construction, working principle, application and identification

3.0 **Spectroscopic Techniques:** Colorimeter: Principle, Molar Extinction coefficient , Beer's law Fluorescent Probes And Their Applications: FRET And FRAP, Sorting of cell- flow cytometry **4 hours**

Keywords: Construction, working principle and application

4.0 **Radioactivity:** Isotopes and isobars, Heavy Isotopes And Radio Isotopes ,Theory and Construction of Mass Spectrometer Ionization ,Fragmentation, M/E ,Time of Flight, MALDI And ESI ,Quadrupole Analyser **4 hours**

Keywords: Construction, working principle and application

4.1 **Radioisotopes In Biology:** ^{3}H, ^{14}C, ^{32}P, ^{131}I, ^{35}S. Concept of Half-Life, Decay Constant ,Specific Activity, carrier free isotope

Detection And Quantification: Geiger Muller Counter, Solid And Liquid Scintillation Counter, Autoradiography, Carbon Dating, Isotope Dilution, Pulse Chase **5 hours**

Radio labelling :Lipids-Choline, Fatty Acids, Proteins- I^{125}, Nucleic Acids Using ATP (γ-P^{32})

***Keywords: Construction, working principle and application* of isotopes and radioactivity detection.**

5.0 **Microscopic techniques:** Principles and applications of light microscopy, phase contrast microscopy, fluorescence microscopy, confocal microscopy, differential microscopy, electron microscopy, Resolving powers of various microscopes Staining techniques for various microscopes **5 hours**

Keywords: Construction, working principle and application

Note: Course content involves 90% Theory and 10% Problems

REFERENCES

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	A Guide to principles and techniques of practical biochemistry	K.Wilson & K.Goulding	Cambridge University Press	3	1994
2.	Principles and techniques of practical biochemistry	Bryan L.Williams and Keith Wilson	Cambridge University Press	4	1996
3.	Principles &Techniques of Biochemistry and Molecular Biology	Keith Wilson & John Walker	Cambridge University Press	7	2010
4.	Introductory Practical Biochemistry	S.K. Sawhney &, R. Singh	Alpha Science International Ltd	5	2005
5.	Introduction to spectroscopy	Pavia	Cengage Learning India Private Limited	3	1999

RECOMMENDED BOOKS

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	An Introduction to Practical Biochemistry	David Plummer	Mc Grow Hill education	3	2011
2.	Text book of Biophysical Chemistry	Upadyaya & Upadyaya	Himalaya Publishing House Pvt. Ltd.	4	2016
3.	Instrumental Methods of Analysis	Muralidhara Rao	CBS Publishers & Distributors	1	2013

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FIRST YEAR - SEMESTER – I

Course Title	**CHEMISTRY OF BIOMOLECULES**								
Course Type	**Hard Core- Theory**		Total Hours	48	Hours/Week	03	Credits		03
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks		100
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Gain knowledge about various macromolecules present in biological system
CO-2	Understand structure, linkage and functions of macromolecules

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Demonstrate knowledge and understanding of the molecular machinery of living cells and principles that govern the structures of macromolecules	PSO-5	Analyze
CLO-2	Isolation and characterization of macromolecules	PSO-4	Understand
CLO-3	Structural elucidation and physiochemical properties of macromolecules	PSO-1	Understand
CLO-4	Structure-Function relationship analysis	PSO-3	Apply

Modules	**COURSE CONTENTS**	**Duration**
1.0	**Structure and Classification of Carbohydrates :Monosaccharides** :Pentoses Hexoses, Ketoses **Disaccharides:** Sucrose, Lactose, Maltose ,Trehalose **Polysaccharides:** Starch, Cellulose, Glycogen, Hyaluronic Acid ,Chondroitin Sulphate ,Chitin, Xylan Bacterial Cell Wall Polysaccharides , Blood Group Polysaccharides Chemistry of Deoxyglucose , Amino Sugars Muramic Acid, Neuraminic Acid **Linkages:** Sucrose, Lactose , Maltose, Trehalose ,Glycosides ***Keywords: Chemistry of sugars and their biological significance***	**5 hours**
2.0	**Chemical analysis of carbohydrates: Methods of Structural Elucidation** Degradation, Graded Acid Hydrolysis, Periodate Oxidation, Degradation of Oxopolysaccharides, Methylation, Acetylation, GC-MS **Glycobiology:** N- And O-Linked Glycoproteins, Lectins, Proteoglycans, Agreecan, Syndecan, Decorin, Pectin And Pectic Polysaccharides ***Keywords: Chemical structural elucidation of sugars, biological importance of complex sugars***	**5 hours**
3.0	**Amino Acids:** Nomenclature, Classification General Reactions of Amino Acids Unusual Amino Acids, Non Protein Amino Acids **Peptide Bond:** Features of the Peptide Bond, Naturally Occurring Peptides- Glutathione, Enkaphalins and Endorphins Chemical Synthesis of Peptides- Khorana's Solution Phase	**5 hours**

Synthesis, Merrifield's Solid Phase Synthesis

Keywords: amino acids, classification, peptides, synthesis

3.1 **Determination of Amino Acid Compositions:** Acid And Base Catalyzed Hydrolysis, Separation, Quantification : Determination of N- And C- Terminal Residues, Determination of Site of Glycosylation and Type of Glycosylation **3 hours**

Keywords: Composition, determination of amino acids

3.2 **Determination of Primary Structure** :Sequencing Strategies : N-Terminal And C-Terminal, Sequencing Methods , Automated Sequanators, Determination of S-S-Bond Position **3 hours**

Keywords: sequencing methods

3.3 **Secondary Structure of Protein**: α, β Sheet, β Bend, β Turn, Super Secondary Structures. Secondary Structure Prediction Method- Ramachandran Plot : Φ, Ψ Angles, Tertiary And Quaternary Structures **3 hours**

Keywords: secondary structures, prediction

3.4 **Weak Forces of Interaction:** Hydrogen Bonding ,Vander Waal's Forces, London Force, Ionic Interactions , Hydrophobic Interactions ,S-S Bridges, Peptide Bond Glycosidic Bond ,Phosphodiester Bond , Allolysine , Molten Globule, Levinthal Paradox, Denaturation And Renaturation of Proteins, Anfinsen's Experiment **4 hours**

Keywords: Bonding, forces of interaction, renaturation, denaturation

3.5 **3D Structures of** Myoglobin, Haemoglobin ,Immunoglobulin, Collagen , Keratin **3 hours**

Keywords: Chemistry, chemical structural elucidation and biological significance of proteins

4.0 **Classification, Occurrence and Properties of lipids:** Oils, Fats, And Waxes, Fatty Acids, Esters of Fatty Acids, Cholesterol, Phosopholipids, Glycolipids Sphingolipids, Cerebrosides, Gangliosides.

Lipid Mediators: Structure and major functions of Eicosanoids, Prostaglandins, Leukotrienes, Prostacyclins, Thromboxanes, DAG, Ceramide, PAF **4 hours**

Keywords: Chemistry, chemical structural elucidation and biological significance of lipids

5.0 **Chemistry of Nucleic Acids:** Isolation & Purification Of DNA And RNA From Biological Sources (Microbes, Plants And Animals) of Nucleic Acids

Physiochemical Properties of Nucleic Acids: Melting of DNA, Tm, Factors Affecting Tm, Cot Curve and Classification of DNA Based on Cot Curve, Chemical Reactions of DNA and RNA. **5 hours**

Keywords: isolation, classification, chemical reactions

5.1 **Sequencing of DNA:** Maxam Gilbert Method, Dideoxy Method , Pyrosequencing Chargaff's Rule, Secondary Structure Of DNA - Watson And Crick Model, B and Z DNA , Other Models of DNA Structure (A DNA)

4 hours

Secondary Structural Features of DNA: Steam Loop Structure, Palindromic Sequences, Cruciform, Secondary Structure Of t-RNA - Clover Leaf Model ***Keywords: Chemistry, chemical structural elucidation and biological significance of nucleic acid***

Note: Course content involves 100% Theory

REFERENCES					
Sl.No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1.	Lehninger Principles of Biochemistry	David L. Nelson & Michael M. Cox	W.H. Freeman	6	2012
2.	Fundamentals of Biochemistry	J L Jain , Sunjay Jain , Nitin Jain	S Chand	7	2016
3.	Biochemistry	U. Sathyanarayana & Chakrapani	Elsevier	4	2013
4.	Harpers Illustrated Biochemistry	Robert K. Murray, Peter J. Kennelly, David A. Bender	McGraw-Hill Medical	29	2012

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	Biochemistry	U. Sathyanarayana & Chakrapani	Elsevier	5	2017
2.	Textbook of Biochemistry for Medical Students	DM Vasudevan Sreekumari SKannan Vaidyanathan	Jaypee Brothers Medical Publishers	6	2011
3.	Color Atlas of Biochemistry	Jan Koolman	Thieme	3	2013

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FIRST YEAR - SEMESTER – I

Course Title	**CELL & MENBRANE BIOLOGY**							
Course Type	**Hard Core- Theory**		Total Hours	48	Hours/Week	03	Credits	03
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Study structure and functions of bio membranes, structure-function relationships, membrane biogenesis
CO-2	Demonstrate knowledge on membrane associated cellular events

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Appreciate the Evolution In Concept Of Membrane Models	PSO-3	Analyze
CLO-2	Understand intracellular targeting of molecules and biogenesis of sub-cellular organelles	PSO-2	Understand
CLO-3	Understand the techniques used to study membrane structures	PSO-1	Apply
CLO-4	Understand the mechanism underlying neurotransmission, muscle contraction and cell cycle	PSO-4	Understand

Modules	**COURSE CONTENTS**	**Duration**
1.0	**Biomembranes:** Evolution In Concept Of Membrane Models, Earlier models, Gorter And Grendel's Experiment, Danielle - Davson Model Of Membrane, Singer And Nicholson's Model, Supra Molecular Organization Models of Membrane Newer Models, ***Keywords: Membrane Models, molecular organization Models***	**8 hours**
1.1	Physicochemical Properties Of Biological Membranes, Compositions-Lipids, Proteins And Carbohydrates, Lipid Phases-Hexagonal I And II, Micellar Phase, Bilayer Phase, Phase Transition Temperature, Membrane asymmetry and its significance ,Polarized Cells, Membrane Domains: Caveolae, Rafts, Membrane Protein Turnover, Ubiquitin pathway, Intracellular Targeting Of Proteins Biogenesis Of Sub Cellular Organelles –peroxisomes, lysosomes ***Keywords: Properties Of Membranes, models of membrane structure, membrane asymmetry***	**8 hours**
2.0	**Methods of Study of Membrane Structure:** Liposome Preparations And Application , Freeze Fracture, Freeze Etching, FRET, FRAP, Single Particle Tracking ***Keywords: Principle and application of methods used in analyzing membrane structure***	**4 hours**
2.1	**Membrane Transport:** Laws of Diffusion Across Membranes, Simple Diffusion and Facilitated Diffusion, Active Transport, Glucose Transporters, Na^+-K^+ATpase (Structure And Mechanism of Action) Bacterial Phosphotransferase System, Receptor Mediated Endocytosis, exocytosis, Membrane flow hypothesis **Ion Channels:** Gated Ion Channels-Ligand and Voltage, Non- Gated Ion Channels Aquaporin Channel, Ionophores	**8 hours**

Keywords: Transporters, carriers, channels, mode of membrane transport

3.0 Mechanisms Of Nerve Conduction, Resting And Action Potential, Pre-synaptic And Postsynaptic Membranes, Acetylcholine Receptor And Neurotransmission, Patch Clamp Technique, Nicotinic And Muscarinic Neurons, GABA, NMDA - Structure And Function **8 hours**

Keywords: Structure and mechanism of neuronal signals

4.0 **Muscle Contraction:** Structure Of Skeletal Muscle, Mechanisms Of Muscle Contraction , Role Of Calcium, Calmodulin, Phospholamban **4 hours**

Keywords: Molecular mechanisms in muscles

5.0 **Cell Cycle and its Regulation:** Phases Of The Cell Cycle, Check Points, Cdks and Cyclins, Cell Cycle Control, Aging and senescence ,Apoptosis **8 hours**

Keywords: Molecular events of a cell, pathways of apoptosis

Note: Course content involves 100% Theory

REFERENCES

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Biochemistry	Geoffrey Zubay	WBC Publishers	4	1998
2.	Lehninger Principles of Biochemistry	David L. Nelson And Michael M. Cox	W.H. Freeman & Company	4	2004
3.	Harper's Biochemistry	Robert K. Murray, Daryl K. Grammer, Peter A. Mayer, Victor W. Rodwell	Appleton & Lange	27	2006
4.	Fundamentals Of Biochemistry, Life At The Molecular Level.	Donald Voet, Judith G. Voet, Charlotte W. Pratt	Wiley	2	2006

RECOMMENDED BOOKS

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	Fundamentals Of Biochemistry, Life At The Molecular Level.	Donald Voet, Judith G. Voet, Charlotte W. Pratt	Wiley	4	2012
2.	Outlines Of Biochemistry	Eric E. Conn, P.K. Stumpf, G Bruening, R.H. Doi	Wiley	5	2006
3.	Color Atlas of Biochemistry	Jan Koolman	Thieme	3	2013

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FIRST YEAR - SEMESTER – I

Course Title	**BIOMOLECULES,TECHNIQUES & CELL BIOLOGY**								
Course Type	**Hard Core-Practical**		Total Hours	48	Hours/Week		06	Credits	03
Course Code		Evaluation	Internal	C1+C2 = 15+15				30 Marks	100
			External	Duration	C3	03Hrs		70 Marks	

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Basic skills in the biochemistry lab.
CO-2	Accurate use of pipettes, making solutions for enzyme and biochemical study.
CO-3	The estimation of Reducing sugar, protein, amino acids by different methods
CO-4	The isolation and detection of various Biomolecules by different chromatographic techniques.
CO-5	lysis, electrophoresis and cholinesterase activity detection in erythrocytes

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Gain technical experience and handle adjustable micro pipettes in a reproducible manner	PSO- 1	Understand
CLO-2	Demonstrate the use of advance microscope.	PSO- 2	Remember
CLO-3	Plan experiments, write protocols	PSO -2	Understand
CLO-4	Perform logical reasoning and criticizing data	PSO -3	Remember
CLO-5	Understand and interpretation experimental results	PSO- 4	Analyse

Modules	**COURSE CONTENTS**	**Duration**
1.0	**Biomolecules**	
1.1	Determination of Protein - Lowry, Biuret methods	**4hours**
1.2	Determination of Reducing sugar-DNS method	**4hours**
1.3	Determination of Amino acids	**4hours**
2.0	**Techniques**	
2.1	Paper chromatography- Circular , Ascending(amino acids) descending (sugars)	**4hours**
2.2	Isolation of lipids from egg yolk- TLC of Lipids	**4hours**
2.3	Gel filtration-purification of cytochrome C	**4hours**
2.4	Ion Exchange chromatography	**4hours**
2.5	Molar Extinction coefficient	**4hours**
3.0	**Cell Biology**	
3.1	Erythrocyte lysis profile in sodium chloride solution	**4hours**
3.2	Erythrocyte cholinesterase activity and inhibition by pesticide residues	**4hours**

3.3	Erythrocyte membrane protein electrophoresis- SDS, PAGE molecular weight calculation	**4hours**
3.4	Glucose uptake in Yeast cells. Kinetics of uptake	**4hours**

Note: Course content involves 100% Practicals

REFERENCES

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Text book of Medical laboratory technology	Praful. B. Godkar	Bhalani Publishing house	3, Volume I and II	2014
2.	Biochemical Methods	Sadasivam, S. and Manickam, A	New Age International (P) Ltd	3	2010

RECOMMENDED BOOKS

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	Medical Laboratory Technology	Kanai L. Mukerjee	Tata McGraw Hill Education	2.	2011

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LIST A- SOFT-CORE GENERAL COURSES

1. Human Physiology
2. Clinical Biochemistry
3. Biotechnology
4. Pharmacology and Toxicology

FIRST YEAR - SEMESTER – I

Course Title	**HUMAN PHYSIOLOGY**							
Course Type	**Soft Core- Theory**		Total Hours	48	Hours/Week	03	Credits	03
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)

CO No.	Course Objectives
CO-1	Gain knowledge regarding biochemistry of various physiological processes specialized tissues and hormone action in animal system
CO-2	Understand structure, operational mechanism and functions of the various organs and organ system in human body
CO-3	Discuss on some of the more important organ related pathophysiological conditions

MAPPING CLO'S WITH PSO's AND CD's

CLO No.	Course Learning Outcomes On completion of the course the student will	PSOs Addressed	CD's

	learn to		
CLO-1	Understand the Digestive and Excretory system Physiology.	PSO- 1	Remember
CLO-2	Understand the Circulatory, Respiratory system	PSO- 2	Understand
CLO-3	Understand the Muscular and Nervous system.	PSO -2	Understand
CLO-4	Analyse the functions of reproductive system and their mechanisms	PSO- 4	Analyse

Modules	COURSE CONTENTS	Duration
1.0	**Introduction to physiology** Basic Body Plan In Humans Location of organs ***Keywords: Human organs***	**2hours**
1.1	**Circulatory Physiology:** Composition, types, Structure and Functions of Plasma Erythrocytes, WBC: Differential Count. Platelets. Plasma Lipoproteins And Their Formation and functions- HDL, LDL, VLDL, Chylomicrons , Buffer Systems, Hemostasis Blood brain barrier , Chemical composition, Formation and Functions of CSF, Lymph, Extracellular Fluid, Interstitial fluid, Transcellular Fluid, Intracellular Fluid **Blood Clotting** Classical And Alternate Pathway Digestion of Clot, Anticoagulants, and blood groups. ***Keywords: Human organs, blood , clotting , body fluids***	**10hours**
2.0	**Cardiovascular & Respiratory physiology:** Anatomy of Heart, myogenic heart, ECG – Its Principle and significance. Cardiac cycle, Heart As A Pump. Blood Volume And Blood Pressure- Neural And Chemical Regulation Structure And Functions of Lungs, Gas Exchange, Oxygen Binding By Haemoglobin , Factors Affecting Oxygenation , Role of lung in acid-base balance ***Keywords: Circulatory system, Respiratory mechanics, heart***	**8hours**
3.0	**Renal & Hepatobiliary system:** Ultra Structure Of The Nephron, Glomerular Filtration, Urine- composition and formation, Role of Kidney in Acid - Base Balance Anatomy of The Liver Hepatocytes, Endothelial Cells And Kupffer Cells, Secretory, Excretory Functions And Formation Of Bile ***Keywords: Nephron, Excretory function***	**8hours**
4.0	**Digestive System:** GI Tract, Digestion And Absorption of Carbohydrates, Proteins, Lipids. Mechanism of HCl Production in the Stomach , Gastrointestinal Hormones Role of Pancreas in Digestion ***Keywords: Breakdown, absorption of food, hormonal regulation***	**6hours**
5.0	**Nerve and Muscle Physiology:** Gross Anatomy of Brain, Central and Peripheral Nervous System, Structure and types of Neurons. Resting and action potential- conduction of nerve impulse. Synaptic transmission. Neurotransmitters. Neuromuscular Junctions **Muscular system** Structure of Skeletal Muscle And Smooth Muscle. Muscle Proteins: Actin, Myosin, Tropomyosine, Troponins	**8hours**

Theories and Mechanism of muscle contraction. Role of ATP and Calcium in muscle contraction.

Key words: Effectors, Muscle Proteins, Gray matter, Acetylcholine

6.0 **Reproductive Physiology:** Physiology of ovulation; mechanisms for single births; impacts of multiple births; control of fertility: contraception and fertility therapy, factors influences on the ovulatory cycle. Induced Abortion; Infertility, IVF, STDs, **6hours**

Key words: ovulation, fertility therapy

Note: Course content involves 100% theory

REFERENCES					
Sl.No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1.	Varley's Practical Clinical Biochemistry	Alan H .Gowenhock	CBS publishers.	6	2014
2.	Text book of Medical laboratory technology	Praful. B. Godkar	Bhalani Publishing house	3	2014
3.	Biochemical Methods	Sadasivam, S. and Manickam, A	New Age International (P) Ltd	3	2010

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	Medical Laboratory Technology	Kanai L. Mukerjee	Tata McGraw Hill Education Private Limited, New Delhi	2 Volume 1, 2 and 3.	2011

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FIRST YEAR - SEMESTER – I

Course Title	**CLINICAL BIOCHEMISTRY**								
Course Type	**Soft Core- Theory**		Total Hours	48	Hours/Week	03	Credits	03	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Remember the historical background for Clinical Biochemistry and understand the basic elements of core biochemistry and specialized test in carbohydrates
CO-2	Analyze the lipid, protein and nucleic acid Metabolism abnormalities.
CO-3	Understand and identify the main test functions
CO-4	Understand the renal function test in clinical biochemistry.
CO-5	Evaluate the scientific explanations cancer and evaluate the role of biomarkers in disease diagnosis.

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Discuss the biochemistry and pathophysiology associated with tests performed in a clinical biochemistry laboratory	PSO -1	Understand
CLO-2	Compare and contrast the basic differences between carbohydrate, lipid and protein metabolism abnormalities.	PSO- 2	Remember
CLO-3	Describe and identify the main characteristics of diagnosis, screening, and prognosis of disease.	PSO- 2	Understand
CLO-4	Critically evaluate the role of clinical biochemistry in diagnosis, monitoring and treatment.	PSO -3	Remember
CLO-5	Applications of biochemistry on health, medical diagnostics and pharmacy.	PSO -4	Apply

Modules	**COURSE CONTENTS**	**Duration**
1.0	**Basic Concepts :**Health And Disease , Normal And Pathological Changes Affecting Cells In The Body , Cell Death and the Physiological Causes Physical, Chemical, Biological Agents And Nutritional Deficiency ***Keywords: Cell Death, pathological & Physiological Causes***	**4Hours**
1.2	**Diagnostic Enzymology:** Mechanisms of Elevated Enzyme Activities, Serum enzymes and isoenzymes in health and disease – Transaminases (AST, ALT) acid & alkaline phosphatases, amylase, LDH and CK. ***keywords: clinically important enzymes***	**4Hours**
2.0	**Disorders of carbohydrate metabolism**: Blood sugar homeostasis: Role of tissues and hormones in the maintenance of blood sugar. Hypoglycemia, hyperglycemia, glycosuria. Diabetes mellitus – classification, metabolic abnormalities, diagnosis and management. Laboratory Investigations: GTT, HbA1c , Complications and Advanced Glycation End Products **In Born Errors of Carbohydrate Metabolism** glycogen storage diseases, galactosemia, fructose intolerance and fructosuria. ***Key words: Disorder inborn errors of carbohydrate metabolism***	**8hours**
2.1	**Disorders of lipid metabolism** – HDL And Reverse Cholesterol Transport. Lipoproteinemias, Lipid storage diseases – Gaucher's, Tay Sach's Niemann Pick disease. Fatty liver. Atherosclerosis-Oxidation Hypothesis , Response to injury Hypothesis, Inflammation as a cause , Risk Factors and Pathogenesis , Diagnosis And Prognosis ***Key words: Disorder of lipid metabolism, cardiovascular disease***	**6hours**
3.0	**Disorders of amino acid and nucleic acid metabolism** Disorders of amino acid metabolism–Phenylketonuria, alkaptonuria, albinism, cystinuria and maple syrup urine disease. Disorders of purine, pyrimidine metabolism: Hyperuricemia and gout. Hypouricemia. Orotic aciduria. Serology: C reactive protein test, Rheumatoid arthritis (RA) test. ***Key words: Disorders of amino acid and nucleic acid metabolism***	**6hours**

4.0 **Liver function test and gastric function test** Jaundice- Causes, consequences, biochemical findings, treatment in jaundice, hepatitis and cirrhosis. Liver function test. Tests related to excretory (bile pigments) synthetic (prothrombin time) detoxifying (hippuric acid) and metabolic (galactose) functions. Gall stones. Gastric function tests- Stimulation tests – insulin and pentagastrin. fractional Gastric Analysis , Hypo And Hyper Acidity Malabsorption Syndrome , Steatorrhea , Diarrhoea , Peptic ulcer, gastritis and Zollinger Ellison syndrome. **6hours**

Key words: Important Liver function test and gastric function test

5.0 **Renal function test and metabolic disorders:** Kidney function- Biochemical findings in glomerulonephritis, renal failure and nephritic syndrome. Nephrolithiasis. Kidney function tests - Glomerular function tests – inulin, urea and creatinine clearance tests, renal plasma flow, plasma microglobulin. Tubular function tests – water load, concentration and acid excretion tests. Abnormal constituents of urine. **8hours**

Key words: Important renal function test , Abnormal constituents of urine

6.0 **Laboratory Diagnosis To Assess the function of endocrine system:**

Function and disorders of Pituitary, Thyroid & Adrenals gland: Graves Disease , Hashimoto Disease ,Addission's Disease , Acromegaly & Gigantism **6hours**

Note: Course content involves 100% theory

REFERENCES

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	Clinical Chemistry in diagnosis and treatment,	Philip. D. Maine & Edward Arnold, 6th ed ELBS.	Bhalani Publishing house	6	2015
2	Varley's Practical Clinical Biochemistry	Alan H .Gowenhock	CBS publishers.	6	2014
3	Text book of Medical laboratory technology	Praful. B. Godkar	Bhalani Publishing house	3	2014
4	Biochemical Methods	Sadasivam, S. and Manickam, A	New Age International (P) Ltd	3	2010

RECOMMENDED BOOKS

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	Clinical Biochemistry-, an Illustrated Colour Text	Allan GAW Michael J	Tata McGraw Hill Education Private Limited, New Delhi	5	2013

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FIRST YEAR - SEMESTER – I

Course Title	**BIOTECHNOLOGY**							
Course Type	**Soft Core- Theory**		Total Hours	48	Hours/Week	03	Credits	03
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand the difference between old biotechnology and modern biotechnology.
CO-2	Provide examples of current applications of biotechnology and advances in the different areas like medical, microbial, environmental, bioremediation, agricultural, plant, animal, and forensic.
CO-3	Explain the concept and application of cell lines
CO-4	Provide examples on how to use microbes and mammalian cells for the production of pharmaceutical products.
CO-5	commercial production & application of Cell lines in treating disorders

MAPPING CLO'S WITH PSO's AND CD's

CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Compare & Contrast between old biotechnology and modern biotechnology	PSO -1	Understand
CLO-2	Apply the knowledge of biotechnology and advances in the different areas like medical, microbial, environmental, bioremediation, agricultural, plant, animal, and forensic	PSO- 2	Apply
CLO-3	understand the concept and application of cell lines	PSO- 3	Understand
CLO-4	Critically evaluate the role of microbes and mammalian cells for the production of pharmaceutical products.	PSO -5	Evaluate
CLO-5	Describe and identify the production & main characteristics of Cell lines in treating disorders	PSO -4	Remember

Modules	**COURSE CONTENTS**	**Duration**
1.0	**Cell culture techniques:** Introduction to plant and animal tissue/cell culture Laboratory design aseptic conditions equipments and materials for cell culture. Different constituents of culture medium - types of media and their applications **Animal cell culture:** Animal Cell Culture: Historical Background, Importance and progress in Animal Cell Culture Technology, Biology of Animal Cell; Laboratory setup and equipments, aseptic technique, different cell culture media and supplements, Importance of Serum and Serum Free Media, preparation and sterilization of cell culture media and supplements. Preparation of primary culture, disaggregation of tissue and primary cultures chick embryo, HUVEC, characterization of cultures ,Ploidy, cell doubling time, Cell surface markers ***Keywords: Cell culture, Markers, media and supplements***	**12hours**

2.0 **Cell lines:** Characteristics and routine maintenance cell separation techniques Measurement of viability and cytotoxicity Scaling-up of animal cell culture bioreactors used in animal cell culture, amplified cultures, continuous cultures and their applications **12hours**

Keywords: Cell lines, viability, application

3.0 **Fermenters:** stirred fermenter, Microcarrier, Encapsulation, hollow fiber chambers, packed Cell, immobilization techniques, glass bead reactors, Organ and histotypic cultures, three-dimensional culture ,tissue engineering eg skin Characterization Cell synchronization of the cultured cells measuring parameters of growth Somatic cell fusion cell cloning cryopreservation **12hours**

Keywords: Fermenters, tissue engineering

4.0 **Applications :**Commercial scale production of animal cells, stem cells &their application; Over view of embryonic and adult stem cells for therapy; Neuro degenerative disease; Parkinsons, Alzheimer, Spinal cord injuries and other brain syndromes; Tissue system failures; Diabetes; Cardiomyopathy; Kideney failure; Liver failure, Cancer, Hemophilia, Application of cell culture technology in production of human and animal vaccines and pharmaceutical proteins. ***Keywords: Commercial Production & Applications*** **12hours**

Note: Course content involves 100% theory

REFERENCES

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Biotechnology	U Satyanarayana	Books & Allied Ltd	1	2008
2.	A Textbook of Biotechnology	R C Dubey	S Chand	5	2014
3.	Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications	R. Ian Freshney	Wiley-Blackwell	6	2010
4.	Animal Cell Culture: Essential Methods	John M Ed Davis	John Wiley & Sons	1	2010

RECOMMENDED BOOKS

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	Introduction to Plant Cell, Tissue and Organ Culture	Sunil D. Purohit	PHI Learning	1	2013
2.	Practical Book of Biotechnology & Plant Tissue Culture	Madhavi Adhav & Nagar Santosh	S Chand & Co Ltd	1	2010

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FIRST YEAR - SEMESTER – I

Course Title	**PHARMACOLOGY AND TOXICOLOGY**								
Course Type	**Soft Core- Theory**		Total Hours	48	Hours/Week	03	Credits	03	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Remember the detailed study of drugs, particularly their actions on living systems
CO-2	Analyze the pharmacokinetics and Pharmacodynamics of drugs .
CO-3	Understand and identify the chemotherapeutic value of drug
CO-4	Understand the adverse effects of drug action.
CO-5	Evaluate the effect of clinical toxicology

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Discuss detailed study of drugs, particularly their actions on living systems	PSO -1	Understand
CLO-2	Compare the pharmacokinetics &pharmacodynamics of drugs	PSO- 2	Remember
CLO-3	Describe and identify the chemotherapeutic value of drug	PSO- 2	Understand
CLO-4	Describe the adverse effects of drug action.	PSO -3	Remember
CLO-5	discuss the effect of clinical toxicology	PSO -4	Apply

Modules	**COURSE CONTENTS**	**Duration**
1.0	**General Pharmacology:** Introduction to pharmacology, sources of drugs, Classification of drugs based on sources, dosage forms, route of administration, site of action of drugs. Mechanism of action, concept of receptors, combined effect of drugs, factors modifying drug action. Dose response curve- ED50 and LD50. ***Keywords: Pharmacology, Dose response curve***	**10hours**
2.0	**Pharmacokinetics:** Absorption and distribution of drugs, importance of drug – protein interaction. Drug metabolism: chemical pathway of drug metabolism, phase I and phase II reactions, role of cytochrome P450, non- microsomal reactions of drug metabolism, drug metabolizing enzymes. Drug elimination of liver and kidney. ***Keywords: Drug metabolism***	**10hours**
3.0	**Therapeutics:** Biochemical mode of action of antibiotics-penicillin and chloramphenicol, actions of alkaloids, antiviral and antimalarial substances. Biochemical mechanism of drug resistance- sulphonamides. Drug potency and drug efficacy. General principles of chemotherapy: chemotherapy of parasitic infections, fungal infections, viral diseases. Introduction to	**10hours**

immuno-modulators and chemotherapy of cancer.

Keywords: Therapeutics, chemotherapy

4.0 **Screening for pharmacological activity:** Analgesic, anti-inflammatory and antipyretic agents, gastrointestinal drugs, antiulcer and laxatives, antioxidants, anticancer and anti-fertility agents. Drugs for metabolic disorders like antidiabetic, anti-hyperlipidemic, anti-obesity and hepatoprotective agents. **8hours**

Keywords: Drugs as analgesics, hepatoprotective

5.0 **Clinical Toxicology:** Definition, classification of toxicity – occupational, environmental and pharmaceutical. Types of toxins and their mechanism of action. Factors affecting toxicity- Drug tolerance, intolerance, addiction, allergy, hypersensitivity, antagonism and synergism. Methods of detection. Drug abuses and their biological effects. Rational prescription of drugs. Toxicity of anticancer drugs. Clinical symptoms of toxicity and marker parameters. **10hours**

Keywords: Toxins, tolerance, intolerance

Note: Course content involves 100% theory

REFERENCES

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	Principles of pharmacology: the pathophysiologic basis of drug therapy	Golan, David E., Armen H. Tashjian, and Ehrin J. Armstrong, eds	Lippincott Williams & Wilkins,	1	2011
2	Essentials of Pharmacotherapeutics	F S K Barar	S. Chand Limited	1	2000
3	pharmaceutical chemistry	J. Lippincot co	McGraw Hill Professional, Philadelphia	2	1999
4	Screening methods in pharmacology	Robert A Turner	academic press, Newyork	1	2001

RECOMMENDED BOOKS

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	The pharmacological basis of therapeutics	Goodman & Gilman	Pentagon press	1	2012
2.	Basic and Clinical Pharmacology	Bertram Katzung, Anthony Trevor	McGraw Hill Professional	1	2014

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LIST B- SOFT-CORE SKILL ENHANCEMENT COURSES

1. Waste Management and Bioremediation
2. Biochemical Applications in Forensics

FIRST YEAR - SEMESTER – I

Course Title	**WASTE MANAGEMENT AND BIOREMEDIATION**								
Course Type	**Soft Core- Skill Enhancement**		Total Hours	30	Hours/Week	02	Credits	02	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand and apply the types of waste and pollution
CO-2	Understand source, types, disposal principles and Municipal Solid wastes management
CO-3	Understand and apply the various Hazardous Waste Management
CO-4	Understand the E-wastes Environmental impacts.
CO-5	Apply the principles behind Bio composting techniques.

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Critically evaluate the Wastes collection, storage, segregation and disposal methods	PSO- 1	Remember
CLO-2	Understand the recovery of recyclable and non-recyclable wastes	PSO- 2	Understand
CLO-3	assess the Hazardous Waste Management	PSO- 2	Remember
CLO-4	know the Sources, Facts and figures of plastic wastes in national and international level	PSO -3	Remember
CLO-5	Define Remediation of Pollutants	PSO- 4	Apply

Modules	**COURSE CONTENTS**	**Duration**
1.0	**Introduction to waste and pollution** : Wastes - Introduction, sources, collection, characteristics, composition, types of wastes – Global scenario of wastes - wastes generation per capita - Wastes collection, storage, segregation – disposal methods - sanitary land fillings. ***key words: waste recycling methods***	**8hours**
2.0	**Municipal Solid wastes management** :MSW – Sources, types, collection, transportation and disposal – Waste segregation, resource recovery, recovery of recyclable and non-recyclable wastes – reuse and recycling of MSW – Disposal – Incineration, pyrolysis, composing, aerobic and anaerobic digestion. Biomedical wastes – source, types, disposal principles ***key words: Use of solid waste as manure***	**8hours**
3.0	**Plastic and E-wastes** :Plastic wastes - Sources, Facts and figures of plastic wastes in national and international level, environmental effects and control measures – E-wastes – sources, types, recovery, reuse – E-wastes pollutant chemicals - E-wastes Environmental	**8hours**

impacts. ***key words: deterioration of e- waste***

4.0 **Remediation of Pollutants:** Bioremediation - Description – Biostimulation, Gaseous nutrient stimulation organic liquid stimulation – Bio-augmentation – Limitations and Concerns – Biofertilizer technology – Bio composting techniques. **6hours**

key words: Biofertilizers from waste

Note: Course content involves 100% theory

REFERENCES					
Sl.No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1	Waste Management and Bioremediation.	Choudharay DK	Oxford Book Company	6	2012
2	Solid Waste Management – Present and Future Challenges.	Singh J and Ramanathan AL	I.K. International Publishing House. Pvt. Ltd.	5	2010
3	Solid Waste Management	Subash Anand	Mittal Publication, New Delhi	4	2010

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	E-waste implications, regulations & Management in India and Current global best	Rakesh Johri	TERI Press, New Delhi	1	2008

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FIRST YEAR - SEMESTER – I

Course Title	**BIOCHEMICAL APPLICATIONS IN FORENSICS**								
Course Type	**Soft Core- Skill Enhancement**		Total Hours	30	Hours/Week	02	Credits		02
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks		100
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Learn the fundamental concepts and principles of forensic science and their significance
CO-2	Understand how a forensic investigation is initiated through preservation of evidences, as well as chemical, physical and biological methods of their analysis including analysis of DNA and other bodily fluids
CO-3	Learn to establish identity of an individual by document evaluation, fingerprints, footprints, DNA analysis etc
CO-4	Obtain hands-on-experience in some of the basic biochemical processes involved in forensic investigation.

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Understand the fundamental concepts and principles of forensic science and their significance	PSO- 1	Remember
CLO-2	understand how a forensic investigation is initiated through preservation of evidences, as well as chemical, physical and biological methods of their analysis including analysis of DNA and other bodily fluids	PSO- 2	Understand
CLO-3	critically evaluate to identity of an individual by document evaluation, fingerprints, footprints, DNA analysis etc	PSO- 5	Evaluate
CLO-4	Apply hands-on-experience in some of the basic biochemical processes involved in forensic investigation.	PSO- 3	Apply
CLO-5	Understand the fundamental concepts and principles of forensic science and their significance	PSO- 4	Understand

Modules	**COURSE CONTENTS**	**Duration**
1.0	**Forensic Science:** Definition of Forensic Science, Role of the Forensic Laboratory, History and Development of Forensic Science in India, Branches of Forensic Science. Administration and Organizational Setup: Brief introduction to DFSS, CFSL, GEQD, SFSL, RFSL, MFSL, FPB, NICFS, CDTS, NCRB and BPR&D. Educational qualifications and employment in Forensic Science Laboratory. ***keywords: Role of the Forensic Laboratory***	**6hours**
2.0	**Forensic Evidences**: Types of cases and evidences involved. Laws and Principles of Forensic Science: Law of Exchange (Locard), Law of Individuality, Law of Comparison, Law of Progressive Changes and Law of Probability. ***keywords: cases and evidences***	**3hours**
2.1	**Biological Evidence**: Nature and importance of biological evidence. Significance of hair evidence. Transfer, persistence and recovery of hair evidence. Structure of human hair. Comparison of hair samples. Morphology and biochemistry of human hair. Comparison of human and animal hair. Types and identification of microbial	**6hours**

organisms of forensic significance. Identification of wood, leaves, pollens and juices as botanical evidence. Diatoms and their forensic significance

keywords: biological evidence

2.2 **Wildlife Forensics:** Fundamentals of wildlife forensic. Significance of wildlife forensic. Protected and endangered species of animals and plants. Illegal trading in wildlife items, such as skin, fur, bone, horn, teeth, flowers and plants. Identification of physical evidence pertaining to wildlife forensics. Identification of pug marks of various animals **4hours**

keywords: Fundamentals of wildlife forensic

2.3 **Forensic Entomology:** Basics of forensic entomology. Insects of forensic importance. Collection of entomological evidence during death investigations. **3hours**

keywords: forensic entomology

3.0 **Criminalistics:** Definition, Securing & Searching methods,

Documentation of crime scene. Methods of collection of forensic evidences, Role of Police at the Crime scene, scientific help at crime scene, handling of various types of crime scenes by police. **4hours**

keywords: Crime scene

4.0 Basics of signature and handwriting comparison, fake currency note examination. Classification of Fingerprint patterns, cases involved methods of development and comparison of fingerprints. Forensic expert, Admissibility of Forensic testimony in Court of

law, Frye and Daubert standards, Cross Examination, Ethics in Forensic Science. Accreditation of Forensic laboratories by NABL. **4hours**

keywords: signature and handwriting comparison

Note: Course content involves 100% theory

REFERENCES

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	Encyclopaedia of Forensic Sciences	J A Siegel, P.J Saukko	Acad. Press	Vol. I, II and III	2000
2	Criminalistics	Saferstein	Prentice Hall Inc., USA	1	1976
3	Forensic Science in Criminal Investigation and Trials	Sharma, B.R	Central Law Agency, Allahabad	2	1974
4	Biochemistry	L. Stryer	W.H. Freeman and Company, New York	3	1988
5	Harper's Biochemistry	R.K. Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell	APPLETON & Lange, Norwalk	3	1993

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	Forensic Science: An introduction to scientific and investigative techniques	James, S.H and Nordby, J.J	CRC Press	1	2003
2	Forensic Biology	S. Chowdhuri	BPRD, New Delhi	1	1971
3	Serology and DNA typing in, Introduction to Forensic Sciences	G.T. Duncan and M.I. Tracey	.G. Eckert (Ed.), CRC Press, Boca Raton	2	1997

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FIRST YEAR - SEMESTER – II

Course Title	**ENZYMOLOGY**								
Course Type	**Hard Core-Theory**		Total Hours	48	Hours/Week		03	Credits	03
Course Code		Evaluation	Internal	C1+C2 = 15+15				30 Marks	100
			External	Duration	C3	03Hrs		70 Marks	

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand the Thermodynamic terms and basic concepts.
CO-2	Understand the classification, structure, properties and functions of enzymes.
CO-3	Understand the mechanism of action of enzymes and analyse the different types of Catalysis.
CO-4	Understand and apply the kinetic studies in the derivation of the M.M equation and their modification and understand different types of inhibition.
CO-5	Apply and evaluate the role of enzymes in different areas like industries, clinical labs etc.

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Remember and understand the major classes of enzyme and their functions in the cell.	PSO- 1	Understand
CLO-2	Explain the role of co-enzyme cofactor in enzyme catalyzed reaction.	PSO- 2	Remember
CLO-3	Differentiate between equilibrium and steady state kinetics and analyzed simple kinetic data and estimate important parameter (Km. Vmax, Kcatetc).	PSO- 2	Remember
CLO-4	Define and describe the properties of enzymes in and regulates biochemical pathway (inhibition)	PSO- 3	Remember
CLO-5	Explain the role of enzymes in different fields.	PSO- 4	Analyse

Modules	COURSE CONTENTS	Duration
1.0	**General Aspects:** Nature Of Enzymes, Localization, Isolation, Purification And Characterization Of Enzymes. Criteria Of Purity Of Enzymes, Fold Purity. Nomenclature And IUB Classification Of Enzymes. Enzyme Specificity, Specific Activity, Assay Methods; Coupled Enzyme Assays, Continuous, End Point And Kinetic Assay. Units Of Enzyme Activity, IU And Katal. ***Key words: Katal ,rpm, Centrifugation, Prosthetic group***	**7hours**
2.0	**Enzyme Kinetics:** Michaelis-Menten Equation, Initial Velocity Approach, Steady State Approach. Vmax, Km And Their Significance. Linear Transformation Of Michaelis-Menten Equation; Line weaver-Burk Plot, Eadie-Hofstee, Wolf And Cornish-Bowden. Scatchard Plot. Rate Of A Reaction, Order And Molecularity. I Order Reaction Kinetics. Rectangular Hyperbola, Michaelis-Menten Equation As Rectangular Hyperbola, Asymptote, Linear Transformation, Calculation Of Slope, Intercepts. **Inhibition:** Reversible And Irreversible Inhibition; Competitive, Non Competitive, Uncompetitive Product Inhibition And Suicide Inhibition. Determination Of Ki And Kd. **Bisubstrate Reaction:** Cleland's Notation With Examples Of Ordered, Ping-Pong, And Random Reactions. General Rate Equation. Primary And Secondary Plots ***Key words: Inhibition***, ***order of reaction***, ***Vmax, Km***	**7hours**
3.0	**Mechanisms Of Enzyme Catalysis:** Active Site Structure; Methods Of Determining Active Site Structure, Isolation Of ES Complex, Affinity Labeling, Chemical Modification Studies And Active Site Structure Investigation **Nature Of Enzyme Catalysis:** Transition State Theory, Proximity And Orientation, Orbital Steering, Acid Base Catalysis, Covalent Catalysis, Metal Ion Catalysis, Nucleophilic and Electrophoilic Catalysis, Intra Molecular Catalyses, Entropy Effects. Effect Of Temperature And Ph On Enzyme Catalyzed Reaction. ***Key words: Active site, Catalysis***.	**7hours**
4.0	**Cooperativity:** binding of Ligands to macromolecules; Scatchard plot, Cooperativity, positive and Negetive Cooperativity. Oxygen binding to hemoglobin. Hill equation, Homotropic and Heterotropic effectors, Aspartyl transcarbamylase as an allosteric enzyme. ***Key words: Co-operativity, Allosteric Enzyme***	**7hours**
5.0	**Mechanisms of action of Specific Enzyme:** Chymotrypsin; Zymogen Activation, Acid-Base Catalysis, Charge Relay Net Work. Lysozyme, Alcohol Dehydrogenase, Ribonuclease, Carboxypeptidase A, RNA as an Enzyme, Abzymes, Coenzymic Action of NAD^+, FAD, TPP, PLP, Biotin, CoA, Folic Acid And Lipoic Acid. ***Key words: Abzymes, Acid-Base Catalysis***	**7hours**
6.0	**Isoenzymes:** LDH, MultifunctionalEnzymes (DNA Polymerase) and Multi EnzymeComplex (PDC). **Metabolic regulation of enzyme activity:** Feedback regulation, fine	**7hours**

control of enzyme activity.

Fast reactions - Stopped flow, temperature jump method with examples of enzymes.

Key words: Isoenzymes, Fast reactions, Metabolic regulation

Note: Course content involves 100% theory

REFERENCES					
Sl.No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1.	Enzymes	Malcolm Dixon & Edwin C. Webb	Academic press Inc	2	1964
2.	Enzymes-Biochemistry, Biotechnology, Clinical Chemistry	Trevor Palmer	East West	2	2004
3.	Fundamentals of Enzymology.	Nicholas Price & Lewis Stevens	Oxford university press.	3	1999
4.	Enzyme Assays: A Practical Approach	R Eisenthal & M.J. Dauson	Oxford University Press	2	2002

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	Enzymes	P. Asokan	Chinnaa Publications	2	2005
2.	Enzymology and Enzyme Technology	Dr. Bhatt S.M	S Chand & Company	1	2014
3.	Enzymology	T. Devasena	Oxford University Press	1	2010

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FIRST YEAR - SEMESTER – II

Course Title	**MOLECULAR BIOLOGY**								
Course Type	**Hard Core-Theory**		Total Hours	48	Hours/Week	03	Credits	03	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand the mechanism of Prokaryotic replication, transcription and regulation.
CO-2	Understand the mechanism of Eukaryotic replication, transcription and regulation.

CO-3	Understand the features of Genetic code and translation mechanism.
CO-4	Understand and the cellular mechanism of Gene expression and regulation.

MAPPING CLO'S WITH PSO's AND CD's

CLO No.	Course Learning Outcomes On completion of the course the student will learn to	PSOs Addressed	CD's
CLO-1	Explain the mechanism of Prokaryotic replication, transcription and regulation.	PSO- 1	Analyse
CLO-2	Describe the mechanism of Eukaryotic replication, transcription and regulation.	PSO- 2	Remember
CLO-3	Enumerate the features of Genetic code and translation mechanism.	PSO- 2	Understand
CLO-4	Evaluate the cellular mechanism of Gene expression and regulation.	PSO -3	Evaluate
CLO-5	Understand the concept of Protein- DNA interactions. And molality.	PSO -4	Understand

Modules	COURSE CONTENTS	Duration
1.0	**Introduction:** historical perspective, composition of RNA and DNA. bases, chargaff s rule. types of RNA. isolation and purification of RNA and DNA, structure of RNA and DNA, central dogma of molecular biology. DNA as genetic material, experiment of Griffiths, Avery and colleagues, Hershey and Chase experiment. RNA as genetic material of viruses, frenkel-conrat experiment ***Key words: Purines, Pyrimidines, N^{14}, Genetic content, Bacteria***	**6hours**
2.0	**DNA-Anti parallel Nature:** nearest neighbour base frequency analysis. Replication of DNA, semi conservative nature; Messelson and Stahl experiment. replication of double stranded dna, direction of replication, cairn's experiment, semi discontinuous replication, okazaki fragements. DNA polymerase i ii and iii, DNA ligase, DNA topoisomerases. Fidelity of replication, trombon model, translesion synthesis (DNA pol iv and v). replication in viruses, rolling circle model, single stranded dna virus. replications of mitochondrial dna ***Key words: Replication, enzymes, Virus***	**10hours**
3.0	**Transcription:** colinearity of genes and proteins, rna polymerase i, ii and iii. rna biosynthesis in prokaryotes and eukaryotes; initiation, elongation and termination. abortive cycling. rna dependent rna synthesis, rna replicase of qßvirus. processing of eukaryotic rna, cap addition, intron splicing, poly a tail addition, rna editing. processing of trna and mrna transcripts. enzymes in dna and rna degradation: nucleases, ribonucleases, classification and role. ***Key words: Post transcriptional events, enzymes***	**10hours**
4.0	**Translation:** genetic code, triplet codon, universality features of the genetic code, assignment of codons, studies of khorana, nirenberg, triplet binding techniques, degeneracy, wobble hypothesis, evolution of genetic code and codon usage, variation in the codon usage. ***Key words: Codes, codons, Bias***	**8hours**

5.0 3d structure of prokaryotic and eukaryotic ribosomes, ribosomal protein synthesis; initiation elongation and termination. role of mRNA and tRNA. Amino acyl tRNA synthesis and its role in translation accuracy. internal ribosome entry sites. **6hours**

Key words: Translation, factors

6.0 **Post Translation Modification Of Proteins**, signal cleavage, disulphide bond formation, O and N-glycosylation, folding of nascent protein, role of chaperones, attachment of glycosyl anchor, and other modifications.dna binding protein motifs-zinc finger, leucine zipper, h-t-h motif. **8hours**

Key words: Significance of PTM

Note: Course content involves 100% theory

REFERENCES					
Sl.No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1.	Genes VII	Lewin B	Oxford univ. Press,	5	1994
2.	Molecular Biology	Robert F. Weaver	McGraw-Hill	4	2008
3.	Cell and Molecular Biology-Concepts and experiments	Karp, G.	Wiley & son	2	1999
4.	The Cell-A Molecular Approach.	Cooper, Geoffrey M	Sinauer Associates	2	2000
5.	Cell and Molecular Biology.	De Robertis, E.D.P. and De Robertis	B. I. Waverly pvt. Ltd.	8	1995

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	Molecular cell biology	Harvey Lodish & David Baltimore.	WH. Freeman and company	4	2000
2.	Principles of Cell and Molecular Biology	Kleinsmith, L. J. & Kish, V.M..	Harper Collins Publishers	2	1995
3.	Molecular cell biology	Harvey Lodish & David Baltimore.	WH. Freeman and company	6	2005

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FIRST YEAR - SEMESTER – II

Course Title	**CARBOHYDRATE & LIPID METABOLISM**								
Course Type	**Hard Core-Theory**		Total Hours	48	Hours/Week		03	Credits	03
Course Code		Evaluation	Internal	C1+C2 = 15+15				30 Marks	100
			External	Duration	C3	03Hrs		70 Marks	

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	understand the metabolism of pathways that yield energy from carbohydrate
CO-2	understand the diversity of metabolic regulation involved in amino acid metabolism
CO-3	understand and analyze how these biochemical processes are integrated with lipids
CO-4	Interlink the metabolism of pathways of heme and porphyrins, integration of all pathways and evaluate the fate of purine and pyrimidine nucleotides through their synthesis and breakdown mechanisms
CO-5	Analyse the energy-yielding and energy-requiring reactions in life, apply and evaluate the role of high energy compounds in driving cellular processes in animals, as well as plants through photosynthesis

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Understand and explain major pathways like Glycolysis, TCA cycle, Urea cycle etc.	PSO- 1	Remember
CLO-2	Analyse and explain the amino acid catabolism like transamination, transmethylation, decarboxylation ,	PSO- 2	Remember
CLO-3	Understand biosynthesis and elongation of fatty acids.	PSO- 2	Understand
CLO-4	Understand regulation of heme synthesis, involvement of organs to achieve energy, explain the	PSO -3	Apply
CLO-5	Analyse bioenergetics of carbohydrates, fatty acids etc. in plants and animals	PSO -4	Analyse

Modules	**COURSE CONTENTS**	**Duration**
1.0	**Bioenergetics:** Free energy and entropy. High energy and Low energy Phosphates. Enzymes involved in redox reactions. Biological oxidation - The electron transport chain – Oxidative Phosphorylation, F1F0 ATPase- structure and mechanism of action. The chemiosmotic theory. Inhibitors of respiratory chain and oxidative. Phosphorylation-uncouplers, ionophores of phosphorylation. ***Key words: thermodynamics; gibbs free energy***	**10hours**
2.0	**Biological oxidation:** Biological redox couplers, participation in oxidative metabolism. Free energy changes in electron transfer reactions. Mitochondrial electron transfer system- Chemical nature, topology and thermodynamic design of electron carriers. Sequence of electron carriers. Isolation of mitochondrial complexes, reconstitution experiments and study of specific inhibitors of Electron Transport Chain. ***Key words: Mitochondrial electron transfer system, ETC***	**10hours**
3.0	**Carbohydrate Metabolism:** Introduction to Metabolism - Anabolism and Catabolism, Experimental approaches to study metabolism. Metabolism of Carbohydrates - Glycolysis, Citric acid cycle, HMP shunt, Glucuronic acid pathway, Gluconeogenesis, Glycogenesis, Glycogenolysis, Glyoxylate cycle. Regulations of Glycolysis, Gluconeogenesis and Glycogen metabolism. Metabolism of Amino sugars, Sialic acids, Mucopolysaccharides and Glycoproteins. Biosynthesis of starch, sucrose & glycogen. ***Key words: insulin resistance, metabolism***	**10hours**

4.0 **Lipid Metabolism:** Biosynthesis & catabolism of fatty acids and its regulation. Knoop's Experiment, Saturated And Unsaturated Fatty Acids Metabolism of ketone bodies - Formation, utilization, excretion and clinical significance Metabolism and regulation of triglycerides, phospholipids and sphingolipids. Cholesterol Biosynthesis, regulation, transport and excretion. Metabolism of lipoproteins. Synthesis of Prostaglandins, thromboxanes, and leukotrienes. **10hours**

Key words: Steroid metabolism

5.0 **Hormonal Regulation of Glucose & Lipid Metabolism:** Effect of Insulin, Glucagon , Catecholamines , Growth & Thyroid Hormones, Corticosteroids on Carbohydrate and Lipid Metabolism in Liver And Adipose tissue **8hours**

Integration of Metabolic Pathways: Integration of carbohydrate and lipid metabolism & their regulation and manipulation.

Note: Course content involves 100% theory

REFERENCES					
Sl.No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1.	Harper's Biochemistry	Murray, et al	McGraw Hill	25	2000
2.	Cell and Molecular Biology.	De Robertis, E.D.P. and De Robertis	B. I. Waverly pvt. Ltd.	8	1995
3.	The Cell-A Molecular Approach.	Cooper, Geoffrey M	Sinauer Associates	2	2000

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publicatio**
1.	Principles of Cell and Molecular Biology	Kleinsmith, L. J. & Kish, V.M..	Harper Collins Publishers	2	1995
2.	Molecular cell biology	Harvey Lodish & David Baltimore.	WH. Freeman and company	6	2005

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FIRST YEAR - SEMESTER – II

Course Title	**ENZYMOLOGY, MOLECULAR BIOLOGY & METABOLISM**								
Course Type	**Hard Core-Practical**		Total Hours	48	Hours/Week		06	Credits	03
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks		100
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Gain an enhanced overall understanding of enzyme assays and in particular the influence of various physicochemical characteristics upon enzyme activity.
CO-2	Gain an understanding of buffers and their importance in the context of pH control.
CO-3	Apply and analyze the basics of the major analytical techniques including sample preparation, standardization and data analysis for each technique and develop interpersonal and teamwork skills
CO-4	Evaluate the theory and practice of protein purification, chromatography, electrophoresis, centrifugation, and other essential methods in modern molecular bioscience
CO-5	Gain knowledge on molecular techniques

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Acquire direct laboratory experience in electrophoresis	PSO- 1	Understand
CLO-2	Recognise, analysis, draw graph and calculated the enzyme	PSO- 2	Remember
CLO-3	Learn how to run gel and chromatography	PSO -2	Understand
CLO-4	Have insight in the physico-chemical properties of proteins that underlie purification methods.	PSO -3	Remember
CLO-5	Acquire direct laboratory experience in electrophoresis	PSO- 4	Analyse

Modules	**COURSE CONTENTS**	**Duration**
1.0	**Enzymology**	
1.1	Purification of sweet potato amylase- Extraction, ammonium sulphate precipitation	**3hours**
1.2	Km and Vmax	**3hours**
1.3	Optimum temperature and energy of activation	**3hours**
1.4	pH optimum of salivary amylase	**3hours**
1.5	Assay of invertase from yeast- initial velocity calculation	**3hours**
2.0	**Molecular Biology**	
2.1	Isolation of DNA and RNA from biological sources	**3hours**
2.2	Estimation of DNA by diphenylamine reagent	**3hours**
2.3	Estimation of RNA by orcinol reagent	**3hours**
2.4	Electrophoresis of DNA and RNA	**3hours**
3.0	**Metabolism**	
3.1	Determination of Pyruvate	**3hours**
3.2	Amino transferase reaction	**3hours**
3.3	Determination of Lactate, activity of LDH	**3hours**

3.4 Determination of Phospholipase and Lipase activity, Lipoprotein Lipase assay **3hours**

Note: Course content involves 100% Practicals

REFERENCES					
Sl.No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1.	Varley's Practical Clinical Biochemistry	Alan H .Gowenhock	CBS publishers.	6	2014
2.	Text book of Medical laboratory technology .	Praful. B. Godkar	Bhalani Publishing house	3, Volume I and II,	2014
3.	Biochemical Methods	Sadasivam, S. and Manickam, A	New Age International (P) Ltd	3	2010

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	Medical Laboratory Technology	Kanai L. Mukerjee	Tata McGraw Hill Education Private Limited, New Delhi	2 Volume 1, 2 and 3.	2011

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LIST C- SOFT-CORE GENERAL COURSES

1. Basics of Herbal Technology
2. Endocrinology
3. Functional Foods and Neutraceuticals

FIRST YEAR - SEMESTER – II

Course Title	**BASICS OF HERBAL TECHNOLOGY**								
Course Type	**Soft Core- Theory**		Total Hours	30	Hours/Week	02	Credits	02	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand the basic concept of Ethano-medicine.
CO-2	Understand and importance of medicinal plants
CO-3	Analyze the medications of tribal and folk to treat diseases
CO-4	Understand the basic concept of traditional knowledge of medicine
CO-5	Understand the medicinal uses of fruits and vegetables

MAPPING CLO'S WITH PSO's AND CD's			
CLO	**Course Learning Outcomes**	**PSOs**	**CD's**

No.	On completion of the course the student will learn to	Addressed	
CLO-1	Demonstrate the importance of Ethano-medicine	PSO- 1	Remember
CLO-2	Develop an understanding of medicinal plants	PSO- 2	Understand
CLO-3	Assess the mechanism of drug action of tribal medicine	PSO -2	Understand
CLO-4	Assess the therapeutic role of plants in day to day life	PSO- 4	Analyse

Modules	COURSE CONTENTS	Duration
1.0	**Ethnomedicine** – definition, history and its scope – Inter disciplinary approaches in ethanobotany Cultivation -harvesting - processing - storage - marketing and utilization of medicinal plants. Pharmacognasy - systematic position medicinal uses of the following herbs in curing various ailments; Tulsi, Ginger, Fenugreek, Indian Goose berry and Ashoka. ***Keywords: key words: sidha,Ayurvedha,unani***	**8 hours**
2.0	**Phytochemistry**- active principles and methods of their testing – identification and utilization of the medicinal herbs; Catharanthus roseus (cardiotonic), Withania somnifera (drugs acting on nervous system), Clerodendron phlomoides (anti-rheumatic) and Centella asiatica (memory booster). Analytical pharmacognasy - Drug adulteration - types, methods of drug evaluation – Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds). ***keywords: Phytochemicals, alkaloids, flavonoids, steroids***	**10 hours**
3.0	**Conservation of herbs**- Medicinal plant banks micro propagation of important species (Withania somnifera, neem and tulsi)- Herbal foods-future of pharmacognosy. ***key words: Withania somnifera, neem, tulsi***	**8 hours**
4.0	**Plants in day today life** – *Ocimum sanctum, Aloe vera.* Nutritive and medicinal value of some fruits (Orange, Mango, Banana, Lemon, Pomegranate) and vegetables - Greens (*Moringa, Solanum nigrum* Cabbage). ***key words: Guava, Sapota*** **Note: Course content involves 100% theory**	**4 hours**

REFERENCES

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Glossary of Indian medicinal plants,	R.N.Chopra, S.L.Nayar and I.C.Chopra	C.S.I.R, New Delhi.	1	1956.

2.	The indigenous drugs of India	Kanny, Lall, Dey and Raj Bahadur	International Book Distributors.	2	1984
3.	Herbal plants and Drugs	Agnes Arber	Mangal Deep Publications.	1	, 1999
4.	Ayurvedic drugs and their plant source	V.V. Sivarajan and Balachandran Indra	Oxford IBH publishing Co	1	1994

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publicatio**
1.	Ayurveda and Aromatherapy	Miller, Light and Miller Bryan	Banarsidass, Delhi	2	1998
2.	Principles of Ayurveda	Anne Green	Thomsons, London	2	2000

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FIRST YEAR - SEMESTER – II

Course Title	**ENDOCRINOLOGY**								
Course Type	**Soft Core- Theory**		Total Hours	30	Hours/Week	02	Credits	02	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand the Structure and functions of Hypothalamic and pituitary hormones.
CO-2	Understand the hormonal regulations of thyroid and parathyroid glands.
CO-3	Understand the synthesis, secretion, metabolism, regulation and biological effects of adrenal hormones
CO-4	Understand the structure, metabolism and biological actions of gonads and pancreatic hormones.
CO-5	Understand the Fundamentals concepts of signal transduction and signaling pathways

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Explain various hormones secreted by endocrine glands and their functions.	PSO -1	Understand
CLO-2	Understand the anatomy of the endocrine system.	PSO- 2	Remember
CLO-3	Understand the basic properties of hormones.	PSO- 2	Understand

CLO-4	Explain the role of the hormones in maintaining body function.	PSO -3	Remember
CLO-5	Understand and explain the major endocrine disorders	PSO -4	Apply

Modules	COURSE CONTENTS	Duration
1.0	**Endocrine System**: Endocrine organs in man. Location and inter relationship of endocrine glands in man; hormones produced by hypothalamus, pituitary, thyroid, parathyroid, pancreas, adrenals, gonads. Hypo and hyper production of hormones secreted by; pituitary, thyroid, pancreas, adrenals and gonads. Heart and kidney as endocrine organs ***Key words: Hormones and organs***	**12hours**
2.0	Hormones produced by hypothalamus; GRH, somatostatin, TRH, CRH, GnRH. Hormones of anterior, posterior and median lobes. Pro-opiomelanocortin. Hormones produced by testes and ovaries, menstrual cycle. ***Key words: POMC, reproductive hormones, hypothalamus, pituitary***	**8hours**
3.0	Regulation of hormone production and release: hypothalamus-pituitary-target organ axis and regulation by feedback mechanism. Conversion of cholesterol to steroid hormone. ***Key words: Inhibition, steroid hormone***	**4hours**
4.0	**Mechanism of hormone action:** **Peptide hormones:** General mechanisms of cell signaling by hydrophilic factors, transmembrane receptors, G protein coupled receptors,α_i and α_s receptor tyrosine kinase. Visual cycle, gustatory and auditory signals. Ion Channel receptors, Sodium channel ***Key words: Receptors, signal transduction***	**14hours**
5.0	**Second messengers:** IP_3, DAG, cAMP, protein Kinases. Nitric oxide; generation and action. **Growth factors:** Structure, mechanism of action and receptors of EGF, PDGF. Structure and function of insulin receptor. ***Key words: NO synthase, insulin, endothelium, platelets***	**6hours**
6.0	**Mechanism of action of steroid hormones:** Steroid receptors, mechanism of action of estrogen receptors. Receptor down regulation, desensitization and up regulation. ***Key words: Steroid receptors, Regulation***	**6hours**
7.0	Pineal gland, melatonin and circadian rhythm. Chemistry and action of prostaglandins, Prostacyclins and Thromboxanes. Eicosanoidreceptors. ***Key words: lipid mediators, melatonin, serotonin***	**6hours**

8.0 **Insect hormones:** Structure and function of molting hormone, ecdysone, juvenile hormones,

Pheromones: Mechanism of perception and action. Special case of communication in honey bees -dance language **8hours**

Key words: Significance of insect hormones, communication

Note: Course content involves 100% theory

REFERENCES					
Sl.No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1.	Biochemistry of Signal Transduction and Regulation	Gerhard Krauss	Wiley VCH	3	1999
2.	Fundamentals of biochemistry	Jain, J.L	S.Chand publication	6	2005
3.	Concepts in cell & molecular biology	Rastogi S.C, Sharma, Anuradha Tanden	New age publishers	3	2010

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	Cell Biology, Genetics, Molecular Biology, Evolution & Ecology	Verma P.S. Agarwal V.K	S Chand publication	5	2006
2.	Biochemistry of Signal Transduction and Regulation	Gerhard Krauss	Wiley VCH	5	2014
3.	Biochemical Messengers: Hormones, neurotransmitters and growth factors	D. Hardie	Springer	2	2012

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FIRST YEAR - SEMESTER – II

Course Title	**FUNCTIONAL FOODS AND NEUTRACEUTICALS**								
Course Type	**Soft Core- Theory**		Total Hours	30	Hours/Week	02	Credits	02	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand basic of the concepts of neutraceutical and functional foods
CO-2	Apply and understand the use of functional food for managing chronic diseases

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Understand basic of the concepts of neutraceutical and functional foods	PSO -1	Understand
CLO-2	Apply and understand the use of functional food for managing chronic diseases	PSO- 2	Apply

Modules	**COURSE CONTENTS**	**Duration**
1.0	**Functional Food and Neutraceuticals**- Definition, history, types	**3 hours**
2.0	**Probiotics**- Taxonomy and important features of probiotic micro-organisms. Health effects of probiotics including mechanism of action. Probiotics in various foods: fermented milk products, non-milk products etc. Quality Assurance of probiotics and safety ***Keywords: probiotics, sources, applications***	**3 hours**
3.0	**Prebiotics**- Definition, chemistry, sources, metabolism and bioavailability, effect of processing, physiological effects, effects on human health and potential applications in risk reduction of diseases. perspective for food applications for the – Non-digestible carbohydrates/oligosaccharides, Dietary fibre, Resistant starch, Gums ***Keywords: prebiotics, sources, applications***	**3 hours**
4.0	**Perspective for food applications** for the – Polyphenols: Flavonoids, catechins, isoflavones, tannins, Phytoesterogens, Phytosterols, Glucosinolates, Organo sulphur compounds, Other components – Phytates, Protease. Definition, chemistry, sources, metabolism and bioavailability, effect of processing, physiological effects, effects on human health and potential applications in risk reduction of diseases. ***Keywords: polyphenols, risk reduction, bioavailability***	**3 hours**
5.0	Concept of free radicals and antioxidants; antioxidants role as nutraceuticals and functional foods. Properties and functions of various nutraceuticals/functional food ingredients: Proteins, Peptides and nucleotides, Conjugated linoleic acid and n-3 fatty acids, Vitamins and Minerals. ***Keywords: free radicals and antioxidants, n-3 fatty acids*** **Note: Course content involves 100% theory**	**3 hours**

REFERENCES					
Sl.No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**

1.	Functional Foods and Nutraceuticals	Aluko, Rotimi	Springer-Verlag New York Inc	1	2012
2.	Handbook of Nutraceuticals and Functional Foods	Robert E.C. Wildman, Robert, Wildman, Taylor C	Wallace	3	2002

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	Nutraceuticals Functional Foods	Satinder Kaur Brar, Surinder Kaur and Gurpreet Singh Dhillon	Wiley VCH	1	2014.

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SECOND YEAR - SEMESTER – III

Course Title	**NITROGEN METABOLISM**								
Course Type	**Hard Core- Theory**		Total Hours	48	Hours/Week		03	Credits	03
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks		100
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Describe the modes of nitrogen fixation (both biological and abiological)
CO-2	Explain the steps involved in nitrogen fixation by free living organisms & leguminous plants
CO-3	Describe the assimilation of nitrate and ammonia by plants
CO-4	Describe amino acid synthesis in plants

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Explain the plant tissue structure, transport mechanism	PSO-2	Understand
CLO-2	Explain the role of the nitrogen cycle in plants	PSO-3	Apply
CLO-3	Describe amino acid synthesis in plants	PSO-1	Understand

Modules **COURSE CONTENTS** **Duration**

1.0 **Nitrogen Metabolism:** Importance Of Nitrogen In Biological Systems, Nitrogen Cycle. Nitrogen Fixation; Symbiotic And Non-Symbiotic, Nitrogenase Complex, Energetics And Regulation. Formation Of Root Nodules In Legumes. Assimilation Of Nitrate And Ammonium Ion. **8hours**

Key words: Plant system, atmosphere

2.0 **Proteins**: General Mechanisms of Degradation In Cells; Ubiquitin-Proteosome Pathway, Lysosomal Pathway. Degradation And Biosynthesis Of Glycoproteins And Proteoglycans. Biosynthesis And Degradation Of Heme And Porphyrins.
Non Ribosomal Peptide Synthesis: Glutathione, Gramicidine.
Biosynthesis Of Creatine **10hours**

Key words: protein degradation, GAGs, Glycans, blood

3.0 **General Mechanisms of Amino Acid Metabolism And Regulations**: Deamination, Transamination, Decarboxylation, Desulphuration, Degradation And Biosynthesis Of Individual Ammo Acids. Ketogenic And Glucogenic Amino Acids. **14hours**

Key words: enzymes

4.0 **Regulation Of Amino Acid Biosynthesis:** aspartate family, branched chain amino acids, aromatic amino acids, histidine, transglutaminase cycle, glutamate dehydrogenase, urea cycle. in born errors of amino acid degradation; phenyl ketonuria, alkaptonuria, maple syrup urine. **8hours**

Key words: Disorders, inhibition

5.0 **Purines And Pyrimidines:** pathways of degradation of nucleic acids, purines and pyrimidines, uric acid formation. salvage pathways, de novo biosynthetic pathways for purines and pyrimidines and regulations. gout and lysch-nyhan syndrome. conversion of nucleotides to deoxynuclotides. mechanism of action of methotrexate **12hours**

6.0 **Biosynthesis of Cofactors:** NAD^+, FAD And Coenzyme A, Polyamine Biosynthesis And Their Metabolic Role. Polyamine Biosynthesis– spermine and spermidine **6hours**

Key words: cofactors

7.0 Transpiration. Photosynthetic apparatus in plants, photosystems I and II, light harvesting antenna complex. Electron flow and phosphorylation; cyclic and noncyclic, oxygen evolution, Calvin cycle, C3, C4, and CAM cycle; Photorespiration, regulation of photosynthesis, RUBISCO Plant hormones: Physiological effects and Mechanisms of action of auxins, gibberlins, cytokinins, ethylene, abscisic acid. Host parasite interaction **9 hours**

Key words: Photorespiration, Plant hormones, Host parasite interaction

Note: Course content involves 100% Theory

REFERENCES

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	A Textbook of Plant Physiology, Biochemistry and Biotechnology	S K Verma & Mohit Verma	S Chand publishers	4	1995
2.	Lehninger	David L. Nelson	W.H. Freeman	4	2004

	Principles of Biochemistry	and Michael M. Cox	& company		
3.	Plant Physiology and Biochemistry	H. S. Srivastava &N. Shankar	Rastogi Publications	1	2005

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	Plant Physiology	Kochhar	Cambridge India	1	2016
2.	Plant Physiology	Malik C.P	Kalyani Publishers	1	2014
3.	Textbook of Biochemistry	Dr Kondreddy Rambabu	Aitbs Publishers	1	2013

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SECOND YEAR - SEMESTER – III

Course Title	**GENETIC ENGINEERING AND GENE EXPRESSION**								
Course Type	**Hard Core- Theory**		Total Hours	48	Hours/Week		03	Credits	03
Course Code		Evaluation	Internal	C1+C2 = 15+15				30 Marks	100
			External	Duration		C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand the principles of the techniques of Gene transfer methods.
CO-2	Analyze the methods of screening for Tissue culture.
CO-3	Evaluate the various techniques used in In-vitro fertilization and embryo transfer.
CO-4	Analyze and evaluate the different applications of Bioprocess Technology.

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	understand the concept of recombinant DNA technology or genetic engineering	PSO-2	Understand
CLO-2	Understand the Plant Tissue Culture and Transgenic plant technology	PSO-3	Apply
CLO-3	Explain the general principles and applications of Bioprocess Technology	PSO-1	Analyse
CLO-4	explain the concept and applications of In vitro fertilization and embryo transfer methods	PSO-1	Understand
CLO-5	Provide examples of current applications of biotechnology and Intellectual Property Rights and types, patenting	PSO-4	Remember

Modules	COURSE CONTENTS	Duration
1.0	**Genetic Engineering:** Extraction and purification of nucleic acids (DNA and RNA) from biological sources. Definition, aims and objectives of recombinant DNA technology, restriction-modification systems, restriction enzymes; type I, II and III, specificity, sticky ends and blunt ends, isoschizomers. Gene cloning; genomic cloning, shot gun cloning, cDNA cloning. **Vectors:** Plasmids, phage, cosmids and phagemid. Yeast cloning vectors, plant vectors, bacterial artificial chromosome, SV40, shuttle vectors, construction of expression vectors. ***Key words: methods, Sites-ORI, genes, significance, Vectors***	**6 hours**
2.0	**Ligation:** Blunt end and sticky end ligation, use of linkers and adopters, homo polymer tailing, colony hybridization, plaque hybridization. **Transformation:** Micro injection, electroporation, lipofection, calcium phosphate method, protoplast fusion/somatic cell hybridization and biolistic methods. Transgenic plants and animals, gene knock out ***Key words: identification, ligation, transformation, gene knock out***	**6 hours**
3.0	**Techniques**: chromosome walking, PCR; analysis of products, nested PCR, applications of PCR in cloning, agriculture and medicine. RT-PCR technique and applications. Real time PCR for quantification. **Identifying the right clone:** Direct screening; insertional inactivation of marker gene, visual screening, and plaque phenotype. Indirect screening; immunological techniques, hybrid arrest translation, hybrid select translation. Screening using probes; construction of gene probes, hybridization and labeling ***Key words: Quantification, identification***	**6 hours**
4.0	**Mapping in Prokaryotes and Viruses:** Bacterial transformation and transduction, conjugation; F+ plasmids, Hfr cells, time of entry mapping. Arrangement of genes in phage chromosome, plaque formation and lytic cycle. Fine structure of rII locus of T4. Lysogeny and lambda phage. ***Key words:lysis, lysogeny, phages, genes***	**6 hours**
5.0	**Blotting techniques:** Dot blot, Southern, Northern, Western blot, DNA foot print assay, DNA finger print assay, gel retardation assay, nuclease protection assay. RFLP, RAPD **Applications**: Gene therapy, applications in agriculture medicine, industry. GM foods, terminator gene, negative impact of genetic engineering. ***Key words: Identification of clones, Golden rice, edible vaccines***	**6 hours**
6.0	**Regulation of gene expression in prokaryotes:** Operon concept-Lac operon, structure and regulation Dual functions of the repressor in arabinose operon , gal operon- role of two operators, tryptophan operon- Transcriptional control by attenuation in tryptophan operon. **Riboswitches-** Role of riboswitches, CRISPR-CAS ***Key words: operons, gene editing***	**6 hours**

7.0 **Regulation of Eukaryotic gene expression - Regulation at the level of genome**-nucleosome structure, Chromatin remodelling, SWI/SNF complex, Chromatin immunoprecipitation (ChIP) analysis,Role of histone modification, Histone code Hypothesis, Transcription factors-NFkB, Si RNA, mi RNA, RNA stability, Regulation of GCN-4 **6 hours**

Key words: RNA types, gene regulation

Note: Course content involves 100% Theory

REFERENCES					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	Introduction to Genetic Engineering	Desmond S. T. Nicholl	Cambridge University Press	3	2008
2.	Genetic Engineering Handbook	David Rhodes	Syrawood Publishing House	1	2017
3.	Principles of Biotechnology and Genetic Engineering	A.J. Nair	Laxmi Publications	2	2009

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	Principles of Gene Manipulation and Genomics	Sandy B. Primrose, Richard Twyman	Wiley-Blackwell	7	2006
2.	Genetic Engineering	Smita Rastogi, Neelam Pathak	Oxford	1	2009
3.	Laboratory Manual for Genetic Engineering	Vennison & S John	Prentice Hall India Learning Private Limited	1	2009

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SECOND YEAR - SEMESTER – III

Course Title	**IMMUNOLOGY**								
Course Type	**Hard Core- Theory**		Total Hours	48	Hours/Week	03	Credits	03	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand and apply the types of immunity and lymphoid organs and lymphocytes
CO-2	Understand Immunity and Complement System
CO-3	Understand and apply the various Immunological Techniques in daily life style
CO-4	Understand the Transplantation and Tumor Immunology and apply the mechanism of autoimmunity

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	State the role of the immune system in the human body	PSO-2	Understand
CLO-2	Describe the functions of Immunity and Complement System	PSO-3	Apply
CLO-3	Describe Immunological techniques	PSO-1	Analyse
CLO-4	Define the gene organization and explain their functions	PSO-1	Understand
CLO-5	Explain Autoimmune and Immunodeficiency Disorders and explain their causes	PSO-4	Remember

Modules	**COURSE CONTENTS**	**Duration**
1.0	**Introduction:** Historical Development And Milestones In Immunology, Antigenicity, Immunogenicity, Innate And Acquired Immunity, Primary And Secondary Lymphoid Organs , Self And Non Self Discrimination ,Antigens And Antibodies, Haptens , Determinants , Epitopes And Paratopes, Carbohydrates, Proteins, Nucleic Acids and Cells as Antigens , Valency of Antigen, Epitope Analysis, Classes And Subclasses of Immunogloblins, Structure of Immunoglobulins, Hyper Variable Region- Isotypic , Allotypic & Idiotypic Variation ***Keywords: Epitope, Valency, Hyper Variable Region***	**10hours**
2.0	**Cellular Basis of Immunity** : Primary And Secondary Immune Response, Reticuloendothelial System ,T, B And Accessory Cells, Development of T And B Cells, Sub Sets of T And B Cells : T-Helper Cells, T-Killer Cells, T-Suppressor Cells, T And B Cell Receptors, Antigen Processing and Presentation, T and B Interaction, Cytokines and Co-Stimulatory Molecules, Lymphokines, Interleukins, Structure And Function of Il-Lα, Il-2, Tnfα, Suppression of Immune Response, Immunoglobulin Genes, Generation of Immunoglobulin Diversity, Gene Rearrangement and Other Mechanisms, Clonal Selection theory of Burnet ***Keywords: Selection theory, Antigen Processing***	**10hours**
3.0	**Non-specific defenses in man:** Barriers to infection : skin, mucous membranes, Inflammation, Complement hyper sensitivity reactions (Type I, II, III and IV) , Defensins, Toll-like receptors, DAMP , PAMP , Pattern recognition **MHC**: MHC gene and its polymorphism , Role of MHC in immune response and transplantation **Transplantation:** Autograft, Isograft, Allograft , Xenograft , Graft rejection : graft vs. host reaction ***Keywords: Transplantation, Barriers to infection***	**10hours**
4.0	**Tumour immunology:** Tumour associated antigens , Factors favoring tumour growth, Immune surveillance ,Tumour necrosis factor- α and β**.** **Disorders of immunity:** Immunological tolerance, auto immune disorders, AIDS , SCID	**10hours**

Keywords: Tumour associated antigens, Immunological tolerance

5.0 **Vaccines:** Adjuvants, vaccines and their preparations, Polyclonal and monoclonal antibodies , hybridoma technique

In-vitro antigen-antibody reaction: Precipitation , Agglutination , Complement fixation, Immunodiffusion , Immunoelectrophoresis , Defense system in lower organisms **8hours**

Keywords: Vaccines, hybridoma technique, Defense system

Note: Course content involves 100% Theory

REFERENCES

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	Essentials of Immunology	Janis Kuby	Freeman, W. H. & Company	3	1997
2.	Monoclonal Antibodies – Priniciples and Practice	J. W. Goding	Academic Press	3	1996
3.	Immunology	Roitt Ivann, Jonathan Brastoff, David Male	Mosby-Year Book	1	1993

RECOMMENDED BOOKS

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	Roitt's Essential Immunology	Peter J. Delves , Seamus J. Martin Dennis R. Burton Ivan M. Roitt	Wiley-Blackwell	12	2011
2.	A Textbook of Immunology	Latha P.Madhavee	S Chand & Company	1	2012
3.	Immunology	Dulsy Fatima (Author), N Arumugam	Saras Publication	1	2014

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SECOND YEAR - SEMESTER – III

Course Title	**NITROGEN METABOLISM, IMMUNOLOGY AND GENE EXPRESSION**								
Course Type	**Hard Core- Practical**		Total Hours	48	Hours/Week		06	Credits	03
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks		100
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	understand and apply the knowledge of the theory and practice of various clinical techniques like genetic engineering and immunology
CO-2	Identify and analyze the staining techniques
CO-3	Understand principles, theory and calculations of each experiment
CO-4	Perform quantitative and qualitative analysis of known standards as well as unknown samples develop problem-solving skills and to nurture professional attitudes
CO-5	Understand the applicability of the biochemical methods to realistic situations.

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Gain technical experience and handle adjustable micro pipettes in a reproducible manner	PSO- 1	Understand
CLO-2	Plan experiments, write protocols	PSO- 2	Remember
CLO-3	Perform logical reasoning and criticizing data	PSO -2	Understand
CLO-4	Demonstrate the use of advance microscope.	PSO -3	Remember
CLO-5	Understand and interpretation of test results	PSO- 4	Analyse

Modules	**COURSE CONTENTS**	**Duration**
1.0	**Nitrogen Metabolism**	
1.1	Estimation of ammonia	**3hours**
1.2	Nitrogen content of food by digestion and nitrogen estimation	**3hours**
1.3	Estimation of Urea	**3hours**
1.4	Estimation of Uric acid	**3hours**
1.5	Estimation of creatine and creatinine	**3hours**
2.0	**Genetic Engineering**	
2.1	Inductionof Beta galactosidase in E.coli	**3hours**
3.0	**Immunology**	
3.1	Immunodiffusion	**3hours**
3.2	Purification of IgY	**3hours**
3.3	Demonstration of ELISA	**3hours**
3.4	Assay of superoxide, Hydrogen peroxide, free radicals and free radical scavenging	**3hours**

3.5	Macrophage phagocytosis	**3hours**
3.6	Cell counting of WBC and Platelets	**3hours**
3.7	Blood Grouping	**3hours**
4.0	**Histochemistry**	
4.1	Simple staining for plant cell	**3hours**
4.2	Isolation of mitochondrial organelle.	**3hours**

Note: Course content involves 100% Practicals

REFERENCES					
Sl.No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1.	Varley's Practical Clinical Biochemistry	Alan H .Gowenhock	CBS publishers.	6	2014
2.	Text book of Medical laboratory technology .	Praful. B. Godkar	Bhalani Publishing house	3, Volume I and II,	2014
3.	Biochemical Methods	Sadasivam, S. and Manickam, A	New Age International (P) Ltd	3	2010

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	Medical Laboratory Technology	Kanai L. Mukerjee	Tata McGraw Hill Education	2	2011

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LIST D- SOFT-CORE GENERAL COURSES

1. Histochemistry & Cancer Biology
2. Ecology & Evolution

SECOND YEAR - SEMESTER – III

Course Title	**HISTOCHEMISTRY & CANCER BIOLOGY**							
Course Type	**Soft Core- Theory**		Total Hours	30	Hours/Week	02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Asses the relationship between histology and the pathogenesis of disease
CO-2	Understand the working principles, tools and techniques of Histochemistry

CO-3	Understand the multistep, genetic alterations which enable the transformation of a normal cell to a cancer
CO-4	types of gene mutations possible and how these mutations can contribute to cancer formation
CO-5	critically evaluate the role of diet in cancer development and cancer prevention

MAPPING CLO'S WITH PSO's AND CD's

CLO No.	Course Learning Outcomes On completion of the course the student will learn to	PSOs Addressed	CD's
CLO-1	Understand the principles of Histochemistry	PSO- 1	Remember
CLO-2	Recall and apply the procedures involved in histopathology to identify the diseases.	PSO- 2	Understand
CLO-3	how external or internal stimuli can lead to apoptosis	PSO -2	Understand
CLO-4	List and describe the steps that lead to metastasis	PSO- 3	Analyse
CLO-5	Clarify how cancer cells escape cell death	PSO- 4	Analyse

Modules	COURSE CONTENTS	Duration
1.0	**Tissues:** Formation of different kinds of tissues from primary germ layers. Types and functions of epithelial tissue, inter-cellular junctions. Connective tissue – extra cellular matrix, Collagens – Types, composition, structure and synthesis, Elastin, fibronectins, and other proteins of the extracellular matrix. Basal lamina; laminins and associated proteins and their functions. ***Keywords: Types of tissues***	**5 hours**
2.0	**Principles of Histochemistry**: Principles, staining, mounting, preservation and methods of application and utility of classical histochemical Techniques: for localization of glycoproteins (PAS), nucleic acids (Feulgen) and steroid dehydrogenase activity. ***Key words: Fixation, Microtome, Microscopic Visualization***	**5 hours**
3.0	**Histopathology in Diseases:** Morphological alterations in cells due to disease, types of degeneration clouding, hyaline, hydrophic and fatty degeneration. Etiology, pathogenesis and histopathology of Liver cirrhosis and atherosclerosis, Neuropathology of alcoholism and methanol poisoning. Histopathology: Tumors-malignant and non-malignant, types of carcinoma, histopathology of breast and prostate tumors. ***Key words: Histopathology of liver cells***	**5 hours**
4.0	**Introduction:** Growth characteristics of cancers cells; neoplasia, anaplasia, metaplasia and hyperplasia, types of cancer benign, malignant, metastatic cancers. Carcinomas, sarcomas, adenomas, haemopoetic cancers. Characteristics of cancer cells, changes in cell membrane structure and functions **Oncogenes:** Provirus, protovirus, oncogenes and proto oncogenes. Mechanism of carcinogenic transformation by oncogenes, viral oncogenes. Tumor suppressor genes - properties, mechanism of tumor suppressor genes in cancer induction with	**8 hours**

special reference to P53 gene.

Key words:cancer, oncogenes

5.0 **Carcinogenesis:** Principles of carcinogenesis- chemical carcinogenesis, stages in chemical carcinogenesis - Initiation, promotion and progression. Physical carcinogenesis – X-ray radiation. Viral carcinogenesis. Free radicals and antioxidants in cancer.

7 hours

Diagnosis and Treatment: Cancer screening diagnosis and treatment. RIA and ELISA. Strategies of anticancer drug therapy chemotherapy, gene therapy, Immunotherapy and radiotherapy.

Key words: carcinogenesis, diagnosis

Note: Course content involves 100% Theory

REFERENCES

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Varley's Practical Clinical Biochemistry	Alan H .Gowenhock	CBS publishers.	6	2014
2.	Text book of Medical laboratory technology .	Praful. B. Godkar	Bhalani Publishing house	3, Volume I and II,	2014
3.	Biochemical Methods	Sadasivam, S. and Manickam, A	New Age International (P) Ltd	3	2010

RECOMMENDED BOOKS

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	Medical Laboratory Technology	Kanai L. Mukerjee	Tata McGraw Hill Education Private Limited, New Delhi	2 Volume 1, 2 and 3.	2011

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SECOND YEAR - SEMESTER – III

Course Title	**ECOLOGY & EVOLUTION**								
Course Type	**Soft Core- Theory**		Total Hours	30	Hours/Week		02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15				30 Marks	100
			External	Duration	C3	03Hrs		70 Marks	

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Analyse the diversity of evolutionary thoughts
CO-2	Identify the species concepts, Life history strategies; adaptive radiation
CO-3	Evaluate the Environmental and Community Ecology
CO-4	Explain the role of Ecosystem structure, function, energy flow
CO-5	Explain the Biodiversity and its conservation

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Understand the diversity of evolutionary thoughts	PSO- 1	Remember
CLO-2	Identify the species concepts, Life history strategies; adaptive radiation	PSO- 4	Apply
CLO-3	Explain the Environmental and Community Ecology	PSO- 2	Understand
CLO-4	Explain the role of Ecosystem structure, function,	PSO -2	Understand
CLO-5	energy flow Understand the Biodiversity and its conservation	PSO- 3	Analyse

Modules	**COURSE CONTENTS**	**Duration**
1.0	Biotic and abiotic interactions. Concept of habitat and niche; Population Ecology; concept of metapopulation. Species Interactions: Types of interactions, inter specific competition, herbivory, carnivory, pollination, symbiosis. Nature, structure and attributes; levels of species diversity and its measurement; edges and ecotones. Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax. ***Key words: Pioneer species***	**8hours**
2.0	Ecosystem structure, function; energy flow (food chain and food web) and mineral cycling (C, N, and P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, esturine). Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India. Conservation Biology: Principles and management, Indian case studies on conservation / management strategy (Project Tiger, Biosphere reserves). ***Key words: Factors affecting energy flow***	**8hours**
3.0	Evolutionary Time scale. Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiment of Miller; The first cell; Evolution of prokaryotes and Eukaryotes. Anaerobic and aerobic metabolism. ***Key words: Evolutionary adaptations***	**5hours**
4.0	Origin, evolution and diversification of life; natural selection; levels of selection. Types of selection (stabilizing, directional etc.); sexual selection; genetic drift; gene flow; adaptation; convergence; species concepts; Life history strategies; adaptive radiation; biogeography and evolutionary ecology; Molecular evolution; molecular clocks;	**5hours**

systems of classification: cladistics and phenetics; molecular systematics; gene expression and evolution.

Key words: Evolutionary research

5.0 Evolutionary Biology – Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Spontaneity of mutations; the evolutionary synthesis. The evolutionary time scale; Eras, periods and epoch; Origins of unicellular and multi cellular organisms; Hardy – Weinberg law. **4hours**

Key words: History, Darwinism

Note: Course content involves 100% Theory

REFERENCES

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Elements of Ecology	SA. Nasim,	Axis Books Pvt.Ltd,	2	2012
2.	A Textbook of Ecology.	SK Dubey	Wisdom Press. New Delhi	4	2010
3.	Genetics	P.S.Verma & V.K. Agarwal,	S.Chand & Company Pvt Ltd	3	2010
4.	Elements of Ecology,	Sharma P.D	Rastogi Publishers, Meerut.	1	1999.

RECOMMENDED BOOKS

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	Cytology, Genetics, Evolution and Ecology.	P S Verma and V K Agarwal.	S. Chand & Co. Ltd	2	2005
2.	Ecology Theories & Application	peter Stiling	PHI Learning Pvt .Ltd,	4	2009

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LIST E- SOFT-CORE ABILITY ENHANCEMENT COURSES

1. Methods in Research
2. Pathological basis of Diseases
3. Food processing and Packaging

SECOND YEAR - SEMESTER – III

Course Title	**METHODS IN RESEARCH**								
Course Type	**Soft Core- Ability Enhancement**		Total Hours	30	Hours/Week		02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15				30 Marks	100
			External	Duration	C3	03Hrs		70 Marks	

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand and apply the concept of various representations of data
CO-2	Understand and apply the measures of central tendency
CO-3	Understand and apply the types of correlations and regressions
CO-4	Understand Characteristics and Function of Research
CO-5	Understand Techniques involved in defining the problem.

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Select, use and interpret results of descriptive statistical methods effectively	PSO -1	Remember
CLO-2	Demonstrate an understanding of the central concepts of modern statistical theory and their probabilistic foundation;	PSO -2	Understand
CLO-3	Select, use, and interpret results of, the principal methods of statistical inference and design	PSO- 2	Remember
CLO-4	Understand the Research and scientific methods	PSO -3	Remember
CLO-5	Understand the Goals and Criteria for identifying problems	PSO -4	Apply

Modules	**COURSE CONTENTS**	**Duration**
1.0	Meaning of Research - Function of Research Meaning of Research - Function of Research – Characteristics of Research – Steps involved in Research – Research in Pure and Applied Sciences - Inter Disciplinary Research. Factors which hinder Research – Significance of Research - Research and scientific methods – Research Process– Criteria of good Research – Problems encountered by Researchers – Literature review. ***keywords: types, criteria of research***	**8hours**
2.0	Statistical survey – Organizing, planning and executing the survey. Source of data - Primary and secondary data, collection, observation, interview, enquiry forms, questionnaire schedule and check list. Classification and tabulation of data. Diagrammatic and graphic presentation of data. ***key words: mini survey***	**8hours**
3.0	Measures of central tendency - arithmetic mean, median, mode, quartiles, deciles and percentiles. Measures of variation - range, quartile deviation, mean deviation, standard deviation, Coefficient of variation. Correlation analysis - Scatter diagram, Karl's Pearson's coefficient of correlation and Spearman's rank method. Regression analysis. ***key words: big data analytics,***	**8hours**

4.0 Probability - Definition, concepts, theorems (proof of the theorems not necessary) and calculations of probability - Simple problems. Theoretical distributions –Binomial, Poisson and normal distribution - Simple problems (proof of the theorems not necessary). Correlation, regression and ANOVA: Analysis of variance: One way and two way ANOVA, MONOVA, SPSS **6hours**

keywords: probability, regression

Note: Course content involves 100% Theory

REFERENCES					
Sl.No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1	Research Methodology, Methods and Techniques	C.R. Kothari,	New Age International Publishers. New Delhi.	2	2001
2	Biostatistics: A Foundation for Analysis in the Health Sciences	Wayne W. Daniel	John Willey and Sons Inc., USA.	9	2006
3	Introduction to bioinformatics	Attwood, T. K., and Parry-Smith, D.J	Pearson Education Ltd., Delhi, India	2	1999

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	Modern Experimental Biochemistry	Rodney F. Boyer	Benjamin-Cummings Publishing, Redwood City, CA	2	1993.

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SECOND YEAR - SEMESTER – III

Course Title	**PATHOLOGICAL BASIS OF DISEASES**								
Course Type	**Soft Core- Ability Enhancement**		Total Hours	30	Hours/Week	02	Credits	02	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand compliments and supplements the necessary knowledge students have gained in Physiology
CO-2	Understand and Consequently it incorporates topics like cellular adaptations, inflammation, neoplasia, cellular ageing and other infectious diseases
CO-3	Understand and apply the necessary inputs for the other disciplines like

	Pharmacology, social and preventive medicine, medicinal biochemistry etc

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Understand compliments and supplements the necessary knowledge students have gained in Physiology	PSO -1	Remember
CLO-2	Understand and Consequently it incorporates topics like cellular adaptations, inflammation, neoplasia, cellular ageing and other infectious diseases	PSO- 2	Understand
CLO-3	Understand and apply the necessary inputs for the other disciplines like Pharmacology, social and preventive medicine, medicinal biochemistry etc	PSO- 2	Remember

Modules	**COURSE CONTENTS**	**Duration**
1.0	**Introduction:** History of pathology, Basic definitions and common terms used in pathology, Survival mechanism and disease, microscopic and cellular pathology, scope and techniques used. ***keywords: pathology, survival***	**6hours**
2.0	**Role of Inflammation in disease** Basic concepts with suitable examples of general features of acute and chronic inflammation: Vascular Changes, cellular events, important chemical mediators of inflammation, Morphological effects inflammation response, Granulomatus Inflammation. ***keywords: inflammatory responses***	**6hours**
3.0	**Role of Tissue repair Healing and Fibrosis** Basic mechanism of tissue regeneration, and repair by healing, scar formation and fibrosis **Common Hemodynamic Disorders in diseases** An overview of Edema, hyperemia, congestion, hemorrhage, hemostasis and thrombosis, Embolism, Infarction and shock with suitable examples ***keywords: tissue repair, disorders***	**6hours**
4.0	**Principles of First Aid Management:** Principles of First Aid. Causality assessment. Priorities of first aid, unconsciousness and recovery positions. Resuscitation, control of major bleedings, chocking, and treatment of shocks. Emergency aid in schools and others. Patient management and care, labeling of causalities. Approach to a causality. Handling and transport of injured persons. Disaster management and multiple causalities, Internal and external bleeding, injuries to muscles, joints and bones, stroke. Miscellaneous injuries, splinting skill tests, head, neck, back, chest, abdomen injuries. ***keywords: Principles of First Aid*, Causality assessment**	**6hours**

5.0 **Emergency Care:** Poisoning - bites - stings. Drug abuse. Frostbite and cold exposure. Burns and Scalds. Heat stroke, heat cramps and heat exhaustion Accident reporting, first aid to victims of road accidents. Patient assessment and management, breathing emergencies, defibrillation. Sudden illness - heart attack, stroke, fainting, convulsion epilepsy, prevention of heart attack and apoplexy. **6hours**

keywords: Accident reporting

Note: Course content involves 100% theory

REFERENCES					
Sl.No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1	Medical Laboratory Technology Methods and Interpretations	Ramnik. Sood	Jaypee Brothers Medical Publishers	6	2009
2	General And Systematic Pathology	J.,Ed. Underwood and J. C. E. Underwood	Churchill Livingstone	2	1996
3	Pathologic Basis of Disease	Robbins and Cotran	Saunders Publishers	8	2009

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	Basic Pathology	. Kumar, Abbas, Fausto and Mitchell; Robbins	Saunders Publication	9	2012

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SECOND YEAR - SEMESTER – III

Course Title	**FOOD PROCESSING AND PACKAGING**								
Course Type	**Soft Core- Ability Enhancement**		Total Hours	30	Hours/Week		02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15				30 Marks	100
			External	Duration	C3	03Hrs		70 Marks	

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand the concepts of food processing and actively participate in every facet of the country's growing food industry.
CO-2	Understand about food systems in the production, processing and consumption of food and an appreciation of their impact on society
CO-3	Understand the nature of food and human nutrition and an appreciation of the importance of food to health
CO-4	Learn skills in researching, analyzing and communicating food issues, skills in experimenting with and preparing food by applying theoretical concepts
CO-5	Understand and apply the skills in designing, implementing and evaluating solutions to food situations.

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Explain the requirements for meat export and chemical and physiological structure of meat.	PSO 1	Remember
CLO-2	Demonstrate processing techniques used to produce a variety of milk products.	PSO 2	Understand
CLO-3	Analyse the process of harvesting, processing and storage of seafood.	PSO 2	Analyse
CLO-4	Evaluate variety of egg products produced in the food processing industry including egg structure and egg quality.	PSO 3	Remember
CLO-5	Understand the sources and processing of Edible Fats and Oils.	PSO 4	Apply

Modules	**COURSE CONTENTS**	**Duration**
1.0	Scope of food processing, principles of food processing and preservation. Processing and preservation by heat blanching, pasteurization, sterilization and UHT processing, canning, extrusion cooking, dielectric heating, microwave heating, baking, roasting and frying, etc. ***Key words: raw food materials***	**6hours**
2.0	Processing and preservation by low temperature, refrigeration, freezing, dehydro-freezing, cold storage methods. Processing and preservation by dehydration, drying, concentration and evaporation- types of dryers and their suitability for different food products, ultra filtration, reverse osmosis. ***Key words: mincing and macerating, liquefaction***	**6hours**
3.0	Definitions and functions of packaging , MAP, CAP, Vacuum packing , Packaging requirements and selection of packaging materials; Types of packaging materials: Paper: Pulping, fibrillation and beating, types of papers and their testing methods. ***Key words: Aseptic processing***	**6hours**

4.0 Food Quality Indices – Meat and Meat Products, Fish and Fish Products, Milk and Dairy Products, Vegetables, Fruits and their Products, Grains, Pulses and Oil Seeds Coffee Tea and Spices Food Adulteration: Definition, Nature of Adulterants, Methods of Evaluation of Food Adulterants and Toxic Constituents. Additives: Meaning, Classification, Types of Additives **6hours**

Key *words: white meat slaughter*

5.0 Food packaging system: Different forms of packaging such as rigid, semi-rigid, flexible forms and different packaging system for (a) dehydrated foods (b) frozen foods (c) dairy products (d) fresh fruits and vegetables (e) meat, poultry and sea foods. **6hours**

Key words: food spoilage

Note: Course content involves 100% theory

REFERENCES					
Sl.No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1	Food and Beverage Packaging Technology	Richard Coles, Mark J. Kirwan	Wiley Blackwell.	2	2011
2	Food Processing Handbook	James G.Brennan, Alistair S Grandison	Blackwell.	2	2011

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	Food Packaging Materials	Mahadeviah M & Gowramma RV.	Tata McGraw Hill	1	1996

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LIST F- SOFT-CORE SELF STUDY COURSES

1. Introduction to Manuscript Writing And Research Presentation
2. Advanced Nutrition
3. Literature review and publication

SECOND YEAR - SEMESTER – III

Course Title	**INTRODUCTION TO MANUSCRIPT WRITING AND RESEARCH PRESENTATION**								
Course Type	**Soft Core- Self Study**		Total Hours	30	Hours/Week	02	Credits	02	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand and apply the concept of various representations of data
CO-2	Understand and apply the measures of central tendency
CO-3	Understand and apply the types of correlations and regressions
CO-4	Understand Characteristics and Function of Research
CO-5	Understand Techniques involved in defining the problem.

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Select, use and interpret results of descriptive statistical methods effectively	PSO- 1	Remember
CLO-2	Demonstrate an understanding of the central concepts of modern statistical theory and their probabilistic foundation	PSO- 2	Understand
CLO-3	Select, use, and interpret results of, the principal methods of statistical inference and design	PSO- 2	Remember
CLO-4	Understand the Research and scientific methods	PSO- 3	Remember
CLO-5	Understand the Goals and Criteria for identifying	PSO -4	Apply

Modules	**COURSE CONTENTS**	**Duration**
1.0	**Identification of Research Problem:** Selecting the Research problem – Necessity of defining the problem – Goals and Criteria for identifying problems for research. Perception of Research problem – Techniques involved in defining the problem – Source of problems – Personal consideration. ***key words: formulation system***	**12hours**
2.0	**Sources of information:** Journals, e-journals, books, biological abstracts, Preparation of index cards, Review writing, Article writing – structure of article. Selection of journals for publication- Impact factor – Citation index and H index. Proposal writing for funding. ***key words: journals, review writing***	**12hours**
3.0	***Each student will have to choose a scientific article and present it***	**6hours**

REFERENCES					
Sl.No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1	Research Methodology, Methods and Techniques	C.R. Kothari,	New Age International Publishers. New Delhi.	2	2001

2	Introduction to bioinformatics	Attwood, T. K., and Parry-Smith, D.J	Pearson Education Ltd., Delhi, India	2	1999

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	Biostatistics: A Foundation for Analysis in the Health Sciences	Wayne W. Daniel	John Willey and Sons Inc., USA.	9	2006

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SECOND YEAR - SEMESTER – III

Course Title	**ADVANCED NUTRITION**								
Course Type	**Soft Core- Self Study**		Total Hours	30	Hours/Week	02	Credits		02
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks		100
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	understand the proximate principles of nutrition with reference to RDA
CO-2	Understand and analyse and quantification of nutritional content of the food items
CO-3	Understand and apply The experiments concerned with energy metabolism and nutritional assessment.
CO-4	Understand and apply nutritional significance of vitamins & Minerals
CO-5	Understand and apply basic requirement of nutrition at different stages of life

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Select, use and interpret results of descriptive statistical methods effectively	PSO -1	Remember
CLO-2	Demonstrate an understanding of the central concepts of modern statistical theory and their probabilistic foundation	PSO -2	Understand
CLO-3	Select, use, and interpret results of, the principal methods of statistical inference and design	PSO -2	Remember
CLO-4	Understand the Research and scientific methods	PSO -3	Remember
CLO-5	Understand the Goals and Criteria for identifying problems	PSO- 4	Apply

Modules	**COURSE CONTENTS**	**Duration**
1.0	Energy Metabolism: Basal metabolism – Basal metabolic rate – Factors affecting BMR - determination of BMR, direct and indirect methods - Benedict's Roth apparatus - respiratory quotient – Biological oxygen demand. Anthropometry; Height, Weight, Skin	**6hours**

fold thickness and arm circumference -Their importance in nutrition.

Keywords: energy metabolism, BMR

2.0 Introduction to Nutritional Biochemistry: Carbohydrate; Source of energy; Glycogen, Fibre in diet. Proteins – essential amino acids and non essential amino acids – sources, functions – relation with Marasmus, Kwashiorkar disease. Biological value of proteins.

Fats: Sources- Saturated and unsaturated fatty acids, essential and non essential fatty acids – disorders concerned with fatty acid metabolism – Refsum's disease, Atherosclerosis. **6hours**

Keywords: Nutritional Biochemistry

3.0 Fat soluble and water soluble vitamins–their source, daily requirements and deficiency manifestations. Role of Vitamins as co-factors- in Electron transport chain; and enzyme reactions; Vitamins involved in haemopoiesis. Role as antioxidants. **6hours**

Keywords: Vitamins in nutrition

4.0 Minerals Micro, macro and trace elements – daily requirements – functions – deficiency manifestations – Role as electrolytes.- sodium and potassium. Food fads and Facts **6hours**

Keywords: Minerals in nutrition

5.0 Nutrition at different Stages of life: During infancy, School children, adolescence, pregnancy, lactation and aging. Assessment of nutritional status, - methods – intake, Biochemical and clinical methods. Nutrition For Diabetes And Cardiovascular Disease Patients ,Wellness Diets, Medeterranean Diet, Paleo Diet, Fitness Diets, Obesity And BMI Diet And Inflammation, Anti-Inflammatory Diets **6hours**

Keywords: special diets

Note: Course content involves 100% theory

REFERENCES

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	Mechanism and Theory in Food Chemistry	Wong, D. W. S	CBS, New Delhi	1	1996
2	Human Nutrition and Dietetics	Garrow, J. S. and James, W. P. T	Churchill Livingstone Publishers, UK.	10	2000
3	Newer Methods of Nutritional Biochemistry	Anthony A. Albanase	Academic Press, New York	2	1976

RECOMMENDED BOOKS

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	Essentials of Food and Nutrition. .	Swaminathan, M	The Bangalore Printing and Publishing Co. Ltd., Bangalore	1	2004

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SECOND YEAR - SEMESTER – III

Course Title	**LITERATURE REVIEW AND PUBLICATION**								
Course Type	**Soft Core- Self Study**		Total Hours	30	Hours/Week	02	Credits		02
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks		100
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand Techniques involved in defining the problem.
CO-2	Learn to review and assess scientific literature critically.
CO-3	Assess the general knowledge and skills to find, interpret
CO-4	Assess the importance, and keep track of the most relevant literature related to a field of research in which they plan to be active
CO-5	Write and present an overview of the relevant literature for a specific research topic.

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Provide foundation of knowledge on topic	PSO- 1	Remember
CLO-2	Identify inconstancies: gaps in research, conflicts in previous studies, open questions left from other research	PSO- 2	Understand
CLO-3	Identify need for additional research (justifying your research)	PSO- 2	Remember
CLO-4	Identify the relationship of works in context of its contribution to the topic and to other works	PSO- 3	Remember
CLO-5	Place your own research within the context of existing literature making a case for why further study is needed.	PSO -4	Apply

Modules	**COURSE CONTENTS**	**Duration**
1.0	Literature Review and Research Question is the start of the students' research preparation. Independently of whether students have already decided their research topic for their master's thesis, it is necessary to do a review of existing research in order to identify gaps in the literature, and to justify their own	**30hours**

projects. The course topic the student selects must be in line with his/her research question. It must be agreed upon by the student and his/her main supervisor early in the literature review process.

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SECOND YEAR - SEMESTER – IV

Course Title	**PROJECTWORK /INDUSTRIAL INTERNSHIP**								
Course Type	**Hard Core- Project work**		Total Hours	20	Hours/Week		02	Credits	10
Course Code		Evaluation	Internal	C1+C2 = 15+15				30 Marks	100
			External	Duration		C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	understand & acquire the ability to make links across different areas of knowledge
CO-2	generate ,develop and evaluate ideas and information so as to apply these skills to their projected task or work plan

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Students will acquire the ability to make links across different areas of knowledge and to generate,	PSO-1	Remember
CLO-2	develop and evaluate ideas and information so as to apply these skills to their projected task or work plan	PSO-2	Understand

Modules	**COURSE CONTENTS**	**Duration**
1.0	A student has to choose either Industry Internship or Project work. The duration is 12-15 weeks. At the end of the internship/Project, the student will prepare a report and submit it to the Department. The report will be evaluated for 30 Marks and a Viva Voce examination will be conducted for 40 marks An evaluation of the performance of the candidate either during internship or project work (in house or external) by the respective supervisor shall also be obtained to assist the evaluation process. The Supervisor's evaluation will be obtained in a structured format to enable the department to have a comparative evaluation	**20hours**

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LIST G - SOFT-CORE GENERAL COURSES

1. Plant tissue culture and Grafting
2. Advanced Endocrinology
3. Genomics, Proteomics and Bioinformatics

SECOND YEAR - SEMESTER – IV

Course Title	**PLANT TISSUE CULTURE AND GRAFTING**							
Course Type	**Soft Core- Theory**		Total Hours	30	Hours/Week	02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand the basic concept of plant tissue culture
CO-2	Understand and importance of medicinal plants
CO-3	Analyze the medications of tribal and folk to treat diseases
CO-4	Understand the basic concept of traditional knowledge of medicine
CO-5	Understand the medicinal uses of fruits and vegetables

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Demonstrate the importance of plant tissue culture	PSO- 1	Remember
CLO-2	Develop an understanding of medicinal plants	PSO- 2	Understand
CLO-3	Assess the mechanism of drug action of tribal medicine	PSO -2	Understand
CLO-4	Assess the therapeutic role of plants in day to day life	PSO- 4	Analyse

Modules	**COURSE CONTENTS**	**Duration**
1.0	Plant cell and tissue culture – culture media and cell culture. Tissue culture, micropropagation and somaclonal variation. Protoplast culture – isolation and purification of protoplasts, protoplast fusion, genetic modification of protoplasts. Use of reporter genes in transformed plant cells. Transgenic plant technology– genetic engineering of plants for pest resistance, virus resistance, Herbicide tolerance, stress tolerance and delay of fruit ripening. Use of plants to produce commercially important proteins, antibodies, viral antigens and peptide hormones. ***Key words: Commercial application of Withania somnifera and Musa paradisiaca, Crop Improvement***	**8hours**
2.0	Principles and applications of plant tissue culture-techniques and prospects. Recombination by protoplast fusion. Genetic engineering of plants- transfer and expression of genes in plants-transgenic plants, manipulating plants for non-food carbohydrates and lipids,	**8hours**

production of vaccines and molecular farming. Terminator

genes, BT gene, production of artificial genes. Plant breeding techniques, methods of crop and live stock improvement

keywords: applications of plant tissue culture

3.0 **Plant propagation -** methods of vegetative propagation- stem cutting, grafting, trenching, layering, suckers, stolons, tubers, corms. Basic nursery methods and green house techniques, Advantages of plant propagation **6hours**

keywords: Plant propagation

4.0 **Grafting:** Conservation of herbs- Medicinal plant banks micro propagation of important species (Withania somnifera, neem and tulsi)- Herbal foods-future of pharmacognosy. **4hours**

key words: Withania somnifera, neem, tulsi

5.0 **Plants in day today life** – *Ocimum sanctum, Aloe vera.* Nutritive and medicinal value of some fruits (Orange, Mango, Banana, Lemon, Pomegranate) and vegetables - Greens (*Moringa, Solanum nigrum* Cabbage). **4hours**

key words: Guava, Sapota

Note: Course content involves 100% theory

REFERENCES

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Glossary of Indian medicinal plants,	R.N.Chopra, S.L.Nayar and I.C.Chopra	C.S.I.R, New Delhi.	1	1956.
2.	The indigenous drugs of India	Kanny, Lall, Dey and Raj Bahadur	International Book Distributors.	2	1984
3.	Herbal plants and Drugs	Agnes Arber	Mangal Deep Publications.	1	1999
4.	Ayurvedic drugs and their plant source	V.V. Sivarajan and Balachandran Indra	Oxford IBH publishing Co	1	1994

RECOMMENDED BOOKS

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	Ayurveda and Aromatherapy	Miller, Light and Miller Bryan	Banarsidass, Delhi	2	1998
2.	Principles of Ayurveda	Anne Green	Thomsons, London	2	2000

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SECOND YEAR - SEMESTER – IV

Course Title	**ADVANCED ENDOCRINOLOGY**								
Course Type	**Soft Core-Theory**		Total Hours	30	Hours/Week		02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks		100
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand the Structure and functions of Hypothalamic and pituitary hormones.
CO-2	Understand the hormonal regulations of thyroid and parathyroid glands.
CO-3	Understand the synthesis, secretion, metabolism, regulation and biological effects of adrenal hormones
CO-4	Understand the structure, metabolism and biological actions of gonads and pancreatic hormones.
CO-5	Understand the Fundamentals concepts of signal transduction and signaling pathways

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Explain various hormones secreted by endocrine glands and their functions.	PSO -1	Understand
CLO-2	Understand the anatomy of the endocrine system.	PSO- 2	Remember
CLO-3	Understand the basic properties of hormones.	PSO- 2	Understand
CLO-4	Explain the role of the hormones in maintaining body function.	PSO -3	Remember
CLO-5	Understand and explain the major endocrine disorders	PSO -4	Apply

Modules	**COURSE CONTENTS**	**Duration**
1.0	**Introduction and Genetic Control of Endocrinology-** Hormones - definition; classical and nonclassical endocrinology. Pituitary hormones and their control by the hypothalamus. Thyroid metabolic hormones. Adrenocortical hormones. Feedback mechanisms (HPA&HPG). Inactivation and degradation of hormones. Hypothalamus - neurohypophyseal hormones. Hormone resistant syndrome and multi endocrine neoplasia – different types. Melatonins and serotonin – light and dark cycles. RIA and ELISA in Bioassay of hormones. Genetic control of hormone formation ***keywords: hormones. bioassay***	**6hours**
2.0	**Hormones acts through cell surface receptors** - Hormones acting through cell surface receptors Hormone – receptor interaction; multiple hormone subunits, scatchard analysis; peptide hormone receptors: types of receptors- beta – adrenergic receptor and insulin receptor- structure and mechanism of action. Signal transducers and second messengers- protein kinases,	**6hours**

cAMP, IP3, DAG, Calcium and Calmodulin. Eicosanoids and mechanism of action

keywords: cell surface receptors

3.0 **Reproductive Endocrinology** - Genetic, endocrine and biochemical aspects of testis and ovarian differentiation and development. Neuroendocrine perspectives of mammalian reproduction. Endocrine, paracrine and autocrine regulation of spermatogenesis, oogenesis, ovulation and steroidogenesis (Testosterone, 17B-estradiol, Progesterone). Control of synthesis and release of steroid hormones. Structure, function and regulation of male and female accessory sex organs. **6hours**

Transport of steroid hormones in blood. Conception and contraception. Apoptosis – steroid hormone action at cell level. Hormonal physiology of parturition and lactation.

keywords: hormonal action on reproductive system

4.0 **Molecular endocrinology of insulin resistance -** Endocrinology of adipose tissues - leptin, gherlin, adiponectin, resistin. Fetal endocrine programming of adult disorders (FEPAD): Adverse effects of glucocorticoids in programming events. Endocrinology of insulin like growth factors (IGF's) and its binding proteins (IGFBP). Modulation of placental hormones and growth factors in FEPAD. **6hours**

keywords: Molecular endocrinology of insulin

5.0 **Nuclear receptors (NR)**- General features, Ligands that act via nuclear receptor and its sub classes (Orphan receptor and variant receptors). Domain structure of NR - hormone binding domain,

antigenic domain and DNA binding domain. Hormone response elements. Detailed study of thyroxine, estrogen, androgen, vitamin D, glucocorticoids, Peroxisome proliferator activated receptor and Liver X Receptor. PPAR in insulin resistance. Receptor activation – upregulation and down regulation. Selective estrogen receptor modulator. Endocrine responsive cancer - breast, endometrial and prostate cancers. **6hours**

keywords: Nuclear receptors

Note: Course content involves 100% theory

REFERENCES

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Fundamentals of biochemistry	Jain, J.L	S.Chand publication	6	2005
2.	Cell Biology, Genetics, Molecular Biology, Evolution & Ecology	Verma P.S. Agarwal V.K	S Chand publication	5	2006
3.	Biochemistry of Signal Transduction and Regulation	Gerhard Krauss	Wiley VCH	3	1999

4.	Concepts in cell & molecular biology	Rastogi S.C, Sharma, Anuradha Tanden	New age publishers	3	2010

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	Biochemistry of Signal Transduction and Regulation	Gerhard Krauss	Wiley VCH	5	2014
2.	Biochemical Messengers: Hormones, neurotransmitters and growth factors	D. Hardie	Springer	2	2012

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SECOND YEAR - SEMESTER – IV

Course Title	**GENOMICS, PROTEOMICS AND BIOINFORMATICS**								
Course Type	**Soft Core- Theory**		Total Hours	30	Hours/Week		02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15				30 Marks	100
			External	Duration	C3	03Hrs		70 Marks	

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand the basic concept of Bioinformatics
CO-2	Understand and importance of proteomics
CO-3	Analyze the genomic study of organisms
CO-4	Understand the basic concepts of data analysis
CO-5	Understand the uses of proteomics

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Demonstrate the importance of proteomics	PSO- 1	Remember
CLO-2	Develop an understanding of data analysis	PSO- 3	Create
CLO-3	Assess the uses of proteomics	PSO -2	Apply
CLO-4	Assess & Analyze the genomic study of organisms	PSO- 4	Analyse

Modules	**COURSE CONTENTS**	**Duration**
1.0	Genomics: Introduction to genomics, comparative genomic databases, objective of genome comparisons, Genome alignments. Proteomics: Overview of proteomics, Experimental techniques, Protein – Protein interaction, databases and software. Molecular visualization softwares, Structure based drug design, Molecular docking software, Protein structure prediction –	**8hours**

comparative modelling, threading.

keywords: comparative genomic databases

2.0 Introduction to bioinformatics. Application of bioinformatics, Bioinformatics resources. Biological databases: overview of biological databases, nucleotide databases (Gen Bank, DDBJ, ENA) Protein structure databases (PDB, SCOP, CATH), Organism specific databases, Bibliographic databases. Sequence analysis: pair wise alignment, multiple sequences alignment, Scoring matrices, Phylogenetic trees. Sequence similarity search, Blast, FASTA, CLUSTAL. **8hours**

keywords: Application of bioinformatics

3.0 **Protein modelling:** Introduction, methods of protein modelling, homology or comparative modelling, model refinement, evaluation of the model. Molecular visualization, protein 3D structure using Rasmol. **6hours**

keywords: protein modelling

4.0 **Docking methods:** Three dimensional descriptions of binding site environment and energy calculation, automatic docking method. Three dimensional database search approaches, design of ligands, drug-receptor interactions, automated structure construction methods, AUTODOCK. **8hours**

keywords: Docking methods

Note: Course content involves 100% theory

REFERENCES

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Statistical Methods	R.N.Chopra, S.L.Nayar and I.C.Chopra	C.S.I.R, New Delhi.	1	1956.
2.	Programming in ANSI C	Kanny, Lall, Dey and Raj Bahadur	International Book Distributors.	2	1984

RECOMMENDED BOOKS

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publicatio
1.	Introduction to bioinformatics	Attwood, T. K., and Parry-Smith, D.J	Pearson Education Ltd., Delhi, India	2	1999
2.	Modern Experimental Biochemistry	Rodney F. Boyer	Benjamin-Cummings Publishing	2	1993.
3.	Developing Bioinformatics Computer Skills -	Wibas C, Jenbeck P	Pearson Education Ltd., Delhi, India	5	2011

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LIST I- SOFT-CORE ABILITY ENHANCEMENT COURSES

1. Genetics & Developmental Biology
2. Principles of Chemistry
3. Fruits and Vegetable preservation

SECOND YEAR - SEMESTER – IV

Course Title	**GENETICS & DEVELOPMENTAL BIOLOGY**								
Course Type	**Soft Core- Ability Enhancement**		Total Hours	30	Hours/Week	02	Credits		02
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks		100
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand and apply the types of inheritance
CO-2	Understand determination & differentiation of species
CO-3	Understand the development and sex determination in humans
CO-4	Understand the Morphogenesis and organogenesis in animals
CO-5	Apply the principles behind Implications of developmental biology

MAPPING CLO'S WITH PSO's AND CD's

CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Critically evaluate the genotype and phenotype, Sex determination And Inheritance	PSO -1	Understand
CLO-2	Understand the General concept of organism's development.	PSO- 2	Understand
CLO-3	Assess the development and sex determination in humans.	PSO- 2	Remember
CLO-4	know the Morphogenesis and organogenesis in animals	PSO -3	Remember
CLO-5	Define Implications of developmental biology	PSO -4	Apply

Modules	**COURSE CONTENTS**	**Duration**
1.0	**Classical Genetics:** Mendelian genetics: genotype and phenotype, Sex determination and Inheritance: Theories of inheritance. Allele concept- principles of segregation and independent assortment. Chromosomal theory, X - linked inheritance. Dominant and recessive of genes. Common X- linked genetic diseases in human. ***key words: X - linked inheritance***	**6hours**
2.0	**Basic concepts**: General concept of organisms development: Potency, commitment, specification, induction, competence, determination & differentiation; morphogenetic gradients; cell fate & cell lineages; genomic equivalence and cytoplasmic determinants; imprinting. General principles of cell-cell communication in development: cell adhesion and roles of different adhesion	**6hours**

molecules, gap junctions, extracellular matrix, integrins, paracrine factors.

key words: determination & differentiation

3.0 ***Fertilization, development and sex determination in humans:*** Gametogenesis. Sperm & Egg formation; ultra-structure of sperm and ovum, egg types, egg membrane. Fertilization, cleavage, Morula, Implantation, blastula ion, gastrulation, formation of germ layers, axis formation - anterior and posterior. Sex determination - chromosomes **6hours**

key words: Sex determination

4.0 **Morphogenesis and organogenesis in animals:** Cell aggregation and differentiation in Dictyostelium; axes and pattern formation in Drosophila, organogenesis and regeneration in vertebrates; Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in Arabidopsis and Antirrhinum. **6hours**
key words: Morphogenesis

5.0 **Implications of developmental biology:** Medical implications of developmental biology - genetic disorders in human development, environmental assaults on human development, Future therapies, Environmental regulation of animal development - Environment as a part of normal development, Polyphenisms, plasticity and Learning. **6hours**
key words: Polyphenisms
Note: Course content involves 90% theory & 10%problems

REFERENCES

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Genetics	Gupta PK	Rastogi Publications	1	1996
2.	Genetics	Strickberger	Prentice Hall of India	3	2002
3.	Genes VII	Benjamin Lewin	Oxford University Press	6	2000
4.	Evolutionary Developmental Biology	Brian K. Hall, Kluwer	Academic Publishers	2	1999

RECOMMENDED BOOKS

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publicatio

1.	Developmental Biology,	Gilbert S.F.	Sinauer Associates Inc. Massachuset	9	2010
2.	Molecular Biology of the Cell	Alberts B	Garland Science, USA	3	2002
3.	Animal Regeneration	Diwan A.P., Dhakad N.K.,	Anmol Publications Ltd, India,	1	1996.

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SECOND YEAR - SEMESTER – IV

Course Title	**PRINCIPLES OF CHEMISTRY**								
Course Type	**Soft Core- Ability Enhancement**		Total Hours	30	Hours/Week		02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15				30 Marks	100
			External	Duration		C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand the stereochemistry, spatial arrangement of atoms/groups and apply it on the course of reactions and mechanism prediction.
CO-2	Describe the fundamental scientific principles in the subfields of chemistry and apply these principles to problems.
CO-3	Solve problems, think critically and reason analytically as these are applied to scientific problems

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Remember & Understand the stereochemistry, spatial arrangement of atoms/groups and apply it on the course of reactions and mechanism prediction.	PSO -1	Understand
CLO-2	Analyse/Describe the fundamental scientific principles in the subfields of chemistry and apply these principles to problems.	PSO- 2	Analyse
CLO-3	critically think & Solve problems, reason analytically as these are applied to scientific problems	PSO- 4	Apply

Modules	**COURSE CONTENTS**	**Duration**
1.0	**Bonding:** covalent bond ,coordinate bond**,** coordinate bond formation in transition metals crystal field theory ligand field theory valence bond theory structure, bonding and special properties of water iron in hemoglobin and cytochromes bonding of cobalt in vit-b_{12} magnesium in chlorophyll chelates, types of ligands and complexes	**5hours**

Keywords: transition metals

1.1 **Electrolytes And Non-Electrolytes** osmotic pressure reflection coefficient vapour pressure vapour pressure osmometer donnan membrane equilibrium **electrodes** electrode potential hydrogen electrode oxygen electrode **5hours**

Keywords: electrodes

2.0 **Stereochemistry** importance of stereochemistry position and order of groups around carbon geometric and optical isomerism absolute and relative configuration symmetry view of chirality relation between chirality and optical activity representation of chiral structures by fischer structure and stereochemistry of glucose; anomer, epimer, stereoisomer, d and l, + and - r and s and stereochemistry of amino acids **5hours**

Keywords: stereomers

3.0 **Mechanism of organic reactions** intermediates and rearrangements in organic reaction reaction energetics classification of reagents and reactions effects of substituents on the benzene ring and the reaction mechanism reaction rates, order and Molecularity of reaction **5hours**

Keywords: organic reactions

4.0 **Mechanisms and stereochemistry** substitution (electrophilic and nucleophilic - sn^1 and sn^2 reactions) addition reactions, elimination reactions, rearrangement reactions, ester hydrolysis, property of Aromaticity and resonance **5hours**

Keywords: substitution , addition reactions

5.0 **Heterocyclic compounds** chemistry and biological occurance of the following Furan, Indole, Thiazole, Pterine, Pteridine, Isoalloxazine, Pyrrole, Porphyrins, Heme **5hours**

Keywords: heterocyclic compounds

Note: Course content involves 100% theory

REFERENCES

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Inorganic Chemistry: Principles of Structure and Reactivity	Huheey / Medhi	Pearson Education India	4	2006
2.	Concise Inorganic Chemistry	J.D. Lee	Oxford University Press;	5	2008
3.	Organic Chemistry	Morrison Boyd & Bhattacharjee	Pearson Education India	7	2010
4.	A Textbook of Organic Chemistry	Bahl Arun & Bahl B.S	S Chand & Company	22	2016

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publicatio**
1.	Principles of physical chemistry	B.R. Puri, L.R. Sharma, M.S. Pathania	Vishal Publishing Co.	47	2017
2.	Chemistry for Degree Students	R L Madan	S Chand Publishing	3	2011

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SECOND YEAR - SEMESTER – IV

Course Title	**FRUITS AND VEGETABLE PRESERVATION**								
Course Type	**Soft Core- Ability Enhancement**		Total Hours	30	Hours/Week	02	Credits	02	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	knowledge related to fruit and vegetable preservation
CO-2	Knowledge of preservation of fruits and vegetables.
CO-3	Understand about food systems in the production, processing and consumption of food and an appreciation of their impact on society
CO-4	Understand the nature of food and human nutrition and an appreciation of the importance of food to health
CO-5	Understand and apply the skills in designing, implementing and evaluating solutions to food situations.

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Understand the basic concepts related to fruit and vegetable preservation	PSO -1	Understand
CLO-2	Understand the basic techniques in preservation of fruits and vegetables.	PSO- 2	Understand
CLO-3	Understand about food systems in the production, processing and consumption of food and an appreciation of their impact on society	PSO- 2	Remember
CLO-4	Understand the nature of food and human nutrition and an appreciation of the importance of food to health	PSO -3	Remember
CLO-5	Understand and apply the skills in designing, implementing and evaluating solutions to food situations.	PSO -4	Apply

Modules **COURSE CONTENTS** **Duration**

1.0 **Purpose and Scope of Preservation:** Objectives of preservation and processing Scope of preservation industry in India. **2hours**

Keywords: preservation

2.0 **Post-harvest Changes and Spoilage:** Physical, chemical and microbiological changes in fruits and vegetables Factors affecting growth of microorganisms and the control measures **2hours**

Keywords: spoilage

3.0 **Food Safety Regulations:** Key terms, factors affecting food safety, recent concerns National food law (FSSA), standards and regulations, Food additives and contaminants, Hygiene and sanitation, HACCP **4hours**

Keywords: Food Safety Regulations

4.0 **Principles and Methods of Preservation**: Asepsis, Low temperature, High temperature, Removal of moisture, Removal of air, Use of chemical preservatives, Fermentation, Irradiation, Newer methods **8hours**

Keywords: preservation methods

5.0 **Fruit and Vegetable Processing:** Chutney and sauces- Definition, method of preservation, steps in preparation of chutney and sauces. Fruit beverages- Definition and classification, method of preservation (with special emphasis on pasteurization, use of chemical preservatives, sugar), role of various ingredients. Jam, Jelly and Marmalade- definition, role of pectin and theory of gel formation, method of preservation, steps of preparation, evaluation. Preserves- definition, method of preservation, steps of preservation, evaluation, candied, crystallized and glazed fruits. Pickles- definition, classification, method of preservation, steps of preparation of vinegar pickles, evaluation. **14hours**

Keywords: Fruit and Vegetable Processing, preservation

Note: Course content involves 100% theory

REFERENCES

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Food Microbiology	Frazier WC and Westhoff DC	Tata McGraw-Hill Publishing Company Ltd	1	1995
2.	Food Processing Principles and Applications	Ramaswamy H and Marcott M	CRC Press	1	2005
3.	Food Processing and Preservation	Subbalakshmi G, Udipi SA	New Age International Publishers	1	2007

			Delhi		
4.	The Food Safety and Standards Act along with Rules and Regulations.	Westhoff DC	Commercial Law Publishers (India) Pvt Ltd	2	2011

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	Food Safety-Theory and Practice	Knechtges LI	Jones and Barlette Learning. USA	2	2012

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LIST I- SOFT-CORE SKILL ENHANCEMENT COURSES

1. QA, QC AND GMP
2. Microbiology
3. Biosafety, Bioethics and IPR

SECOND YEAR - SEMESTER – IV

Course Title	**QA, QC and GMP**								
Course Type	**Soft Core- Skill Enhancement**		Total Hours	30	Hours/Week		02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15				30 Marks	100
			External	Duration	C3	03Hrs		70 Marks	

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand the cGMP aspects in a pharmaceutical industry
CO-2	To appreciate the importance of documentation
CO-3	To understand the scope of quality certifications applicable to Pharmaceutical industries
CO-4	To understand the responsibilities of QA & QC departments.
CO-5	To appreciate the importance of documentation

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Understand the cGMP aspects in a pharmaceutical industry	PSO -1	Understand
CLO-2	To appreciate the importance of documentation	PSO- 2	Understand
CLO-3	To understand the scope of quality certifications applicable to Pharmaceutical industries	PSO- 2	Remember

CLO-4	To understand the responsibilities of QA & QC departments.	PSO -3	Apply
CLO-5	To appreciate the importance of documentation	PSO -4	Remember

Modules	COURSE CONTENTS	Duration
1.0	**Introduction:** Concept and evolution and scopes of Quality Control and Quality Assurance, Good Laboratory Practice, GMP, Overview of ICH Guidelines - QSEM, with special emphasis on Q series guidelines. Good Laboratory Practices: Scope of GLP, Definitions, Quality assurance unit, protocol for conduct of non clinical testing, control on animal house, report preparation and documentation. CPCSEA guidelines ***Keywords: QC,QA,GMP***	**6hours**
2.0	**Quality Assurance**: Basic concept of quality, difference between QC and QA, quality audit, types of quality audits, concept of TQM, ISO 9000 series. Elementary study of WHO guidelines. Different documents prepared by QA department (batch manufacturing record, master formula record, validation master plan). Basic concept of validation, types of validation, different validation parameters, protocols for process validation. ***Keywords: Validation, record maintainace***	**6hours**
3.0	**Introduction to good manufacturing practices** (GMP), good clinical practices (GCP) and good laboratory practices (GLP). Schedule M. Standard operating procedure (SOP): Introduction, preparation, validation and revision. Documentation: Protocols, forms and maintenance of records in pharmaceutical industry, preparation of document for investigational new drug (IND), new drug application (NDA), abbreviated new drug application (ANDA) and export registration. Introduction to 21-Code of federal regulations. Current good manufacturing practices (c-GMP) guidelines according to United States Food and Drug Administration (USFDA), difference between GMP and c-GMP. Sampling: Introduction, WHO guidelines, sampling plans and techniques, operating characteristics curves, maintenance of sampling records of finished product and packaging material. ***Keywords: sampling, GMP***	**12hours**
4.0	Manufacturing operations and controls: Sanitation of manufacturing premises, mix-ups and cross contamination, processing of intermediates and bulk products, packaging operations, IPQC, release of finished product, process deviations, charge-in of components, time limitations on production, drug product inspection, expiry date calculation, calculation of yields, production record review, change control, sterile products, aseptic process control, packaging, reprocessing, salvaging, handling of waste and scrap disposal ***Keywords: Operational controls*** **Note: Course content involves 100% theory**	**8hours**

REFERENCES

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Quality Assurance Guide	organization of Pharmaceutical Procedures of India	International Pharmacopia	3	1996.
2.	Good Laboratory Practice Regulations	Sandy Weinberg	Marcel Dekker Series	2	1995
3.	General Methods of Analysis and Quality specification for Pharmaceutical Substances, Excepients and Dosage forms	WHO	International Pharmacopia	3	2005

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	The drugs and cosmetics act 1940	Deshpande Nilesh Gandhi	Susmit Publishers	4	2006
2.	Quality Systems and Controls for Pharmaceuticals	Sarker DK	John Wiley & Sons	1	2008

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SECOND YEAR - SEMESTER – IV

Course Title	**MICROBIOLOGY**								
Course Type	**Soft Core- Skill Enhancement**		Total Hours	30	Hours/Week		02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15				30 Marks	100
			External	Duration	C3	03Hrs		70 Marks	

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Analyse the diversity of microorganisms, bacterial cell structure and function, microbial growth and metabolism.
CO-2	Identify the microorganisms in environment.
CO-3	Evaluate and apply the microorganisms in various industries
CO-4	Explain the role of microorganisms in food and industrial production and preservation.
CO-5	Explain the role of microorganisms in antibiotics production

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Describe the structure and functions of major	PSO -1	Understand

	components of microbial cells.		
CLO-2	Understand the concept of microbial growth, its measurement and growth curves.	PSO- 2	Remember
CLO-3	Classify microorganisms based on nutrition.	PSO- 2	Understand
CLO-4	Isolate bacteria on solid media.	PSO -3	Remember
CLO-5	Discuss various methods of sterilization and disinfection	PSO -4	Analyse

Modules	COURSE CONTENTS	Duration
1.0	**General microbiology:** Introduction and scope of microbiology. Brief study of structure and organization of major groups of microorganisms - Archaebacteria, cyan bacteria, eubacteria, fungi, algae, protozoa and viruses. Culture of microorganisms – batch, continuous and pure cultures. Control of microorganisms – physical, chemical and chemotherapeutic agents. Preservation of Microorganisms. ***keywords: Culturing, preservation***	**6hours**
2.0	**Environmental Microbiology:** Microbiology of soil – soil microflora, role of soil microbes in biogeochemical cycles (C, N, S) - Marine and fresh water microbiology. Contamination of domestic and marine waters. Water purification and sewage treatment. Microbes in waste water treatments. Microbiology of air. ***Key words: Pathogen detection, Environmental Management***	**6hours**
3.0	**Industrial microbiology** Selection of industrially useful microbes. Industrial production of alcohol, vinegar, lactic acid, antibiotics, enzymes and amino acids. Microbiology of food: sources of contamination, food spoilage and food preservation methods. ***Key words: Food fermentation, , probiotics, prebiotics***	**6hours**
4.0	**Clinical Microbiology**: Epidemic, endemic, pandemic and sporadic diseases. Pathogenicity, virulence and infection. Epidemiology of infectious diseases. Bacterial diseases of human (typhoid& gonorrhoea). Fungal diseases of human (superficial, cutaneous, subcutaneous and systemic mycoses) Mycotoxins. Viral diseases of human (AIDS & polio). Mycoplasmal, Chlamydial, Rickettsial and protozoan diseases of human. ***Key words: Disease management***	**6hours**
5.0	**Applied Microbiology:** Role of microbes in the manufacture of antibiotics and vaccines. Microorganisms as biofertilizers. Microbes as foods - SCP production. Role of microbes in biogas production, petroleum industry and mining. Microbial degradation of lignin, cellulose and pesticides. Microbial immobilization. Microbes in biological warfare. ***Key words: Retardation, bioproduction*** **Note: Course content involves 100% theory**	**6hours**

REFERENCES

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Microbiology	Pelczer M.J. Chan E.C. S Noel R.Krieg	Tata McGraw Hill publishing company Limited, New Delhi.	5	2004
2.	Microbiology	Lansing M Prescott, John P Harley and Donald A Klein.	Mc Graw Hill, New York.	7	2007
3.	Text Book of Microbiology	Ananthanarayan, R. and Jayaram Paniker, C.K	Orient Longman Ltd., Chennai	7	2007

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	Clinical Microbiology Made Ridiculously Simple	Gladwin and Trattler	Medmaster, UK.	6	2013

SECOND YEAR - SEMESTER – IV

Course Title	**BIOSAFETY, BIOETHICS AND IPR**								
Course Type	**Soft Core- Skill Enhancement**		Total Hours	30	Hours/Week	02	Credits	02	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Assess the knowledge of Biosafety and risk assessment of products derived from recombinant DNA research and environment release of genetically modified organisms, national and international regulations
CO-2	Analyze ethical aspects related to biological, biomedical, health care and biotechnology research
CO-3	Understand the systemic and cross-functional identification, control and governance of IP assets in sourcing, collaboration and exploitation
CO-4	Understand different types of intellectual property rights in general and protection of products derived from biotechnology research and issues related to application and obtaining patents
CO-5	Organize policy of companies and other technology

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**

CLO-1	Distinguish knowledge of Biosafety and risk assessment of products derived from recombinant DNA research and environment release of genetically modified organisms, national and international regulations	PSO -1	Understand
CLO-2	Analyze ethical aspects related to biological, biomedical, health care and biotechnology research	PSO- 2	Remember
CLO-3	Differentiate systemic and cross-functional identification, control and governance of IP assets in sourcing, collaboration and exploitation	PSO- 2	Understand
CLO-4	Analyze different types of intellectual property rights in general and protection of products derived from biotechnology research and issues related to application and obtaining patents	PSO -3	Remember
CLO-5	Organize policy of companies and other technology	PSO -4	Apply

Modules	**COURSE CONTENTS**	**Duration**
1.0	**Biosafety:** Introduction; Historical Background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals;.	**4hours**
	keywords: Recommended Biosafety Levels	
1.1	**Biosafety guidelines**: Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of National Regulations and relevant International Agreements including; Cartegana Protocol	**6hours**
	keywords: Biosafety guidelines	
2.0	**Bioethics:** Ethical implications of biotechnological products and techniques. Social and ethical implications of biological weapons. Ethics in Clinical trials	**2hours**
	keywords: Ethical implications	
3.0	**Introduction to Intellectual Property:** Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of GMOs IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies	**4hours**
	keywords: Intellectual Property	
3.1	**Agreements and Treaties:** History of GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments	**4hours**
	keywords: recent amendments	
4.0	**Basics of Patents and Concept of Prior Art:** Introduction to Patents; Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; Specifications: Provisional and	**5hours**

complete; Forms and fees Invention in context of "prior art"; Patent databases; Searching International Databases; Country-wise patent searches (USPTO, esp@cenet(EPO), PATENTScope(WIPO), IPO, etc.)

keywords: recent amendments

5.0 **Patent filing procedures:** National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Precautions while patenting–disclosure/non-disclosure; Financial assistance for patenting-introduction to existing schemes, Patent licensing and agreement Patent infringement- meaning, scope, litigation, case studies **5hours**

keywords: Patent filing procedures

Note: Course content involves 100% theory

REFERENCES					
Sl.No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of**
1.	Indian Patent Act 1970 Acts & Rules	Bareact	Universal Law Publishing Co. Pvt. Ltd	1	2007
2.	Bioethics and Biosafety in Biotechnology	V. Shree Krishna	New Age International Pvt. Ltd. Publishers	1	2007

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publicatio**
1.	Genetic Patent Law & Strategy,	Kankanala C	Manupatra Information Solution Pvt. Ltd	1	2007

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SOFTCORE -INTERDISCIPLINARY COURSES OFFERED IN II SEMESTER

FIRST YEAR - SEMESTER – II

Course Title	**BASICS OF HERBAL TECHNOLOGY**								
Course Type	**Soft Core-Interdisciplinary**		Total Hours	30	Hours/Week		02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15				30 Marks	100
			External	Duration	C3	03Hrs		70 Marks	

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand the basic concept of Ethano medicine.
CO-2	Understand and importance of medicinal plants
CO-3	Analyze the medications of tribal and folk to treat diseases
CO-4	Understand the basic concept of traditional knowledge of medicine
CO-5	Understand the medicinal uses of fruits and vegetables

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Demonstrate the importance of Ethano medicine	PSO- 1	Remember
CLO-2	Develop an understanding of medicinal plants	PSO- 2	Understand
CLO-3	Assess the mechanism of drug action of tribal medicine	PSO -2	Understand
CLO-4	Assess the therapeutic role of plants in day to day life	PSO- 4	Analyse

Modules	**COURSE CONTENTS**	**Duration**
1.0	**Ethnomedicine** – definition, history and its scope – Inter disciplinary approaches in ethanobotany Cultivation -harvesting - processing - storage - marketing and utilization of medicinal plants.	
	Pharmacognasy - systematic position medicinal uses of the following herbs in curing various ailments; Tulsi, Ginger, Fenugreek, Indian Goose berry and Ashoka.	**8hours**
	Keywords: key words: sidha,Ayurvedha,unani	
2.0	**Phytochemistry-** active principles and methods of their testing – identification and utilization of the medicinal herbs; Catharanthus roseus (cardiotonic), Withania somnifera(drugs acting on nervous system), Clerodendron phlomoides (anti-rheumatic) and Centella asiatica (memory booster).	
	Analytical pharmacognosy - Drug adulteration - types, methods of drug evaluation – Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds).	**10hours**
	keywords: Phytochemicals, alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds	
3.0	**Conservation of herbs**- Medicinal plant banks micro propagation of important species (Withania somnifera, neem and tulsi)- Herbal foods-future of pharmacognosy.	**8hours**
	key words: Withania somnifera, neem, tulsi	
4.0	**Plants in day today life** – *Ocimum sanctum, Aloe vera.* Nutritive and medicinal value of some fruits (Orange, Mango, Banana, Lemon, Pomegranate) and vegetables - Greens (*Moringa, Solanum nigrum* Cabbage).	**4hours**

key words: Guava, Sapota

Note: Course content involves 100% theory

REFERENCES					
Sl.No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1.	Glossary of Indian medicinal plants,	R.N.Chopra, S.L.Nayar and I.C.Chopra	C.S.I.R, New Delhi.	1	1956.
2.	The indigenous drugs of India	Kanny, Lall, Dey and Raj Bahadur	International Book Distributors.	2	1984
3.	Herbal plants and Drugs	Agnes Arber	Mangal Deep Publications.	1	, 1999
4.	Ayurvedic drugs and their plant source	V.V. Sivarajan and Balachandran Indra	Oxford IBH publishing Co	1	1994

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publicatio**
1.	Ayurveda and Aromatherapy	Miller, Light and Miller Bryan	Banarsidass, Delhi	2	1998
2.	Principles of Ayurveda	Anne Green	Thomsons, London	2	2000

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FIRST YEAR - SEMESTER – II

Course Title	**BIOPHARMACEUTICALS-I**								
Course Type	**Soft Core-Interdisciplinary**		Total Hours	30	Hours/Week	02	Credits	02	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Study the preparation and packaging methodologies in pharmaceuticals.
CO-2	Demonstrate various drug delivery systems.
CO-3	Learn the types and preparation methods of tablets, capsules.
CO-4	Analyse different methods of quality control.
CO-5	Understand & apply the basic knowledge of nanotechnology and its potential as medicines.

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will**	**PSOs Addressed**	**CD's**

	learn to		
CLO-1	Demonstrate the importance of pharmaceuticals	PSO- 1	Remember
CLO-2	Develop an understanding of various drug delivery systems	PSO- 2	Understand
CLO-3	analyse the types and preparation methods of tablets	PSO- 2	Remember
CLO-4	Assess the therapeutic role of tablets & Capsules	PSO- 3	Remember
CLO-5	Demonstrate the methods of quality control.	PSO- 4	Apply

Modules	COURSE CONTENTS	Duration
1.0	**Tablets** - Characteristics, advantages and disadvantages. Types of tablets, excipients, granulation methods and machinery involved. Tablet compression, operation-single punch and rotary tablet presses, processing problems, evaluation, packaging. Tablet coating: Types-sugar coating, film coating, compression coating, electrostatic and enteric coating. Film forming materials, formulation of coating solution, equipments for coating, Processing, problems in coating, evaluation. ***key words: Tablets,types,excipients***	**8hours**
2.0	**Capsules**: Advantages and disadvantages of capsules. Materials and method of production of hard gelatin capsule, size of capsules, Formulation, method of filling, equipments involved, finishing techniques and evaluation. Storage of capsules. Soft gelatin capsules-shell and capsule content, manufacture, processing and control. Sterilization of injections, formulations, aerosols, ophthalmic preparations, Surgical ligatures and sutures, Blood products and plasma substitutes. ***key words: Capsules, types, application***	**8hours**
3.0	**Packaging materials:** Types of glasses and plastics employed for packing and their evaluation. Cosmetics. Introduction, fundamentals of cosmetic science. Formulation, preparation, packaging and evaluation of following Cosmetics- cosmetics for skin and face, Nail polish, lipstick, rouge, Hair preparation-Shampoo, Hair dyes, depilatories, shaving cream, after shave lotion. Oral hygiene preparation-dentifrices, mouth washes. ***key words: packaging materials, and their formulation***	**8hours**
4.0	**Controlled drug delivery systems:** Advantages of controlled drug delivery systems. a) An introduction to novel drug delivery systems- Liposomes, noisome, nanoparticles and osmotically controlled systems b) Microencapsulation c) Transdermal drug delivery systems- Formulation and evaluation. ***key words: drug delivery systems***	**6hours**
5.0	**Introduction to Nanotechnology**: Properties and Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Buckyballs, and Nanotubes), Green synthesis. Characterization of Nano material; Absorption, Fluorescence, and Resonance; Microscopy measurements: SEM, TEM, AFM and STM. Confocal and TIRF imaging. Applications of nanotechnology in medicine & health, food, agriculture, livestock, aquaculture, forestry and sustainable environment.	

Keywords: Quantum dots, nanomaterials

Note: Course content involves 100% theory

REFERENCES					
Sl.No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1	Theory and practice of industrial pharmacy	Leon Lachman, Herbert.A. Lieberrman,	International Book Distributors.	3	2008
2	Pharmaceutics, The Science of Dosage Form Design:	Michael. E. Aulton;	Churchill Livingstone.	2	2001

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	Pharmaceutical dosage forms: Tablets	Leon Lachman, Herbert.A. Lieberrman	Dekker INC.	3	1999

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FIRST YEAR - SEMESTER – II

Course Title	**CLINICAL DIAGNOSIS IN HEALTH AND DISEASE-I**								
Course Type	**Soft Core-Interdisciplinary**		Total Hours	30	Hours/Week		02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15				30 Marks	100
			External	Duration	C3	03Hrs		70 Marks	

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand the basic concepts in Clinical diagnosis in health and diseases
CO-2	understand about analysis of body fluids and detection of body metabolites
CO-3	Analyze exposure to know about liver, heart, brain, lung and kidney function test
CO-4	Understand the basic concept of pathogens which cause diseases.
CO-5	Understand the basis of non-communicable diseases.

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Demonstrate the analysis of body fluids and detection of body metabolites	PSO- 1	Remember
CLO-2	Develop an understanding of basic concepts in Clinical diagnosis in health and diseases	PSO- 2	Understand
CLO-3	Assess exposure to know about liver, heart, brain, lung and kidney function test	PSO -2	Understand
CLO-4	Apply the concept of pathogens which cause diseases	PSO-3	Apply

CLO-5	Understand the basis of non-communicable diseases.	PSO- 4	Analyse

Modules	COURSE CONTENTS	Duration
1.0	**General health analysis :** Introduction: General health, syndrome and common diseases – communicable and non-communicable diseases. Samples for analysis: Blood, urine, pleural fluid, synovial fluid, cerebro spinal fluid and tissues and histology. General checkup: Blood group, Hb, height and weight, waist to hip ratio, electro cardio gram, X-ray, abdomen scan and appearance of scars, urine analysis – routine analysis (protein, sugar, pigments and cells ***keywords: sample analysis***	**6hours**
2.0	***Clinical Assays:*** Detection of metabolites and its importance. Tests for liver function: Enzyme assay (SGOT, SGPT, Alkaline phosphatase, GGT), Total protein, albumin /globulin ratio and their significance. Test for kidney function: Urea and creatinine estimation and their significance. ***keywords: detection of metabolites***	**6hours**
3.0	***Clinical diagnosis :*** Test for heart function: Blood pressure (cystolic and diastolic), lipid profile (cholesterol, triglycerides, HDL, LDL estimation) and their importance. Test for lung function: Chest X- ray, Spirometry. Test for Brain function: EEG, MRI, CT. Test for Surgery: Bleeding time, clotting time. Special test: X-ray, CT, MRI, Doppler, TMT, angioplasty. ***keywords: Clinical diagnosis***	**6hours**
4.0	**Clinical Infection**: Bacterial, viral, fungal and protozoans. Blood: Total cell count, differential count, erythrocyte sedimentation rate. Infectious diseases: Tuberculosis, Leprosy, Malaria, Hepatitis, Cholera, Dengue, HIV, Chikungunya and H1N1. TORCH – Panel (infertility profile), Infection in pregnancy, Koch postulations – Microscopic examination of body fluids, ELISA and PCR tests. ***keywords: infections***	**6hours**
5.0	**Non communicable diseases:** Diabetes: Blood sugar, urine sugar, glucose tolerance test, HbA1c. Hyper tension: Lipid profile, electrolyte (sodium, potassium, chloride and biocarbonate) investigation. Cancer markers: ELISA and DNA Probs. ***keywords: Non-communicable diseases and cancer markers*** **Note: Course content involves 100% theory**	**6hours**

REFERENCES

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Varley's practical clinical Biochemistry	Gowenlock, A.H. and Donald, J	CBS publications	6	2002
2.	Text book of medical biochemistry	Chatterjee and Shindae	Jaypae Brothers (p) ltd, New Delhi	7	2007

3.	Essentials of Medical Physiology	Sembulingam, K and Sembulingam, P	Jaypae Brothers (p) ltd, New Delhi	5	2010

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	Book of Biochemistry with clinical correlations	Devlin, T.M	Willey Publishers	5	2002
2.	Fundamentals of Clinical chemistry	Burtis and Ashwood	Oxford Science Publications	6	2007
3.	Clinical Biochemistry	Gans, G and Murphy, J.M	Churchill Livingstone, Elsevier	4	2008

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SOFTCORE -INTERDISCIPLINARY COURSES OFFERED IN IV SEMESTER

1. Plant tissue culture and Grafting
2. Biopharmaceuticals-II
3. Clinical Diagnosis in Health and Disease-II

SECOND YEAR - SEMESTER – IV

Course Title	**PLANT TISSUE CULTURE AND GRAFTING**								
Course Type	**Soft Core-Interdisciplinary**		Total Hours	30	Hours/Week		02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15				30 Marks	100
			External	Duration	C3	03Hrs		70 Marks	

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand the basic concept of plant tissue culture
CO-2	Understand and importance of medicinal plants
CO-3	Analyze the medications of tribal and folk to treat diseases
CO-4	Understand the basic concept of traditional knowledge of medicine
CO-5	Understand the medicinal uses of fruits and vegetables

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Demonstrate the importance of plant tissue culture	PSO- 1	Remember
CLO-2	Develop an understanding of medicinal plants	PSO- 2	Understand
CLO-3	Assess the mechanism of drug action of tribal medicine	PSO -2	Understand
CLO-4	Assess the therapeutic role of plants in day to day life	PSO- 4	Analyse

Modules	COURSE CONTENTS	Duration
1.0	Plant cell and tissue culture – culture media and cell culture. Tissue culture, micropropagation and somaclonal variation. Protoplast culture – isolation and purification of protoplasts, protoplast fusion, genetic modification of protoplasts. Use of reporter genes in transformed plant cells. Transgenic plant technology– genetic engineering of plants for pest resistance, virus resistance, Herbicide tolerance, stress tolerance and delay of fruit ripening. Use of plants to produce commercially important proteins, antibodies, viral antigens and peptide hormones. ***Key words: Commercial application of Withania somnifera and Musa paradisiaca, Crop Improvement***	**8hours**
2.0	Principles and applications of plant tissue culture-techniques and prospects. Recombination by protoplast fusion. Genetic engineering of plants- transfer and expression of genes in plants-transgenic plants, manipulating plants for non-food carbohydrates and lipids, production of vaccines and molecular farming. Terminator genes, BT gene, production of artificial genes. Plant breeding techniques, methods of crop and live stock improvement ***keywords: applications of plant tissue culture***	**8hours**
3.0	**Plant propagation -** methods of vegetative propagation- stem cutting, grafting, trenching, layering, suckers, stolons, tubers, corms. Basic nursery methods and green house techniques, Advantages of plant propagation ***keywords: Plant propagation***	**6hours**
4.0	**Grafting:** Conservation of herbs- Medicinal plant banks micro propagation of important species (Withania somnifera, neem and tulsi)- Herbal foods-future of pharmacognosy. ***key words: Withania somnifera, neem, tulsi***	**4hours**
5.0	**Plants in day today life** – *Ocimum sanctum, Aloe vera.* Nutritive and medicinal value of some fruits (Orange, Mango, Banana, Lemon, Pomegranate) and vegetables - Greens (*Moringa, Solanum nigrum* Cabbage). ***key words: Guava, Sapota*** **Note: Course content involves 100% theory**	**4hours**

REFERENCES

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Glossary of Indian medicinal plants,	R.N.Chopra, S.L.Nayar and I.C.Chopra	C.S.I.R, New Delhi.	1	1956.
2.	The indigenous drugs of India	Kanny, Lall, Dey and Raj Bahadur	International Book Distributors.	2	1984
3.	Herbal plants and Drugs	Agnes Arber	Mangal Deep Publications.	1	1999
4.	Ayurvedic drugs and their plant source	V.V. Sivarajan and Balachandran Indra	Oxford IBH publishing Co	1	1994

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publicatio**
1.	Ayurveda and Aromatherapy	Miller, Light and Miller Bryan	Banarsidass, Delhi	2	1998
2.	Principles of Ayurveda	Anne Green	Thomsons, London	2	2000

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SECOND YEAR - SEMESTER – IV

Course Title	**BIOPHARMACEUTICALS-II**								
Course Type	**Soft Core-Interdisciplinary**		Total Hours	30	Hours/Week	02	Credits	02	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Analyse the design, structure and activity relationship of drugs.
CO-2	Assess various modes of spread of common diseases and their treatment.
CO-3	Understand the advanced drugs used for treating new diseases.
CO-4	Remember the mechanism of action of drugs on the biological systems
CO-5	Critically evaluate the structure of important drugs such as anti-biotics and anti-septics

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Analyse the design, structure and activity relationship of drugs.	PSO- 4	Analyse
CLO-2	Understand various modes of spread of common diseases and their treatment.	PSO- 2	Understand
CLO-3	Understand the advanced drugs used for treating new diseases.	PSO -2	Understand
CLO-4	Remember the mechanism of action of drugs on the biological systems	PSO- 1	Remember
CLO-5	Critically evaluate the structure of important drugs such as anti-biotics and anti-septics	PSO- 4	Analyse

Modules	**COURSE CONTENT**	**Duration**
1.0	**Introduction:** Drugs: definition, sources, classification (Biological chemical, commercial and utility), Nomenclature of drugs-Biotransformation, Drug design - factors affecting the stability of drugs, Encapsulation – drug delivery systems and sustained release of drugs. ***Keywords: Biotransformation, Encapsulation***	**6hours**

2.0 **Pharmaceutical Aids:** Preservatives: Antioxidants, Sequestering agents, Emulsifiers- Colorantsm, Flavouring agents – Sweeteners, Stabilizers - suspending agents- Ointment bases- Solvents. **6hours**

Keywords: Preservatives, suspending agents

3.0 **Common Diseases and Treatment :** Insect borne disease - Treatment using drugs Air borne disease-Treatment using drugs , water borne disease- Treatment using drugs, Digestive disorder – treatment, disease of respiratory system- treatment disease of nervous system - treatment , other common disease- treatment **6hours**

Keywords: disease , Insect borne, Air borne, water borne

4.0 **Pathogenicidal Drugs :** Antibiotics – Classification, penicillin Chloramphenicol, streptomycin, Tetracycline, Erythromycin Antiseptics and disinfectants - Phenols Halogen compounds, Analgesics, Antipyretics , Anti -inflammatory agents - Sulpha drugs. **6hours**

Keywords: Antibiotics, Antiseptics, Antipyretics

5.0 **Bio Regulatory Drugs:** Cardiovascular drugs - Cardiac glycosides - anti arrhythmic drugs - antihypertensive agents : anti-anginal agents. Diabetes and Hypoglycaemic drugs - two types of diabetes: Diabetes insipidus and diabetes mellitus, Control of diabetes - Insulin -Hypoglycaemic agents. Anticonvulsants, Cancer and antineoplastic drugs - Common causes – anti metabolites **6hours**

Keywords: Cardiovascular, antihypertensive, Diabetes

Note: Course content involves 100% theory

REFERENCES

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	A Complete Text Book of Medical Pharmacology	Srivastava, S K	Avichal Publishing Company	2	2012
2.	Theory and practice of industrial pharmacy	Leon Lachman, Herbert.A. Lieberrman,	International Book Distributors.	3	2008
3.	Pharmaceutics, The Science of Dosage Form Design:	Michael. E. Aulton;	Churchill Livingstone.	2	2001

RECOMMENDED BOOKS

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	Chemistry for Health Science	Satake M and Mido Y	Discovery Publishing	1	2003
2.	Pharmaceutical dosage forms: Tablets	Leon Lachman, Herbert.A. Lieberrman	Dekker INC.	3	1999

SECOND YEAR - SEMESTER – II

Course Title	**CLINICAL DIAGNOSIS IN HEALTH AND DISEASE-II**								
Course Type	**Soft Core-Interdisciplinary**		Total Hours	30	Hours/Week	02	Credits	02	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand and enhance the practical skills and enable to work in a Hospital setup
CO-2	understand about analysis of body fluids and detection of body metabolites
CO-3	Analyze exposure to know about liver, heart, brain, lung and kidney function test
CO-4	Understand the basic concept of pathogens which cause diseases.
CO-5	Understand the basis of non-communicable diseases.

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Demonstrate and enhance the practical skills and enable to work in a Hospital setup	PSO- 1	Remember
CLO-2	Develop an understanding of basic concepts in Clinical diagnosis in health and diseases	PSO- 2	Understand
CLO-3	Assess exposure to know about liver, heart, brain, lung and kidney function test	PSO -2	Understand
CLO-4	Apply the concept of pathogens which cause diseases	PSO-3	Apply
CLO-5	Understand the basis of non-communicable diseases.	PSO- 4	Analyse

Modules	**COURSE CONTENTS**	**Duration**
1.0	**Fundamentals of Clinical Diagnostics:** Sterilization Techniques: Physical methods and Chemical methods. General overview of blood banking, blood typing, blood screening in transfusion medical lab ***Keywords: Sterilization, blood screening***	**6hours**
2.0	**Approaches to diagnosis of infectious diseases I:** Isolation of bacteria from mixed culture. Study of morphological, cultural, biochemical characteristics of common bacterial pathogen. Composition and use of important differential media for identification of pathogenic bacteria EMB agar, McConkey agar, TCBS agar and Salmonella-Shigella agar and blood culture media (any two) ***Keywords: biochemical characteristics, Isolation***	**6hours**
3.0	**Approaches to diagnosis of infectious diseases II:** Enumerate the microbial load on the selected fresh produce from major outlets. Isolate and identify the common microorganisms present on their surface using microbiological, biochemical and PCR techniques. ***Keywords:*** microbial load, PCR	**6hours**
4.0	**Immunoserology: Principles and Application I:** Antigen-antibody	**6hours**

interaction and its use in diagnosis: Detection and diagnosis of common infectious diseases: Widal and typhi dot for typhoid, Malaria antigen in Malaria, NS1 antigen in Dengue

Keywords: Antigen-antibody interaction

5.0 **Immuno serology: Principles and Application II:** Antigen-antibody interaction and its use in diagnosis: Detection and diagnosis of common non-infectious diseases: Acylated haemoglobin in Diabetes, TSH levels in Thyroid condition **6hours**

Keywords: Immuno serology

Note: Course content involves 100% theory

REFERENCES					
Sl.No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1.	Medical Laboratory Technology Methods and Interpretations	Ramnik Sood	Jaypee Brothers Medical Publishers	6	2009
2.	Varley's practical clinical Biochemistry	Gowenlock, A.H. and Donald, J	CBS publications	6	2002
3.	Text book of medical biochemistry	Chatterjee and Shindae	Jaypae Brothers (p) ltd, New Delhi	7	2007
4.	Essentials of Medical Physiology	Sembulingam, K and Sembulingam, P	Jaypae Brothers (p) ltd, New Delhi	5	2010

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	Book of Biochemistry with clinical correlations	Devlin, T.M	Willey Publishers	5	2002
2.	Fundamentals of Clinical chemistry	Burtis and Ashwood	Oxford Science Publications	6	2007
3.	Clinical Biochemistry	Gans, G and Murphy, J.M	Churchill Livingstone, Elsevier	4	2008

OPEN ELECTIVE COURSES OFFERED TO UNRELATED DEPARTMENT IN II SEMESTER

1. Biochemistry in Daily Life
2. Biochemistry of Common Disorders

FIRST YEAR - SEMESTER – II

Course Title	**BIOCHEMISTRY IN DAILY LIFE**							
Course Type	**Soft Core- Open Elective**		Total Hours	30	Hours/Week	02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100

			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand the basic concepts in food, health, Disease
CO-2	Demonstrate the usefulness and concepts of Prebiotics & Probiotics
CO-3	Learn the types and effects of sweetening and food additives
CO-4	Learn the types and application of enzymes.
CO-5	Critically evaluate on food processing & fortification

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Understand the basic concepts in food, health, Disease	PSO 1	Remember
CLO-2	Demonstrate the usefulness and concepts of Prebiotics & Probiotics	PSO 2	Understand
CLO-3	Assess the types and effects of sweetening and food additives	PSO 2	Remember
CLO-4	Assess types and application of enzymes.	PSO 3	Remember
CLO-5	Critically evaluate on food processing & fortification	PSO 4	Apply

Modules	**COURSE CONTENTS**	**Duration**
1.0	**Definition of Biochemistry:** Definition of life, The different forms of life, micro-organisms to human beings. Building blocks of life. Introduction to the common macro- and micro constituents of unicellular and multi cellular organisms. Differences encountered in plant and animal kingdoms. **Food and Nutrition:** Importance of food for existence of life. Modes of nutrition in life forms –Comparable and contrasting features **Human Health and Disease:** Nutrition (Health), definition, classification, food and non food sources. Nutraceuticals; use of nutraceuticals in traditional health sciences. Role of omega-3 fatty acids, carotenoids, dietary fiber, phytoestrogens; glucosinolates; organo-sulphur compounds in health and disease (prevention and control). ***Keywords: neutraceuticals, Importance of food& health***	**10hours**
2.0	**Prebiotics and probiotics**: Mechanics and usefulness of probiotics and prebiotics in gastrointestinal health and other benefits. Beneficiary microbes; prebiotic ingredients in foods; types of prebiotics and their effects on gut microbes. *Functional foods:* Definition, development of functional foods, benefits and sources of functional foods in Indian diet. Effects of processing conditions and storage. *Development of nutraceutical and functional foods;* Standards for health claims. Process of developing-preclinical & clinical studies. **Food additives:** Definitions, functions and uses in processed food products. Chemical, technological and toxicological aspects of acid, base buffer systems, salts and chelating/sequestering agents, leavening agents, antioxidants, emulsifying and stabilizing agents, Anti-caking agents, thickeners, firming agents, flour bleaching	**10hours**

agents and bread improvers.

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

Keywords: Food additives & Sweetening agents

3.0 **Enzymes:** Introduction and essentiality to life forms. Use of enzyme in beverages- fruit juices, beer, wine, and distilleries; dairy, baking, oils and fats, plantation products, animal products. Malting and germination of grains – process, characteristics, nutritional benefits and uses.

Domestic use products like detergents. Textiles-Denim processing. Leather industry.

Food processing and fortification: Principles, objectives and rationale, selection and basis of fortificants. Technology of fortifying cereal products. Characteristics of nutrients used in cereal fortification. Fortification methods. Fortification premixes, Design and composition of premixes and quality control. Fortification of bread, pasta, noodles, biscuits, and breakfast cereals. **10hours**

Beverages; importance of beverage fortification, Health benefits of fortification, Selection of nutrients for fortification, Levels to be added, Characteristics of fortificants and method of fortification, Bioavailability, Organic Vs inorganic salts. *Health foods;* selection of nutrients, Technology of incorporation of fortificants, bioavailability.

Keywords: Enzymes, Beverages, Fortification

Note: Course content involves 100% theory

REFERENCES

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	Theory and practice of industrial pharmacy	Leon Lachman, Herbert.A. Lieberrman,	International Book Distributors.	3	2008
2	Pharmaceutics, The Science of Dosage Form Design:	Michael. E. Aulton;	Churchill Livingstone.	2	2001

RECOMMENDED BOOKS

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	Pharmaceutical dosage forms: Tablets	Leon Lachman, Herbert.A. Lieberrman	Dekker INC.	3	1999

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FIRST YEAR - SEMESTER – II

Course Title	**BIOCHEMISTRY OF COMMON DISORDERS**								
Course Type	**Soft Core- Open Elective**		Total Hours	30	Hours/Week		02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15				30 Marks	100
			External	Duration	C3	03Hrs		70 Marks	

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand compliments and supplements the necessary knowledge students have gained in Physiology
CO-2	Understand and Consequently it incorporates topics like cellular adaptations, inflammation, neoplasia, cellular ageing and other infectious diseases
CO-3	Understand and apply the necessary inputs for the other disciplines like Pharmacology, social and preventive medicine, medicinal biochemistry etc

MAPPING CLO'S WITH PSO's AND CD's

CLO No.	Course Learning Outcomes On completion of the course the student will learn to	PSOs Addressed	CD's
CLO-1	Understand compliments and supplements the necessary knowledge students have gained in Physiology	PSO- 1	Remember
CLO-2	Understand and Consequently it incorporates topics like cellular adaptations, inflammation, neoplasia, cellular ageing and other infectious diseases	PSO-2	Understand
CLO-3	Understand and apply the necessary inputs for the other disciplines like Pharmacology, social and preventive medicine, medicinal biochemistry etc	PSO- 3	Remember

Modules	COURSE CONTENTS	Duration
1.0	**Human Physiology:** Introduction and brief description of cells, tissues and organs, their functions; Body fluids and their composition. Introduction to molecules as building blocks. Definition and differentiation of disease and disorder, types and causes. Relation between food, environment and illness. Analysis of various biochemical parameters in body fluids and specific tissues during disorders, diseases and forensics **Diagnostic Techniques:** Collection and storage of biological samples for clinical use. Commonly used tests for diagnosis of various diseases and their interpretation. **Blood analysis:** Total blood count including ESR, Total serum proteins and their fractions.Blood glucose (GTT) (Fasting and post- prandial), serum lipid fraction–cholesterol, triglyceride, LDL and HDL, blood urea, and serum calcium.*Urine:* Creatinine, Glucose and protein (albumin). *Enzymes:* SGPT, SGOT and isoenzymes as markers in various disorders and diseases ***Keywords: Blood & Urine analysis***	**10hours**
2.0	**Diseases and Disorders (common occurence):** Aetiology; classification (if any); causative factors; incidence, symptoms and biochemical aspects and markers for-identification, monitoring, prevention and interventions; and nutritional aspects, overweight and obesity. **Renal disease:** Nephrotic syndrome, Acute and Chronic renal failure- diagnostic procedures and dietary management. Dialysis, medical and nutrition therapy. ***Keywords: common occurence***	**10hours**
3.0	**Gastrointestinal diseases/disorders:** Gastro-oesophageal reflux and esophagitis, Gastritis and Peptic ulcer. Characteristics of and comparison of the stomach and duodenal ulcers. Diagnostic tests for malabsorption, sprue and tropical sprue, Crohn's disease, diarrhoea, constipation, ulcerative colitis, diverticular disease and colon cancer. **Cancer and HIV/AIDS:** Biochemistry of carcinogenesis, types,	**10hours**

stages of cancer, diagnosis and existing medicines. Biochemistry of HIV infection, ART and social issues.

Keywords: GI Track, Cancer

REFERENCES					
Sl.No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1.	Biochemistry- The Chemical Reactions of Living Cells	David E. Metzler	Academic Press	2	2001
2.	Outlines of Biochemistry	Eric E. Conn, Paul K. Stumpf, George Breuning, Roy H. Doi	John-Wiley and sons	5	2009
3.	Fundamentals of Practical Biochemistry	Mohanty and Basu	BI Publications	1	2002

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	Biochemistry	Donald Voet, Judith G. Voet	John Wiley and sons	4	2010
2.	Lehninger-Principles of Biochemistry	David L. Nelson and Michael M. Cox	W. H. Freeman	6	2013

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OPEN ELECTIVE COURSES OFFERED TO UNRELATED DEPARTMENT IN IV SEMESTER

1. Lifestyle Disorders
2. Fundamentals of Biochemistry

SECOND YEAR - SEMESTER – IV

Course Title	**LIFESTYLE DISORDERS**								
Course Type	**Soft Core- Open Elective**		Total Hours	30	Hours/Week	02	Credits	02	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand the basic concepts health, Disease
CO-2	Demonstrate the connection between knowledge of anatomy and physiology and real-world situations
CO-3	Critically evaluate on healthy lifestyle decisions and homeostatic imbalances

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Understand the basic concepts health, Disease	PSO- 1	Remember
CLO-2	Demonstrate the connection between knowledge of anatomy and physiology and real-world situations	PSO- 2	Understand
CLO-3	Critically evaluate on healthy lifestyle decisions and homeostatic imbalances	PSO- 3	Apply

Modules	**COURSE CONTENTS**	**Duration**
1.0	**Nutrition in various stages of life :** Life Cycle nutrition, lactation & pregnancy, Nutrition during pregnancy and lactation. Maternal Health, Practices incompatible with pregnancy, Fetal alcohol syndrome. Nutrition in infancy, childhood Nutrition and adolescence. The early development of chronic diseases, Nutrition in adulthood and later years. Illness and nutrition status, Nutrition Medications and complementary therapies Nutrition intervention ***Keywords: Importance of food& health***	**6hours**
2.0	**Nutrition in GI disorders:** Nutrition and disorders of the gastro intestinal tract, parenteral nutrition. Nutrition in Severe stress, Nutrition and diabetes mellitus, Complication of diabetes mellitus, Treatment of diabetes, Medical Nutrition therapy for diabetes, Mastering diabetes control. ***Keywords:*** **GI disorders,** ***Nutrition therapy***	**6hours**
3.0	**Nutrition for cardio disorders:** Nutrition and disorders of the heart blood vessels and lungs. Atherosclerosis, hypertension, treatment and prevention of heart disease, Diet strategies, Drug therapy, Acute respiratory failure, The metabolic syndrome. ***Keywords: Atherosclerosis, metabolic syndrome***	**6hours**
4.0	**Nutrition in Renal disorders :** Nutrition and Renal disease, kidney stones and treatment, the nephrotic syndrome, Renal failure, kidney transplants and diet, Dialysis and Nutrition, Nutrition and liver disorders, Fatty liver and hepatitis, Cirrhosis, Gall stones, Nutrition ***Keywords: Renal disease, kidney transplants***	**6hours**
5.0	**Nutrition in Cancer and HIV :** Cancer and HIV infection, How cancer develops, Consequence of cancer, Treatment for cancer, Medical Nutrition therapy. How HIV develops, Consequences of HIV infection. Medical Nutrition Therapy. Ethical issues in Nutrition care ***Keywords: Cancer and HIV infection*** **Note: Course content involves 100% theory**	**6hours**

REFERENCES

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Textbook of Medical Biochemistry	M N Chatterjee and Rana shinde	Jaypee Publishers	8	2011
2.	Biochemistry- The Chemical Reactions of Living Cells	David E. Metzler	Academic Press	2	2001
3.	Fundamentals of Practical Biochemistry	Mohanty and Basu	BI Publications	1	2002
4.	Outlines of Biochemistry	Eric E. Conn, Paul K. Stumpf, George Breuning, Roy H. Doi	John-Wiley and sons	5	2009

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	Biochemistry	Donald Voet, Judith G. Voet	John Wiley and sons	4	2010
2.	Textbook of Clinical Chemistry and Molecular Diagnostics	Carl A. Burtis and Edward R. Ashwood . Tietz	Saunders Publication	5	2012
3.	Lehninger-Principles of	David L. Nelson and Michael M. Cox	W. H. Freeman	6	2013

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SECOND YEAR - SEMESTER – IV

Course Title	**FUNDAMENTALS OF BIOCHEMISTRY**								
Course Type	**Soft Core- Open Elective**		Total Hours	30	Hours/Week	02	Credits	02	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Understand the common concepts of Biochemistry like Blood and its components
CO-2	Demonstrate the connection between knowledge of organ systems and its inter connection
CO-3	Understand importance of Nutritional components
CO-4	Understand importance of macro & micronutrients for life
CO-5	Critically evaluate on general Implications in health and disease

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Understand the common concepts of Biochemistry like Blood and its components	PSO- 1	Remember

CLO-2	Assess the organ systems and its inter connection	PSO- 2	Understand
CLO-3	Critically evaluate on Nutritional components	PSO- 3	Apply
CLO-4	Understand importance of macro & micronutrients for life	PSO- 2	Understand
CLO-5	Critically evaluate on general Implications in health and disease	PSO- 4	Apply

Modules	COURSE CONTENTS	Duration
1.0	**Blood**: Composition, cell types red blood cells and white blood cells and their function. Hemostasis, blood clotting, digestion of clot, anticoagulants, blood volume, blood pressure and serum enzymes.	**6hours**
	Keywords: cell types	
2.0	**Respiratory System:** Lungs, structure and functions, exchange of gases, **Excretory System:** Ultra structure of the nephron, formation of urine. **Hepatobiliary System:** Anatomy of the liver, cells types.. Secretory and excretory function and formation of bile. **Digestive System:** GI tract, digestion and absorption of carbohydrates, proteins and lipids. Function of HCl **Muscle physiology:** Skeletal muscle and smooth muscle, muscle proteins	**9hours**
	Keywords: organ systems and its inter connection	
3.0	**Nutrition:** Small molecules: sugars, amino acids, nucleotides, lipids. **Macromolecules:** polysaccharides, proteins, nucleic acids. **Carbohydrates**: Dietary sources, dietary fiber, essentiality of carbohydrates. **Proteins:** Essential amino acids, nutritional classification of proteins, supplementary value of proteins, protein malnutrition. **Fats**: Sources, invisible fat, essential fatty acids, PUFA. **Vitamins:** Classification, source, deficiency symptoms Fat soluble and water soluble vitamins. **Minerals metabolism:** Macro and micro nutrients, sources, requirements, functions and deficiency symptoms. **Water metabolism:** distribution in body, water balances, factors affecting water balance.	**9hours**
	Keywords: Nutritional components	
4.0	**Implications in health and disease:** Diabetes, Hyper tension, Hypotension, Gout arthritis Immunology: Historical development and milestones in immunology Vaccines and Vaccination.	**6hours**

Toxicity: Xenobiotics, heavy metals, pesticide poisoning

Keywords: Implications in health and disease

Note: Course content involves 100% theory

REFERENCES					
Sl.No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1.	Biochemistry- The Chemical Reactions of Living Cells	David E. Metzler	Academic Press	2	2001
2.	Fundamentals of Practical Biochemistry	Mohanty and Basu	BI Publications	1	2002
3.	Outlines of Biochemistry	Eric E. Conn, Paul K. Stumpf, George Breuning, Roy H.	John-Wiley and sons	5	2009
4.	Biochemistry	Donald Voet, Judith G. Voet	John Wiley and sons	4	2010

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	Textbook of Medical	M N Chatterjee and Rana shinde	Jaypee Publishers	8	2011
2.	Textbook of Clinical Chemistry and Molecular Diagnostics	Carl A. Burtis and Edward R. Ashwood . Tietz	Saunders Publication	5	2012
3.	Lehninger-Principles of Biochemistry	David L. Nelson and Michael M. Cox	W. H. Freeman	6	2013

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Certificate Courses offered for related/Unrelated departments

1. Mushroom Cultivation Technology
2. Vermi compost Technology

Course Title	**MUSHROOM CULTIVATION TECHNOLOGY**								
Course Type	**Certificate Course**		Total Hours	30	Hours/Week	02	Credits	02	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	C3	03Hrs	70 Marks		

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	Enable the students to identify edible and poisonous mushrooms
CO-2	Provide hands on training for the preparation of bed for mushroom cultivation and spawn production
CO-3	Give the students exposure to the experiences of experts and functioning mushroom farms
CO-4	Help the students to learn a means of self employment and income generation

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Identify edible types of mushroom	PSO 1	Remember
CLO-2	Gain the knowledge of cultivation of different types of edible mushrooms and spawn production	PSO 2	Understand
CLO-3	Manage the diseases and pests of mushrooms	PSO 3	Apply
CLO-4	Learn a means of self-employment and income generation	PSO 4	Apply

Modules	**COURSE CONTENTS**	**Duration**
1.0	**Introduction,** history of mushroom cultivation; biology of mushrooms; Nutritional value: (Proteins, amino acids, mineral elements, carbohydrates, fibers, vitamins); Medicinal value of mushrooms; Poisonous and edible mushrooms. Scope and importance of mushroom ***Keywords: mushroom cultivation***	**7hours**
2.0	**Cultivation Technology:** Infrastructure, equipments and substrates in mushroom cultivation: Polythene bags, vessels etc. Mushroom unit or mushroom house, pure culture, Spawn: types of spawn, preparation of spawn, mushroom bed preparation and factors affecting mushroom bed preparation; compost technology in mushroom production ***Keywords: mushroom production***	**8hours**
3.0	**Casing;** raw material used for casing, preparation of casing material; important sanitation during various stages of mushroom cultivation. Cultivation of important mushrooms: General process for the cultivation of Agaricus bisporus and Volvariellavolvaceae ***Keywords: raw material used for casing***	**8hours**
4.0	**Storage and food preparation** from mushrooms: Methods of storage of mushroom cultivation, Long term and short term storage of mushrooms Foods/recipes from mushrooms. ***Keywords: Storage and food preparation*** **Note: Course content involves 100% theory**	**7hours**

REFERENCES					
Sl.No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1.	A hand book of edible mushroom, Today & Tomorrows	Kannaiyan, S. Ramasamy, K	Printers & Publishers, New Delhi	1	1980
2.	A textbook of fungi	Pandey B P	Chand and Company N Delhi	2	1996

3.	Mushroom Production and Processing	Pathak, V. N. and Yadav, N	Agrobios, Jodhpur	1	1998
4.	Mushrooms-The art of cultivation	Harander Singh	Sterling Publishers	1	1991

RECOMMENDED BOOKS					
Sl.No	**Title of the book**	**Name of the Author**	**Name of the Publisher**	**Edition**	**Year of Publication**
1.	Mushroom Cultivation	Tripathi, D.P	Oxford & IBH Publishing	1	2005
2.	Mushroom Production and	PathakYadavGour	Agrobios (India	2	2010

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Course Title	**VERMICOMPOST TECHNOLOGY**								
Course Type	**Certificate Course**		Total Hours	30	Hours/Week		02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15				30 Marks	100
			External	Duration		C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)	
CO No.	**Course Objectives**
CO-1	To inculcate concepts of bio fertilizers like vermicomposting
CO-2	To understand techniques in Vermicomposting.
CO-3	To increase employability of the students.
CO-4	To improve the soil quality by promoting the bio fertilizers.

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	**Course Learning Outcomes On completion of the course the student will learn to**	**PSOs Addressed**	**CD's**
CLO-1	Plan and organize vermi compost processes, identify necessary materials and tools for the production	PSO-1	Remember
CLO-2	Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations.	PSO-2	Understand
CLO-3	Apply professional knowledge and soft skills& entrepreneurship while performing the vermi compost production.	PSO-3	Apply

Modules	**COURSE CONTENTS**	**Duration**
1.0	**General Vermiculture/ Vermicompost**: Introduction to vermiculture. Definition, meaning, history, economic important, their value in maintenance of soil structure, role as four r's of recycling reduce, reuse, recycle, restore. His role in bio transformation of the residues generated by human activity and production of organic fertilizers. How does nature works. The matter and humus cycle (product, qualities). Ground population, transformation process in organic matter. Choosing the right worm.	**8hours**

Useful species of earthworms. Local species of earthworms. Exotic species of earthworms.

Keywords: Vermiculture, earthworms

2.0 **Earthworm Biology and Rearing:** Biology of Eisenia fetida. a) Taxonomy, Anatomy, physiology and reproduction of Lumbricidae. b) Vital cycle of Eisenia fetida: alimentation, fecundity, annual reproducer potential and limit factors (gases, diet, humidity, temperature, PH, light, and climatic factors). Biology of Eudrilus eugeniae. c) Taxonomy Anatomy, physiology and reproduction of Eudrilidae. d) Vital cycle of Eudrilus eugeniae: alimentation, fecundity, annual reproducer potential and limit factors (gases, diet, humidity, temperature, PH, light, and climatic factors). **8hours**

Keywords: Eisenia fetida, Eudrilus eugeniae.

3.0 **Vermicompost Technology (Methods and Products):** Small Scale Earthworm farming for home gardens - Earthworm compost for home gardens, Conventional commercial composting - Earthworm Composting larger scale, Earthworm Farming (Vermiculture), Extraction (harvest), vermicomposting harvest and processing. Nutritional Composition of Vermicompost for plants, comparison with other fertilizers, Vermiwash collection, composition &use, Enemies of Earthworms, Sickness and worm's enemies. Frequent problems. How to prevent and fix them. **8hours**

Keywords: Vermiwash, Earthworm Farming, home gardens

4.0 **Applied vermiculture**: The working group experience with E. fetida populations comportment with farm industrial residues (frigorific, cow places, feed-lot, aviaries exploitations, and solid urban residues). b) Lineaments to vermicomposting elaboration projects. Considerations about economical aspects of this activity. Research and ratability according to different exploitation orientations (worm's meat production, worm's humus production, or integrated projects). Toxins released by the worms (harmful effects) **6hours**

Keywords: farm industrial residues

Note: Course content involves 100% theory

REFERENCES

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Earthworm for Gardeners and Fisherman	Kevin, A and K.E.Lee	CSIRO, Australia, Division of Soils	1	2004
2.	Earthworms: Their ecology and Relationship with Soils and Land Use	Lee, K.E.	Academic Press, Sydney	1	1985

3.	Earthworm Biology	Wallwork, J.A	Edward Arnold (Publishers) Ltd. London	1	1983
4.	Biology of Earthworms	Edwards, C.A. and J.R. Lofty	Chapman and Hall Ltd	2	1977

RECOMMENDED BOOKS

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	"Role of Earthworms in Agriculture"	Bhatt J.V. & S.R. Khambata	Indian Council of Agricultural Research, New Delhi	1	1959

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Blue print of question papers for practical exams from I-IV semesters

St. Philomena's College (Autonomous), Mysore		
M.Sc Biochemistry		
Time: 4 Hours		**Max Marks: 70**
1.	Procedure writing	5 marks
2.	Major experiment	35 marks
3.	Minor experiment/ spotters/calculations	20 marks
4.	Viva	10 marks

Blue print of question papers from I-IV semesters

St. Philomena's College (Autonomous), Mysore			
M.Sc Biochemistry			
Time: 3 Hours			**Max Marks: 70**
PART-A			
Answer any TEN of the following:			**10x2=20**
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
PART-B			
Answer any SIX questions:			**6x5=30**
13.			
14.			
15.			
16.			
17.			
18.			
19.			
20.			
		PART-C	
Answer any TWO questions:			**2x10=20**
21.			
22.			
23.			

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