

*Placed at the meeting of
Academic Council
held on 15.11.2023*

APPENDIX-BM
MADURAI KAMARAJ UNIVERSITY
(University with Potential for Excellence)

MODIFIED SYLLABUS FOR
B.Sc. BIOCHEMISTRY
CBCS SEMESTER PATTERN (w.e.f. 2023-24)

1. Introduction of the Programme

The Bachelor of Science in Biochemistry is a full- time programme spread over 3 years and is divided into 6 semesters. The programme of study shall consist of 1-Foundation Course, 16 Core papers which are compulsory, 8 Allied papers, 2 Elective papers, 2 Non major Elective Papers, 5 Skill Based papers, 2 mandatory papers under Part-IV (Value Education and Environmental Studies) and 1 under Part-V Extension Activities. Each of these carries 100 marks. It has been developed to provide students the opportunity to be trained in recent development in Biochemistry. The course is designed to impart the students a vigorous training in Biochemistry both in theory and experiments. Our approach is a comprehensive one. It is believed that teaching students both how to ask and address questions. This Programme has been designed to expose students' knowledge in Biochemistry to contemporary national and international problems. At the end of the course, students are expected to have state- of- the- art quantitative skills valued both in academia and in the corporate world. During the course time, one gets as in-depth knowledge about core subjects like Biochemistry, Molecular Biology, Microbiology and Immunology.

2. Eligibility for Admission

Candidate should have passed the higher secondary examinations conducted by the Board of higher secondary Education, Govt. of Tamilnadu or any other examination accepted by the syndicate as equivalent there to

- Biology/physics/ chemistry
or
- Biology/ physics/ chemistry/ mathematics
as subjects in the higher secondary education
- Candidates should have secured at least 50% in the above subjects and above in the aggregate
- A relaxation of 10% marks in the aggregate will be given to SC/ST candidates

- Candidates sponsored by the industrial / hospitals/clinical laboratories may also considered for admissions.

3. Objectives of the Programme

- To offer the knowledge, understanding and skills to UG students.
- To offer a balance between Theoretical and Experimental –Biochemistry.
- To improve the employability of the students
- To develop core competencies on critical thinking skills, hypothesizing and solving problems.

4. Outcome of the Programme

- It serves as a basis to build a purely academic profile for further studies Masters and research in Biochemistry.
- On successful completion of this course, one can apply for the Masters in Biochemistry. The degree holders can opt for further higher studies and career in various specializations of Biochemistry, Microbiology and Biotechnology

5. Core Subject Papers

Core Subject papers shall consists of 16papers as listed below.

1. Nutritional Biochemistry
2. Nutritional Biochemistry Lab
3. Cell Biology
4. Cell Biology Lab
5. Biomolecules
6. Biomolecules Lab
7. Biochemical Techniques
8. Biochemical Techniques Lab
9. Enzymes
10. Intermediary Metabolism
11. Clinical Biochemistry
12. Clinical Biochemistry Lab
13. Molecular Biology
14. Human Physiology
15. Plant Biochemistry
16. Core Project

6. Allied Subject Papers

Allied papers shall consists of 8 papers as listed below.

1. Chemistry- Theory I
2. Chemistry Lab I
3. Chemistry- Theory II
4. Chemistry Lab II

1. Biology - Theory I
2. Biology Lab I
3. Biology - Theory II
4. Biology - Lab II

Major Elective

1. Immunology
2. Biochemical pharmacology
3. Research methodology
4. Bio entrepreneurship
5. Bioinformatics
6. Biotechnology

7. Non-major Electives

1. Health and Nutrition
2. Life style diseases

Skill Based Electives

Skill Based Elective shall consists of 5 papers as listed below.

1. Basics of Forensic Science
2. Medical Laboratory Technology
3. Tissue Culture
4. Medical Coding
5. Microbial Techniques

Part-IV: 1. Value Education, 2. Environmental Studies

Part-V: Extension Activities

8. Unitization

Each subject Paper consist of five units. One unit (Preferably the 5th unit) will be handled by the students as a part of peer team teaching/learning process.

9. Pattern of Semester Examination

Three-year B. Sc., Biochemistry degree shall be having examinations of 16 Core papers, 8 Allied subjects, 2 Subject- Elective papers, 2 Non- Major Elective papers, 5 Skill Based Elective paper, 2 mandatory papers under Part-IV (Value Education and Environmental Studies) and 1 under Part-V Extension Activities to be conducted in six semesters. First, third and fifth semester examinations shall be conducted in the month of November. The second, fourth and sixth semester examinations shall be held in the month of April. Each paper shall carry 100 marks of which 25 marks for internal assessment and 75 marks for external examinations for all the theory papers. For practical, 40 marks for internal and 60 marks for external.

10. Scheme of Internal Assessment

The components of Internal Assessment marks shall be as follows, for theory.

Test	: 10 Marks (Average of the best two tests)
Assignment	: 5 Marks
Seminar/ Group Discussion/Quiz	: 5 Marks
Peer Team Teaching	: 5 Marks
Total	: 25 Marks

For practical's, 40 marks is for internal.

11.External Examinations

External examination for each Theory paper shall be conducted for 75 marks.

Section A: 10 Multiple choice questions (One question from each unit) ($10 \times 1 = 10$ marks)

Section B: 5 either/ or type questions (One question from each unit) ($5 \times 7 = 35$ marks)

Section C: 3 out of 5 questions. This may include 2 problems. ($3 \times 10 = 30$ marks)

Total : 75 Marks.

12. Question paper pattern

a) For all 3 credits and above courses

The existing pattern of question paper will be as follows:

Time : 3 Hours

Max Marks : 75

Section A : (10 × 1 = 10 Marks)

Question No. 1 to 10

1. Two questions from each unit.
2. Four choices in each question.
3. Answer all questions. Choose the write answer.

Section B: (5×7 = 35 Marks)

Answer all questions – Either or types

Answer not exceeding two pages.

(one question from each unit)

Question NOs.

11a or 11b

12a or 12b

13a or 13b

14a or 14b

15a or 15b

Section C: (3 × 10 =30 Marks)

Answers not exceeding four pages

Answer any **THREE** out of Five (one question from Each Unit)

Question Nos. 16-20

b) Practical Exams : External (Max: 60 marks) Practical

Exams: External (Max : 60 Marks)

One major experiment = 25

One minor experiment = 10

Two spotters = 05

Record book =1 0

Viva voce = 10

The pattern for **internal valuation** for 40 marks may be:

- a) Two internal tests of 25 marks each : Average = 25 marks

- | | |
|---------------------|------------|
| b) Observation book | = 10 mark |
| c) One assignment | = 05 marks |

13. Scheme of Evaluation

Students shall be evaluated on the basis of internal tests, seminar, and assignment, peer-teaching and external examinations. Question paper setters shall be requested to prepare scheme of valuation for all the papers.

14. Passing Minimum

To get a pass, a student should fulfill the following conditions:

A) Theory:

1. 40% of the aggregate (External + Internal).
2. No separate pass minimum for internal
3. 27 marks out of 75 is the pass minimum for the External.

B) Practicals :

1. 40% of the aggregate (External + Internal)
- 2. No separate pass minimum for the internal**
3. 21 marks out of 60 is the pass minimum for the External

C) Project:

1. 40% of the aggregate (project evaluation + Viva- voce).
2. No separate pass minimum for viva -voce
3. 28 mark out of 80 is the pass minimum for the project evaluation.

15. Model Question paper

Maximum Time: 3 hrs

Maximum Marks: 75

Section A

Answer All Questions

All multiple choice Questions Two
Questions from each Unit (Questions
are numbered from 1 to 10)

(10 × 1= 10 Marks)

Section B

Answer All Questions

(Either/ or type: either (a) or (b)) One
question from each Unit Questions are
numbered from 11 to 15)

(5 × 7= 35 Marks)

Section C

Answer any three Questions One
question from each Unit (Questions are
numbered from 16 to 20)

(3 × 10= 30 Marks)

16. Teaching Methodology

Methodology shall consist of stimulation of students' interest, presentation of teaching material, team formation and activities' determination, conduction of activities and discussion and assessment. For the sake of simplicity and easy understanding, the methods like problem solving, discussion, lab demonstration and lecture method shall be adopted. The use of ICT shall be co- opted for the visual presentation of the lessons. One unit (mostly 5th unit will be handled by the students).

17. Text Books: The list of text books is given at the end of syllabus of each paper.

18. Reference Books: The list of reference books is given at the end of syllabus

19. Re-totaling and Revaluation Provision

Students shall be provided the facility of applying for retotaling the marks within 15 days after the publication of results on payment of a minimum fee fixed by the University and they shall be allowed to apply for revaluation of their papers within 15 days after the publication of results on payment of a fee to be fixed by the University.

20. Transitory Provision (3+3): Syllabus revision shall be done once in 3 years and afterwards
3 years shall be under transitory provision.

21. Subjects and paper related websites

The related websites for each paper shall be provided at the end of the syllabus wherever necessary.

**B.Sc BIOCHEMISTRY
PROGRAMME CONTENT
SEMESTER I**

S.No .	Components		Title of the Course	Course Code	Hours Per Week	Credits	Exam. Hours	Marks		
								Int.	Ext.	Total
1.	Part I		Tamil/Hindi		6	3	3	25	75	100
2.	Part II		English		4	3	3	25	75	100
3.	Part III	Core Course -I	Nutritional Biochemistry		4	3	3	25	75	100
4.		Core Practical - II	Core Practical I -Nutritional Biochemistry		3	3	3	40	60	100
5.		Allied Paper 1	Chemistry I		4	3	3	25	75	100
6.		Allied Practical 1	Chemistry Practical –I		3	2	3	40	60	100
7.	Part IV	SEC – 1 (NME)	NME 1 Health and Nutrition		2	2	3	25	75	100
8.		SEC- Foundation Course	Fundamentals of Biochemistry		2	2	3	25	75	100
9.		AECC – Soft Skill-1	Soft Skill – I		2	2	3	25	75	100
Total					30	23				

B.Sc BIOCHEMISTRY - SEMESTER II

S.No .	Components		Title of the Course	Course Code	Hour s Per Week	Credits	Exam. Hours	Marks		
								Int.	Ext.	Tota l
1.	Part I		Tamil/ Hindi		6	3	3	25	75	100
2.	Part II		English		4	3	3	25	75	100
3.	Part III	Core Course -III	Cell Biology		4	3	3	25	75	100
4.		Core Course -IV	Cell Biology Practical		3	3	3	40	60	100
5.		Allied Course - II	Chemistry- II		4	3	3	25	75	100
6.		Allied Practical - II	Chemistry Practical – II		3	2	3	40	60	100
7.	Part IV	SEC – 2 (NME)	NME – II		2	2	3	25	75	100
8.		SEC-3	*		2	2	3	25	75	100
9.		AECC- Soft Skill-2	Soft Skill – II		2	2	3	25	75	100
Total					30	23				

* SEC courses can be selected from the list given in the Enclosure

**B.Sc BIOCHEMISTRY
PROGRAMME CONTENT
SEMESTER III**

S.No .	Components		Title of the Course	Course Code	Hours Per Week	Credits	Exam. Hours	Marks		
								Int.	Ext.	Total
1.	Part I		Tamil/Hindi		6	3	3	25	75	100
2.	Part II		English		4	3	3	25	75	100
3.	Part III	Core Course -3	Biomolecules		4	3	3	25	75	100
4.		Core Practical -3	Biomolecules Practical		3	3	3	40	60	100
5.		Allied Paper 3	Biology		4	3	3	25	75	100
6.		Allied Practical 3	Biology Practical –I		2	2	3	40	60	100
7.	Part IV	SEC – 3	*		2	2	3	25	75	100
8.		SEC- 4	*		2	2	3	25	75	100
9.		AECC – Soft Skill-3			2	2	3	25	75	100
			Environmenta l Studies		1	-				
Total					30	25				

*** SEC courses can be selected from the list given in the Enclosure**

B.Sc BIOCHEMISTRY - SEMESTER IV

S.No .	Components		Title of the Course	Course Code	Hours Per Week	Credits	Exam. Hours	Marks		
								Int.	Ext.	Total
1.	Part I		Tamil/Hindi		6	3	3	25	75	100
2.	Part II		English		4	3	3	25	75	100
3.	Part III	Core Course -IV	Biochemical Techniques		4	3	3	25	75	100
4.		Core Practical - IV	Biochemical Techniques Practical		3	3	3	40	60	100
5.		Allied Course - IV	Biology- II		4	3	3	25	75	100
6.		Allied Practical - IV	Biology Practical – II		3	2	3	40	60	100
7.	Part IV	SEC – 5	*		2	2	3	25	75	100
8.		SEC-6	*		2	2	3	25	75	100
9.		AECC- Soft Skill-4			2	2	3	25	75	100
			Environmental Studies		-	2				
Total					30	23				

* SEC courses can be selected from the list given in the Enclosure

B.Sc BIOCHEMISTRY

PROGRAMME CONTENT SEMESTER V

S.No .	Components		Title of the Course	Course Code	Hours Per Week	Credits	Exam. Hours	Marks		
								Int.	Ext.	Total
1.	Part III	Core Course -5	Enzymes		6	4	3	25	75	100
2.		Core Course -6	Intermediary Metabolism		6	4	3	25	75	100
3.		Core Course -7	Clinical Biochemistry		5	4	3	25	75	100
4.		Core Practical -3	Clinical Biochemistry Practical		6	4	3	40	60	100
5.		Elective Paper 1	*		5	4	3	25	75	100
7.	Part IV	Value Education			2	2	3	25	75	100
8.		Internship / Industrial Training				2	3	25	75	100
Total					30	24				

*** Elective courses can be selected from the list given in the Enclosure**

**B.Sc BIOCHEMISTRY
PROGRAMME CONTENT
SEMESTER VI**

S.No .	Components		Title of the Course	Course Code	Hours Per Week	Credits	Exam. Hours	Marks		
								Int.	Ext.	Total
1.	Part III	Core Course -8	Molecular Biology		5	4	3	25	75	100
2.		Core Course -9	Human Physiology		5	4	3	25	75	100
3.		Core Course -10	Plant Biochemistry & Plant Therapeutics		5	4	3	25	75	100
4.		Elective Paper 2	*		5	4	3	40	60	100
5.		Core Project			8	4	3	25	75	100
7.	Part IV	Professional Competency Skill			2	2	3	25	75	100
8.	Part V	Extension Activity				1				
Total					30	23				

*** Elective courses can be selected from the list given in the Enclosure**

7.Consolidated Semester wise and Component wise Credit distribution

Parts	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total Credits
Part I	3	3	3	3	-	-	12
Part II	3	3	3	3	-	-	12
Part III	11	11	11	11	22	20	84
Part IV	6	6	5	8	4	2	31
Part V	-	-	-	-	-	1	1
Total	23	23	22	25	24	23	140

***Part I, II, and Part III components will be separately taken into account for CGPA calculation and classification for the under graduate programme and the other components. IV, V have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the UG degree**

MethodsofEvaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall(K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/Comprehend(K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/ concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze(K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
Evaluate(K5)	Longer essay/Evaluation essay, Critique or justify with pros and cons	
Create(K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

8. Illustration for B.Sc Biochemistry Curriculum Design

First Year

Semester-I

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-I	Language -Tamil	3	6
Part-II	English	3	4
Part-III	Nutritional Biochemistry	3	4
	Chemistry I	3	4
	Core Practical I -Nutritional Biochemistry	3	3
	Allied Chemistry Practical –I	2	3
Part-IV	Skill Enhancement Course (Non Major Elective)	2	2
	Foundation Course FC Bridge course	2	2
	Ability Enhancement Compulsory Course(AECC 1) Soft Skill-1	2	2
	Chemistry Practical –I	23	30

Semester-II

Part	List of Courses	Credit	Hours per week(L/T/P)
Part-I	Language - Tamil	3	6
Part-II	English	3	4
Part-III	Cell Biology	3	4
	Allied Chemistry- II	3	4
	Core Practical II -Cell Biology	3	3
	Allied Chemistry Practical II	2	3
Part-IV	Data Analytic Skill	2	2
	Skill Enhancement Course (Discipline / Subject Specific) – Computational Mathematics	2	2
	Ability Enhancement Compulsory Course(AECC 2) Soft Skill-2	2	2
		23	30

Second Year :Semester-III

Part	List of Courses	Credit	Hours per week(L/T/P)
Part-I	Language -Tamil	3	6
Part-II	English	3	4
Part-III	Biomolecules	3	4
	Allied Paper III	3	3
	Core Practical III Biomolecules	3	3
	Allied Practical –III	2	3
Part-IV	Skill Enhancement Course-4 (Entrepreneurial Based)	1	2
	Skill Enhancement Course -SEC-5	2	2
	Ability Enhancement Compulsory Course(AECC 3) Soft Skill-3	2	2
	Environmental Studies	-	1
		22	30

Second Year :Semester-IV

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-I	Language - Tamil	3	6
Part-II	English	3	4
Part-III	Biochemical techniques	3	3
	Allied Paper IV	3	3
	Core Practical IV -Biochemical Techniques	3	3
	Allied Practical –IV	2	3
Part-IV	Skill Enhancement Course -6	2	2
	Skill Enhancement Course - 7	2	2
	Ability Enhancement Compulsory Course(AECC 4) Soft Skill-4	2	2
	Environmental Studies	2	2
		25	30

Third Year :Semester-V

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-III	Enzymes	4	6
	Intermediary Metabolism	4	6
	Clinical Biochemistry	4	5
	*Elective Paper 1	4	5
	Core Practical V -Clinical Biochemistry	4	6
Part-IV	Value Education	2	2
	Internship / Industrial Training (Summer vacation at the end of IV semester activity)	2	
		24	30

Third Year :Semester-VI

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-III	Molecular Biology	4	5
	Human Physiology	4	5
	Plant Biochemistry & Plant therapeutics	4	5
	*Elective paper 2	4	5
	Core Project	4	8
Part-IV	Professional Competency Skill	2	2
Part -V	Extension Activity	1	
		23	30

Total Credits : 140

**Remarks: English Soft Skill Two Hours Will be handled by English Teachers
(4+2 = 6 hours for English).**

9.Suggestive Topics in Core Component

- Nutritional Biochemistry
- Cell Biology
- Biomolecules
- Biochemical techniques
- Enzymes
- Intermediary metabolism
- Clinical Biochemistry
- Molecular Biology
- Human Physiology
- Plant Biochemistry and Plant therapeutics

10.Suggestive Topics in skill enhancement courses (NME))

Group I

- Medicinal Diet
- Lifestyle Diseases
- Health and Nutrition

11.Suggestive Elective Courses (Discipline-centric)

Group II

- Immunology
- Biochemical pharmacology
- Research methodology
- Bioentrepreneurship
- Bioinformatics
- Biotechnology

12.Suggestive Topics in Skill Enhancement Courses (SEC)

Group III –

- Biomedical Instrumentation
- First Aid
- Basics of forensic science
- Medical Laboratory technology
- Tissue culture
- Medical coding
- Microbial techniques

I YEAR :SEMESTER I

NUTRITIONAL BIOCHEMISTRY

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CI A	External	Total
	Core Paper1- Nutritional Biochemistry	Core	2	1	0	0	3	4	25	75	100

Learning Objectives

The objectives of this course are to

- Create awareness about the role of nutrients in maintaining proper health
- Understand the nutritional significance of carbohydrates, lipids and proteins.
- Understand the importance of a balanced diet.
- Study the effect of additives, emulsifiers, flavour enhancing substances in food.
- Study the significance of nutraceuticals.

Module I : Concepts of food and nutrition. Basic food groups-energy yielding, body building and functional foods.Modules of energy.Calorific and nutritive value of foods.Measurement of Calories by bomb calorimeter. Basal metabolic rate (BMR)- definition, determination of BMR and factors affecting BMR. Respiratory quotient (RQ) of nutrients and factors affecting the RQ. SDA-definition and determination- Anthropometric measurement and indices – Height,Weight, chest and waist circumference BMI.
12 Hrs

Module II: Physiological role and nutritional significance of carbohydrates, lipids and protein. Evaluation of proteins by nitrogen balance method- Biological value of proteins- Digestibility coefficient, , Protein Energy Ratio and Net Protein Utilization. Protein energy malnutrition – Kwashiorkar and Marasmus, Obesity-Types and preventive measures.12 Hrs

Module III : Balanced diet, example of low and high cost balanced diet- for infants, children, adolescents, adults and elderly people. ICMR classification of five food groups and its significance food pyramid. Junk foods- definition and its adverse effects .12 Hrs

Module IV : Food additives: Structure, chemistry, function and application of preservatives, emulsifying agents, buffering agents, stabilizing agents, natural and artificial sweeteners, bleaching, starch modifiers, antimicrobials, food emulsions, fat replacers, viscosity agents,

gelling agents and maturing agents. Food colors, flavors, anti-caking agent, antioxidants. Safety assessment of food additives. 12 Hrs

Module V : Nutraceuticals and Functional Foods: Definition, properties and function of Nutraceuticals, food Supplements, dietary supplements prebiotics and probiotics, and functional Foods. Food as medicine. Natural pigments from plants– carotenoids, anthocyanins and its benefits. 12 Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Cognizance of basic food groups viz. Carbohydrates, proteins and lipids and their nutritional aspects as well as calorific value	PO1,PO5
CO2	Identify and explain nutrients in foods and the specific functions in maintaining health.	PO1
CO3	Classify the food groups and its significance	PO1,PO2
CO4	Understand the effect of food additives	PO1,PO2
CO5	Describe the importance of nutraceuticals and pigments	PO1,PO5,PO6

Text books

1. Gaile Moe, Danita Kelley, Jacqueline Berning and Carol Byrd-Bredbenner. 2013. Wardlaw's Perspectives in Nutrition: A Functional Approach. McGraw-Hill, Inc., NY, USA.
2. M. Swaminadhan (1995) Principles of Nutrition and Dietetics. Bappco.
3. Tom Brody (1998). Nutritional Biochemistry (2nd ed), Academic press, USA
4. Garrow, JS, James WPT and Ralph A (2000). Human nutrition and dietetics (10th ed) Churchill Livingstone.
5. Andreas M. Papas (1998). Antioxidant Status, Diet, Nutrition, and Health (1st ed) CRC

Reference Books

1. Branen, A.L., Davidson PM & Salminen S. 2001. Food Additives. 2nd Ed. Marcel Dekker.
2. George, A.B. 1996. Encyclopedia of Food and Color Additives. Vol. III. CRC Press.
3. Advances in food biochemistry, Fatih Yildiz (Editor), CRC Press, Boca Raton, USA, 2010
4. Food biochemistry & food processing, Y.H. Hui (Editor), Blackwell Publishing, Oxford, UK, 2006.
5. Geoffrey Campbell-Platt. 2009. Food Science and Technology. Wiley-Blackwell, UK.

Web resources

<http://old.noise.ac.in/SecHmscicour/english/LESSON O3.pdf>

<https://study.com/academy/lesson/energy-yielding-nutrients-carbohydratesfat-protein.html>.

<https://www.nhsinform.scot/healthy-living/food-and-nutrition/eatingwell/vitamins-and-minerals>

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3				2		3	3	3	3
CO 2	3						3	3		3
CO 3	3	2					3	1		3
CO 4	3	2					3	3		3
CO5	3				2	2	3	3		3

S-Strong(3) M-Medium (2) L-Low (1)

I YEAR :SEMESTER I

PRACTICAL I -NUTRITIONAL BIOCHEMISTRY

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CI A	External	Total
	Core paper 2 Practical 1- Nutritional Biochemistry	Core	0	0	3	0	3	3	25	75	100

Learning objectives

The objectives of this course are to

- Impart hands-on training in the estimation of various constituents by titrimetric method
- Prepare Biochemical preparations
- Determine the ash content and extraction of lipid

TITRIMETRY 20hrs

1. Estimation of ascorbic acid in a citrus fruit.
2. Estimation of calcium in milk .
3. Estimation of glucose by Benedict's method in honey.
4. Estimation of phosphorous (Plant source)

BIOCHEMICAL PREPARATIONS 15 Hrs

Preparation of the following substances and its qualitative tests

5. Lecithin from egg yolk.
6. Starch from potato.
7. Casein and Lactalbumin from milk.

GROUP EXPERIMENT 10Hrs

8. Determination of ash content and moisture content in food sample
9. Extraction of lipid by Soxhlet's method.

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Estimate the important biochemical constituents in the food samples.	PO1,PO3
CO2	Prepare the macronutrients from the rich sources.	PO1,PO3
CO3	Determine the ash and moisture content of the food samples	PO1,PO3
CO4	Extract oil from its sources	PO1,PO3,PO6

Text books

1. Laboratory manual in Biochemistry, J. Jayaraman, 2nd edition, NewAge International Publishers, 2011,
2. An Introduction to Practical Biochemistry, David T. Plummer, 3 rd edition, Tata McGraw-Hill Publishing Company Limited, 2001.

Reference books

1. Biochemical Methods, Sadasivam S and Manickam A, 4h edition, NewAge International Publishers, 2016
2. Essentials of Food and Nutrition, Vol. I & II, M.S. Swaminathan.
3. Bowman and Robert M. 2006. Present Knowledge in Nutrition. 9th edition, International Life Sciences Publishers.

4. Indrani TK. 2003. Nursing Manual of Nutrition and Therapeutic Diet, 1st edition Jaypee Brothers medical publishers.

5. Martha H. and Marie A. 2012. Biochemical, Physiological, and Molecular Aspects of Human Nutrition. 3rd edition. Chand Publishers.

Web resources

1. <https://www.elsevier.com/journals/clinical-biochemistry/0009-9120/guide-for-authors>

2. <http://rajswasthya.nic.in/RHSDP%20Training%20Modules/Lab.%20Tech/Biochemistry/Dr.%20Jagarti%20Jha/Techniques%20In%20Biochemistry%20Lab.pdf>

3. https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical_biochemistrypdf.pdf?sequence=1&isAllowed=y

4. https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical_biochemistrypdf.pdf?sequence=1&isAllowed=y

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3		3				3	3	3	3
CO 2	3		3				3	3	3	3
CO 3	3		3				3	3	3	3
CO 4	3		3			3	3	3	3	3

S-Strong(3) M-Medium (2) L-Low (1)

ALLIED CHEMISTRY (2023-2024 onwards)

(for UG Biochemistry–IYear / I Semester)

Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	External	Total
ALLIED COURSE I- ORGANIC, INORGANIC AND PHYSICAL CHEMISTRY – I	Core	2	1	-	-	3	4	25	75	100

COURSE OUTCOME

On completion of the course, the students will be able to

- know the theories of Chemical bonding, Fuel gases, hybridisation, antibiotics and principles of volumetric analysis.
- recognize the bonding and antibonding orbitals, Silicones, Polar effect, structure of drugs and uses.
- explain the nuclear reactions, manufacture of fuel gas, hyperconjugation, artificial sweeteners, distillation and crystallisation.
- understand the nuclear fission and fusion reactions, fertilizers, geometry of the molecules, and chromatography.
- identify the applications of radioactive isotopes, NPK fertilizers, types of reactions, organic halogen compounds, and the types of chromatography.

UNIT I

Chemical Bonding and Nuclear Chemistry

Chemical Bonding: Molecular Orbital Theory- bonding, anti bonding and non-bonding orbitals. Molecular diagrams for Hydrogen, Helium, Nitrogen; discussion of bond order and magnetic properties.

Nuclear Chemistry: Fundamental particles- Isotopes, Isobars, Isotones and Isomers-

Differences between chemical reactions and nuclear reactions- group displacement law. Nuclear binding energy - mass defect calculations. Nuclear fission and nuclear fusion- differences- Stellar energy. Applications of radioisotopes- carbon dating, rock dating and medicinal applications.

(12 Hours)

Unit II

Industrial Chemistry

Fuels: Fuel gases: Natural gas, water gas, semi water gas, carbureted water gas, producer gas, CNG, LPG and oil gas (manufacturing details not required).

Silicones: Synthesis, properties and uses of silicones.

Fertilizers: Urea, ammonium sulphate, potassium nitrate NPK fertilizer, superphosphate, triple superphosphate. **(12 Hours)**

UNIT III

Fundamental Concepts in Organic Chemistry

Hybridization: Orbital overlap hybridization and geometry of CH_4 , C_2H_4 , C_2H_2 and C_6H_6 .

Polar effects: Inductive effect and consequences on K_a and K_b of organic acids and bases, electromeric, mesomeric, hyper conjugation and steric-examples and explanation

Reaction mechanisms: Types of reactions- aromaticity- aromatic electrophilic substitution; nitration, halogenation, Friedel-Craft's alkylation and acylation Heterocyclic compounds:

Preparation, properties of pyrrole and pyridine.

(12 Hours)

UNIT IV

Drugs and Speciality Chemicals

Definition, structure and uses: Antibiotics viz., Penicillin, Chloramphenicol and Streptomycin; Anaesthetics viz., Chloroform and ether; Antipyretics viz., Aspirin, paracetamol and ibuprofen; Artificial Sweeteners viz., saccharin, Aspartame and cyclamate; Organic Halogen compounds viz., Freon, Teflon.

(12 Hours)

UNIT V:

Analytical Chemistry

Introduction qualitative and quantitative analysis. Principles of volumetric analysis.

Separation and purification techniques: extraction, distillation and crystallization.

Chromatography: principle and application of column, paper and thin layer chromatography.

(12 Hours)

Recommended Text

1. V.Veeraiyan, Textbook of Ancillary Chemistry; Highm ountpublishinghouse, Chennai, first edition, 2009.
2. S.Vaithyanathan, Textbook of Ancillary Chemistry; Priya Publications, Karur, 2006.
3. ArunBahl, B.S.Bahl, Advanced Organic Chemistry; S.Chand and Company, NewDelhi, twenty third edition, 2012.
4. P.L.Soni, H.M.Chawla, TextBookofInorganicChemistry; SultanChand&sons, NewD elhi, twentyninthedition, 2007.

Reference Books

1. P.L.Soni, Mohan Katyal, Text book of Inorganic chemistry; Sultan Chand and Company, NewDelhi , twentieth edition, 2007.
2. B.K, Sharma, Industrial Chemistry; GOEL publishinghouse, Meerut, sixteenth edition, 2014.
3. Jayashree gosh, Fundamental Concepts of Applied Chemistry; Sultan&Chand, Edition 2006.

ALLIED CHEMISTRY PRACTICAL (2023-2024 onwards)

(for UG Biochemistry–IYear / I Semester)

Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	External	Total
VOLUMETRIC ANALYSIS	Allied practical	-	-	3	-	3	3	40	60	100

COURSE OUTCOME

On completion of the course, the students will be able to

- CO1** : understand the use of Standard flask, pipette and burette
- CO2** : carry out the reactions and find out the values in titrations.
- CO3** : interpret the results of Volumetric titrations.
- CO4** : apply their skill in the analysis of hardness using EDTA
- CO5** : identify the Chemical constituents in allied chemical products.

VOLUMETRIC ANALYSIS

1. Estimation of sodium hydroxide using standard sodium carbonate.
2. Estimation of hydrochloric acid using standard oxalic acid.
3. Estimation of ferrous sulphate using standard Mohr's salt.
4. Estimation of oxalic acid using standard ferrous sulphate.
5. Estimation of potassium permanganate using standard sodium hydroxide.
6. Estimation of magnesium using EDTA. (Demonstration only)

Reference Books

V.Venkateswaran,R.Veerassamy,A.R.Kulandaivelu, Basic Principles of Practical Chemistry; Sultan Chand&sons, Second edition,1997.

FIRST YEAR :SEMESTER II

CELL BIOLOGY

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Core paper 3: Cell Biology	Core	2	1	-	-	3	4	25	75	100

Learning Objectives

The main objectives of this course are to

- Provide basic understanding of architecture of cells and its organelles.
- Understand the organization of prokaryotic and eukaryotic genome.
- Educate on the structural organization of bio membrane and transport mechanism
- Impart knowledge on cell cycle, cell division and basics of cells
- Familiarize the concept of mechanism of cell-cell interactions.

Module I: Architecture of cells- Structural organization of prokaryotic and eukaryotic cells microbial, plant and animal cells. The ultra structure of nucleus, mitochondria, RER, SER, golgi apparatus, lyso some, peroxi some and their functions 12 Hrs

Module II: Cytoskeleton- microfilament, microtubules and intermediary filament- structure, composition and functions. Organization of Genome -prokaryotic, and eukaryotic genome. Organization of chromatin – histones, nucleosomeconcept, formation of chromatin structure.Special types of chromosomes – lamp brush chromosomes, polytene chromosomes. 12 Hrs

Module III:Biomembranes-Structuralorganizationofbilipidlayermodelandbasicfunctions-transport across cell membranes- uniport, symport and antiport. Passive and active transport.12Hrs

Module IV: Cellcycle-DefinitionandPhasesofCellcycle-Celldivision-MitosisandMeiosis and its significance, Cancer cells- definition, types andcharacteristics of cancer cells. 12 Hrs

Module V: Extracellular matrix – Collagen, laminin, fibronectin and proteoglycans-structure and biological role. Structure and role of cadherin, selectins, integrins, Cell-cell interactions- Types-gap junctions, tight junctions and Desmosomes 12 Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Explain the structure and functions of basic components of prokaryotic and eukaryotic cells, especially the organelles.	PO1
CO2	Familiarize the cytoskeleton and chromatin	PO1,PO2
CO3	Illustrate the structure, composition and functions of cell membrane related to membrane transport	PO1,PO2
CO4	Elaborate the phases of cell cycle and cell division-mitosis and meiosis and characteristics of cancer cells.	PO1, PO2
CO5	Relate the structure and biological role of extra cellular matrix in cellular interactions	PO1,PO2

Text books

- 1.Arumugam.N,Cellbiology.Saraspublication(10ed, paperback), 2019
2. Devasena.T.CellBiology.OxfordUniversityPressIndia-ISBN:9780198075516, 0198075510, 2012
- 3.Bruce Alberts and Dennis Bray. 2013, Essential Cell Biology. (4thed). Garland Science.

Reference books

1. S.C,R.CellBiology.NewagePublishers -ISBN-10: 8122416888/ISBN-13: 978-8122416886, 2008
- 2.Cooper,G.A.TheCell:AMolecularApproach.SinauerAssociates,Inc -ISBN10: 0878931066 / ISBN 13: 9780878931064, 2013
- 3...E.M.F.,D.R,CellandMolecularBiology.LippincottWilliams&WilkinsPhiladelphia - ISBN: 0781734932 9780781734936, 2006
4. LodishH.A ,Berk C.A, Kaiser M, Krieger M.P, Scott A, Bretscher H, Ploegh and Matsudaira. 2007. Molecular Cell Biology, 6th Edition, WH. Freeman Publishers, New York, USA.

Web resources

- <https://nicholls.edu/biol-ds/bio1155/Lectures/Cell%20Biology.pdf>
- <https://www.medicalnewstoday.com/article/320878.php>

<https://biologydictionary.net/cell>

Mapping with Program Outcome

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3			3
CO 2	3	3					3			3
CO 3	3	3					3			3
CO 4	3	3					3	3		3
CO5	3	3					3			3

S-Strong(3) M-Medium (2) L-Low (1)

FIRST YEAR : SEMESTER II
PRACTICAL II CELL BIOLOGY

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Core paper 4 practical II: Cell Biology	Core practical	-	-	3	-	3	3	40	60	100

Learning Objectives

The main objectives of this course are to

- Learn the parts of microscope
- Investigate the cell under microscope.
- Image the cells using different stains
- Identify the cells, organelles and stages of cell division
- Identify the spotters

I MICROSCOPY AND STAINING TECHNIQUES

1. Study the parts of light and compound microscope
2. Preparation of Slides and Micrometry
3. Examination of prokaryotic and eukaryotic cell
4. Visualization of animal and plant cell by ethylene blue
5. Visualization of nuclear fraction by ace to carmine stain
6. Staining and visualization of mitochondria by Janus green stain

II GROUP EXPERIMENT

7. Identification of different stages of mitosis in onion root tip
8. Identification of different stages of meiosis in onion bulb

III SPOTTERS

9. a) **Cells:** Nerve, plant and Animal cell
- b) **Organelles:** Mitochondria, Chloroplast, Endoplasmic reticulum,
- c) **Mitosis stages**—Prophase, Anaphase, Metaphase, Telophase

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Identify the parts of microscope.	PO1,PO2
CO2	Preparation of Slides	PO1,PO2
CO3	Identify The stages of mitosis & meiosis	PO1,PO2
CO4	Visualize nucleus and mitochondria by staining methods	PO1,PO2
CO5	Identify the spotters of cells, organelles and stages of cell division	PO1,PO2

Text books

1. Rickwood, D and J.R. Harris cell Biology: Essential Techniques, John Wiley 1996.
2. Davis, J.M. Basic Cell culture: A practical approach, IRL 1994.
3. Ganesh M.K. and Shivashankara A.R. 2012. Laboratory Manual for Practical Biochemistry Jaypee publications, 2nd Edn.

Reference books

- 1) Essential practical handbook of Cell biology ,Genetics and Microbiology -A Practical manual- Debarati Das Academic publishers, ISBN, 9789383420599, 1st Edition 2017
- 2) Cell biology Practical, Dr. Venugupta ISBN 8193651219, Prestige publisher, 1st Jan 2018.
- 3) Cell and Molecular biology, De Robertis, 8th edition, 1st June, 1987

Web resources

1. <http://amrita.olabs.edu.in/?sub=79&brch=18&sim=237&cnt=1>
2. <https://www.microscopemaster.com/organelles.html>
3. <https://www.pdfdrive.com/biochemistry-books.htm>
4. http://medcell.med.yale.edu/histology/cell_lab.php#:~:text=The%20electron%20microscope%20is%20necessary,and%20small%20granules%20and%20vesicles.
5. <http://amrita.olabs.edu.in/?sub=79&brch=18&sim=237&cnt=1>
6. <https://www.khanacademy.org/science/ap-biology/heredity/meiosis-and-genetic-diversity/a/phases-of-meiosis>
7. <https://www.microscopemaster.com/organelles.html>
8. <https://www.pdfdrive.com/biochemistry-books.html>

Mapping with Program Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2	3					3	3	3	3
CO 2	2	3					3	3	3	3
CO 3	2	3					3	3	3	3
CO 4	2	3					3	3	3	3

S-Strong(3) M-Medium (2) L-Low (1)

ALLIED CHEMISTRY

(2023-2024 onwards)

(for UG Biochemistry–IYear / II Semester)

Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	External	Total
ALLIED COURSE II- ORGANIC, INORGANIC AND PHYSICAL CHEMISTRY – II	Core	2	1	-	-	3	4	25	75	100

COURSE OUTCOME

On completion of the course, the students will be able to

- know about the basic concepts in organic, inorganic and physical chemistry
- understand the chemical constituent in oils, fats, soaps, detergents,
- biomolecules, colloids and pollutants
- identify the methods of preparation for organic and inorganic compounds, sources, effects and control measures of pollutions, methods for removal of salt from water
- comprehend the classification of biomolecules, colloids, catalyst, pollutions, application of adsorption and biomolecule
- analyze the oils, fats and biomolecules functions, sources of pollutions,
- characteristics of catalysts and the effects with control measures for various pollution

UNIT I

1. Oils and Fats – Definition – Properties - Distinction between them -Hydrogenation, Hydrogenolysis, Rancidification and Drying of oils – Preparation of Vanaspathi- Analysis of oils and Fats – Saponification and iodine number.

2. Soaps and Detergents

Soap – Definition – Different types – Manufacture of soap – Kettle process - Detergent – Definition – Synthetic detergents – examples – Distinction between soaps and detergents.

(12Hours)

UNIT II

1. Carbohydrates – classification – Differences between glucose and fructose – Inter conversion of glucose and fructose – Haworth structure of glucose and fructose- Differences between starch and cellulose – Derivatives of cellulose and their uses.

2. Amino acids – classification – preparation of α -amino acids– properties – Zwitterion – isoelectric point .

3. Proteins – classification – Biological function – colour reaction of proteins.

4. Nucleic acids – RNA and DNA – Biological functions (Elementary idea only).

(12Hours)

UNIT III

1. Colloids – Definition and classification.

2. Sols – Different types – examples –Dialysis – electro osmosis – electrophoresis – stability of colloids- Gold number.

3. Emulsion – Types of emulsion – Emulsifier – Examples – Cleansing action of soap.

4. Gels – Types of gels – examples – Properties – Hydration – Swelling – syneresis – Thixotropy.

5. Applications of colloids.

(12Hours)

UNIT IV

1. Adsorption – Characteristics – Types of adsorption and comparison – Factors influencing adsorption – Langmuir and Freundlich adsorption isotherm (No derivation) – Applications of adsorption.

2. Catalysts – Characteristics- Different types with examples – Catalytic poisoning – promoters
with examples. (12 Hours)

UNIT V

1. Air pollution – Definition – sources of air pollution –classification and effects of air pollutants – Ozone layer- formation and depletion – Green house effect – Acid rain – Preventive measures of air pollution.

2. Water pollution –types and sources of water pollution –classification and effects of water pollutants-control of water pollution-Desalination of sea water by electrodialysis and reverse osmosis.

3. Radioactive pollution – sources – nuclear waste disposal – Effects of radiations.

(12 Hours)

TEXT BOOKS

1. Soni P.L.,(2008).*Text book of Organic Chemistry*, Latest Edition.Sultan Chand & Sons.
2. Soni P.L.,(2008).*Text book of Inorganic Chemistry*, Latest Edition. Sultan Chand & Sons.
3. Arun Bahl, Bahl B.S &.Tuli G.D, (2009) *Essentials of Physical chemistry*, S.Chand & Company Ltd., New Delhi.

REFERENCE BOOKS

1. Jain, M.K. & Sharma, S.C. (2016). *Modern Organic Chemistry*, ^{1st} Edition. New Delhi: Vishal Publishing Co.
2. Madan .R.D, *Modern Inorganic Chemistry*, S.Chand & Company Ltd.

ALLIED CHEMISTRY PRACTICAL- II (2023-2024 onwards)

(for UG Biochemistry–IYear / II Semester)

Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	External	Total
VOLUMETRIC ANALYSIS- II	Allied practical-2	-	-	3	-	3	3	40	60	100

COURSE OUTCOME

On completion of the course, the students will be able to

- remember the functional group of Organic Compounds.
- carry out the reactions and find out the elements of Organic compounds.
- determine the functional group and distinguish the aliphatic and aromatic compounds.
- apply the skill in the analysis of functional group of Organic compounds.
- identify the chemical constituents of Organic compounds.

SYSTEMATIC ANALYSIS OF ORGANIC COMPOUNDS

The analysis must be carried out as follows:

- Functional group tests [phenol, acids (mono & di), aromatic primary amine, amides (mono & di), ester, aldehyde and glucose].
- Detection of elements (N, S, Halogens).
- To distinguish between aliphatic and aromatic compounds.
- To distinguish – Saturated and unsaturated compounds. **(30 Hours)**

Reference Book

1.V.Venkateswaran,R.Veerasingam,A.R.Kulandaivelu,Basic Principles of Practical Chemistry;SultanChand&sons,Second edition,1997.

SECOND YEAR :SEMESTER III BIOMOLECULES

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Core paper 5: Biomolecules	Core	2	1	-	-	3	4	25	75	100

Learning objectives

The main objectives of this course are to:

- Introduce the structure, properties and biological significance of carbohydrates
- Comprehend the classification, functions and acid base properties of amino acids
- Elucidate the various levels of organization of Proteins.
- Impart knowledge on the classification, properties and characterization of lipids.
- Acquaint with the classification, structure, properties and functions of nucleic acids

Module I:Carbohydrates-Classification and biological significance, physical properties - stereo isomerism, optical isomerism, anomers,epimers and mutarotation. Monosaccharides: Occurrence, linear and cyclic structure, Reactions of monosaccharides due to the presence of hydroxyl, aldehyde and keto groups. Disaccharides: Structure and properties of reducing disaccharides (lactose and mannose), non-reducing disaccharide(sucrose).Polysaccharides: Homopolysaccharides - Occurrence, structure and biological significance of starch, glycogen and cellulose. Heteropolysaccharides - Structure and biological significance of mucopolysaccharides - hyaluronic acid, chondroitin sulphate and heparin. (structural elucidation not needed).12 hrs

Module II :Amino acids -Classification based on composition of side chain and nutritional significance. General structure of amino acids. 3 - and 1- letter abbreviations. Modified amino acids in protein non - protein amino acids. Physical properties of amino acids, isoelectric point, titration curve (alanine, lysine, glutamic acid), optical activity. Chemical reactions due to carboxyl group, amino group and side chains. Colour reactions of amino

acids. 12Hrs

Module III :Proteins-Classification based on shape, composition, solubility and functions. Properties of proteins - Ampholytes, isoelectric point, salting in and salting out, denaturation and renaturation, UV absorption. Levels of Organization of protein structure- Primary structure, Formation and characteristics of peptide bond, phi and psi angle, Secondary structure- α helix (egg albumin), β -pleated sheet (keratin), triple helix (collagen). Tertiary structure – with reference to myoglobin. Quaternary structure with reference to haemoglobin. 12 Hrs

Module IV :Lipids- Lipids: Bloor's classification, chemical nature and biological functions. Fatty acids: classification, nomenclature, structure and properties of fatty acids. Simple and mixed triglycerides: structure and general properties, Characterization of fats- iodine value, saponification value, acid number, acetyl number, polensky number, Reichert –Meissl number along with their significance. Compound lipids- Structure and functions of phospholipids and glycolipids. Derived lipids- Structure and functions of cholesterol, bile acids and bile salts. 12Hrs

Module V :Nucleic acids-Structure of purine and pyrimidine bases, nucleosides and nucleotides and their biological importance. Types of DNA: A, B, C, Z DNA, structure and biological significance, superhelicity. Types of RNA: mRNA, tRNA, rRNA, hnRNA, snRNA, Secondary and tertiary structure of tRNA. Properties of DNA-Hypochromic and hyperchromic effect, melting temperature, viscosity. Denaturation and annealing. 12Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Classify, illustrate the structure and explain the physical and chemical properties of carbohydrates.	PO1
CO2	Indicate the classification, structure, properties and biological functions of amino acids.	PO1
CO3	Explain the classification and elucidate the different levels of structural organization of proteins.	PO1
CO4	Elaborate on classification, structure, properties, functions and characterization of lipids	PO1, PO4

CO5	Describe the structure, properties and functions of different types of nucleic acids	PO1
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Textbooks

1. Biochemistry, U. Sathyanarayana & U. Chakrapani, 2013, 5th edition Elsevier India Pvt. Ltd., Books & Allied Pvt. Ltd.
2. Fundamentals of Biochemistry, J.L. Jain, Sunjay Jain, Nitin Jain, 2013, 7th edition S. Chand & Company Ltd.
3. Textbook of Medical Biochemistry, MN Chatterjea, Rana Shinde, 2002, 8th edition, Jaypee Brothers.

Reference books

1. David L. Nelson, Michael M. Cox, 2005, Principles of Biochemistry, 4th edition W. H. Freeman and Company.
2. Voet D., Voet J. G. and Pratt, C. W, 2004, Principles of Biochemistry, 4th edition John Wiley & Sons, Inc.
3. Zubay G. L., *et al.*, 1995, Principles of Biochemistry, 1st edition, Wm C. Brown Publishers.

Web resources

<https://www.britannica.com/science/biomolecule> <https://en.wikipedia.org/wiki/Biomolecule> <https://www.khanacademy.org/science/biology/macromolecules>

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3			3
CO 2	3						3			3
CO 3	3						3			3
CO 4	3			2			3	2		3
CO5	3						3			3

S-Strong(3) M-Medium (2) L-Low

SECOND YEAR :SEMESTER III
PRACTICAL III BIOMOLECULES

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Core Paper-6 practical III Biomolecules	Core Practical	-	-	3	-	3	3	40	60	100

Learning Objectives

The main objectives of this course are to

- Identify the bio molecules carbohydrates and amino acids by qualitative test
- Determine the quality of Lipids by titrimetric methods
- Isolate nucleic acids from plant and animal source

I) Qualitative test for 15 Hrs

1) Carbohydrates

a) Glucose b) Fructose c) Arabinose d) Maltose e) Sucrose f) Lactose g) Starch

2) Amino acids

a) Arginine b) Cysteine c) Histidine d) Proline e) Tryptophan f) Tyrosine g) Methionine

II Titrimetric methods 15 Hrs

1) Determination of Saponification value of an edible oil

2) Determination of Iodine number of an edible oil

3) Determination of Acid number of an edible oil

III. Group Experiments 15 hrs

1) Isolation of DNA from plant/animal source.

2) Isolation of RNA from rich source.

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Qualitatively analyze the carbohydrates and report the type of carbohydrate based on specific tests	PO1, PO2, PO3
CO2	Qualitatively analyze amino acids and report the type of amino acids based on specific tests	PO1, PO2, PO3
CO3	Determine the Saponification, Iodine and acid number of edible oil	PO1, PO3, PO4

CO4	Isolate the nucleic acid from biological sources	PO1,PO3
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Text books

1. David T Plummer, An Introduction to Practical Biochemistry, 3rd edition, Tata McGraw-Hill Edition
2. J. Jayaraman Laboratory Manual in Biochemistry New Age International (P) Limited Fifth edition 2015
3. S. Sadasivam A. Manickam Biochemical Methods New age International Pvt Ltd publisher's third edition 2018

Reference books

1. Rageeb, Kiran Patil, M. Bakshi Rahman, Sufiyan Ahmad Raees A Practical book on Biochemistry Everest publishing house 1st Edition, 2019
2. Introductory practical Biochemistry – S.K. Sawhney, Randhir Singh, 2nd ed, 2005.
3. Biochemical Tests – Principles and Protocols. Anil Kumar, Sarika Garg and Neha Garg. Vinod Vasishtha Viva Books Pvt Ltd, 2012.
4. Harold Varley, Practical Clinical Biochemistry, CBS. 6 edition, 2006.
5. Keith Wilson and John Walker. Principles and Techniques of Practical Biochemistry, 4th edition, Cambridge University press, Britain. 1995.

Web resources

1. <https://www.pdfdrive.com/instant-notes-analytical-chemistry-e912659.html> 14
2. <https://www.pdfdrive.com/analytical-biochemistry-e46164604.html>
3. <https://www.pdfdrive.com/biochemistry-books.html>

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2	3	3				3	3	3	3
3CO 2	2	3	3				3	3	3	3
CO 3	2		3	2			3	3	3	3
CO 4	2		3				3	3	3	3

S-Strong(3) M-Medium (2) L-Low (1)

SECOND YEAR : SEMESTER IV

BIOCHEMICAL TECHNIQUES

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Core Paper 7 Biochemical techniques	Core	2	1	-	-	3	3	25	75	100

Learning objectives

The objectives of this course are to

- Introduce the basic principles, types and applications of various sedimentation technique.
- Provide an understanding of the underlying principles of chromatographic techniques
- Demonstrate experimental skills in various electrophoretic techniques.
- Appraise the use of colorimetric and spectroscopic techniques in biology
- Impart knowledge about the measurement of radioactivity and safety aspects of radioactive isotopes.

Module I : Centrifugation - Basic principles, RCF, Sedimentation coefficient, Svedberg constant. Types of rotors. Preparative centrifugation- differential and density gradient centrifugation, Ratezonal and Isopycnic techniques, construction, working and applications of analytical ultracentrifuge-Determination of molecular weight (Derivation excluded) 9 Hrs

Module II: Chromatography - adsorption, partition. Principle, instrumentation and applications of paper chromatography, thin layer chromatography, ion-exchange chromatography, gel permeation chromatography and affinity chromatography. 9 Hrs

Module III : Electrophoresis - General principles, factors affecting electrophoretic mobility. Tiselius moving boundary electrophoresis. Electrophoresis with paper and starch. Principle, instrumentation and applications of agarose gel electrophoresis and SDS-PAGE. 9 Hrs

Module IV: Basics of Electromagnetic radiations- Energy, wavelength, wave number and frequency. Absorption and emission spectra, Lambert – Beer Law, Light absorption and transmittance. Colorimetry-Principle, instrumentation and applications. Visible and UV spectro photometry – Principle, instrumentation and applications -enzyme assay, structural studies of proteins and nucleic acids. 9 hrs

Module V: Radioactivity - Types of Radioactive decay, half-life, units of radioactivity, Detection and measurement of radioactivity - Methods based upon ionization -Geiger MullerCounter. Methods based upon excitation - Solid & Liquid scintillation counters. Autoradiography. Biological applications and safety aspects of radioisotopes. 9 Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Describe types of rotors and identify the centrifugation technique for the separation of biomolecules.	PO1, PO2, PO6
CO2	Demonstrate the principles, operation and procedure and applications of planar and column chromatography.	PO1, PO2, PO6
CO3	Specify the factors and explain the separation of DNA and protein using electrophoretic technique.	PO1, PO2, PO6
CO4	State Beer's Law and illustrate the instrumentation and uses of colorimeter and spectrophotometer.	PO1, PO2, PO6
CO5	Enumerate various methods of measurement of radio activity and safety aspects of radioactive isotopes.	PO1, PO2, PO6

Textbooks

1. Avinash Upadhyay, Kakoli Upadhyay & Nirmalendu Nath, 2002, Biophysical Chemistry, Principles and Techniques, 3rd edition, Himalaya Publishing House.
2. L. Veerakumari, 2009, Bioinstrumentation, 1st edition, MJ Publishers.
3. Keith Wilson & John Walker, 2000, Practical Biochemistry-Principles and techniques, Cambridge University Press, 4th edition.

Reference books

1. Terrance G. Cooper The tools of Biochemistry, 1977, John Wiley & Sons, Singapore.
2. Gurumani, Research Methodology for Biological Sciences, 2011, 1st edition, MJ Publishers.
3. Saroj Dua, Neera Garg, Biochemical Methods of Analysis, 2010, 1st edition, Narosa Publishing house.

Web Resources

1. <https://www.britannica.com/science/chromatography>

2.<https://www.youtube.com/watch?v=xgxFBQZYXIE>

3.<https://www.youtube.com/watch?v=7onjVBsQwQ8>

Mapping with Program Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2	3				2	3	3	3	3
CO 2	2	3				2	3	3	3	3
CO 3	2	3				2	3	3	3	3
CO 4	2	3				2	3	3	3	3
CO 5	2	3				2	3	3	3	3

S-Strong(3) M-Medium (2) L-Low (1)

SECOND YEAR :SEMESTER IV

PRACTICAL IV BIOCHEMICAL TECHNIQUES

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
	Core paper 8-PracticalIV-Biochemical techniques	Core Practical	-	-	3	-	3	3	40	60	100

Learning objectives

The objectives of this course are to:

- Acquaint the students with colorimetric estimations of biomolecules.
- Equip skills on various separation techniques.
- Impart knowledge about the estimation of minerals and vitamins.

I Colorimetry

1. Estimation of amino acid by Ninhydrin method.
2. Estimation of protein by Biuret method.
3. Estimation of DNA by Diphenylamine method.
4. Estimation of RNA by Orcinol method.
5. Estimation of Phosphorus by Fiske and Subbarow method.

II Chromatography

1. Separation and identification of sugars and amino acids by paper chromatography.
2. Separation and identification of amino acids and lipids by thin layer chromatography.

III Demonstration

1. Separation of serum and plasma from blood by centrifugation.
2. Separation of serum proteins by SDS-PAGE.

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Estimate the amount of bio molecules by Colorimetric method.	PO1,PO3,PO6
CO2	Quantify the amount of minerals by Colorimetric method	PO1,PO3,PO6
CO3	Separate and identify sugars, lipids and amino acids by chromatography	PO1,PO3
CO4	Operate centrifuge for the separation of serum and plasma	PO1,PO3,PO6
CO5	Demonstrate the separation of proteins electro phoretically	PO1,PO3,PO6

Text books

1. J. Jayaraman, Laboratory Manual in Biochemistry New Age International (P) Limited Fifth edition 2015.
2. S.SadasivamA.ManickamBiochemicalMethodsNewageInternationalPvtLtdpublisher s third edition 2018.
3. KeithWilsonandJohnWalkerPrinciplesandtechniquesofPracticalBiochemistryCambridge University Press2010, Seventh edition.

Reference books

1. S. K. Sawhney andRandhir Singh, Introductory Practical Biochemistry. Alpha Science International, Ltd 2nd edition, 2005.
- 2.David T. Plummer, 2001, An Introduction to Practical Biochemistry, 3rd edition, Tata McGraw- Hill publishing company limited.
3. Varley's Practical Clinical Biochemistry by Alan H Gowenlock, published by CBS Publishers and distributors, India Sixth Edition,1988.

Web resources

<https://www.pdfdrive.com/biochemistry-books.html>

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2		3			2	3	3	3	3
CO 2	2		3			2	3	3	3	3
CO 3	2		3				3	3	3	3
CO 4	2		3			2	3	3	3	3
CO 5	2		3			2	3	3	3	3

S-Strong(3) M-Medium (2) L-Low (1)

THIRD YEAR: SEMESTER V

ENZYMES

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Core paper 9 Enzymes	Core	3	1	-	-	4	5	25	75	100

Learning objectives

The main objectives of this course are to

- Provide fundamental knowledge on enzymes and their properties.
- Understand the mechanism of action of enzymes and the role of coenzymes in catalysis.
- Introduce the kinetics of enzymes and determine the K_m and V_{max} .
- Explain the effect of inhibitors on enzyme activity
- Understand the role of enzymes in clinical diagnosis and industries.

Module I : Introduction to enzymes :Nomenclature and Classification based on IUB with examples, enzyme as catalyst-Activation energy, Enzyme specificity-absolute, Group, linkage and stereo specificities. Concept of Active site, Lock and key hypothesis and induced fit theory, Enzyme expression Units-IU, turnover number, katal and specific activity.12 Hrs

Module II : Mechanism of enzyme catalysis -

AcidBasecatalysis,covalentcatalysis,electrostaticcatalysis,metal ion catalysis, proximity and orientationeffect. Coenzymes -Definition, types, co-enzymatic forms of vitamins- NAD/NADP,FAD, FMN, Coenzyme A TPP,PLP, lipoic acid and biotin. Multienzyme complexes - Pyruvate dehydrogenase complex. Isoenzyme with reference to LDH and CK.12 Hrs

Module III: Enzymekinetcs --Definition of kinetics,

Factorsaffectingenzymeactivity - temperature, pH, substrate and enzyme concentration, activators-cofactors, Derivation of Michaelis-Menton equation for unisubstrate reactions , Lineweaver - Burk plot, Eadie -Hofsteepplot Significance of K_m and V_{max} andtheirdeterminationusing the plots.12 Hrs

Module: IV Enzyme inhibition - Reversible and irreversible inhibition-types of reversible inhibitors, competitive, non-competitive, un-competitive inhibitors. Graphical representation by L-B

plot,(Kineticderivationsnotrequired),Determinationof K_m and V_{max} inthe presence and absence of inhibitors. Allosteric enzymes - Sigmoidal curve, positiveandnegativemodulators12 Hrs

Module : V Applications of enzymes -Immobilized enzymes - methods of immobilization-

adsorption,covalentbonding,crosslinking,encapsulation,entrapmentandapplication s of immobilized enzymes. Biosensors – e.g. Glucose sensors. Industrial applications of enzymes –Food, textile and pharmaceutical industries.12Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Programme outcome
CO1	Identify the major classes of enzymes, differentiate between a chemical catalyst and a biocatalyst and define the units of enzymes.	PO1
CO2	Explain the mechanism of enzyme catalysis and the role of coenzymes in enzyme action.	PO1,PO2
CO3	Illustrate the steady state kinetics,, interpret MM plot and LBplo tbased on kinetics data, and determine K_m and V_{max} .	PO1,PO3
CO4	Distinguish the types of inhibition along with it simportance	PO1,PO3

	in biochemical reactions.	
CO5	Comprehend the various methods for production of immobilized enzymes and discuss the application of enzymes in clinical diagnosis and various industries.	PO1,PO2,PO6

Textbooks

- 1.U.Sathyanarayana&U.Chakrapani,2013,Biochemistry, 4th edition,ElsevierIndiaPvt.Ltd.,Books&AlliedPvt.Ltd.
- 2.Dr. G.R Agarwal, Dr. Kiran Agarwal & O.P. Agarwal, 2015, Textbook ofBiochemistry(Physiologicalchemistry),18thedition,GoelPublishingHouse,
- 3.T.Devasena,2010,Enzymology,1stedition,OxforduniversityPress.

Referencebooks

- 1.Trevor Palmer, 2008, Enzymes: Biochemistry, Biotechnology, ClinicalChemistry,2ndedition,EastWestPressPvt.Ltd.
- 2.DavidL.Nelson,MichaelM.Cox,2005,PrinciplesofBiochemistry,4theditionW.H.Freemanand Company,
3. Voet.D,Voet.J.G.andPratt,C.W,2004,PrinciplesofBiochemistry,4theditionJohnWiley&Son s,Inc.
4. ZubayG.L,*et.al.*,1995,PrinciplesofBiochemistry,1stedition,WmC.BrownPublishers.

Web resources

[www.biologydiscussion.com/notes/enzymes-
noteshttps://www.britannica.com/science/protein/The-mechanism-of-enzymatic-
actionhttps://www.youtube.com/watch?v=oVJ2LJxO6tU](http://www.biologydiscussion.com/notes/enzymes-noteshttps://www.britannica.com/science/protein/The-mechanism-of-enzymatic-actionhttps://www.youtube.com/watch?v=oVJ2LJxO6tU)

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3			3
CO 2	3	2					3			3
CO 3	3		2				3			3
CO 4	3		2				3			3
CO 5	3	2				2	3	3	3	3

S-Strong(3) M-Medium (2) L-Low (1)

THIRD YEAR :SEMESTER V
INTERMEDIARY METABOLISM

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
	Core paper:10 Intermediary metabolism	Core	3	1	-	-	4	5	25	75	100

Learning Objectives

The main objectives of this course are to

- Review the basic concepts of free energy transformation and describe biological oxidation.
- Illustrate the path ways of carbohydrate metabolism.
- Explain the path ways of oxidation and biosynthesis of lipids.
- Detail the catabolism of amino acids and synthesis of specialized products from amino acids.
- Acquaint the metabolism of nucleic acids and its regulation

Module I :Bio energetics-High energy compounds: Role of high energy compounds, free energy hydrolysis of ATP and other organophosphates, ATP-ADP cycle.

Biological Oxidation: Electron transport chain -its organization and function.

Inhibitors of ETC. Oxidative phosphorylation, P/O ratio, Peter Mitchell's chemiosmotic hypothesis. Mechanism of ATP synthesis, uncouplers of oxidative phosphorylation, substrate level phosphorylation with examples. 15 Hrs

Module II: Metabolism of carbohydrates -Glycolysis, TCA Cycle, Amphibolic nature and integrating role of TCA cycle. Anaplerosis, Pentose Phosphate Pathway (HMP shunt), Gluconeogenesis, Glycogenesis, Glycogenolysis and its regulation, glyoxylate cycle, Entner-Doudoroff pathway and Citric cycle. 15 Hrs

Module III: Metabolism of lipids -Oxidation of fatty acids - α , β and ω -oxidation of saturated fatty acids, Oxidation of fatty acids with odd number of carbon atoms and unsaturated fatty acids, Ketogenesis, Biosynthesis of saturated fatty acids and unsaturated fatty acids, Biosynthesis and degradation of triglycerides, phospholipids and cholesterol. 15 Hrs

Module IV: Metabolism of amino acid- Metabolic nitrogen pool, Catabolism of amino acid: Oxidative deamination, non – oxidative deamination, transamination and decarboxylation, Biogenic amines, Urea cycle and its regulation. 15 Hrs

Module V: Metabolism of nucleotides- Biosynthesis of purines and pyrimidines, - de novo synthesis and salvage pathways, Degradation of purines and pyrimidines, Conversion of ribonucleotide to deoxyribonucleotide 15 Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO 1	State the concepts of bio energetics and illustrate the mechanism of flow of electrons and the production of ATP.	PO1, PO2
CO 2	Elaborate the biochemical reactions and integration of pathways of carbohydrate metabolism.	PO1,
CO 3	Sketch the oxidation and biosynthesis of fatty acids, phospholipids, triglycerides and cholesterol with suitable examples	PO1
CO 4	Explain catabolism of amino acids, synthesis of non essential amino acids and specialized products from amino acids.	PO1
CO 5	Describe the metabolism of nucleic acids with necessary illustrations and its regulation.	PO1

Textbooks

1. U. Sathyanarayana & U. Chakrapani, 2015, Biochemistry, 4th Elsevier India Pvt. Ltd.,
2. M.N. Chatterjea and Rana Shinde, 2002, Textbook of Medical Biochemistry, 5th edition Jaypee Brothers Medical Publishers Pvt. Ltd.

Reference books

1. Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox, 2008, 5th edition, W.H. Freeman and Company.
2. Robert K. Murray, Daryl K. Granner, Victor W. Rodwell, 2006, Harper's Illustrated Biochemistry, 27th edition, McGraw Hill Publishers.
3. Principles of Biochemistry Voet D, Voet J.G, and Pratt C.W., 2010, Fourth edition, John Wiley & Sons, Inc.,

4.PrinciplesofBiochemistry,GeoffreyL.Zubay,WilliamW.Parson,DennisE.Vance,1995,2ndEd
ition,Wm.C. BrownPublishers.

5.Biochemistry, Garret,R.H.andGrisham,C.M.2005,
3rdEdition.ThomsonLearningINC.

Web resources

1.<https://nptel.ac.in/courses/104/105/104105102/>

2.<http://www.nptelvideos.in/2012/11/biochemistry-i.html>

3.[https://www.saddleback.edu/faculty/jzoval/mypptlectures/ch15_metabolism/lecture
_notes_ch15_metabolism_current-v2.0.pdf](https://www.saddleback.edu/faculty/jzoval/mypptlectures/ch15_metabolism/lecture_notes_ch15_metabolism_current-v2.0.pdf)

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3	2					3			3
CO 2	3						3			3
CO 3	3						3			3
CO 4	3						3			3
CO 5	3						3			3

S-Strong(3) M-Medium (2) L-Low (1)

THIRD YEAR :SEMESTER V CLINICAL BIOCHEMISTRY

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Core paper 11 Clinical Biochemistry	Core	3	1	-	-	4	5	25	75	100

Learning objectives

The main objectives of this course are to

- Comprehend the basic concepts and disorders of carbohydrate metabolism
- Explain the disorders of lipid metabolism.
- Elucidate the liver function test and kidney function test.
- Designate the gastric function test.

- Familiarize the clinical enzymology.

Module I : Disorders of carbohydrate metabolism: Maintenance of blood glucose by hormone with special reference to insulin and glucagon. Abnormalities in glucose metabolism: Diabetes mellitus; types, causes, biochemical manifestations, diagnosis and treatment, glycated hemoglobin. Inborn errors of carbohydrate metabolism, glycosuria, Fructosuria, Pentosuria, Galactosemia and Glycogen storage diseases. 15 hrs

Module II: Disorders of Lipid Metabolism: Lipid Profile, Atherosclerosis, Fatty liver and hyperlipidemia. Hypercholesterolemia, Lipidosis and Xanthomatosis, Tay-Sach's disease, Niemann-Pick disease, lipotropic agents 15 Hrs

Module III : Liver Function Tests: Bilirubin metabolism and jaundice, Estimation of conjugated and total bilirubin in serum (Diaz method). Detection of bilirubin and bile salts in urine (Fouchet's test and Hay's Sulphur test). Thymol turbidity test, prothrombin time, serum enzymes in liver disease serum transaminases (SGPT & SGOT) and lactate dehydrogenase (LDH). 15 Hrs

Kidney Function Tests: Measurement of urine pH, volume, specific gravity, osmolality, sediments in urine, inulin, urea and creatinine clearance tests. Concentration and dilution tests. Phenol red test. Levels of plasma protein and its significance related to kidney function. Proteinuria. 15 Hrs

Module IV : Gastric Function test: Composition of gastric juice, collection of gastric contents, examination of gastric residuum, fractional test meal (FTM), stimulation test-alcohol and histamine stimulation, Tubeless gastric analysis 1.5 Hrs

Module V: Clinical enzymology: Enzymes of diagnostic importance- LDH, creatine kinase, transaminases, phosphatases, Isoenzymes of lactate dehydrogenase. 15 Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Explain the concepts of hormones and their importance to maintain glucose and types of Diabetes, diagnosis and treatment.	PO1, PO3, PO6
CO2	Analyze the lipid profile and different deficiency state.	PO1, PO3, PO6

CO3	Describe the liver and kidney functions and specific diagnostic methods used for biological sample.	PO1,PO3,PO6
CO4	Detail about the composition of gastric juice and special test for diagnosis.	PO1,PO3,PO6
CO5	Elaborate the enzyme markers used for diagnostic studies.	PO1,PO3,PO6

Text books

1. MNChatterjeeandRanaShinde,TextBookofMedicalBiochemistry,JaypeeBrothers Medical Publishers (P) LTD, New Delhi, 8th Edition,2012
2. Ambika Shanmugam's Biochemistry for medical students, 8th edition, Published by Wolters Kluwer India Pvt. Ltd.

Referencebooks

1. Philip.D.Mayne,ClinicalChemistryindiagnosisandtreatment.ELBSPublication,6th edition, 1994.
2. Thomas M. Devlin (2014) Text book of Biochemistry with clinical correlations (7thed). John Wiley and sons.
3. Tietz Fundamentals of clinical chemistry and molecular Diagnostics (2014) (7thed) Saunders.

Web Resources

1. <https://www.britannica.com/science/metabolic-disease/Disorders-of-carbohydrate-metabolism>
2. <https://www.slideshare.net/MohitAdhikary/gastric-and-pancreatic-function-tests>
3. https://onlinecourses.nptel.ac.in/noc20_ge13/preview

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3		3			2	3	2	2	3
CO 2	3		3			2	3	2		3
CO 3	3		3			2	3	3	2	3
O 4	3		3			2	3	3	2	3
CO 5	3		3			2	3	3	2	3

S-Strong(3) M-Medium (2) L-Low (1)

THIRD YEAR :SEMESTER V

IMMUNOLOGY

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Elective Course IA Immunology	Elective	3	1	-	-	4	5	25	75	100

Learning Objectives

The objective of this course are to

- Introduce the structure and functions of lymphoid organs and cells of the immune system
- Illustrate the structure and classification of antibodies and adaptive immune response
- Impart knowledge on the types of immunity and uses of vaccines
- Provide an understanding of immune related diseases and transplantation
- Study the Ag-Ab interaction and immunological techniques to identify antigens and antibodies

Module I :Structure and function of primary lymphoid organs (thymus ,bone marrow), secondary lymphoid organs (spleen, lymph node), Cells involved in immune system- Functions-Phagocytosis -Inflammation 15 Hrs

Module II: Antigens - Nature, Immunogens, haptens ,cross reactions - Immunoglobulin- types- structure and function. Cells involved in antibody formation, Clonal selection theory, Co-operation of T-cell with B-cell. Differentiation of T and B lymphocyte - Humoral and cell mediated immunity. Monoclonal antibody – Production and application in biology. 15Hrs

Module III- Immunity and its types-Innate, Acquired, active and passive.- Natural and Artificial - Commonly used toxoid vaccines, killed vaccines, live attenuated vaccines, rDNA Vaccines, DNA and subunit vaccines 15Hrs

Module IV: Hypersensitivity – Immediate (Type 1) and Delayed (Type IV), Auto- immune diseases with examples. Organ specific and systemic autoimmunity. SLE, RA. Transplantation – Types of Grafts, structure& functions of MHC, graft Vs host reaction, immunosuppressive Agents. 15Hrs

Module V: Antigen-antibody reactions, General features of Antigen Antibody reactions. Precipitation, Immuno diffusion, SID and DID -Oudin Procedure, Oakley Fulthorpe Procedure, Radio immunodiffusion, Ouchterlony double diffusion, CIE, Rocket electrophoresis, Agglutination-Coomb's test Complement Fixation test-Wasserman's reaction, RIA, ELISA. 15Hr

Course Outcomes

CO	On completion of this course, students will be able to	Programoutcomes
CO1	Associate structure and function of the organs involved in our body's natural Defence	PO1
CO2	Classify antigens and antibodies and the role of lymphocytes in defending the host	PO1,PO2
CO3	Describe the types of immunity and the uses of vaccines	PO1, PO4
CO4	Understand the immune related diseases and mechanism of transplantation	PO1,PO2
CO5	Examine the immunological tests and relate it to the immune status of an Individual	PO1,PO3

Text Books

- 1.Kuby, J. (2018). Immunology(5th ed). W.H. Freeman - ISBN-10 : 1319114709 / ISBN-13 : 978-1319114701
2. Rao, C. V. (2017). Immunology (3rd ed.). Chennai: Alpha Science Int. Ltd - ISBN-10 : 1842652559/ ISBN 13:978-1842652558
- 3.Tizard(1995). An Introduction to Immunology. Harcourt Brace College Publications

References Books

- 1.Kenneth M. Murphy, Paul Travers, Mark Walport - (2007), Janeway's Immunobiology, 7th edition, Garland Science.
2. Abul K. Abbas, Andrew H. Lichtman, Jordan S. Pober - (1994), Cellular and molecular immunology, 2nd edition, B. Saunders Company.
3. Basic Immunology Functions and Disorders of the Immune System, 6th Edition - January 25, 2019 Authors: Abul Abbas, Andrew Lichtman, Shiv Pillai, ISBN: 9780323549431 eBook ISBN: 9780323639095
4. Peter Delves, Seamus Martin, Dennis Burton, Ivan Roitt - (2006), Roitt's Essential Immunology, 11th edition, Wiley-Blackwell

Web resources

- 1.https://onlinecourses.nptel.ac.in/noc22_bt40/preview
- 2.https://onlinecourses.swayam2.ac.in/cec20_bt05/preview
- 3.<https://youtu.be/8uahFPl6ny8>

Mapping with ProgramOutcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3			3
CO 2	3		2				3			3
CO 3	3			2			3	3		3

CO 4	3	2					3	1		3
CO 5	3		3				3	3	3	3

S-Strong(3) M-Medium (2) L-Low (1)

THIRD YEAR: SEMESTER V

BIOCHEMICAL PHARMACOLOGY

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Elective Course IB Biochemical Pharmacology	Elective	3	1	-	-	4	5	25	75	100

Learning Objectives

The objectives of this course are to

- Introduce the basic concepts of pharmacology.
- Explain the metabolism of drugs and factors responsible for metabolism.
- Acquaint the adverse response and side effects of drugs .
- Familiarize important drugs used for common metabolic disorders.
- Provide an understanding about the action of antibiotics .

Module I: Drugs – classification based on sources, routes of drug administration - Oral/Enteral, Parenteral and Local application. Absorption of drugs, factors influencing drug absorption, distribution and excretion of drugs. 15 Hrs

Module II: Drug metabolism - Phase I and Phase II reactions, role of cytochrome P₄₅₀ , non-microsomal reactions of drug metabolism. Factors influencing drug metabolism. Therapeutic index. 15 Hrs

Module III: Drug allergy, Drug tolerance - IC 50, LD50 of a drug, Drug intolerance, Drug addiction, Drug abuses and their biological effects. Drug resistance - biochemical mechanism. 15 Hrs

Module IV : Therapeutic Drugs - Analgesics and Non-steroidal anti-inflammatory drugs (NSAIDs) – Aspirin and Acetaminophen. Insulin, Oral antidiabetic drugs - Sulfonylureas, Biguanides. Antihypertensive drugs - ACE inhibitors, Calcium channel blockers. Anti-cancer agents – Antimetabolites. 15 Hrs

Module V: Antibiotics - Definition, Examples and Biochemical mode of action of penicillin, streptomycin, tetracyclines and chloramphenicol. 15 Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Classify the different routes of drug administration, describe the absorption, distribution, metabolism and excretion of drugs.	PO1
CO2	Illustrate the metabolism of drugs, classify the microsomal and non-microsomal reactions and explain the role of cytochromes.	PO1
CO3	List out the various adverse response and side effects of drugs.	PO1,PO2,PO4
CO4	Justify the use of synthetic drugs and elucidate its pharmacological actions and its adverse effects for different disease.	PO1,PO4
CO5	Highlight the importance and explain the mode of action of important antibiotics.	PO1,PO4

Text Books

1. N.Muruges, A concise text book of Pharmacology –Sathya Publishers.
2. Jayashree Ghosh, A Textbook of Pharmaceutical chemistry –S. Chand & Company Ltd.
3. S C Metha, Ashutosh Kar, Pharmaceutical Pharmacology –New Age International (P) Limited, Publishers.

References Books

1. Lippincott's illustrated Reviews- Pharmacology by Mary J.Mycek, Richard A.Harvey, Pamela C. Champe, Lippincott – Raven publishers, New Delhi.
2. David . E. Golan, Principles of Pharmacology, Wolters Kluwer (India) Pvt.Ltd.
3. R.S. Satoskar, S. B. Elsevier Pharmacology and pharmacotherapy. - ISBN-10 : 9788131248867 / ISBN-13 : 978-8131248867 ,2017.
4. Tripathi, K.Essentials of Medical Pharmacology. Jaypee Publishers- ISBN-10 : 9350259370 / ISBN-13 : 978-9350259375.2018.

Web Resources

<https://slideplayer.com/slide/3728296/64/video/What+is+bioremediation%3F.mp4>

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3			3
CO 2	3						3			3
CO 3	3	2		2			3	2		3
CO 4	3			2			3	2		3
CO 5	3			2			3	2		3

S-Strong(3) M-Medium (2) L-Low (1)

THIRD YEAR :SEMESTER V
RESEARCH METHODOLOGY

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Elective Course IC Research Methodology	Elective	3	1	-	-	4	5	25	75	100

Learning objectives

The objectives of the course are to:

- Introduce the components of research.
- Acquaint on the experimental design and literature survey
- Analyse the data and find out the significance statistically
- Highlight the importance of computation in research.
- Provide mechanics of writing a research report hands-on experience in designing and working on small projects.

Module I: Characteristics and types of Research, Research Methods versus Methodology, Research designs in Biochemistry: experimental, *in vitro*, *in vivo*, *in situ*, clinical trials. Identification and criteria of selecting a research problem (Hypothesis); Formulation of objectives; Research plan and its components. 15 Hrs

Module II: Experimental design - Objective, Design of work, Guidelines for design of experiments, Literature Search - Databases for literature search, Material and methods, Designing biological experiments, Compilation and documentation of data 15 Hrs

Module III : Statistical Analysis: Measures of variation - standard deviation, Non-linear regression, Standard error. Analysis of variance for one-way and two-way classified data and multiple comparison procedures. Significance - students "t" test, chi-square test. Dunnet's test 15Hrs

Module IV: Computer and its role in research: Basics of MS word, MS Excel: tabulation, calculation and data analysis, preparation of graphs, histograms and charts. Use of statistical software SPSS. Power Point: preparation of presentations and scientific poster designing 15 hrs.

Module V: Scientific writing for journals - Preparation of Abstract, Impact factor, h-index, i-10 index, citation index, Dissertation/Thesis writing: format, content and chapterization, writing style, drafting titles & sub-titles, captions and legends. Writing results, discussion and conclusions. Bibliography and references, referencing style - Harvard and Vancouver

systems, Appendices and acknowledgement; Ethical issues in research; Intellectual property right and plagiarism.15 Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Programme outcome
CO1	Explain the types of research and formulate and plan the research.	PO1,PO3
CO2	Design experimental setup, review the literature, compile and document the data.	PO1,PO3
CO3	Analyze and validate the experimental data using statistical tools	PO1,PO2,PO3
CO4	Interpret the data using computational tools.	PO1,PO2,PO3
CO5	Compile and draft a research report, present results findings and publish ethically.	PO1,PO3,PO4

Text Books

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., Research Methodology: Methods and Techniques. 2004, New Age International.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, EssEss Publications.2 volumes.
4. Gurumani.N, Research Methodology for biological Sciences, 2014, MJP Publishers.

Reference Books

1. Dr. Prabhat Pandey ,Dr.Meenu Mishra Pandey, Research Methodology: Tools and Techniques 2015
- 2.Coley, S.M. and Scheinberg, C. A., 1990, "Proposal Writing", Sage Publications.
4. Day, R.A., 1992.How to Write and Publish a Scientific Paper, Cambridge University Press.
5. Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications
6. Scientific Thesis Writing and Paper Presentation . MJP Publishers.2010
7. Research Methodology (2 Vols-Set) ,Suresh C. Sinha and Anil K. Dhiman, Vedams Books (P) Ltd.2002.

Web Resources

1. <https://explorable.com/research-methodology>
2. <http://www.scribbr.com>
3. <http://www.open.edu>
4. <http://www.macmillan.ihe.com>.

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3		3				3			3
CO 2	3		3				3	3	3	3
CO 3	3	2	3				3	3	3	3
CO 4	3	2	3				3	3	3	3
CO 5	3		3	2			3	3	33	3

S-Strong(3) M-Medium (2) L-Low (1)

THIRD YEAR :SEMESTER V

CLINICAL BIOCHEMISTRY

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CI A	Ext erna l	Total
	Core paper 12 Practical V- Clinical Biochemistry	Core Practi cal V	1	0	5	0	4	6	40	60	100

Learning Objectives

The objectives of this course are to

- Introduce the methods of sample collection (blood & urine) for analytical purpose.
- Impart practical knowledge on the assay of activity of various diagnostically important enzymes
- Understand the estimation procedure for various important biomolecules.
- Help students learn the routine qualitative analysis of urine sample for diagnostic purpose.
- Train students on various hematological tests and its significance.

1. Collection and preservation of blood and urine samples.
2. Estimation of creatinine by Jaffe's method (serum & urine)

3. Estimation of urea by diacetyl monoxime method (serum&urine)
4. Estimation of uric acid (serum&urine)
5. Estimation of cholesterol by Zak's method
6. Estimation of Glucose by Ortho Toluidine method
7. Estimation of Protein by Lowry's method
8. Estimation of Hemoglobin by Shali's/Drabkins method
9. Assay of SGPT and SGOT
10. Qualitative analysis of normal constituents of urine

Urea, Creatinine, Phosphorus, Calcium

Abnormal constituents

- a) Calcium
- b) Sugar (Glucose, fructose, pentose)
- c) Protein
- d) Amino acids (Tyrosine, Histidine, Tryptophan)
- e) Ketone bodies
- f) Bile pigments with clinical significance. 80 Hrs

DEMONSTRATION EXPERIMENTS(10 Hrs)

HEMATOLOGY

- a. RBC Counting
- b. Total and differential count of white blood cells
- c. Packed cell volume
- d. Erythrocyte sedimentation rate
- e. Blood clotting time
- f. Blood grouping

Course Outcomes

CO	On completion of this course, students will be able to	Programme outcome
CO1	Acquaint knowledge on collection of biological samples (urine, blood) and their preparation for diagnostic purpose.	PO1, PO2
CO2	Assay the activity of various clinically important enzymes and relate their clinical importance.	PO1, PO2

CO3	Estimate the important biomolecules in biological samples and relate their clinical significance	PO1,PO2,PO3,PO6
CO4	Qualitatively analyze urine sample for normal and abnormal constituents in urine and interpret the results	PO1,PO2,PO3
CO5	Perform the routine haematological tests.	PO1,PO2,PO3,PO6

Text Books

- 1.Manickam,S.S.(2018).BiochemicalMethods(3rded.).NewageInternationalPvtLtd publishers - ISBN 10: 8122421407 / ISBN 13: 9788122421408
- 2.Plummer,D.T.(n.d.).AnIntroductiontoPracticalBiochemistry.TataMcGrawHill- ISBN: 97800708416
- 3.Alan H Gowenlock. 1998. Varley's Practical Clinical Biochemistry, 6th edition, CBS Publishers, India.
4. B. Godkar. 2020. Textbook of Medical Laboratory Technology Vol 1 & 2 Paperback, 3rd edition, Bhalani Publishers.
5. Kanai L Mukerjee. 1996. Medical Lab Technology, Vol I& II, 1st edition, Tata Mcgraw Hill, Pennsylvania.
6. Ranjna Chawla. 2014. Practical Clinical Biochemistry Methods and interpretations 58 (Paperback). 4th edition, Jaypee Brothers Medical Publishers, New York.

Referencebooks

- 1.Singh,S.K.(2005).IntroductoryPracticalBiochemistry(2nded.).AlphaScience International, Ltd- ISBN 10: 8173193029 / ISBN 13: 9788173193026
- 2.Ashwood, B. a. (2001). Tietz Fundamentals of Clinical chemistry. WB Saunders Company, Oxford Science Publications USA - ISBN 10: 0721686346 / ISBN 13: 978072168634

Web resources

- 1.<https://www.elsevier.com/journals/clinical-biochemistry/0009-9120/guide-for-authors>
- 2.[http://rajswasthya.nic.in/RHSDP%20Training%20Modules/Lab.%20Tech/Biochemistry/ Dr.%20Jagarti%20Jha/Techniques%20In%20Biochemistry%20Lab.pdf](http://rajswasthya.nic.in/RHSDP%20Training%20Modules/Lab.%20Tech/Biochemistry/Dr.%20Jagarti%20Jha/Techniques%20In%20Biochemistry%20Lab.pdf)
- 3.https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical_biochemistryp.pdf?sequence=1&isAllowed=y

4. https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical_biochemist_ryp.pdf?sequence=1&isAllowed=y *

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3	3					3	3	3	3
CO 2	3	3					3	3	3	3
CO 3	3	3	3			3	3	3	3	3
CO 4	3	3	2				3	3	3	3
CO 5	3	3	3			3	3	3	3	3

S-Strong(3) M-Medium (2) L-Low (1)

THIRD YEAR: SEMESTER VI

MOLECULAR BIOLOGY

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Core Paper 13 Molecular Biology	Core	3	1	-	-	4	5	25	75	100

Learning Objectives

The objectives of this course are to

- Provide insights into the central dogma of molecular biology and explain the mechanism of DNA replication.
- Elaborate the mechanism of transcription and reverse transcription.
- Highlight the characteristics of genetic code and describe the process of protein synthesis.
- Introduce the concept of regulation of gene expression in prokaryotes
- Familiarize the different types of mutations and explain the mechanism of DNA repair.

Module I: Central Dogma of molecular Biology, DNA as the unit of inheritance. Experimental evidences by Griffith's transforming principle, Avery, McLeod and McCarthy's experiment, and Hershey and Chase Experiment. Replication in prokaryotes: Modes of replication, Meselson and Stahl's experimental proof for semi conservative replication. Mechanism of Replication – Initiation, events at Ori C, Elongation - replication fork, semi discontinuous replication, Okazaki fragments, and termination. Bidirectional replication, Inhibitors of replication. Models of replication - the theta, rolling circle and D loop model.

Module II: Transcription - Mechanism of transcription: DNA dependent RNA polymerase(s), recognition, binding and initiation sites, TATA/ Pribnow box, elongation and termination. Post-transcriptional modifications; inhibit or soft ranscription. RNA splicing and processing of mRNA, t RNA and r RNA. Reverse transcription. 15 Hrs

Module III: GeneticCode and its characteristics, Wobble hypothesis. Translation: Adaptor role of tRNA, Activation of amino acids, Initiation, elongation and termination of protein synthesis,post-translationalmodificationsandinhibitors of protein synthesis.

15 Hrs

Module IV: Regulation Of Gene Expression In Prokaryotes - Principlesofgeneregulation,negativeandpositiveregulation,conceptofoperons,regulatory proteins, activators, repressors, regulation of lacier on and trp operon.15 Hrs

Module V:Mutation:Types- Nutritional,Lethal,Conditionalmutants.Missensemutationandother point mutations. Spontaneous mutations; chemical and radiation – induced mutations.DNA repair: Direct repair, Photoreactivation, Excision repair, Mismatch repair, Recombination repair and SOS repair . 15 Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Programoutcomes
CO1	IllustratetheCentralDogmaofmolecularbiology, explainthe multiplication of DNA in the cell and describe the types andmodesofreplication.	PO1
CO2	Elaborate the mechanism of transcribing DNA into RNA, discuss the formationofdifferentspeciesofRNA.	PO1
CO3	Decipher the genetic code and summarize the processoftranslation.	PO1
CO4	Comprehend the principles ofgeneexpression and explain the concept of operon inprokaryotes.	PO1,PO2
CO5	Distinguish the types of mutations and explain the various mechanismsofDNArepair.	PO1,PO2

Textbooks

- 1.Veer Bala Rastogi, 2008, Fundamentals of Molecular Biology, 1st edition,AnebooksIndia.
- 2.David Friefelder,1987, Molecular Biology, 2nd edition, Narosa PublishingHouse.
- 3.Dr.P.S.VermaandDr.V.K.Agarwal,2013,Cellbiology,

Genetics, Molecular Biology, Evolution and Ecology, 1st edition, S. Chand & Company Pvt. Ltd.

Reference books

1. Karp, G., 2010, Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons, Inc.
2. DeRobertis, E. D. P. and DeRobertis, E. M. F., 2010, Cell and Molecular Biology, 8th edition, Lippincott Williams and Wilkins, Philadelphia.
3. James. D. Watson, 2013, Molecular Biology of the Gene 7th edition, Benjamin Cummings.
4. George M. Malacinski, 1992, Freifelder's Essentials of Molecular Biology, 4th edition, Narosa publishing House.

Web resources

1. www.mednotes.net/notes/biology
2. <https://www.onlinebiologynotes.com/repair-mechanism-of-mutation/>
3. <https://teachmephysiology.com/biochemistry/protein-synthesis/dna-translation/>

Mapping with Program Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3			3
CO 2	3						3			3
CO 3	3						3			3
CO 4	3	2					3			3
CO 5	3	2					3	1		3

S-Strong(3) M-Medium (2) L-Low (1)

THIRD YEAR : SEMESTER VI

HUMAN PHYSIOLOGY

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Core paper 14 Human Physiology	Core	3	1	-	-	4	5	25	75	100

Learning Objectives

The main objectives of this course are to

- Aid in understanding the physiology of respiratory and circulatory systems
- Explain the structure and physiology of the nervous and muscular system
- Explicate the functions of digestive and excretory system of the body.

- Impart knowledge about the process of reproduction.
- Emphasize the importance of various endocrine factors that regulate metabolism, growth, homeostasis and reproduction.

Module I: Respiratory System-Overview of respiratory system, Types of respiration, Transport of respiratory gases, Exchange of respiratory gases in lungs and tissues -Chloride Shift&Bohr's effect, Lung surfactant. Circulatory System-Structure and functions of the Heart. Arterial and venous system, Cardiac cycle, Pace maker, Blood pressure and Factors affecting blood pressure. 15Hrs

Module II: Nervous system- Structure of neuron, synaptic transmission, reflex action, neurotransmission- Resting membrane and Action potential. Neurotransmitters- acetylcholine, Noradrenaline, Dopamine, Serotonin, Histamine, GABA, Substance P. Muscular system-structure and types of muscles - skeletal, smooth and cardiac muscles, muscle proteins- types and functions, mechanism of muscle contraction. 15Hrs

Module III: Digestive system- composition, functions of saliva, gastric pancreatic intestine and bile secretions, structure of digestive system, Digestion, absorption of carbohydrates, lipids, proteins. Excretory system-Structure of nephron, mechanism of urine formation, Concentration and acidification of Urine. Role of kidneys in the maintenance of acid base balance. 15Hrs

Module IV: Reproductive system:-Oogenesis, spermatogenesis, capacitation and transport of sperm- blood testis barrier. Fertilization, early development, Implantation, Placentation and Parturition. 15Hrs

Module V: Endocrinology- Classification of hormones, endocrine glands and their secretions, structure and functions of Insulin, thyroxine. Steroid hormones- Corticosteroids, Sex hormones – testosterone and estrogen, menstrual cycle. 15Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Explain the exchange of gases, design of blood vessels and cardiac cycle.	PO1
CO2	Summarize the events in transmission of nerve impulses, mechanism of muscle contraction.	PO1
CO3	Elaborate the structure and functions of digestive system, structure of nephron and mechanism of urine formation and role of kidney in maintenance of pH.	PO1

CO4	Describe the process of Oogenesis, Spermatogenesis, Fertilization, and Parturition.	PO1,PO2
CO5	Understand the role of different hormones that regulate metabolism, growth, glucose homeostasis and reproductive function.	PO1.PO2

Textbooks

- 1.K.Sembulingam&PremaSembulingam,2016,EssentialsofMedicalPhysiology,7thedition Jaypee Brothers MedicalPublishers(P)Ltd.
- 2.Chatterjee. C.C.,1988,HumanPhysiology-VolI&II,1stedition,MedicalAlliedAgency.
- 3,AnimalPhysiology-MariakuttikanandArumugam,Saraspublication,2017.

Reference books

- 1.Text book of medical biochemistry physiology- MN. Chatterjee and Rana shinde, 7th edition, Jaypee brothers- medical publishers, 2007.
- 2.Meyer,Meyer&Meij,2002,HumanPhysiology,3rdedition,A.I.T.B.SPublishers.
- 3.GuytonandHall,2011,TextbookofMedicalPhysiology, 12thedition,W.B.SaundersCompany.
- 4.TestbookofMedicalPhysiology –Guyton&Hall,12thedition,Saunders Publishers, 2010
- 5.Humananatomyandphysiology–ElaineN.Marieb,3rdedition,Benjamin/Cummings (a Pearson education company), 1995.

Web resources

- <https://www.youtube.com/watch?v=6qnSsV2syUE>
- https://www.youtube.com/watch?v=9_h0ZXx1lFw
- <https://slideplayer.com/slide/9431799/>

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3	2		3
CO 2	3						3	2		3
CO 3	3						3	2		3
CO 4	3	3					3	2		3

CO5	3	3					3	2		3
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S-Strong (3) M-Medium (2) L-Low (1)

THIRD YEAR

SEMESTER VI

PLANT BIOCHEMISTRY AND PLANT THERAPEUTICS

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Core paper 15 Plant Biochemistry and Plant Therapeutics	Core	3	1	-	-	4	5	25	75	100

Learning Objectives

The main objectives of this course are to

- Convey the knowledge of photosynthesis.
- Detail the structure and types of secondary metabolites.
- Impart the idea on various plant hormones.
- Emphasize the effects of free radicals and the importance of antioxidants
- Understand the role of medicinal plants in treating diseases.

Module I: Photosynthesis- Photosynthesis apparatus, pigments of photosynthesis, photo chemical reaction, photosynthetic electron transport chain, path of carbon in photosynthesis- Calvin cycle, Hatch – lack pathway (4 ways) CAM path way, significance of photosynthesis

Module II: Secondary metabolites: Structure, Types, Sources, Biosynthesis and function of phenolics, tannins, lignins, terpenes and alkaloids. Medicinal properties of secondary metabolite 15Hrs

Module

III:

Plant hormones Structure and function of plant hormones such as ethylene, cytokinins, auxins, Abscic acid, Florigin and Gibberellins. 15Hrs

Module IV: Free radicals, types, production, free radical induced damages, lipid peroxidation, reactive oxygen species, antioxidant defense system, enzymatic and non-enzymatic antioxidants, role of antioxidants in prevention of disease, phytochemicals as antioxidants. 15Hrs

Module V: Plant therapeutics: Bioactive principles in herbs, plants with antidiabetic, anticancer, antibacterial, antiviral, anti-malaria and anti-inflammatory properties.15Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Programoutcomes
CO1	Gain knowledge on photosynthetic apparatus, pigments present, pathways, and significance of photosynthesis	PO1
CO2	Learn in detail about the structure, types, sources, biosynthesis and functions of secondary metabolites.	PO1,PO3
CO3	Understand the structure and functions of plant hormones.	PO1
CO4	Discuss about free radicals, types and its harmful effects. Role of enzymatic and non-enzymatic antioxidant in defence mechanism, prevention in disease.	PO1,PO2.PO3
CO5	Identify the plants with antidiabetic, anticancer, antibacterial, antiviral, anti-malaria and anti-inflammatory properties.	PO1, PO2,PO3

Text books1. SinghM.PandPanda.H2005.MedicinalHerbswiththeirformulations,Daya publishing house, Delhi

2. PlantPhysiology-DevlinN.RobertandFrancisH.Witham,CBSPublications

3. Molecular activities of plant cell – An Introduction to Plant Biochemistry. John. W.

4. Anderson and John Brardall, Black well Scientific Publications, 1994.

Referencebooks

1. Khan,I.AandKhanum.A2004.Roleofbiotechnologyinmedicinalandaromaticplants, Vol.1andVol.10,Ukka2publications,Hyderabad.

2. Plant Biochemistry and Molecular Biology – Hans Walter Heldt, Oxford University, 4th Edition, 2010

3. Plant biochemistry (2008), Caroline bowsher, Martin steer,Alyson Tobin, garlandscience.

4.Plant physiology and development (sixth edition) by Lincoln Taiz ,Eduardo Zeiger , Ian Max Moller and Angus Murphy publisher ; Oxford university press

Web resources

1 <https://www.intechopen.com/books/secondary-metabolites-sources-and-applications/anintroductory-chapter-secondary-metabolites>

2 <https://www.toppr.com/guides/biology/plant-growth-and-development/plantgrowth>

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3			3
CO 2	3		2				3	3		3
CO 3	3						3			3
CO 4	3	3	3				3	3		3
CO5	3	3	3				3	3		3

S-Strong (3) M-Medium (2) L-Low (1)

THIRD YEAR SEMESTER VI BIOTECHNOLOGY

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CI A	Ext erna l	Total
	Elective Course2 A - Biotechnology	Elective	2	1	0	0	3	5	25	75	100

Learning objectives

The main objectives of this course are to

- Impart knowledge on gene manipulation and gene transfer technologies
- Make the students understand the procedures involved in plant tissue culture.
- Acquire knowledge on animal cell culture and stem cell technology.
- Improve the employability skills of students by providing knowledge in recent techniques such as PCR, blotting, ELISA etc.
- Understand the application of fermentation technology.

Module I: Recombinant DNA technology

Recombinant DNA technology - Principles of gene cloning: restriction endonucleases and other enzymes used in manipulating DNA molecules. Ligation

of DNA molecules, DNA ligase, linkers and adapters, homopolymer tailing, end labeling and construction maps of PBR322, λ bacteriophage. 15 Hrs

Module II: Plant Tissue culture

Plant tissue culture- basic requirements for culture, M S medium, callus culture, protoplast culture. Vectors – Ti plasmid (cointegration vector and binary vector), Viral vectors- TMV, CaMV and their applications. Transgenic plants – pest resistant, herbicide resistant and stress tolerant plants. 15 Hrs

Module III: Animal Tissue culture

Animal cell lines and organ culture - culture methods and applications. Transgenic animals: transgenic mice- Production and its applications. Stem cell technology: definition, types, and applications. 15 Hrs

Module IV: Molecular Techniques

PCR –Principle, types and its application in clinical diagnosis and forensic science. Southern blotting, Northern blotting and DNA finger printing Technique-principle and their applications. 15 Hrs

Module V: Fermentation technology

Fermentation technology – Fermentors - general design, fermentation processes - Media used, downstream processing. Production and applications of ethanol, Streptomycin and Proteases. Production of edible vaccines. 15 Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Acquire knowledge on rDNA technology, DNA manipulation, and use of restriction endonuclease	PO1, PO3
CO2	Get acquainted with the use of cloning and vectors in plant tissue culture.	PO1, PO2, PO3
CO3	Understand the methods for production of proteins using recombinant DNA technology and their applications, basics of tissue culture, transgenesis, stem cell technology, risks, and safety aspects and patenting in biotechnology	PO1, PO3
CO4	Gain knowledge about the importance of gene and gene manipulation technologies	PO1, PO3
CO5	Know the concept fermentation technology and its applications.	PO1, PO3

Text Books

1. James D. Watson , Amy A. Caudy , Richard M. Myers , Jan Witkowski (2006) Recombinant DNA: Genes and Genomes - a Short Course (3rd ed), W.H. Freeman & Co
2. Satyanarayana U (2008), Biotechnology, Books & Allied (P) Ltd.
3. Cassida L (2007) Industrial Microbiology , New Age International

Reference books

1. Reed G (2004) Prescott and Dunn's Industrial Microbiology, CBS Publishers & Distributors
2. Biotechnology: applying the genetic revolution- David P. Clark , Pazdernik N. J, Elsevier (2009).
3. Click B.R. and Pasternak J.J (2010). Molecular Biotechnology: Principles and Applications of Recombinant DNA. (4th ed) American Society for Microbiology

Web Sources

NPTEL Certification course - Gene Therapy by Sachin Kumar
<https://nptel.ac.in/courses/102/103/102103041/>

Coursera Certification course –Vaccines

<https://futureoflife.org/background/benefits-risks-biotechnology/>

<https://www.sciencedirect.com/topics/neuroscience/genetic-engineering>

[http://www.biologydiscussion.com/biotechnology/techniques-](http://www.biologydiscussion.com/biotechnology/techniques-biotechnology/important-techniques-of-biotechnology-3-techniques/15683)

[biotechnology/important-techniques-of-biotechnology-3-techniques/15683](http://www.biologydiscussion.com/biotechnology/important-techniques-of-biotechnology-3-techniques/15683)

<https://iopscience.iop.org/book/978-0-7503-1347-6/chapter/bk978-0-7503-1347-6ch1>

https://www.slideshare.net/zeal_eagle/fermentation-technology

https://www.slideshare.net/zeal_eagle/fermentation-technology

<https://www.slideshare.net/Chepkitwai/blotting-techniques-6129300>

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3		3		3	3	3	3	3	3
CO 2	3		3		3	3	3	3	3	3
CO 3	3		3		3	3	3	3	3	3
CO 4	3		3		3	3	3	3	3	3
CO5	3		3		3	3	3	3	3	3

S-Strong (3) M-Medium (2) L-Low (1)

THIRD YEAR : SEMESTER VI
BIOINFORMATICS

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CI A	External	Total
	Elective Course2 B Bioinformatics -	EP2	2	1	0	0	3	5	25	75	100

Learning Objectives

The objective of this course are to

- Impart knowledge on bioinformatics and applications
- Learn about biological databases
- Understand the local and global sequence alignment
- Provide insights on BLAST and Microarray
- Familiarize about structural genomics and visualization tools

Module I: Introduction to Bioinformatics – Bioinformatics and its applications. –Genome, Metabolome-Definition and its applications. Metabolome-Metabolome database-E.coli metabolome database, Human Metabolome database. Transcriptome-Definition and applications. 15 Hrs

Module II : Biological Databases - definition, types and examples –, Nucleotide sequence database (NCBI, EMBL, Genbank, DDBJ) Protein sequence database- SwissProt, TrEMBL, Structural Database-PDB, Metabolic database-KEGG 15 Hrs

Module III : Sequence Alignment-Local and Global alignment-Dot matrix analysis, PAM, BLOSUM. Dynamic Programming, Needleman- Wunch algorithm, Smith waterman algorithm. Heuristic methods of sequence alignment 15 Hrs

Module IV : BLAST-features, types (BLASTP, BLASTN, BLASTX), PSI BLAST, result format. DNA Microarray-Procedure and applications. 15 Hrs

Module V: Structural genomics-Whole genome sequencing (Shotgun approach), Comparative genomics-tools for genome comparison, VISTA servers and precomputed tools. Molecular visualization tools. RASMOL, Swiss PDB viewer. Nutrigenomics-Definition and applications 15 Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Introduce the fundamentals of Bioinformatics and its applications Genome, metabalome& Transcriptome.	PO1
CO2	Classify biological database and to correlate the different file formats by nucleic acid, protein database, structural and metabolic database..	PO1,PO2, PO3
CO3	Develop algorithms for interpreting biological data.	PO1,PO2
CO4	Discuss the concepts of sequence alignment and its types. Understand the tool used to detect the expression of genes	PO1.PO2, PO3
CO5	Apply the various tools employed in genomic study and protein visualization. Analyse the entire genome by shot gun method.	PO1.PO2

Text books

- 1.Basic of Bioinformatics by Rui Jiang Xuegong Zhang and Michael Q. Zhang Editors
- 2.Bioinformatics for Beginners Genes, Genomes, Molecular Evolution, Databases and Analytical Tools By: SupratimChoudhuri(Author)
- 3.Bioinformatics by Saras publication
- 4.Introduction to Bioinformatics by Arthur Lesk

Reference books

- 1.Computation in BioInformatics Multidisciplinary Applications S Balamurugan, Anand T. Krishnan, Dinesh Goyal, Balakumar Chandrasekaran
- 2.Chemoinformatics and Bioinformatics in the Pharmaceutical Sciences
Navneet Sharma PhD Pharmaceutics, Himanshu Ojha, Pawan Raghav, Ramesh K. Goyal

Web resources

- 1.<https://nptel.ac.in/courses/102/106/102106065/>
- 2 <http://www.digimat.in/nptel/courses/video/102106065/L65.html>
- 3 <https://www.slideshare.net/sardar1109/bioinformatics-lecture-notes>

Mapping with Program Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3		2	3
CO 2	3	3	3				3		3	
CO 3	3	3					3		3	
CO 4	3	3	3				3		3	
CO5	3	3					3		3	

S-Strong (3) M-Medium (2) L-Low (1)

THIRD YEAR**SEMESTER VI****BIO ENTREPRENEURSHIP**

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Elective Course 2C Bio entrepreneurship	Elective	2	1	-	-	3	5	25	75	100

Learning Objectives

The objective of this course are to

- Impart knowledge on bio entrepreneurship and the types of industries
- Learn about business plan, proposal and funding agencies
- Understand the market strategy and the role of information technology in expansion of business
- Provide insights on legal requirement and accounting to establish as Bio entrepreneurship
- Familiarize about business bio incubators centres

Module I: Introduction to Bio entrepreneurship; Types of industries – Biopharma, Bio agriculture and CRO; Introduction to Trademarks , Copyrights and patents 15 Hrs

Module II: Business Plan, Budgeting and Funding Idea or opportunity; Business proposal preparation; funds/support from Government agencies like MSME/banks, DBT, BIRAC, Start-up and make in India Initiative; dispute resolution skills; external environment changes; avoiding/managing crisis; Decision making ability. 15 Hrs

Module III :Market Strategy- Basics of market forecast for the industry; distribution channels – franchising, policies, promotion, advertising, branding and market; Introduction to information technology for business administration and Expansion 15 Hrs

Module IV:Legal Requirements, Finance and Accounting; Registration of company in India; Ministry of Corporate Affairs (MCA); basics in accounting: introduction to concepts of balance sheet, profit and loss statement, double entry, bookkeeping; finance and break-even analysis; difficulties of entrepreneurship in India.15 Hrs

Module V:Role of knowledge centres such as universities, innovation centres, research institutions (public & private) and business incubators in Entrepreneurship development; quality control and quality assurance; Definition, role and importance of CDSCO, NBA, GLP, GCP, GMP.15 Hrs

Course Outcomes

After completion of the course the students will be able to

CO	On completion of this course, students will be able to	Programoutcomes
CO1	Understand the concept and scope for entrepreneurship	PO1
CO2	Identify various operations involved in a venture creation	PO1.PO5,PO6
CO3	Gather funding and launching a winning business	PO1.PO5,PO6
CO4	Nurture the organization and harvest the rewards	PO1.PO5,PO6
CO5	Illustrate about the Business incubator centres and Bio entrepreneurship	PO1.PO5,PO6

Text books

- 1.Adams, D. J. (2008). Enterprise for life scientists: Developing innovation and entrepreneurship in the biosciences. Bloxham: Scion - ISBN 10: 1904842364 / ISBN 13: 9781904842361
- 2.Shimasaki, C. (2014). Biotechnology Entrepreneurship: Starting, managing, and Leading Biotech Companies. Academic London Press - ISBN 10: 0124047300 / ISBN 13: 9780124047303
- 3.Onetti, A. &. (2015). Business modeling for life science and biotech companies: Creating value and competitive advantage with the milestone bridge. Routledge - ISBN 10: 1138616907 / ISBN 13: 9781138616905
4. Kapeleris, D. H. (2006). Innovation and entrepreneurship in biotechnology: Concepts, theories & cases - ISBN-13: 978-1482210125, ISBN-10: 1482210126

Reference books

- 1.Desai, V. (2009). The Dynamics of Entrepreneurial Development and Management New Himalaya. New Himalaya House Delhi:pub - ISBN : 9789350440810 9350440814
- 2.Ono, R. D. (1991). The Business of Biotechnology, From the Bench of the Street. Butterworth-Heinemann - ISBN 10: 1138616907 / ISBN 13: 9781138616905
3. Jordan, J. F. (2014). Innovation, Commercialization, and Start-Ups in Life Sciences. London: CRC Press - ISBN-10 : 812243049X ,ISBN-13 : 978-8122430493

Web sources

1. <http://www.simplynotes.in/e-notes/mbabba/entrepreneurship-development/>
2. <https://openpress.usask.ca/entrepreneurshipandinnovationtoolkit/chapter/chapter-1-introductionto-entrepreneurship/>

Mapping with Program Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2						3			3
CO 2	2				2	3	3			3
CO 3	2				2	3	3			3
CO 4	2				2	3	3		3	3
CO 5	2				2	3	3			3

S-Strong(3) M-Medium (2) L-Low (1)

THIRD YEAR; SEMESTER VI
PROJECT

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Core paper 16 Project	Core	3		5	-	3	8	40	60	100

SKILL ENHANCEMENT COURSE -SEC (NME)

SKILL ENHANCEMENT COURSE -SEC (NME)

Choose any of the skill enhancement course (NME) for Semester I & II

FIRST YEAR

SEMESTER I/II

HEALTH AND NUTRITION

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	NME:Health and Nutrition	SEC	1	1	-	-	2	2	25	75	100

Learning Objectives

The main objectives of this course are to

- Gain basic knowledge about health.
- Understand about vitamins.
- Learn about functions of fat on health.
- Understand the types of minerals and its functions
- Know about the importance of carbohydrates and proteins on health

Module I: Health – definition, Factors affecting human health. Importance of health care of children, adults and elderly people. Balanced diet and calorific value. 6Hrs

Module II: Vitamins-definition, classification, sources, properties, functions and deficiency symptoms. Recommended daily allowances. 6Hrs

Module III: Sources and functions of dietary fats, role of fats in health and diseases. 6Hrs

Module IV: Minerals- Role of minerals on human health, sources, biological functions, deficiency disorders with special reference to Calcium, Phosphorus, Potassium, Copper, Iron, Zinc and Selenium. Minerals in biological systems and their importance –Iron, Calcium, Phosphorus, Iodine, Copper, Zinc. 6Hrs

Module V: Role of proteins and carbohydrates in health. Functions of protein and carbohydrate and their calorific value. Dietary sources and deficiency disorders – Kwashiorkor and Marasmus – supplementation programs in India and their implications.6Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Programoutcomes
CO1	Understand about the importance of health and diet	PO1
CO2	Discuss about the classification properties and deficiencies of vitamins	PO1
CO3	Understand about sources and functions of fats and lipids on health	PO1.PO4
CO4	Detail about the different typed of minerals and its role in health	PO1,PO4
CO5	Relatetherole of proteins and carbohydrates on health	PO1,PO4

Text books

- 1 S.Davidson and J.R.Passmore (1986) Human Nutrition and Dietetics, (8th ed), Churchill Livingstone
2. J. S. Garrow, W. Philip T. James, A. Ralph (2000), Human Nutrition and Dietetics (10th ed), Churchill Livingstone
3. M.Swaminathan (1995) Principles of Nutrition and Dietetics, Bappco

Reference Books

1. Margaret Mc Williams (2012). Food Fundamentals (10th ed), Prentice Hall

Web Resources

1. <https://www.universalclass.com/articles/health/nutrition/nutritional-needs-for-differentages>.
2. nhp.gov.in/healthyliving/healthydiet
3. www.anme.com.mx/libros/PrinciplesofNutrition.pdf

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3	3		3
CO 2	3						3	3		3
CO 3	3			2			3	3		3
CO 4	3			2			3	3		3
CO5	3			2			3	3		3

S-Strong (3) M-Medium (2) L-Low (1)

FIRST YEAR :SEMESTER I/II LIFE STYLE DISEASES

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Lifestyle Diseases	Non – Major Elective	2		-	-	2	2	25	75	100

Learning Objectives

The objectives of this course are to

- Create a war emission life style diseases among adolescents.
- List out the lifestyle diseases.
- Explain the common lifestyle diseases and their prevention.
- Acquaint the dis orders associated with women's health.
- Impart life skillsso as to prevent lifestyle diseases.
-

Module I: Lifestyle diseases: Definition, Factors contributing to lifestyle diseases - Physical inactivity, Poor food habits, disturbed biological clock, sleep deprivation.
6Hrs

Module II: Top lifestyle diseases, Impact of Lifestyle diseases on family, society and economy of country. 6 Hrs

Module III : Causes, symptoms, types, preventive measures and treatment of Obesity, cardiovascular diseases, diabetes and cancer. 6 hrs

Module IV: Women's lifestyle diseases : Polycystic Ovarian Disease, Infertility, Breast and cervical cancer and Osteoporosis. 6 hrs

Module V: Prevention of lifestyle diseases: Balanced diet, sufficient intake of water, physical activity, sleep-wake cycle, stress management and meditation.
6Hrs

Course outcomes

CO	On completion of the course the students will be able to	Program Outcomes
CO1	Define Lifestyle diseases and describe the contributing factors	PO1
CO2	Enumerate the top lifestyle diseases and its impact on life.	PO1,PO4,PO5
CO3	Elaborate the treatment and prevention measures of common lifestyle diseases.	PO1,PO4,PO5
CO4	Highlight the lifestyle diseases that affects the women's health	PO1,PO4,PO5
CO5	Illustrate the various measures for prevention of lifestyle diseases	PO1,PO4,PO5

Textbooks

1. James M R, Lifestyle Medicine, 2nd Edition, CRC Press, 2013
2. Akira Miyazaki, New Frontiers in Lifestyle-Related Disease, Springer, 2008

Reference books

1. Steyn K, Lifestyle and related risk factors for chronic diseases
2. Willett WC, Prevention of chronic disease by means of diet and lifestyle.
3. Kumar M & R. Kumar, Guidet oprevention of life style diseases. Deep & Deep publications

Web resources

1. <https://youtu.be/jDdL2bMQXfE>
2. <https://youtu.be/7WnpSB14nDM>
3. <https://youtu.be/ollz9MqtW-U>

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2						3	3		3
CO 2	2			2	3		3	3		3
CO 3	2			2	3		3	3		3
CO 4	2			2	3		3	3		3
CO 5	2			2	3		3	3		3

S-Strong(3) M-Medium (2) L-Low (1)

FIRST YEAR : SEMESTER I/II**MEDICINAL DIET**

Course Code	Course Name	Category		L	T	P	S	Credits	Inst. Hours	Marks		
										CIA	External	Total
	NME: Medicinal Diet	SEC		1	1	-	-	2	2	25	75	100

Learning Objectives

The main objectives of this course are to

- Provide basic knowledge about diet
- Understand of diet modification for GI diseases
- Plan a diet for liver diseases
- Prepare diet chart for Infectious diseases
- Plan a diet for Diabetes ,Renaland Cardio-vascular diseases

Module-I :Principlesof Therapeutic Diet: Definitions of Normal diet, Therapeutic diet, soft Diet and Liquid diet. Objectives of Diet Therapy.Advantages of using normal diet as the basis for Therapeutic diet.Normal Diet-therapeutic modification of normal diet.6 Hrs

Module II:Diet modification in Gastrointestinal diseases: Peptic ulcer, Diarrhea, Lactose intolerance, Constipation and Malabsorption syndrome 6 Hrs

Module III:Diet Modification in liver and gall bladder in diseases: Etiology, symptoms and dietary treatment in jaundice, hepatitis, cirrhosis of liver and hepatic coma. 6 Hrs

Module IV:Diet Modification in Infectious Diseases: Fevers, Typhoid, Tuberculosis and Viral Hepatitis. Dietary modifications in Tuberculosis.6 Hrs

Module V:Diet Modification in Diabetes , Renaland Cardio-vascular diseases-Diabetes, acute & chronic glomerulonephritis, nephrosis, renal failure, kidney stone and Hypertension.6 Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Possess basic knowledge about diet	PO1
CO2	Sketch diet plan for GI diseases	PO1,PO4,PO5,PO6
CO3	Sketch diet plan for liver diseases	PO1,PO4,PO5,PO6
CO4	Sketch a diet plan for Infectious diseases	PO1,PO4,PO5,PO6
CO5	Prepare diet chart for Diabetes Renal and Cardio-vascular diseases	PO1,PO4,PO5,PO6

Text Books

1.M.Raheena Begum ,A Text Book of Foods, Nutrition and Dietetics, Sterling Publishers Pvt.Ltd.

2.M.V.Raja Gopal,Sumati.R.,Mudambi, Fundamentals of foods and Nutrition, Wiley Eastern Limited, Year-1990.

3.William S.R Nutrition and Diet Therapy, 1985, 5th edition, Mosby Co.St.Louis.

Reference books

1.Rodwell Williams Nutrition and Diet Therapy, 1985,the C.V Mosby St.Louis.

2.M.V.Krause&M.A.Mohan ,Food Nutrition and Diet Therapy, 1992 by W.B Saunders Company, Philadelphia, London.

3.Davidson and Passmore ,Human Methods and Diabetics, 1976 the English Language Book Society and Churchill.

Web sources

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2						3	3		3
CO 2	2			2	3	2	3	3		3
CO 3	2			2	3	2	3	3		3
CO 4	2			2	3	2	3	3		3
CO 5	2			2	3	2	3	3		3

S-Strong(3) M-Medium (2) L-Low (1)

SKILL ENHANCEMENT COURSE -SEC

(Discipline/Subject/ Entrepreneurial))

Choose any of the skill enhancement course (Discipline/subject/ entrepreneurial) for Semester - II,III& IV/ Year - I/II

BIOMEDICAL INSTRUMENTATION

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Biomedical Instrumentation	SEC(Discipline)	2	-	-	-	2	2	25	75	100

Learning Objectives

The objectives of this course are to

- Provide insights about the blood pressure and its measurement.
- Elaborate the mechanism of instruments related to respiration.
- Highlight the importance of imaging techniques.
- Acquaint students about the basics of medical assisting devices.
- Familiarize about the life saving therapeutic equipments.

Module I: Measurement of blood pressure – sphygmomanometer. Cardiac output – Cardiac rate – Heart sound – Stethoscope, ECG – EEG – EMG – ERG. 6 Hrs

Module II: Monitoring of inspired/expired anaesthetic gases, capnograph, inhalators, nebulizers, aspirators, infant respirator, Plethysmography. 6 Hrs

Module III: Medical imaging: X-ray machine - Radio graphic and fluoroscopic techniques – Computed tomography – MRI – PET, Ultrasonography – Endoscopy – Thermography. 6 Hrs

Module IV: Assisting equipments: Pacemakers – Defibrillators – Ventilators. 6 Hrs

Module V: Therapeutic equipments: Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialyzers. 6 Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Programme outcome
CO1	Illustrate the functions of instruments used for measuring blood pressure.	PO1,PO2, PO5
CO2	Elaborate the devices required for monitoring of respiratory gases.	PO1,PO2, PO5
CO3	Understand the operation of the imaging and sonographic instruments.	PO1,PO2, PO5
CO4	Differentiate between the action of pacemakers, defibrillators and ventilators.	PO1,PO2, PO5
CO5	Demonstrate the function of therapeutic equipments	PO1,PO2, PO5

Text books

1. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies.
2. L.A. Geddes and L.E.Baker, 'Principles of Applied Bio-Medical Instrumentation', John Wiley & Sons.
3. J.Webster, 'Medical Instrumentation', John Wiley & Sons.
4. C.Rajarao and S.K.Guha, 'Principles of Medical Electronics and Bio-medical Instrumentation', Universities (India) Ltd, Orient Longman Ltd.

Reference books

1. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, 'Bio-Medical Instrumentation and Measurements', II Edition, Pearson Education, 2002.
2. R.S.Khandpur, 'Handbook of Bio-Medical instrumentation', Tata McGraw Hill Publishing Co Ltd.,

WebResources

<https://youtu.be/GkUCmb0cKwo?list=PLCZ9KmODEcu138IIVeHClJ4nskArYr1Dg>

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2	3			3		3	3	3	3
CO 2	2	3			3		3	3	3	3
CO 3	2	3			3		3	3	3	3
CO 4	2	3			3		3	3	3	3
CO 5	2	3			3		3	3	3	3

S-Strong(3) M-Medium (2) L-Low

FIRST AID

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	First Aid	SEC (Discipline)	1	1	-	-	2	2	25	75	100

Learning Objectives

The main objectives of this course are to:

- Provide knowledge on the basics of first aid.
- Perform first aid during various respiratory issues.
- Demonstrate the first aid to treat injuries.
- Learn the first aid techniques to be given during emergency.
- Familiarize the first aid during poisoning.

Module I: Aims and important rules of first aid, dealing with emergency, types and content of a first aid kit. First aid technique – Dressing and Bandages, fast evacuation technique, transport techniques. 6 Hrs

Module II: Basics of Respiration – CPR, first aid during difficult breathing, drowning, choking, strangulation and hanging, swelling within the throat, suffocation by smoke or gases and asthma. 6 Hrs

Module III: Common medical aid- first aid for wounds, cuts, head, chest, abdominal injuries, shocks, burns, amputations, fractures, dislocation of bones. 6Hrs

Module IV: First aid related to unconsciousness, stroke, fits, convulsions- seizures, epilepsy 6Hrs

Module V: First aid in poisonous bites (Insects and snakes), honey bee stings, animal bites, disinfectant, acid and alkali poisoning. 6Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Discuss on the rules of first aid, dealing during emergency and first aid techniques	PO1.PO4,PO5
CO2	Understand the first aid techniques to be given during different types of respiratory problems	PO1.PO4,PO5
CO3	Provide first aid for injuries, shocks and bone injury	PO1.PO4,PO5
CO4	Detail on the first aid to be given for unconsciousness, stroke, fits and convulsions	PO1.PO4,PO5
CO5	Gain expertise in giving first aid for insect bites and chemical poisoning	PO1.PO4,PO5

Text books

- 1) First aid and health Dr. Gauri Goel, Dr. Kumkum Rajput, Dr.ManjulMungali
1ISBN-978-93-92208-19-5
- 2) Indian First Aid Mannual-<https://www.indianredcross.org/publications/FA-manual.pdf>
- 3) Red Cross First Aid/CPR/AED Instructor Manual

Reference books

Web resources

- 1)<https://www.redcross.org/take-a-class/first-aid/first-aid-training/first-aid-online>
- 2)<https://www.firstaidforfree.com/>

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2						3	3	3	3
CO 2	2			3	3		3	3	3	3
CO 3	2			3	3		3	3	3	3
CO 4	2			3	3		3	3	3	3
CO5	2			3	3		3	3	3	3

S-Strong (3) M-Medium (2) L-Low (1)

BASICS OF FORENSIC SCIENCE

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Basics of Forensic Science	SEC (Discipline)	1	1	-	-	2	2	25	75	100

Learning Objectives

The main objectives of this course are to

- C1 Gain knowledge on the basic practices of forensic analysis.
- C 2 Perform investigation using fresh blood.
- C 3 Carry out the analysis using body fluids
- C 4 Investigate the presence of forms of drugs and poisons in body fluids.
- C5 Execute the identification test on multiple samples.

Module I: Forensic Science: Definition, History and Development. Crime scene management and investigation; collection, preservation, packing and forwarding of physical and trace evidences for analysis. 6Hrs

Module II: Blood – grouping and typing of fresh blood samples including enzyme .Cases of disputed paternity and maternity problems, DNA profiling.6Hrs

Module III: Analysis of body fluids- Analysis of illicit liquor including methyl and ethyl alcohol in body fluids and breathe. Chemical examination, physiology and pharmacology of Insecticides and pesticides. 6Hrs

Module IV: Psychotropic drugs -Sedatives, stimulants, opiates and drugs of abuse. Identification of poisons from viscera, tissues and body fluids. 6Hrs

Module V: Identification tests- Identification of hair, determination of species origin, sex, site and individual identification from hair. Classification and identification of fibers. Examination and identification of saliva, milk, urine and faecal matter 6Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Gain knowledge on basics of forensic science and method for collection and preservation of samples	PO1,PO2,PO6
6CO2	Assess the paternity ,maternity problems and DNA profiling	PO1,PO2

CO3	Identify the presence of alcohol ,insecticides and pesticides in body fluids	PO1,PO2
CO4	Detail on the test performed to identify the presence of drugs and poisons in body fluids	PO1,PO2
CO5	Identify species and sex from the available body fluids	PO1,PO2

Reference books

1. An Introduction to Forensic DNA Analysis by Norah Rudin & Keith Inman USA, Second edition.
2. Forensic Science Handbook, Volume 2 & 3 by Saferstein, Richard E.
4. Forensics by Embar-Seddon, Ayn and Pass. Allan D.
5. Forensic Medicine by Adelman, Howard C &Kobilinsky, Lawrence Page 24 of 63

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2	3					3		3	3
CO 2	2	3					3		3	3
CO 3	2	3					3		3	3
CO 4	2	3					3		3	3
CO5	2	3					3		3	3

S-Strong (3) M-Medium (2) L-Low (1)

MEDICAL LABORATORY TECHNOLOGY

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CI A	Ext erna l	Total
	Medical Laboratory Technology	SEC (Discipline)	1	1	0	0	2	2	25	75	100

Learning Objectives

The main objectives of this course are to

- Impart knowledge on specimen collection and disposal of waste.
- Acquaint knowledge on collection, preservation and transfusion of blood.

- Quantify the biomolecules in biological sample
- Understand the significance of various tests and their interpretation in diseased conditions
- Acquaint knowledge on enzymes, hormones and Immunoglobulins as markers for diagnosis.

Module I :Collection, transport, analysis of specimen – blood, routine urine, feces, sputum, semen, CSF Documentation of samples & results. Disposal of laboratory/ hospital waste-Non infectious waste , biomedical waste, infected sharp waste disposal, infected non sharp disposal – color coding as per guidelines 6 Hrs

Module II : Determination of Blood group and Rh factor -Basic blood banking procedures-cross matching, screening test. Blood transfusion and hazards.6 Hrs

Module III :Estimation of blood sugar – Enzymatic method,HbA1C, Qualitative and quantitative analysis of urine sample- NPN-urea, uric acid, creatinine. Mineral ,vitamin and CSF analysis.6 Hrs

Module IV :Immuno diagnostics -Widal test, VDRL test, ASO, RA, CRP and Complement fixation Test. RIA, ELISA,, Skin test – Montaux and Lepramin test.6 Hrs

Module V :.Assay of clinically important enzymes- Estimation of clinically important hormones – Insulin, Thyroid and Reproductive hormones and its clinical significance6 Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Collect&preserve of biological samples.	PO1,PO2
CO2	Estimate the various constituents in biological sample	PO1,PO2,PO6
CO3	Perform the routine procedures adopted in blood bank	PO1,PO2,PO6
CO4	Analyze and interpret the values for both normal and disease conditions.	PO1,PO2,PO6
CO5	Assay the enzymes and hormones &interpret clinical implications	PO1,PO2,PO6

Text Books

- 1 Kanai L Mukherjee and Anuradha Chakravarthy Medical Laboratory Technology IVth edition, Vol I, 2022
2. Ramnik Sood, Text Book of Medical Laboratory Technology, Jaypee Publishers, 2006
3. Tietz, N. (2018) Fundamentals of Clinical Chemistry and Molecular Diagnostics 8th edition, W.B. Saunders Company

Reference books

Web Resources

- 1 <https://www.youtube.com/watch?v=QNYIX5Ne9IQ>
- 2 <https://www.slideshare.net/doctorrao/agglutination-tests-and-immunoassays>
- 3 <https://microbenotes.com/introduction-to-precipitation-reaction/>

Mapping with Program Outcome

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2	3					3	3	3	3
CO 2	2	3				2	3	3	3	3
CO 3	2	3				2	3	3	3	3
CO 4	2	3				2	3	3	3	3
CO5	2	3				2	3	3	3	3

S - Strong (3) M - Medium (2) L -Low(1)

TISSUE CULTURE

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CI A	Ext erna l	Total
	Tissue Culture	SEC (Discipline)	1	1	0	0	2	2	25	75	100

Learning Objectives

The objectives of this course are to

- Introduce the tools and techniques used in tissue culture technique.
- Acquire knowledge on preparation of growth medium for culture techniques.
- Impart knowledge on procedures involved gene transfer.
- Acquaint with the process of tissue culture technique.
- Understand the importance of plant and animal tissue culture for the production and evaluation of bioactive compounds

Module I: Introduction to Tissue culture, Types- seed, embryo, Callus, Organ, Protoplast culture, Advantages and importance of tissue culture, Tools and techniques 6 Hrs

Module II : Media and Culture Preparation - pH, temperature, solidifying agents. Role of Micro and macro nutrients. Maintenance of cultures. 6 Hrs

Module III : Methods of gene transfer in plants and animals - direct and indirect gene transfer methods. 6 Hrs

Module IV : Cell culture technique - Explants selection, sterilization and inoculation. 6 Hrs

Module V : Transgenic plants for crop improvement. Transgenic plants for molecular farming. Animal Cloning - an overview-Applications of animal cell culture 6 Hrs

Course outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Introduction to plant tissue culture	PO1, PO2, PO3
CO2	Brief knowledge on preparation of tissue culture media	PO1, PO2
CO3	Understanding on different methods of gene transfer	PO1, PO2, PO3
CO4	Gain knowledge on plant and animal cell culture techniques	PO1, PO2, PO3

CO5	Study of applications of genetically modified plants and animals.	PO1,PO2,PO3
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Text books

- 1.Trivedi, P.C.2000. Applied Biotechnology: Recent Advances. PANIMA Publishing corporation.
- 2,Ignacimuthu. 1996. Applied Plant Biotechnology. Tata McGraw – Hill.
- 3.Lycett, G.W. and Grierson, D. (ed). 1990. Genetic Engineering of crop plants.
- 4.Grierson and Covey, S.N.1988. Plant Molecular biology.Blackie.
- 5.Chawla, H.S., "Introduction to Plant Biotechnology", 3rd Edition, Science Publishers, 2009.

Reference books

- 1.Gamburg OL, Philips GC, Plant Tissue & Organ Culture fundamental Methods, arias Publications. 1995.
- 2.Stewart Jr., C.N., "Plant Biotechnology and Genetics: Principles, Techniques and Applications" Wiley-Interscience, 2008.
- 3.Freshney, R. I. (2010). Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. Wiley-Blackwell, 2010.6th Edition.
- 4.Davis, J. M. (2008). Basic Cell Culture. Oxford University Press. New Delhi.
- 5.Davis, J. M. (2011).Animal Cell Culture.John Willy and Sons Ltd. USA.
- 6.Freshmen R. I. (2005).Culture of Animal Cells.John Willy and Sons Ltd. USA.
- 6.Butler, M. (2004). Animal Cell Culture and Technology.Taylor and Francis. Keywork USA.
- 7.Verma, A. S. and Singh, A. (2014).Animal Biotechnology. Academic Press, ELSEVIER, USA

Web Resources

<https://www.britannica.com/science/tissue-culture>

https://en.wikipedia.org/wiki/Plant_tissue_culture

<https://microbeonline.com/animal-cell-culture-introduction-types-methods-applications/>

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2	3	3				3	3	3	3
CO 2	2	3					3	3	3	3
CO 3	2	3	3				3	3	3	3
CO 4	2	3	3				3	3	3	3
CO5	2	3	3				3	3	3	3

S - Strong (3)

M - Medium (2)

L -Low(1)

MEDICAL CODING

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Medical Coding	SEC(Discipline)	1	1	-	-	2	2	25	75	100

Course objectives

The objectives of this course are to

- Understand the basic concept of Medical coding
- Familiarize the student about medical terminology
- Understand about the classification of diseases based on WHO/AHA
- Understand about the CPT code used for diseases as per American Medical Association (AMA)

Module- I : Introduction to Medical coding, coding theory, Healthcare Common Procedure Coding, First Aid and CPR 6Hrs

Module- II: Introduction to Medical Terminology, specialization I & II, Diagnostic coding, factors affecting diagnostic coding 6Hrs

Module III: Documenting medical records- Importance of Documentation, Types of dictation formats 6Hrs

Module- IV : Introduction to Human Anatomy and Coding, ICD-10- CM classification system

6Hrs **Module- V** : Introduction to CPT coding, types of CPT coding Medical Law and Ethics 6hrs

Course Outcome

CO	On completion of this course, students will be able to	Program Outcomes
CO1	Explaining the basic concept of coding and its application. Possess the knowledge about the First aid and CPR	PO1, PO2, PO6
CO2	Possess the knowledge about medical terminology used in Medical coding industry	PO1, PO2, PO6
CO3	Possess the knowledge about the ICD-10 CM international classification of diseases based on WHO	PO1, PO2, PO6
CO4	Possess the knowledge about the CPT codes used for diseases as per American Medical Association (AMA)	PO1, PO2, PO6
CO5	Understand CPT coding and its types	PO1, PO2, PO6

Text books

1. Understanding Medical Coding, A comprehensive guide Sandra L Johnson Robin Linker
2. Buck's Step – by – step Medical Coding Elsevier reference

Reference books

- 1.Terry Tropin M Shai, RHIA, CCS-P, AHIMAICD-10-CMcoding guidelines made easy2017.
- 4.Besty J Shiland- Medical terminology and anatomy for ICD-10.

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2	3				3	3		2	3
CO 2	2	3				3	3		2	3
CO 3	2	3				3	3		2	3
CO 4	2	3				3	3		2	3
CO5	2	2				2	3		2	3

S - Strong (3) M - Medium (2) L -Low(1)

MICROBIAL TECHNIQUES

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	SEC-Microbial techniques	SEC(Discipline)	1	1	-	-	2	2	25	75	100

Learning objectives

The objectives of this course are to

- Study the growth of bacteria
- Know the parts & uses of microscope
- Learn staining methods to identify microbes
- Learn different types of culture methods
- Study food preservation methods

Module – I: Growth of bacteria- Definition, growth phases, factors affecting growth (pH, temperature, and oxygen), cell count (hemocytometer, Bacterial cell- Bacillus subtilis), fungal cell (Saccharomyces) and human blood cell.6 Hrs

Module -II:Microscopy- Principle, types - Compound microscope, electron microscope-TEM, SEM, use of oil immersion objective.6 Hrs

Module III :Stains and staining- Principles of staining, simple staining, negative staining, Differential staining, Gram and acid-fast staining, flagella staining, capsule and endospore

Staining. Staining of yeast (methylene blue), lactophenol cotton blue, staining of mold (Penicillium, Aspergillus), Agaricus.6 Hrs

Module IV:Cultivation of bacteria– Types of growth media (natural, synthetic, complex, enriched, selective- definition with example), culture methods (streak plate, spread plate, pour plate, stab culture, slant culture, liquid shake culture, anaerobiosis) - aerobic and Anaerobic bacteria.6 Hrs

Module V:Food microbiology- Microbiological examination of food: microscopic examination and culture, phosphatase test of Pasteurized milk. Preservation of food- High temperature (boiling, pasteurization, appreciation), low temperature (freezing), dehydration, osmotic pressure, chemical preservations, radiation. Microorganisms as food SCP.6 Hrs

Course Outcome

CO	On completion of this course, students will be able to	Program Outcomes
CO1	Understand the growth of bacteria and to perform cell count	PO1,PO2
CO2	Acquire knowledge of microscope and its uses	PO1,PO2
CO3	Identify the microbes by staining methods	PO1,PO2, PO6
CO4	Culture microbes by various methods	PO1,PO2, PO6
CO5	Preserve foods at high and low temperature	PO,PO2, PO6

Text books

1. Sherris Medical Microbiology, 7th Edition by Authors: Kenneth Ryan, C. George Ray, Nafees Ahmad, W. Lawrence Drew, Michael Lagunoff, Paul Pottinger, L. Barth Reller and Charles R. Sterling
2. Food Microbiology: Fundamentals And Frontiers, 5th Edition by Editor(s):Michael P. Doyle, Francisco Diez-Gonzalez, Colin Hill
3. Text book of microbiology by Ananthanarayan and Panicker's
4. Textbook of microbiology by P.C. Trivedi Sonali Pandey Seema Bhadauria
5. Prescott's Microbiology, 10th Edition by Authors: Joanne Willey, Linda Sherwood and Christopher J. Woolverton

Reference books

1. Bailey & Scott's Diagnostic Microbiology, 14th Edition by Author: Patricia Title
2. Medical Microbiology, 7th Edition Authors: Patrick R. Murray, Ken S. Rosenthal and Michael A. Pfaller
3. Microbiology: Laboratory Theory and Application, 3rd Edition Authors: Michael J. Leboffe and Burton E. Pierce

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2	3					3	3	3	3
CO 2	2	3					3	3	3	3
CO 3	2	3				2	3	3	3	3
CO 4	2	3				2	3	3	3	3
CO5	2	3				2	3	3	3	3

S - Strong (3) M - Medium (2) L -Low(1)

ALLIED COURSE OFFERED BY BIOCHEMISTRY

FIRST YEAR : FIRST SEMESTER

ALLIED BIOCHEMISTRY I

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Allied Biochemistry I	(Theory)Allied I	2	1	-	-	3	4	25	75	100

Learning objectives

The objectives of this course are to

- Introduce the structure and classification of carbohydrates
- Comprehend the metabolism of carbohydrates
- Study the classification and properties of amino acids
- Elucidate the various levels of organization of Proteins
- Study functions and deficiency diseases of vitamins

Module I: Definition and classification of carbohydrates, linear and cyclic forms (Haworth projection) for glucose, fructose and mannose and disaccharides (maltose, lactose,

sucrose).General properties of monosaccharides and disaccharides. Occurrence and significance of polysaccharides. 12Hrs

Module II:Metabolism- Catabolism and Anabolism.Carbohydrate metabolism- Glycolysis, TCA cycle, HMP shunt and glycogen metabolism and energetics 12Hrs

Module III:Amino acids -Classifications, physical properties -amphoteric nature, isoelectric point and chemical reactions of carboxyl ,amino and both groups. Amino acid metabolism- transamination, deamination and decarboxylation.12Hrs

Module IV :Proteins- classification - biological functions ,physical properties- ampholytes, isoelectric point, salting in and salting out, denaturation, nature of peptide bond. Secondary structure, α -helix and β -pleated sheet, tertiary structure, various forces involved- quaternary structure. 12Hrs

Module V: Vitamins- Fat(A,D,E and K) and water soluble vitamins(B complex and C)- sources, RDA, biological functions and deficiency diseases12 Hrs

Course Outcome

CO	On completion of this course, students will be able to	Programme Outcome
CO1	Classify the structure of carbohydrates and its properties	PO1
CO2	Explain the metabolism of carbohydrates and its significance	PO1
CO3	Classify amino acids and its properties	PO1
CO4	Explain the classification and elucidate the different levels of structural organization of proteins	PO1
CO5	Identify the disease caused by the deficiency of vitamins	PO1

Text Books

- 1 Satyanarayan,U (2014) Biochemistry (4th ed), Arunabha Sen Books & Allied (P) Ltd, Kolkata.
- 2.Jain J.L.(2007) Fundamentals of Biochemistry,S.Chand publishers 311

Reference books

1. David L.Nelson and Michael M.Cox (2012) Lehninger Principles of Biochemistry (6th ed) W.H. Freeman.
2. Voet.D&Voet. J.G (2010) Biochemistry , (4th ed), John Wiley & Sons, Inc.
3. Lubert Stryer (2010) Biochemistry,(7th ed), W.H.Freeman
4. Satyanarayan,U (2014) Biochemistry (4th ed), Arunabha Sen Books & Allied (P) Ltd, Kolkata.
- 5.Jain J.L.(2007) Fundamentals of Biochemistry,S.Chand publishers 31

Web sources

- 1.onlinecourses.swayam2.ac.in/cec20_bt12
- 2 onlinecourses.swayam2.ac.in/cec20_bt19

Mapping with Program Outcome

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3			3
CO 2	3						3			3
CO 3	3						3			3
CO 4	3						3			3
CO5	3						3	3		3

S - Strong (3) M - Medium (2) L -Low(1)

FIRST YEAR : SEMESTER I

ALLIED BIOCHEMISTRY PRACTICAL-I

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	AlliedBiochemistry Practical I	Allied Practical I	-	-	3	-	3	4	25	75	100

Learning objectives

- Identify carbohydrates by qualitative test
- Estimate biomolecules volumetrically
- Estimate protein quantitatively

I Qualitative analysis of carbohydrates- 25Hrs

- Monosaccharides-Glucose, Fructose
- Disaccharides- Lactose, Maltose, Sucrose
- Polysaccharides-Starch

II Volumetric analysis 15 Hrs

- Estimation of ascorbic acid using 2,6dichlorophenolindophenol as link solution
- Estimation of Glucose by Benedicts method
- Estimation of Glycine by Sorenson Formal titration

III Quantitative analysis(Demonstration Expt)5 hrs

- Colorimetric estimation of protein by Biuret method

Course Outcome

CO	On completion of this course, students will be able to	Program Outcomes
CO1	Qualitatively analyze and report the type of carbohydrate based on specific tests	PO1,PO2,PO3
CO2	Quantitatively estimate the carbohydrates, amino acids and ascorbic acid	PO1,PO2,PO3
CO3	Estimate protein by colorimetric method	PO1,PO2,PO3

Text books

- 1.Laboratory manual in Biochemistry, J. Jayaraman, 2nd edition, New Age International Publishers, 2011,
2. An Introduction to Practical Biochemistry, David T. Plummer, 3 rd edition, Tata McGraw-Hill Publishing Company Limited, 2001.
3. Biochemical Methods, Sadasivam S and Manickam A, 4h edition, New Age International Publishers, 2016

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2	3	3				3	3	3	3
CO 2	2	3	3				3	3	3	3
CO 3	2	3	3				3	3	3	3

S - Strong (3) M - Medi) L -Low(1)

FIRST YEAR ; SEMESTER II
ALLIED BIOCHEMISTRY II

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Allied Biochemistry II	Allied II	2	1	-	-	3	4	25	75	100

Learning objectives

The objectives of this course are to

- Impart knowledge on the classification, properties and characterization of lipids.
- Comprehend the metabolism of Lipids
- Acquaint with the structure, properties and functions of nucleic acids
- Learn about the enzyme kinetics and inhibition
- Study the importance of Hormones

Module I : Lipids—Bloor's classification of lipids- simple lipids, fatty acids (saturated and unsaturated), compound lipids, derived lipids. Properties of lipids- reduction, oxidation, halogenation, saponification and rancidity .Classification and functions of phospholipids, Cholesterol – structure and biological importance. 12 Hrs

Module II : Lipid metabolism- Oxidation of fatty acids (Palmitic acid) – Beta oxidation- Role of carnitine, energetics , alpha oxidation and omega oxidation. Biosynthesis of saturated fatty acids. 12 Hrs

Module III : Purine and pyrimidine bases, nucleosides, nucleotides, polynucleotides, DNA structure, various types, properties- absorbance, effect of temperature. Different types of RNA, structure and function, Genetic code. 12 Hrs

Module III : Enzymes - Nomenclature, IUB system of enzyme classification, active site, specificity, isoenzymes, units of enzyme activity factors affecting enzyme activity- substrate concentration, pH, temperature. Enzyme Kinetics- Michaelis and Menten equation. Lineweaver- Burk plot. Enzyme inhibition, competitive, uncompetitive and non competitive inhibition 12 Hrs

Module V: Hormones -classification, Biological functions of Insulin, Thyroid and Reproductive hormones . 12Hr

Course Outcome

CO	On completion of this course, students will be able to	Program Outcomes
CO1	Elaborate on classification, structure, properties, functions and characterization of lipids	PO1
CO2	Discuss the metabolism of lipids and its importance	PO1
CO3	Explain about structure, properties and functions of nucleic acids	PO1
CO4	Derive Michaelis Menten equation and concepts of enzyme inhibition	PO1,PO3
CO5	Classify the Hormones and its biological functions	PO1,PO4

Text books

- 1.Satyanarayan,U (2014) Biochemistry (4th ed), Arunabha Sen Books & Allied (P) Ltd, Kolkata.
- 2.Jain J.L.(2007) Fundamentals of Biochemistry,S.Chand publishers

Reference books

1. David L.Nelson and Michael M.Cox (2012) Lehninger Principles of Biochemistry (6th ed) W.H. Freeman.
2. Voet.D & Voet. J.G (2010) Biochemistry , (4th ed), John Wiley & Sons, Inc.
3. Lubert Stryer (2010) Biochemistry,(7th ed), W.H.Freeman

Web sources

- 1.onlinecourses.swayam2.ac.in/cec20_bt12
- 2 onlinecourses.swayam2.ac.in/cec20_bt19

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3			3
CO 2	3						3			3
CO 3	3		3				3			3
CO 4	3			3			3			3
CO5	3						3	3		3

S - Strong (3) M - Medium (2) L -Low(1)

FIRST YEAR: SEMESTER II

ALLIED BIOCHEMISTRY : PRACTICAL II

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Allied Bio chemistry Practical II	Allied Practical II	2	1	-	-	3	4	25	75	100

Learning objectives

The objectives of this course are to

- Identify amino acids by qualitative test
- Prepare biomolecules from its sources
- Estimate phosphorus quantitatively

I. Qualitative analysis of amino acids

a) Arginine b) Cysteine c) Tryptophan d) Tyrosine e) Histidine

II. Biochemical preparations

- a) Preparation of casein from milk.
 b) Preparation of starch from potato.
 c) Preparation of albumin from egg.

III. Group Experiment

Determination of Iodine/ Saponification number of an edible oil (Demonstration) .

Course Outcome

CO	On completion of this course, students will be able to	Programme Outcome
CO1	Qualitatively analyze the amino acids and report the type of amino acids based on specific tests	PO1, PO2, PO3
CO2	Prepare the macronutrients from the rich sources.	PO1, PO2, PO3
CO3	Check the quality of edible oil	PO1, PO2, PO3

Text books

1. Laboratory manual in Biochemistry, J. Jayaraman, 2nd edition, New Age International Publishers, 2011,
2. An Introduction to Practical Biochemistry, David T. Plummer, 3rd edition, Tata McGraw-Hill Publishing Company Limited, 2001.

Reference books

1. Biochemical Methods, Sadasivam S and Manickam A, 4h edition, NewAge International Publishers, 2016
2. Essentials of Food and Nutrition, Vol. I & II, M.S. Swaminathan.

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2	3	3				3	3	3	3
CO 2	2	3	3				3	3	3	3
CO 3	2	3	3				3	3	3	3

S - Strong (3) M - Medium (2) L -Low

Semester I	FUNDAMENTALS OF BIOCHEMISTRY	Hours/Week: 2	
Foundation Co		Credits: 2	
Course Code		Internal 25	External 75

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Define the terms frequently used in Biochemistry.

CO2: Explain the basics of biochemistry.

CO3: Identify the fundamental elements of biochemistry.

CO4: Write the basic principle applied in the biological field.

CO5: Determine the significance of biochemistry related concepts.

UNIT I:

Biochemistry - Introduction, history and scope. Branches of biochemistry, applications of biochemistry, role of biochemistry in various fields.(6 Hours)

UNIT II:

Origin of life, chemical composition of life, structure of atoms, molecules and chemical bonds. Atomic number, types of chemical bonds and its biological importance. Water - structure, property and functions. (6 Hours)

UNIT III :

Enzymes- Definition, nomenclature, classification and functions. Introduction to metabolism- anabolism and catabolism, ATP. Introduction to Immunology - antigen and antibodies - definition and structure. (6 Hours)

UNIT IV:

Introduction to Basic Laboratory Operations - identification and use of common laboratory glassware, laboratory reagents and equipment. Care and maintenance of common laboratory instruments. Basic needs of a biochemistry laboratory, safety measures in laboratory. (6 Hours)

UNIT V:

Biomolecules - carbohydrates, amino acids, lipids, nucleic acids - classification and its importance. Basic principles of pH meter, Colorimetry, Electrophoresis and Chromatography (Paper chromatography only) (6 Hours)

TEXT BOOKS

1. Fundamentals of Biochemistry, J.L.Jain, Sunjay Jain, Nitin Jain, 2013, 7th edition S. Chand & Company Ltd.
2. Biochemistry, U. Sathyanarayana & U. Chakrapani, 2013, 5th edition Elsevier India Pvt. Ltd., Books & Allied Pvt. Ltd.

REFERENCE BOOKS

1. David L. Nelson, Michael M. Cox, 2005, Principles of Biochemistry, 4th edition W.H. Freeman and Company.
2. Voet, D., Voet, J.G. and Pratt, C. W, 2004, Principles of Biochemistry, 4th edition John Wiley & Sons, Inc.
3. Zubay G.L., *et.al.*, 1995, Principles of Biochemistry, 1st edition, WmC. Brown Publishers.
4. Microbiology: Laboratory Theory and Application, 3rd Edition Authors: Michael J. Leboffe and Burton E. Pierce

