B.SC.,
BIOCHEMISTRY

SYLLABUS

FROM THE ACADEMIC YEAR
2023 – 2024

TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION, CHENNAI – 600 005

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THE REGULATIONS ON LEARNING OUTCOMES BASED CURRICULUM FRAME WORK FOR UNDERGRADUATE EDUCATION

1. Preamble

Biochemistry is the cross over scientific discipline that integrates the living world and chemistry. It involves the study of the structure of biomolecules and explores the biological processes at molecular level in the living organisms. It is the laboratory science that has several domains like cell biology, molecular biology, clinical biology, enzymology, immunology, physiology, pharmacology etc., It has enlightened many aspects of health and diseases and paved the way for many interdisciplinary technological innovations like metabolomics, genomics and proteomics. There is a continuous demand for biochemists in public and private health care sectors, agriculture, medical and forensic departments. Almost all food, pharmaceuticals, health and beauty care etc required quality control and safety checks for which experts in the field of Biochemistry are always in need. The syllabi for the three year B.Sc., degree programme in Biochemistry was framed in such a way that at the end of the course they could apply the knowledge and expertise in industries, diagnostic laboratories and various research fields

The programme endeavours to provide students a broad based training in biochemistry with a solid background of basic concepts as well as exposing them to the exciting advancements in the field. In addition to theoretical knowledge, significant emphasis has been given to provide hands on experience to the students in the forefront areas of experimental biochemistry. A multidisciplinary approach has been employed to provide the best leverage to students to enable them to move into frontier areas of biological research in the future.

The course defines clearly the objectives and the learning outcomes, enabling students to choose the elective subjects for broadening their skills. The course also offers skills to pursue research in the field of Biological Chemistry and thus would produce best minds to meet the demands of society.

Biochemistry, today is considered as an application oriented integrated basic science. It's an interdisciplinary science that has emerged by the confluence of principles of Chemistry, Physics and Mathematics to Biology. Advances in Biochemistry have immense positive implications on the understanding of biochemical interactions, cellular communications, hormonal mechanisms and the cross talks between them. The research in Biochemistry has been translational and there is a shift from hypothesis driven research to data dependent

research that promises translational, product oriented research. Much of the advancement in Biochemistry is in the advancement of Biotechnology, as a basic science discipline Biochemistry lead to Biotechnological advancement. Considering its pivotal role in biological sciences, it is imperative to strengthen the fundamental concepts of Biochemistry.

TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR UNDERGRADUATE EDUCATION	
Programme:	**B.Sc Biochemistry**
Programme Code:	131
Duration:	**3 years [UG]**
Programme Outcomes:	**PO1: Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study **PO2: Communication Skills:** Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups. **PO3: Critical thinking:** Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development. **PO4: Problem solving: Capacity** to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations. **PO5: Analytical reasoning**: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints. **PO6: Research-related skills**: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesising and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation

	PO7: Cooperation/Team work: Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team **PO8: Scientific reasoning**: Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective. **PO9: Reflective thinking**: Critical sensibility to lived experiences, with self awareness and reflexivity of both self and society. **PO10 Information/digital literacy:** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data. **PO 11 Self-directed learning**: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion. **PO 12 Multicultural competence:** Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups. **PO 13: Moral and ethical awareness/reasoning**: Ability toembrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstratingthe ability to identify ethical issues related to one"s work, avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work. **PO 14: Leadership readiness/qualities:** Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way. **PO 15: Lifelong learning:** Ability to acquire knowledge and skills, including „learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.
Programme Specific Outcomes:	**PSO1 – Placement:** To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions. **PSO 2 - Entrepreneur:** To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate

	startups and high potential organizations **PSO3 – Research and Development:** Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development. **PSO4 – Contribution to Business World:** To produce employable, ethical and innovative professionals to sustain in the dynamic business world. **PSO 5 – Contribution to the Society:** To contribute to the development of the society by collaborating with stakeholders for mutual benefit

PROGRAM OUTCOMES

PO1	Acquire knowledge in Biochemistry and apply the knowledge in their day to day life for betterment of self and society
PO2	Develop critical ,analytical thinking and problem solving skills
PO3	Develop research related skills in defining the problem, formulate and test the hypothesis, analyse, interpret and draw conclusion from data
PO4	Address and develop solutions for societal and environmental needs of local, regional and national development
PO5	Work independently and engage in lifelong learning and enduring proficient progress
PO6	Provoke employability and entrepreneurship among students along with ethics and communication skills

PROGRAM SPECIFIC OUTCOMES

PSO1	Comprehend the knowledge in the biochemical, analytical, biostatistical and computational areas
PSO2	Ability to understand the technical aspects of existing technologies that help in addressing the biological and medical challenges faced by human kind
PSO3	Acquiring analytical and hands on skills to perform research in multidisciplinary environments
PSO4	Use library search tools and online databases and sources to locate and retrieve scientific information about a topic and techniques related to biochemistry

Eligibility for admission

Candidate for admission to the first year of B.Sc. Degree Course in Bio-Chemistry shall be required to have passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry.

3.Highlights of the Revamped Curriculum

- The curriculum is created to improve the relationship between business and academia
- Every semester,practicals based on the course taken that semester will aid students in applying what they have learned
- Students will benefit from the introduction of skill based elective courses including Bioinformatics,Nanobiotechnology,Therapeutic nutrition, and Medical Laboratorytechnology as they keep up withtechnological advancements in their fields of study
- The fourth semester internship will give students a chance to apply what they have learned in class to a real world working experiment
- Skill enhancement courses help students venture new platforms in career.
- Equip students with employability skills,generateself employment and small scale entrepreneurs.

4.Value additions in the Revamped Curriculum:

Semester	Newly introduced Components	Outcome / Benefits
I	**Foundation Course** It depicts the overview of entry education and makes the students assimilate with the biochemistry course. This course will inculcate knowledge of the academic skills, laboratory skills and research	It gives a strong determination to undergo the course.Be committed and interested in learning the subject.

I, II, III, IV	**Skill Enhancement papers (Discipline centric / Generic / Entrepreneurial)**	Improve employability. Develop the skill as Laboratory Analyst To make students compete with industrial expectations.
		Incorporating the interest on health, diet, lifestyle diseases will enable the students gain knowledge to get exposed themselves in medical field
		Biomedical Instrumentation skills will aid the students gain knowledge on the various instruments used in the field of medical laboratory and research.
		Entrepreneurial skill training will increase the chance to build their career independently.Learning this skills will encourage the students to enhance creativity, innovation and collaboration
		Discipline /subject specific skill will serve as a route for employability
V & VI	**Elective papers-** An open choice of topics categorized under Generic and Discipline Centric	It reinforces additional knowledge inputs along with core course.Students are familiarized with multi-disciplinary,crossdisciplinary and inter disciplinary subjects. It broadens the knowledge on immunological aspects, pharmacology and research. Additional Employability skills are facilitated through computational biology and Bioentrepreneurship.
V semester Vacation activity	**Internship/ Industrial visit/Field visit**	Hand on training in Medical Labs/ Industry/ Research centres enable the students to explore the practical aspects in career path. They gain confident to fix their career.
VI Semester	**Project with Viva – voce**	Self-learning is enhanced·It serves as a platform to express their innovative ideas in a practical way, which serves as a pathway to enter in the field of research.
VI Semester	**Introduction of Professional Competency skill**	The revamped curriculum caters the education to all category of learners; Learning multidisciplinary papers, updated in the curriculum will help the

		students to fix their career in the fields of Medical, pharmaceutical, forensic, nutritional, diagnostic coding ,etc ·Students are trained in the field of research to bring out the progress in the field of Medical, Agriculture ,Nutrition ,etc which will be a back bone for health and wealth creation and improve the quality of life
Extra Credits: **For Advanced Learners / Honours degree**		ETo cater to the needs of peer learners / research aspirants
Skills acquired from the Courses		Analytical, Laboratory operating, Predicting, Experimenting, Critical thinking, Problem solving, Communication, Interpersonal, Time management and Multi-tasking Skills

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	13	12	12	12	22	21	92
Part IV	4	4	4	6	4	1	23
Part V	-	-	-	-	-	1	1
Total	23	22	22	24	26	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	ContinuousInternalAssessmentTest	25 Marks
	Assignments	
	Seminars	
	AttendanceandClassParticipation	
External Evaluation	EndSemesterExamination	75 Marks
	Total	100 Marks
MethodsofAssessment		
Recall(K1)	Simpledefinitions,MCQ,Recallsteps,Conceptdefinitions	
Understand/Comprehend(K2)	MCQ,True/False,Shortessays,Conceptexplanations,Shortsummaryor overview	
Application (K3)	Suggestidea/conceptwithexamples,Suggestformulae, Solveproblems, Observe,Explain	
Analyze(K4)	Problem-solvingquestions,Finishaprocedureinmanysteps,Differentiate	
	betweenvariousideas,Mapknowledge	
Evaluate(K5)	Longer essay/Evaluationessay,Critiqueorjustifywithprosandcons	
Create(K6)	Checkknowledgeinspecificoroffbeatsituations,Discussion,Debatingor Presentations	

B.Sc., Biochemistry

Sem.	Part	Course Code	Courses	Title of the Paper	T/P	Cr.	Hrs./ Week	Max. Marks		
								Int.	Ext.	Total
I	I	2311T	T/OL	தமிழ் இலக்கிய வரலாறு-I /Other Languages -I	T	3	6	25	75	100
	II	2312E	E	General English - I	T	3	6	25	75	100
	III	23BBC1C1	CC-I	Nutritional Biochemistry	T	4	5	25	75	100
		23BBC1P1	CC-II	Core Practical I-Nutritional Biochemistry	P	4	4	25	75	100
		-	Generic Elective (Allied)	Chemistry I/Botany/Microbiology/ Home science	T	3	3	25	75	100
				Allied Lab	P	2	2	25	75	100
	IV	23BBC1S1	SEC-I	Medicinal Diet	T	2	2	25	75	100
		23BBC1FC	FC	Fundamentals of Biochemistry	T	2	2	25	75	100
				Total		**23**	**30**	**200**	**600**	**800**
II	I	2321T	T/OL	தமிழ் இலக்கிய வரலாறு-2 /Other Languages-II	T	3	6	25	75	100
	II	2322E	E	General English - II	T	3	6	25	75	100
	III	23BBC2C1	CC-III	Cell Biology	T	4	5	25	75	100
		23BBC2P1	CC-IV	Core Practical II-Cell Biology	P	3	4	25	75	100
		--	Generic Elective (Allied)	Chemistry I/Botany/Microbiology/ Home science	T	3	3	25	75	100
		--		Allied Lab	P	2	2	25	75	100
	IV	23BBC2S1	SEC-II	First Aid	T	2	2	25	75	100
		23BBC2S2	SEC-III	Medical Laboratory technology	T	2	2	25	75	100
		--		Naan Mudhalvan Course		2		25	75	100
				Total		**22**	**30**	**200**	**600**	**800+ 100**
III	I	2331T	T/OL	**தமிழக வரலாறும் பண்பாடும்** /Other Languages-III	T	3	6	25	75	100
	II	2332E	E	General English – III	T	3	6	25	75	100
	III	23BBC3C1	CC-V	Biomolecules	T	4	5	25	75	100
		23BBC3P1	CC-VI	Core Practical III- Biomolecules	P	3	4	25	75	100
		--	Generic Elective (Allied)	Chemistry I/Botany/Microbiology/ Home science	T	3	3	25	75	100
		--		Allied Lab	P	2	2	25	75	100
	IV	23BBC3S1	SEC-IV	Tissue Culture	T	2	2	25	75	100
		233AT/ 23BBC3S2	SEC-V	Adipadai Tamil/ Basics of Forensic Science	T	2	2	25	75	100
		--		Naan Mudhalvan Course		2		25	75	100
				Total		**22**	**30**	**200**	**600**	**800+ 100**
IV	I	2341T	T/OL	**தமிழும் அறிவியலும்** /Other Languages -IV	T	3	6	25	75	100
	II	2342E	E	General English – IV	T	3	6	25	75	100
	III	23BBC4C1	CC-VII	Biochemical techniques	T	4	4	25	75	100
		23BBC4P1	CC-VIII	Core Practical IV -Biochemical Techniques	P	3	3	25	75	100

		--	Generic Elective (Allied)	Chemistry I/Botany/Microbiology/ Home science	T	3	3	25	75	100
		--		Allied Lab	P	2	2	25	75	100
	IV	23BBC4S1	SEC-VI	Microbial techniques	T	2	2	25	75	100
		234AT/ 23BBC4S2	SEC-VII	Adipadai Tamil/Medical Coding	T	2	2	25	75	100
		23BES4	EVS	Environmental Studies	T	2	2	25	75	100
		--		Naan Mudhalvan Course		2		25	75	100
				Total		**24**	**30**	**225**	**675**	**900+ 100**
V	III	23BBC5C1	CC-IX	Enzymes	T	4	5	25	75	100
		23BBC5C2	CC-X	Intermediary Metabolism	T	4	5	25	75	100
		23BBC5C3	CC-XI	Clinical Biochemistry	T	4	5	25	75	100
		23BBC5P1	CC-XII	Core Practical V- Clinical Biochemistry	P	4	5	25	75	100
		23BBC5E1	DSE-I	Immunology	T	3	4	25	75	100
		23BBC5E2/ 23BBC5E3	DSE-II	Biochemical Pharmacology/ Research Methodology	T	3	4	25	75	100
	IV	23BVE5		Value Education	T	2	2	25	75	100
		23BBC5I/ 23BBC5IV/ 23BBC5FV		Internship/Industrial Visit/ Field Visit	PR	2	-	25	75	100
		--		Naan Mudhalvan Course		2	2	25	75	100
				Total		**26+ 2**	**30**	**200**	**600**	**900+ 100**
VI	III	23BBC6C1	CC-XIII	Molecular Biology	T	4	5	25	75	100
		23BBC6C2	CC-XIV	Human Physiology	T	4	5	25	75	100
		23BBC6C3	CC-XV	Plant Biochemistry & Plant therapeutics	T	3	4	25	75	100
		23BBC6D/ 23BBC6PR		Dissertation/Project	PR	3	4	25	75	100
		23BBC6E1	DSE-III	Biotechnology	T	3	5	25	75	100
		23BBC6E2/ 23BBC6E3	DSE-IV	Bioinformatics / Bio entrepreneurship	T	3	5	25	75	100
	IV	23BBC6S1		Essential Reasoning and Quantitative Aptitude	T	2	2	25	75	100
	V	23BEA6		Extension Activity	P	1	-	25	75	100
		--		Naan Mudhalvan Course		2		25	75	100
				Total		**23+2**	**30**	**150**	**450**	**700+ 100**
				Grand Total		**140 + 10**	**--**	**1175**	**3525**	**4700 +500**

- TOL-Tamil/Other Languages,
- E – English
- CC-Core course
- Generic Elective (Allied)

- SEC-Skill Enhancement Course
- FC-Foundation Course
- DSE – Discipline Specific Elective

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		
									CIA	External	Total
23BBC1C1	**Core Paper1-Nutritional Biochemistry**	Core	2	1	0	0	4	5	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.

Unit 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.
Unit 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.
Unit 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 .

Unit 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.
Unit 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.

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 Dietics. Bappco.

3.Tom Brody(1998). Nutritional Biochemistry (2nded), Academic press, USA

4.Garrow, JS,James WPT and Ralph A (2000). Human nutrition and dietetics(10thed) Churchill Livingstone.

5.Andreas M.Papas(1998). Antioxidant Status, Diet, Nutrition, and Health (1sted) CRC

Reference Books

1.Branen, A.L., Davidson PM &Salminen S. 2001. Food Additives.2nd Ed. Marcel Dekker.

2. Gerorge, A.B. 1996. Encyclopedia of Food and Color Additives. Vol. III. CRC Press.

3.Advances in food biochemistry, FatihYildiz (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

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

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)

IYEAR : SEMESTER I

PRACTICAL I -NUTRITIONAL BIOCHEMISTRY

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BBC1P1	**Practical 1- Nutritional Biochemistry**	Core	0	0	3	0	4	4	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

TITRIMETRY20hrs

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.

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.

3Bowman 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

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 moisturecontent of the food samples	PO1,PO3
CO4	Extract oil from its sources	PO1,PO3,PO6

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)

FIRST YEAR :SEMESTER I

MEDICINAL DIET

Course Code	Course Name	Category		L	T	P	S	Credits	Inst. Hours	Marks		
										CIA	External	Total
23BBC1S1	**Medicinal Diet**	SEC			2	-	-	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.

Unit I	Principles of 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.
Unit II	Diet modification in Gastrointestinal diseases: Peptic ulcer, Diarrhea, Lactose intolerance, Constipation and Malabsorption syndrome
Unit III	Diet Modification in liver and gall bladder in diseases: Etiology, symptoms and dietary treatment in jaundice, hepatitis, cirrhosis of liver and hepatic coma.
Unit IV	Diet Modification in Infectious Diseases: Fevers, Typhoid, Tuberculosis and Viral Hepatitis. Dietary modifications in Tuberculosis.
Unit V	Diet Modification in Diabetes , Renaland Cardio-vascular diseases-Diabetes, acute & chronic glomerulonephritis, nephrosis, renal failure, kidney stone and Hypertension.

Text Books

1.M.RaheenaBegum ,AText Book of Foods, Nutrition and Dietetics, Sterling Publishers Pvt.Ltd.

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

3.William S.R Nutrition and Diet Therapy, 1985, 5thedition, MoslyCo.St.Louis.

Reference books

1.Rodwell Williams Nutrition and Diet Therapy, 1985,the C.V MoslySt.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

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 Renaland Cardio-vascular diseases	PO1,PO4,PO5,PO6

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)

FOUNDATION COURSE

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									I	E	T
23BBC1FC	Fundamentals of Biochemistry	FC	2	2	0		2	2	25	75	100

Learning Objectives

The objectives of this course are to

- Build a basic idea about the structure and functions of carbohydrates
- Create an idea about the structure of Amino acids and important properties of proteins.
- Create awareness about the classification of fatty acids, lipo proteins, steroids
- Study about the structure and types of DNA and RNA
- Understand the nature and mode of action of enzymes.

Unit I	Carbohydrates- Monosaccharides- Structure & Biological importance of Glucose and Fructose only. Disaccharides-Structure & Biological importance of Sucrose, Maltose and Lactose. Polysaccharides-Structure & Biological importance of Starch and Glycogen.
Unit II	Amino acids- Basic structure of amino acid, essential and non-essential amino acids. Proteins: Definition, Primary structure, and Classification of Proteins. Renaturation and Denaturation of Proteins, Iso electric points.
Unit III	Lipids: Definition, Classification, and properties. Types of fatty acids -saturated, unsaturated, and essential fatty acids. Classification and significance of lipoproteins and phospholipids. Importance of steroids, structure, and biological significance of cholesterol.
Unit IV	Components of DNA and RNA. Structure and types of DNA and RNA. Denaturation and renaturation of DNA. Genetic code.
Unit V	Classification of enzymes with examples, coenzymes and cofactors (structures not needed). Active site: Lock and Key model, Induced fit hypothesis. Factors affecting enzyme activity. Types of inhibition of enzyme action. Industrial applications of enzymes.

Text books:

1. Ambika Shanmugam's Fundamentals of Biochemistry for Medical Students, Wolters Kluwer India Pvt. Ltd.8th Edition,2016.
2. Fundamentals of Biochemistry, JL.Jain et al,S. Chand Publishing,7thEdition,2004.
3. Fundamentals of Biochemistry , A.C. Deb, New central book agency-kolkata, 7th Edition,2001.

Reference Books:

1. Lehninger, A.L., Nelson, D.L., Cox, M.M., Principles of Biochemistry, CBS Publishers, 7th Edition
2. Harper's Biochemistry: R.K. Murray, D. K Granner, P.A. Mayes and U.W.Rodwell – Lange Medical publications, 31st edition
3. Textbook of Medical Biochemistry – Rana Shindae and Chatterjee, 8th Edition, 2012.

Web resources:

1. https://open.umn.edu/opentextbooks/textbooks/866
2. https://www.qmul.ac.uk/library/library-skills/resource-guides-by-subject/biological-sciences/useful-websites/biochemistry---useful-websites/
3. https://libguides.bodleian.ox.ac.uk/biochemistry/free-online-resources

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Understand about the structure and function of carbohydrates	PO1
CO2	Describe the structure of amino acids, classification of proteins, primary structure of proteins, Iso electric point.	PO1,PO2
CO3	Understand the structure and classification of lipids	PO1,PO2
CO4	Aquire knowledge on the structure and types of DNA and RNA	PO1
CO5	Understand the nature and activity of enzymes	PO1,PO2, PO6

Mapping with Program Outcome

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

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

FIRST YEAR :SEMESTER II

CELL BIOLOGY

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BBC2C1	**Cell Biology**	Core -III	2	1	-	-	4	5	25	75	100

Learning Objectives

Themainobjectivesofthiscourseareto

- 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 transportmechanism
- Impart knowledge on cellcycle, cell division and basics of cells
- Familiarize the concept of mechanism of cell-cell interactions.

Unit I	Architecture of cells- Structural organization of prokaryotic and eukaryotic cells microbial, plant and animal cells. The ultrastructure of nucleus, mitochondria, RER, SER, golgi apparatus, lysosome, peroxisome and their functions
Unit 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.
Unit III	Biomembranes-Structuralorganizationofbilipidlayermodelandbasicfunctions- transport across cell membranes- uniport, symport and antiport. Passive and active transport.
Unit IV	Cellcycle-DefinitionandPhasesofCellcycle-Celldivision-MitosisandMeiosis and its significance, Cancer cells- definition, types andcharacteristics of cancer cells.
Unit 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

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. (4”ed). 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

Course Outcomes

CO	On completion of this course, students will be able to	Programoutcomes
CO1	Explainthestructureandfunctionsofbasiccomponentsofprokaryotic and eukaryotic cells, especially the organelles.	PO1
CO2	Familiarize the cytoskeleton and chromatin	PO1,PO2
CO3	Illustrate thestructure,composition and functionsofcellmembranerelated to membrane transport	PO1,PO2
CO4	Elaborate thephasesofcellcycle and cell division-mitosisandmeiosis and characteristics of cancer cells.	PO1, PO2
CO5	Relatethestructureandbiologicalroleofextracellularmatrix in cellular interactions	PO1,PO2

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	Hours	Marks		
									CIA	Terminal	Total
23BCC2P1	**Practical II: Cell Biology**	Core practical	-	-	3	-	3	4	25	75	100

Learning Objectives

Themainobjectivesofthiscourseareto

- Learn the parts of microscope
- Investigatethecellsunder microscope.
- Image the cellsusing different stains
- Identify the cells, organelles and stages of cell division
- Identify the spotters

I MICROSCOPYANDSTAININGTECHNIQUES

1. Studythepartsoflightandcompoundmicroscope
2. Preparation of Slides andMicrometry
3. Examinationofprokaryoticandeukaryoticcell
4. Visualization of animal and plant cell by methylene blue
5. Visualization of nuclear fraction by acetocarmine stain
6. StainingandvisualizationofmitochondriabyJanusgreenstain

II GROUP EXPERIMENT

7.Identificationofdifferentstagesofmitosisinonionroottip

8.Identification of different stages of meiosis in onion bulb

III SPOTTERS

9. a) **Cells**:Nerve,plantandAnimalcell

   b) **Organelles**:Mitochondria,Chloroplast,Endoplasmicreticulum,

   c) **Mitosisstages**–Prophase,Anaphase,Metaphase,Telophase

Text books

1.Rickwood,DandJ.R.HarriscellBiology:EssentialTechniques,Johnwikey1996.

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, 2ndEdn.

Referencebooks

1) Essential practical handbook of Cell biology ,Genetics andMicrobiology -A Practical manual- Debarati Das Academic publishers, ISBN, 9789383420599, 1st Edition 2017
2) CellbiologyPractical,Dr.VenuguptaISBN8193651219,Prestigepublisher,1stJan2018.
3) Cell and Molecular biology, DeRobertis, 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-geneticdiversity/a/phases-of-meiosis
7. https://www.microscopemaster.com/organelles.html
8. https://www.pdfdrive.com/biochemistry-books.html

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Identifythepartsofmicroscope.	PO1,PO2
CO2	PreparationofSlides	PO1,PO2
CO3	Identifythestagesofmitosis&meiosis	PO1,PO2
CO4	Visualizenucleusandmitochondriabystaining methods	PO1,PO2
CO5	Identifythespottersofcells,organellesandstagesofcelldivision	PO1,PO2

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)

FIRST AID

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BBC2S1	**First Aid**	SEC -II	1	1	-	-	2	2	25	75	100

Learning Objectives

Themainobjectivesofthiscourseareto:

- 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.

Unit 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.
Unit II	Basics ofRespiration – CPR, first aid during difficult breathing, drowning, choking, strangulation and hanging, swelling within the throat, suffocation by smoke or gases and asthma.
Unit III	Common medical aid- first aid for wounds, cuts, head, chest, abdominal injuries, shocks, burns, amputations, fractures, dislocation of bones.
Unit IV	First aid related to unconsciousness, stroke, fits, convulsions- seizures, epilepsy
Unit V	First aidin poisonous bites (Insects and snakes), honey bee stings, animal bites, disinfectant , acid and alkali poisoning

Text books

1) First aid and health Dr. Gauri Goel, Dr. Kumkum Rajput, Dr.ManjulMungali

1SBN-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/

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

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)

MEDICAL LABORATORY TECHNOLOGY

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BBC2S2	**Medical Laboratory Technology**	SEC-III	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.

Unit 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
Unit II	Determination of Blood group and Rh factor -Basic blood banking procedures- cross matching, screening test. Blood transfusion and hazards.
Unit 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.
Unit IV	Immuno diagnostics -Widal test, VDRL test, ASO, RA, CRP and Complement fixation Test. RIA, ELISA,, Skin test – Montaux and Lepramin tes
Unit V	Assay of clinically important enzymes- Estimation of clinically important hormones – Insulin, Thyroid and Reproductive hormones and its clinical significance

Text Books

1 Kanai L Mukherjee and Anuradha Chakravarthy Medical Laboratory Technology IVthedition,Vol I,2022

2.RamnikSood,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=QNYlX5Ne9lQ

2 https://www.slideshare.net/doctorrao/agglutination-tests-and-immunoassys

3 https://microbenotes.com/introduction-to-precipitation-reaction/

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

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)

SECOND YEAR :SEMESTER III

BIOMOLECULES

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BBC3C1	**Biomolecules**	Core -V	2	1	-	-	4	5	25	75	100

Learning objectives

Themainobjectivesofthiscourseareto:

- Introduce the structure, properties and biological significance of carbohydrates
- Comprehend the classification, functions and acid base properties of amino acids
- ElucidatethevariouslevelsoforganizationofProteins.
- Impartknowledgeonthe classification, propertiesandcharacterization of lipids.
- Acquaint with the classification, structure, properties and functions of nucleic acids

Unit 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 ofstarch, glycogen and cellulose. Heteropolysaccharides - Structure and biological significanceofmucopolysaccharides - hyaluronic acid, chondroitin sulphate and heparin. (structural elucidation not needed).
Unit 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.
Unit III	Proteins-Classification based on shape, composition, solubility and functions. Properties of proteins - Ampholytes,isoelectricpoint,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 sheath (keratin), triple helix (collagen). Tertiary structure – with reference to myoglobin.Quaternary structure with reference to haemoglobin.
Unit IV	Lipids- Lipids: Bloor'sclassification, 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 withtheirsignificance. Compoundlipids-Structureandfunctionsofphospholipidsandglycolipids.Derivedlipids-Structureandfunctionsofcholesterol,bileacidsandbilesalts.

Unit 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.

Textbooks

1.Biochemistry,U.Sathyanarayana&U.Chakrapani,2013,5th edition ElsevierIndiaPvt.Ltd.,Books&AlliedPvt.Ltd.

2.Fundamentals of Biochemistry, J.L.Jain, Sunjay Jain, Nitin Jain, 2013, 7th editionS.Chand&CompanyLtd.

3.TextbookofMedicalBiochemistry,MNChatterjea,RanaShinde,2002,8th edition,JaypeeBrothers.

Referencebooks

1.DavidL.Nelson,MichaelM.Cox,2005,Principlesof Biochemistry,4th editionW.H.FreemanandCompany.

2.Voet.D,Voet.J.G.andPratt,C.W,2004,PrinciplesofBiochemistry,4th editionJohnWiley&Sons,Inc.

3.ZubayG.L,*et.al*.,1995,PrinciplesofBiochemistry,1st edition,WmC.BrownPublishers.

Webresources

https://www.britannica.com/science/biomoleculehttps://en.wikipedia.org/wiki/Biomoleculehttps://www.khanacademy.org/science/biology/macromolecules

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Classify, illustratethestructureandexplainthephysicalandchemicalpropertiesofcarbohydrates.	PO1
CO2	Indicate the classification, structure, properties and biological functions of amino acids.	PO1
CO3	Explain the classification and elucidate the different levels ofstructuralorganizationofproteins.	PO1
CO4	Elaborateonclassification,structure,properties,functionsandcharacterization ofl ipids	PO1,PO4
CO5	Describe the structure, properties and functions of different types of nucleic acids	PO1

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
23BBC3P1	**Practical III Biomolecules**	Core Practical	-	-	3	-	3	4	25	75	100

Learning Objectives

Themainobjectivesofthiscourseare to

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

I)**Qualitative testfor 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 methods15 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.

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 house1st Edition, 2019

2.Introductory practical Biochemistry – S.K. Sawhney, Randhir Singh, 2nd ed, 2005.

3. Biochemical Tests – Principles and Protocols. Anil Kumar, SarikaGarg and NehaGarg.VinodVasishtha 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, 4thedition, 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

Course Outcomes

CO	On completion of this course, students will be able to	Programoutcomes
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

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)

TISSUE CULTURE

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BBC3S1	**Tissue Culture**	SEC-IV	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

Unit I	Introduction to Tissue culture, Types- seed, embryo, Callus, Organ, Protoplast culture, Advantages and importance of tissue culture, Tools and techniques
Unit II	Media and Culture Preparation - pH, temperature, solidifying agents. Role of Micro and macro nutrients. Maintenance of cultures.
Unit III	Methods of gene transfer in plants and animals - direct and indirect gene transfer methods
Unit IV	Cell culture technique - Explants selection, sterilization and inoculation
Unit V	Transgenic plants for crop improvement. Transgenic plants for molecular farming. Animal Cloning - an overview-Applications of animal cell culture

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.6Freshmen 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/

Course outcomes

CO	On completion of this course, students will be able to	Programoutcomes
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 knowledgeon plant and animal cell culture techniques	PO1,PO2,PO3
CO5	Study of applications of genetically modified plants and animals.	PO1,PO2,PO3

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)

BASICS OF FORENSIC SCIENCE

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BBC3S2	Basics of Forensic Science	SEC-V	1	1	-	-	2	2	25	75	100

Learning Objectives

Themainobjectivesofthiscourseareto

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.

Unit I	Forensic Science: Definition, History and Development. Crime scene management and investigation; collection, preservation, packing and forwarding of physical and trace evidences for analysis.
Unit II	Blood – grouping and typing of fresh blood samples including enzyme .Cases of disputed paternity and maternity problems, DNA profiling.
Unit 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.
Unit IV	Psychotropic drugs -Sedatives, stimulants, opiates and drugs of abuse. Identification of poisons from viscera, tissues and body fluids.
Unit 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

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

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
CO2	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

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)

SECOND YEAR :SEMESTER IV

BIOCHEMICAL TECHNIQUES

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BBC4C1	**Biochemical techniques**	Core – VII	2	1	-	-	4	4	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.
- Appraisetheuseofcolorimetricandspectroscopictechniquesin biology
- Impart knowledge about the measurement of radioactivity and safety aspects of radioactive isotopes.

Unit I	Centrifugation - Basic principles, RCF**,** Sedimentation coefficient,Svedberg constant. Types of rotors. Preparative centrifugation- differential and density gradient centrifugation, RatezonalandIsopycnictechniques, construction, working and applicationsofanalyticalultracentrifuge-Determinationofmolecularweight (Derivation excluded)
Unit II	Chromatography - adsorption, partition. Principle, instrumentation and applications of paper chromatography, thin layer chromatography, ion-exchange chromatography, gel permeation chromatography and affinity chromatography.
Unit III	Electrophoresis - Generalprinciples,factorsaffectingelectrophoreticmobility. Tiselius moving boundary electrophoresis.Electrophoresis with paper and starch.Principle, instrumentationandapplicationsofagarosegelelectrophoresisand SDS-PAGE.
Unit IV	Basics of Electromagnetic radiations- Energy, wavelength, wavenumber and frequency. Absorption and emission spectra, Lambert – Beer Law, Lightabsorption and transmittance.Colorimetry-Principle, instrumentationandapplications. Visible and UV spectrophotometry – Principle, instrumentation and applications - enzymeassay,structuralstudiesofproteinsandnucleicacids.

Unit 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 &Liquidscintillationcounters. Autoradiography. Biological applications and safety aspects of radioisotope.

Textbooks

1.AvinashUpadhyay,KakoliUpadhyay&NirmalenduNath,2002,Biophysical Chemistry, Principles and Techniques, 3rd edition, HimalayaPublishingHouse.
2.L.Veerakumari,2009,Bioinstrumentation,1st edition,MJPPublishers.
3.Keith Wilson & John Walker, 2000, Practical Biochemistry-Principles andtechniques, CambridgeUniversityPress,4thedition.

Referencebooks

1.Terrance G. Cooper The tools of Biochemistry ,. 1977, , John Wiley &Sons,Singapore.
2.Gurumani,ResearchMethodologyforBiologicalSciences, 2011,1st edition,MJPPublishers.
3.SarojDua, Neera Garg, Biochemical Methods of Analysis,2010, 1st edition,NarosaPublishinghouse.

Web Resources

1.https://www.britannica.com/science/chromatography
2.https://www.youtube.com/watch?v=xgxFBQZYXlE
3.https://www.youtube.com/watch?v=7onjVBsQwQ8

Course Outcomes

CO	On completion of this course, students will be able to	Programoutcomes
CO1	Describetypesof rotors and identify the centrifugation technique for the separation of biomolecules.	PO1,PO2,PO6
CO2	Demonstratetheprinciples,operationalprocedureandapplicationsofplanarandcolumnchromatography.	PO1,PO2, PO6
CO3	Specifythe factors andexplain the separationofDNAandproteinusingelectrophoretictechnique.	PO1,PO2, PO6
CO4	State Beer's Law and illustrate theinstrumentation and usesofcolorimeterand spectrophotometer .	PO1,PO2, PO6
CO5	Enumerate various methodsof measurement ofradioactivityand safety aspects of radioactive isotopes.	PO1,PO2, PO6

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	Inst. Hours	Marks		
									CIA	External	Total
23BBC4P1	**Practical IV-Biochemical techniques**	Core Practical	-	-	3	-	3	3	25	75	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. SeparationofserumproteinsbySDS-PAGE.

Text books

1. J. Jayaraman, Laboratory Manual in Biochemistry New Age International (P) Limited Fifth edition 2015.

2. S.SadasivamA.ManickamBiochemicalMethodsNewageInternationalPvtLtdpublishers 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

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Estimate the amount of biomolecules 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 electrophoretically	PO1,PO3,PO6

Mapping with ProgramOutcomes

	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)

MICROBIAL TECHNIQUES

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BBC4S1	**Microbial techniques**	SEC-VI	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

Unit 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.
Unit II	Microscopy- Principle, types - Compound microscope, electron microscope- TEM, SEM, use of oil immersion objective.
Unit 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.
Unit 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.
Unit 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.

Text books

1. Sherris Medical Microbiology, 7th Edition byAuthors: 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 Bhadauria5. 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

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

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)

MEDICAL CODING

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BBC4S2	**Medical Coding**	SEC-VII	1	1	-	-	2	2	25	75	100

Courseobjectives

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)

Unit I	Introduction to Medical coding, coding theory, Healthcare Common Procedure Coding, First Aid and CPR
Unit II	Introduction toMedical Terminology, specialization I & II, Diagnostic coding, factors affecting diagnostic coding
Unit III	Documenting medical records- Importance of Documentation, Types of dictation formats
Unit IV	Introduction to Human Anatomy and Coding, ICD-10- CM classification system
Unit V	Introduction to CPT coding, types of CPT coding Medical Law and Ethics

Text books

1.Understanding Medical Coding,A comprehensive guideSandraLJohnsonRobin Linker

2.Buck's Step – by – step Medical CodingElsevier 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.

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

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)

THIRD YEAR: SEMESTER V

ENZYMES

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BBC5C1	**Enzymes**	Core-IX	3	1	-	-	4	5	25	75	100

Learning objectives

Themainobjectivesofthiscourseareto

- Providefundamentalknowledgeonenzymesandtheirproperties.
- Understandthemechanismofactionofenzymes and the role of coenzymes in catalysis.
- Introduce the kinetics of enzymes and determine the Km and Vmax.
- Explaintheeffectofinhibitorsonenzymeactivity
- Understandtheroleofenzymesinclinicaldiagnosisandindustries.

Unit 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.
Unit 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.
Unit III	**Enzymekinetics** --Definition of kinetics,Factorsaffectingenzymeactivity - temperature, pH, substrate and enzyme concentration, activators-cofactors, Derivation of Michaelis-Menton equation for unisubstrate reactions , Lineweaver - Burk plot, Eadie -Hofsteeplot Significance of Km and V max andtheirdeterminationusing the plots.

Unit IV	Enzyme inhibition - Reversible and irreversible inhibition-types of reversible inhibitors, competitive, non-competitive, un-competitive inhibitors. Graphical representation by L-B plot,(Kineticderivationsnotrequired),DeterminationofKmandVmaxinthe presence and absence of inhibitors. Allosteric enzymes - Sigmoidal curve, positive and negative modulators
Unit V	Applications of enzymes -Immobilized enzymes - methods of immobilization-adsorption,covalentbonding,crosslinking,encapsulation,entrapmentandapplications of immobilized enzymes. Biosensors – e.g. Glucose sensors. Industrial applications of enzymes –Food, textile and pharmaceutical industries.

Textbooks

1.U.Sathyanarayana&U.Chakrapani,2013,Biochemistry, 4th edition, Elsevier India Pvt.Ltd., Books&AlliedPvt.Ltd.

2.Dr. G.R Agarwal, Dr. Kiran Agarwal & O.P. Agarwal, 2015, Textbook of Biochemistry (Physiological chemistry),18thedition, Goel Publishing House,

3.T.Devasena,2010, Enzymology,1stedition,Oxforduniversity Press.

Reference books

1.Trevor Palmer, 2008, Enzymes: Biochemistry, Biotechnology, ClinicalChemistry,2ndedition,EastWestPressPvt.Ltd.

2.DavidL.Nelson,MichaelM.Cox,2005,PrinciplesofBiochemistry,4theditionW.H.FreemanandCompany,

3.

Voet.D,Voet.J.G.andPratt,C.W,2004,PrinciplesofBiochemistry,4theditionJohnWiley&Sons,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

Course Outcomes

CO	On completion of this course, students will be able to	Programme outcome
CO1	Identifythe major classes of enzymes,differentiatebetweenachemicalcatalyst and a biocatalyst and define the units of enzymes.	PO1
CO2	Explain the mechanismofenzymecatalysis and the role of coenzymes in enzyme action.	PO1,PO2
CO3	Illustrate the steady state kinetics,,interpretMMplotandLBplotbasedonkineticsdata, and determineKmandVmax.	PO1,PO3

CO4	Distinguish the types of inhibition along with itsimportanceinbiochemicalreactions.	PO1,PO3
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

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	Inst. Hours	Marks		
									CIA	External	Total
23BBC5C2	**Intermediary metabolism**	**Core -X**	3	1	-	-	4	5	25	75	100

Learning Objectives

Themainobjectivesofthiscourseareto

- Reviewthebasicconceptsoffreeenergytransformationanddescribebiologicaloxidation.
- Illustratethepathwaysofcarbohydratemetabolism.
- Explainthepathwaysofoxidationandbiosynthesis of lipids.
- Detail the catabolism of amino acids and synthesis ofspecializedproductsfromaminoacids.
- Acquaint the metabolismofnucleicacidsanditsregulation

Unit I	Bioenergetics-High energy compounds**:** Role of high energy compounds, free energy hydrolysis of ATP and other organophosphates, ATP-ADPcycle. Biological Oxidation: Electron transport chain -its organization and function. Inhibitors of ETC. Oxidative phosphorylation, P/Oratio, Peter Mitchell's chemiosmotic hypothesis. Mechanism of ATP synthesis, uncouplers of oxidativephosphorylation,substratelevelphosphorylationwithexamples.
Unit II	Metabolism of carbohydrates -Glycolysis, TCA Cycle, AmphibolicnatureandintegratingroleofTCAcycle.Anaplerosis,Pentose Phosphate Pathway (HMP shunt), Gluconeogenesis, Glycogenesis, Glycogenolysis anditsregulation, glyoxylate cycle, Entner- Duodoroff pathway andCoricycle.
Unit 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 fattyacids, Ketogenesis,Biosynthesis of saturated fatty acids and unsaturated fattyacids, Biosynthesis and degradation of triglycerides, phospholipids and cholesterol.
Unit 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.
Unit V	Metabolismof nucleotides-Biosynthesis of purines and pyrimidines, - denovo synthesis and salvage pathways, Degradation of purines and pyrimidines, Conversion of ribonucleotide to deoxyribonucleotide

Textbooks

1,U.Sathyanarayana&U.Chakrapani,2015,Biochemistry,4th ElsevierIndiaPvt.Ltd.,

2.M.N. Chatterjea andRanaShinde,2002,

TextbookofMedicalBiochemistry,5th editionJaypeeBrothersMedicalPublishersPvt.Ltd.

Referencebooks

1.LehningerPrinciplesofBiochemistry, David L. Nelson, Michael M.Cox, 2008, 5th edition, W.H. Freeman and Company.

2.RobertK.Murray,DarylK.Granner,VictorW.Rodwell,2006,Harper'sIllustratedBiochemistry,27th edition, McGrawHillPublishers.

3.PrinciplesofBiochemistry Voet.D,Voet.J.G,andPrattC.W.,2010,,Fourthedition,JohnWiley&Sons,Inc,.

4.PrinciplesofBiochemistry,GeoffreyL.Zubay,WilliamW.Parson,DennisE.Vance,1995,2nd Edition,Wm.C. BrownPublishers.

5.Biochemistry, Garret, R.H.andGrisham, C.M.2005,3rd Edition. Thomson Learning INC.

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

Course Outcomes

CO	On completion of this course, students will be able to	Programoutcomes
CO1	Statetheconceptsofbioenergeticsandillustratethemechanismofflowofelectronsandtheproductionof ATP.	PO1,PO2
CO2	Elaboratethebiochemicalreactionsandintegrationofpathwaysofcarbohydratemetabolism.	PO1,
CO3	Sketch the oxidation and biosynthesisoffattyacids,phospholipids,triglyceridesandcholesterolwithsuitableexamples	PO1
CO4	Explain catabolism of amino acids,synthesisofnonessentialaminoacidsandspecializedproductsfromaminoacids.	PO1
CO5	Describethemetabolismofnucleicacids with necessaryillustrationsanditsregulation.	PO1

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
23BBC5C3	**Clinical Biochemistry**	Core-XI	3	1	-	-	4	5	25	75	100

Learning objectives

Themainobjectivesofthiscourseareto

- Comprehendthebasicconcepts and disorders of carbohydrate metabolism
- Explainthedisorders of lipid metabolism.
- Elucidatetheliver function test and kidney function test.
- Designate the gastric function test.
- Familiarize the clinical enzymology.

Unit I	Disordersofcarbohydratemetabolism: 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 andGlycogenstoragediseases.
Unit II	Disorders of Lipid Metabolism**:** Lipid Profile,Atherosclerosis,Fattyliverandhyperlipidemia.Hypercholesterolemia, Lipidosis and Xanthomatosis, Tay-Sach`s disease, Niemann-Pick disease, lipotropic agents
Unit III	Liver Function Tests**:** Bilirubin metabolism and jaundice, Estimation of conjugated and total bilirubininserum (Diazomethod). Detection of bilirubin and bilesaltsinurine (Fouchet'stest and Hay's Sulphur test). Thymolturbidity test, prothrombintime, serumenzymesinliverdisease 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.
Unit IV	GastricFunctiontest: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
Unit V	Clinical enzymology**:** Enzymes of diagnostic importance- LDH, creatine kinase, transaminases, phosphatases, Isoenzymes of lactate dehydrogenase.

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 (7^{th}ed). John Wiley and sons.

3. Tietz Fundamentals of clinical chemistry and molecular Diagnostics (2014) (7^{th}ed) 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

Course Outcomes

CO	On completion of this course, students will be able to	Programoutcomes
CO1	Explaintheconceptsofhormones and their importance to maintain glucose and types of Diabetes, diagnosis and treatment.	PO1,PO3,PO6
CO2	Analyzethelipid 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	Elaboratetheenzyme markers used for diagnostic studies.	PO1,PO3,PO6

Mapping with ProgramOutcomes

	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

CLINICAL BIOCHEMISTRY

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BBC5P1	**Practical V- Clinical Biochemistry**	Core Practical V	1	0	4	0	4	5	25	75	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)Aminoacids(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

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

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 *

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

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 V

DSE-I -IMMUNOLOGY

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BBC5E1	**Immunology**	DSE-I	3	1	-	-	3	4	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

Unit I	Structure and function of primary lymphoid organs (thymus ,bone marrow), secondarylymphoid organs (spleen, lymph node), Cells involved in immune system-Functions-Phagocytosis -Inflammation
Unit 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.
Unit 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
Unit 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.
Unit V	Antigen-antibody reactions, General features of Antigen Antibody reactions. Precipitation, Immuno diffusion, SID and DID -Oudin Procedure, Oakley Fulthrope Procedure, Radio immunodiffusion, Ouchterlony double diffusion, CIE, Rocket electrophoresis, Agglutination-Coomb's test Complement Fixation test-Wasserman's reaction, RIA, ELISA.

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, 7thedition, Garland Science.

2. Abul K. Abbas, Andrew H. Lichtman, Jordan S. Pober - (1994), Cellular and molecular immunology, 2ndedition, 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: 9780323549431eBook 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

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
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

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
23BBC5E2	**Biochemical Pharmacology**	DSE-II	3	1	-	-	3	4	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 .

Unit 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.
Unit II	Drug metabolism **-** Phase I and Phase II reactions, role of cytochrome P_{450} , non-microsomal reactions of drug metabolism. Factors influencing drug metabolism.Therapeutic index.
Unit 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.
Unit 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.
Unit V	Antibiotics - Definition, Examples and Biochemical mode of action of penicillin, streptomycin, tetracyclines and chloramphenicol.

Text Books

1. N.Murugesh, 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

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

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
23BBC5E3	**Research Methodology**	DSE-II	3	1	-	-	3	4	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 reporthands-on experience in designing and working on small projects.

Unit 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.
Unit 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
Unit 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
Unit 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
Unit 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.

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.

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

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 VI

MOLECULAR BIOLOGY

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BBC6C1	**Molecular Biology**	Core -XIII	3	1	-	-	4	5	25	75	100

Learning Objectives

The objectives of this course are to

- Provide insightsintothecentraldogmaofmolecularbiology and explainthemechanismofDNAreplication.
- Elaborate themechanismof transcription andreverse transcription.
- Highlight the characteristics of genetic code and describetheprocessofprotein synthesis.
- Introduce the concept of regulationofgeneexpressioninprokaryotes
- Familiarize the different types of mutationsand explain the mechanismof DNA repair.

Unit I	Central Dogma of molecular Biology, DNA as the unit of inheritance. Experimentalevidences by Griffith's transforming principle, Avery, McLeod and McCarthy'sexperiment,andHersheyandChaseExperiment.Replicationinprokaryotes:Modesofreplication,MeselsonandStahl'sexperimental proof for semiconservative replication. Mechanism of Replication – Initiation, events at Ori C, Elongation - replicationfork, semi discontinuous replication, Okazaki fragments, and termination. Bidirectional replication, Inhibitorsofreplication. Modelsofreplication-theta,rollingcircleandDloopmodel.
Unit II	Transcription - Mechanism of transcription: DNA dependent RNA polymerase(s), recognition, binding and initiation sites, TATA/ Pribnow box, elongation and termination. Post-transcriptional modifications;inhibitorsoftranscription.RNAsplicing and processing of mRNA, tRNA and rRNA. Reverse transcription.
Unit III	GeneticCode and its characteristics, Wobble hypothesis. Translation: Adaptor role of tRNA, Activation of amino acids, Initiation, elongationandterminationofproteinsynthesis,post-translationalmodificationsandinhibitors of protein synthesis.
Unit IV	RegulationOfGeneExpressionInProkaryotes - Principlesofgeneregulation,negativeandpositiveregulation,conceptofoperons,regulatory proteins, activators, repressors, regulation of lac operon and trp operon.
Unit 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 .

Textbooks

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

Genetics,MolecularBiology,EvolutionandEcology,1st edition,S.Chand&CompanyPvt. Ltd.

Referencebooks

1.Karp,G.,2010,CellandMolecularBiology:ConceptsandExperiments,6th edition,JohnWiley&Sons.Inc.

2.DeRobertis,E.D.P.andDeRobertis,E.M.F.,2010,CellandMolecularBiology,8th edition,LippincottWilliamsandWilkins,Philadelphia.

3.James.D.Watson,2013,MolecularBiologyoftheGene7th edition,BenjaminCummings.

4.GeorgeM.Malacinski,1992,Freifelder'sEssentialsofMolecularBiology,4th edition,NarosapublishingHouse.

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/

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 formationofdifferenttypesofRNA.	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

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
23BBC6C2	**Human Physiology**	Core -XIV	3	1	-	-	4	5	25	75	100

Learning Objectives

Themainobjectivesofthiscourseareto

- Aidinunderstandingthephysiologyofrespiratory and circulatory systems
- Explain the structure and physiology of the nervous and muscular system
- Explicatethefunctionsof digestive and excretory system of the body.
- Impartknowledge about the process of reproduction.
- Emphasize the importance of various endocrine factors that regulate metabolism, growth, homeostasis and reproduction.

Unit I	Respiratory System-Over view of respiratory system, Types of respiration, Transport of respiratory gases, Exchange of respiratory gases in lungs and tissues –Chloride Shift & Bohr'seffect, 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.
Unit II	Nervous system- Structure ofneuron,synaptic transmission, reflex action, neurotransmission- Resting membrane andAction potential. neuro transmitters- acetyl choline, Noradrenaline, Dopamine,Serotonin,Histamine,GABA,SubstanceP.Muscular system-structure and types of muscles - skeletal, smooth and cardiac muscles, muscle proteins- types and functions, mechanism of muscle contraction.
Unit III	Digestive system- composition, functions of saliva, gastric pancreatic intestine and bile secretions, structure of digestive system, Digestion, absorption of carbohydrates, lipids, proteins.Excretorysystem-Structureofnephron,mechanism of urine formation, Concentration and acidificationofUrine.Roleofkidneysinthemaintenanceofacidbasebalance.
Unit IV	Reproductive system:-Oogenesis, spermatogenesis, capacitation and transport of sperm- blood testisbarrier.Fertilization, early development, Implantation, Placentation and Parturition.
Unit V	Endocrinology- Classification of hormones, endocrineglandsand their secretions, structure and functions of Insulin, thyroxine. Steroid hormones-Corticosteroids, Sex hormones – testosterone and estrogen, menstrual cycle.

Textbooks

1.K.Sembulingam&PremaSembulingam,2016,EssentialsofMedicalPhysiology,7thedition,JaypeeBrothersMedicalPublishers(P)Ltd.

2.Chatterjee.C.C.,1988,HumanPhysiology-VolI&II,1st edition,MedicalAlliedAgency.

3,AnimalPhysiology-MariakuttikanandArumugam,Saraspublication,2017.

Referencebooks

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,3rd edition,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/

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Explaintheexchangeofgases,designofbloodvesselsandcardiaccycle.	PO1
CO2	Summarize the events in transmission nerveimpulsesandmechanismofmuscle contraction.	PO1
CO3	Elaborate the structure and functions of digestive system, structure of nephron and mechanismofurineformationandroleofkidneyinmaintenanceofpH.	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

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

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
23BBC6C3	**Plant Biochemistry and Plant Therapeutics**	Core - XV	3	1	-	-	3	4	25	75	100

Learning Objectives

Themainobjectivesofthiscourseareto

- 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.

Unit 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.
Unit II	Secondary metabolites: Structure, Types, Sources, Biosynthesis and function of phenolics, tannins, lignins, terpenes and alkaloids. Medicinal properties of secondary metabolite
Unit III	PlanthormonesStructureandfunctionofplanthormonessuchasethylene,cytokinIns,auxins, Absicic acid, Florigin and Gibberlins.
Unit 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.
Unit V	Plant therapeutics: Bioactive principles in herbs, plants with antidiabetic, anticancer, antibacterial, antiviral, anti-malaria and anti-inflammatory properties

Text books

1. 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

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

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		
									CIA	External	Total
23BBC6E1	**Biotechnology**	DSE-III	2	1	0	0	3	5	25	75	100

Learningobjectives

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.

Unit 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.endlabeling and construction maps of PBR322, λ bacteriophage.
Unit 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**.**
Unit 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.

Unit 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.
Unit 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.

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 Pasternark 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.cm/biotechnology/techniques-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

Course Outcomes

CO	On completion of this course, students will be able to	Programoutcomes
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

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		
									CIA	External	Total
23BBC6E2	**Bioinformatics**	DSE-IV A	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

Unit 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.
Unit II	Biological Databases - definition, types and examples –, Nucleotide sequence database (NCBI, EMBL, Genebank, DDBJ) Protein sequence database-SwissProt, TrEMBL, Structural Database-PDB,Metabolic database-KEGG
Unit III	Sequence Alignment-Local and Global alignment-Dot matrixanalysis, PAM, BLOSUM. Dynamic Programming, Needleman- Wunch algorithm, Smith waterman algorithm.Heuristic methods of sequence alignment
Unit IV	BLAST-features, types (BLASTP, BLASTN, BLASTX), PSI BLAST, result format. DNAMicroarray-Procedure and applications.
Unit V	Structural genomics-Whole genome sequencing (Shotgun approach), Comparative genomics-tools for genome comparison, VISTA servers and precomputed tools. Molecular visualizationtools.RASMOL, Swiss PDB viewer. Nutrigenomics-Definition and applications

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

Course Outcomes

CO	On completion of this course, students will be able to	Programo utcomes
CO1	Introduce the fundamentals of Bioinformatics and its applications Genome, metabalome& Transcriptome.	PO1
CO2	Classify biological database and to correlate the different fileformatsused by nucle 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

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

BIOENTREPRENEURSHIP

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BBC6E3	**Bioentrepreneurship**	DSE-IV B	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

Unit I	Introduction to Bio entrepreneurship; Types of industries – Biopharma, Bio agriculture and CRO; Introduction to Trademarks , Copyrights and patents
Unit 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.
Unit 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
Unit 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.
Unit 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.

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/

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

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

DISSERTATION/PROJECT

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BBC6D/ 23BBC6PR	**Core paper 16 Project**	Core	3		5	-	3	4	25	75	100

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">ESSENTIAL REASONING AND QUANTITATIVE APTITUDE</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Professional Competency Skill</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">PCS</td><td>Year</td><td>III</td><td>Credits</td><td>2</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>VI</td><td colspan="3">23BBC6S1</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>1</td><td>1</td><td colspan="2">-</td><td colspan="2">2</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">• Develop Problem solving skills for competitative examinations
• Understand the concepts of averages , simple interest , compound interest</td></tr>
<tr><td colspan="2">UNIT-I:</td><td colspan="6">Quantitative Aptitude: Simplifications=averages-Concepts –problem-Problems on numbers-Short cuts- concepts –Problems</td></tr>
<tr><td colspan="2">UNIT-II:</td><td colspan="6">Profit and Loss –short cuts-Concepts –Problems –Time and work - Short –uts -Concepts -Problems.</td></tr>
<tr><td colspan="2">UNIT-III:</td><td colspan="6">Simple interest –compound interest- Concepts- Prolems</td></tr>
<tr><td colspan="2">UNIT-IV:</td><td colspan="6">Verbal Reasoning : Analogy- coding and decoding –Directions and distance –Blood Relation</td></tr>
<tr><td colspan="2">UNIT-V:</td><td colspan="6">Analytical Reasoning :Data sufficiency
Non-Verbal Reasoning : Analogy ,Classification and series</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Studnets relating the concepts of compound interest and simple interest</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">1.”Quantitative Aptitude” by R.S aggarwal ,S.Chand & Company Ltd 2007</td></tr>
<tr><td colspan="2">Website and e-Learning Source</td><td colspan="6">https://nptel.ac.in</td></tr>
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