Mahayogi Gorakhnath University, Gorakhpur
Faculty of Health and Life Sciences
Department of Biochemistry, Session 2025-26

B. Sc. (Hons./Hons. with Research) Biochemistry As per NEP2020

[Prepared as per Curriculum and Credit Framework for Undergraduate Programmes (CCFUP) given by UGC, 2022]

Effective from 2025-26

(Also applicable for 2024-25 batch)

Annexure-I

Subject prerequisite

To study **BIOCHEMISTRY** at undergraduate, a student must have Chemistry, Biology and /or Biotechnology in Class 12.

Programme Objectives (POs)

1. The programme intends to develop a strong theoretical and practical background in various domains of biochemistry.
2. The programme includes details of biomolecules, clinical biochemistry, tools and techniques, enzymes, immunology, cell biology, molecular biology, genetic engineering, plant biochemistry, industrial biochemistry biostatistics, and bioinformatics to make the living system more interesting human studies, which is the need of the hour.
3. The practical courses will equip the students with laboratory skills in biochemistry. Students will able to design and conduct experiments, as well as to analyze and interpret scientific data.
4. The programme will provide students with the knowledge and skill base that would enable them to undertake further studies in biochemistry and related areas or in multidisciplinary areas that involve biochemistry and help develop a range of generic skills that are relevant in enhancing entrepreneurship skills among students
5. The students will be exposed to a wide range of careers that combine biology, plants, and medicine.

Certificate Course in Clinical Biochemistry

B.Sc. I Programme Specific Outcomes (PSOs)

PSO1	This course introduces the fundamentals of structure and function of biomolecules. Students will be able to understand the interrelationships within and between the anatomical and physiological systems of the human body.
PSO2	The students will develop an understanding of basic concepts of clinical biochemistry; they will be able to relate clinical disorders with metabolic processes.
PSO3	The students will develop an understanding of basic concepts of genetics and genetic engineering.
PSO4	The students will learn the basic principles of biochemistry relevant to possibilities of employment and research. Stress will be rigorous learning of lab practices like accurate preparation of solutions and buffers. The course is intended to develop a sound, fundamental understanding of Bimolecular testing.
PSO5	The students will have hands-on training on the qualitative estimation of importance which will help them in getting employment in pathology labs and contribute to health care system.
PSO6	This Certificate courses will enable students to apply for technical positions in government and private labs, academic and research institutes.

Diploma in Biochemistry	
B.Sc. II Programme Specific outcomes	
PSO 1	Students will develop an understanding of Principle, working, and applications of Biochemical tools & techniques to prepare them for independent execution of laboratory experiments using standard methods and techniques.
PSO2	The objective of this course is to develop an understanding of the concepts of enzyme and enzyme kinetics.
PSO3	The students will develop an understanding of basic concepts of cell biology, cell signaling and cancer biology.
PSO4	The students will develop an understanding of the basics of Immunology, types of Immune Responses, antigens and antibodies, histocompatibility, vaccines, and immunization. The students will develop the capability to function as paramedical staff during the emergency.
PSO5	The course aims to develop an understanding of the concepts of enzyme dynamics. The students will also have an understanding of the basics of immunology, types of Blood grouping, cell counts, ELISA, Ouchterlony Double diffusion(ODD), and Separation of serum from blood &precipitation of Immunoglobulins
PSO6	The Diploma courses will ensure employability in Hospitals/Diagnostics and Pathology labs with good hands-on training. It will also enable students to take up higher studies and Research as their career and work in renowned national and international labs. Students can have their own start-ups as well.

Degree in Bachelor of Science (B Sc in Biochemistry)	
B.Sc III Programme Specific Outcomes (PSOs)	
PSO1	The students will develop an understanding of fundamental concepts of microbiology and microbial techniques.
PSO2	The students will develop an understanding of basic concepts of bioenergetics and biomolecules metabolism.
PSO3	The student after the course will be able to have a detailed and conceptual understanding of molecular processes.
PSO4	The students will be able to understand and apply the principles and techniques of molecular biology which prepares students for further career in molecular biology. Independently execute a laboratory experiment using the standard methods and techniques.
PSO5	The principles of genetic engineering, gene cloning, microbial and related technologies will enable students to play an important role in applications of biotechnology in various fields like agriculture, forensic sciences, industry and human health and make a career out of it. Students can have their own start-ups as well.
PSO6	The basic tools of bioinformatics will enable students to analyze large amount of genomic data and its application to evolutionary biology. Apply knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics existing software effectively to extract information from large databases and to use this information in computer modeling.
PSO7	The Degree courses will enable students to go for higher studies like Masters and Ph.D in Biochemistry and Allied subjects.

Degree in Bachelor of Science with Honors or Honors with Research (B.Sc. (Hons./Hons. With Research) in Biochemistry)	
B.Sc IV Programme Specific Outcomes (PSOs)	
PSO1	The student at the completion of the course will be able to have a detailed and conceptual understanding of plant biochemistry and related techniques.
PSO2	The students will be able to understand and apply the principles and techniques of medicinal chemistry which prepares students for further career in medicinal chemistry. Independently execute a laboratory experiment using the standard methods and techniques.
PSO3	The students will able to know the principle and concept of industrial Biochemistry and applied biochemistry. The principles of industrial biochemistry, applied biochemistry and related technologies will enable students to play an important role in applications of biochemistry in various fields like forensic sciences, food industry, vaccine and medicine industry for human health and make a career out of it. Students can have their own start-ups as well.
PSO4	The student at the completion of the course will be able to have a detailed and conceptual understanding of research methodology which make student aware about how to conduct a good work.
PSO5	After completion of six month research dissertation work from any reputed laboratory, student will able to perform a specific research work in specific area which make them eligible for Ph.D.
PSO6	**The Degree courses will enable students to go for higher studies like Masters and Ph.D in Biochemistry and Allied subjects.**

B Sc.(Hons./Hons. with Research) Biochemistry

Study Evaluation Scheme (as per NEP2020)

Effective from the session 2025-26

I Year: I Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	BSB101	Basics of Human Physiology	4	0	0	25	75	100	4	Major	Own faculty
2	BSB102	Fundamentals of Biochemistry	4	0	0	25	75	100	4	Major	Own faculty
3	BSB103	Chemistry	4	0	0	25	75	100	4	Multidisciplinary	Any faculty
4	BSB121AE	Comprehension &Communication Skills in English	3	1	0	25	75	100	4	Ability Enhancement Courses (AEC)	Any faculty
5	BSB131	First Aid and Health	2	0	0	25	75	100	2	Value Added Courses	Any faculty
Practical											
6	BSB151	Human Physiology Lab	0	0	2	25	75	100	1	Major	Own faculty
7	BSB152	Biochemistry and chemistry Lab	0	0	2	25	75	100	1	Major	Own faculty
Total			17	01	04	175	525	700	20		

Hons	Honours
L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination
AEC	Ability Enhancement Courses
SEC	Skill Enhancement Courses

MOOCS/NPTEL/SWYAM/Other University/College	
Fundamentals of Biochemistry	https://nptel.ac.in/courses/102105034 BioChemistry I, IIT Kharagpur Prof. S. Dasgupta
Basics of Human Physiology	https://nptel.ac.in/courses/102104058 Animal Physiology, IIT Kanpur Prof. Mainak Das

Note: Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.

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Study Evaluation Scheme (as per NEP2020)
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I Year: II Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	BSB201	Clinical Biochemistry	4	0	0	25	75	100	4	Major	Own faculty
2	BSB202	Genetics and Genetic Engineering	4	0	0	25	75	100	4	Major	Own faculty
3		**Vocational Elective-1**	4	0	0	25	75	100	4	Minor Vocational	Any faculty
4	BSB231	Food, Nutrition and Hygiene	2	0	0	25	75	100	2	Value Added Courses	Other faculty
5	BSB221SE	Computer Application	3	0	0	25	75	100	3	SEC	Any faculty
6	BSB221AE	Communication skill and Personality Development	3	0	0	25	75	100	3	AEC	Any Faculty
Practical											
7	BSB251	Clinical Biochemistry Lab	0	0	2	25	75	100	1	Major	Own faculty
8	BSB252	Genetics Lab	0	0	2	25	75	100	1	Major	Own faculty
Total			20	0	4	200	600	800	22		

Certificate Course in Clinical Biochemistry

Hons	Honours
L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination
AEC	Ability Enhancement Courses
SEC	Skill Enhancement Courses

Vocational Elective-1			
Course Code	**Course Name**	MOOCS/NPTEL/SWYAM/ Other University/College	
BSB221VO	Forensic sciences	BSB221VO Forensic Sciences	https://onlinecourses.swayam2.ac.in/cec25_ge11/preview Prof. Devashish Bose, Department of Criminology and Forensic Sciences Dr. Harsingh Gour Vishwavidyalya, Sagar, M.P.
BSB222VO	Molecular diagnostics		

Note: 1. Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.
2. Students who opt to exit after completion of the first year and have secured 40 credits will be awarded a UG certificate if, in addition, they complete one vocational course of 4 credits during the summer vacation of the first year. These students are allowed to re-enter the degree programme within three years and complete the degree programme within the stipulated maximum period of seven years.

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Study Evaluation Scheme (as per NEP2020)

Effective from the session 2025-26

II Year: III Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	BSB301	Cell Biology	4	0	0	25	75	100	4	Major	Own faculty
2	BSB302	Tools and Techniques in Biochemistry	4	0	0	25	75	100	4	Major	Own faculty
3	BSB303	Food Sciences	4	0	0	25	75	100	4	Major	Own faculty
4	------	**Minor Elective-1**	4	0	0	25	75	100	4	Minor	Any faculty
5	BSB331	Physical Education and Yoga	2	0	0	25	75	100	2	Value Added Courses	Any faculty
Practical											
6	BSB351	Cell biology and histopathology lab	0	0	2	25	75	100	1	Major	Own faculty
7	BSB3532	Tools and Techniques in Biochemistry Lab	0	0	2	25	75	100	1	Major	Own faculty
Total			18	0	4	175	525	700	20		

Hons	Honours
L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination

Minor Elective-1		MOOCS/NPTEL/SWYAM/ Other University/College
Course Code	**Course Name**	
BSB321	Histopathology and Cytology	https://nptel.ac.in/courses/104105139
BSB322	Medical Biotechnology	
BSB301	Cell Biology	https://nptel.ac.in/courses/102103012 Cell Biology, IIT Guwahati Dr. SanjuktaPatra

Note: Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.

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II Year: IV Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	BSB401	Enzymology	4	0	0	25	75	100	4	Major	Own faculty
2	BSB402	Immunology and Serology	4	0	0	25	75	100	4	Major	Own faculty
3		**Minor Elective-2**	4	0	0	25	75	100	4	Minor	Own faculty
4	-----	**Vocational Elective-2**	4	0	0	25	75	100	4	Minor Vocational	Any faculty
5	BSB431	Human Values and Environmental Ethics	2	0	0	25	75	100	2	Value Added Courses	Any faculty
Practical											
6	BSB451	Enzymology Lab	0	0	2	25	75	100	1	Major	Own faculty
7	BSB452	Immunology and Serology Lab	0	0	2	25	75	100	1	Major	Own faculty
8	BSB453SI	Summer Internship	0	0	4	25	75	100	2	Summer Internship	Any lab
Total			18	0	8	200	600	800	22		

Diploma in Biochemistry

Hons	Honours
L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination

Vocational Elective-2	
Course code	**Course Name**
BSB421VO	Ecology and Environments
BSB422VO	Nanobiotechnology

Minor Elective-2	
Course code	**Course Name**
BSB421	Pharmaceutical Chemistry
BSB422	Polymer chemistry

MOOCS/NPTEL/SWYAM/Other University/College	
Immunology and Serology	https://nptel.ac.in/courses/102103038 Cellular and Molecular Immunology, IIT Guwahati Dr. Sachin Kumar
Enzymology	https://onlinecourses.nptel.ac.in/noc23_bt05/preview Enzyme Sciences and Technology By Prof. Vishal Trivedi, IIT Guwahati

Note: 1. Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.
2. Students who opt to exit after completion of the second year and have secured 80 credits will be awarded the UG diploma if, in addition, they complete one vocational course of 4 credits during the summer vacation of the second year. These students are allowed to re-enter within a period of three years and complete the degree programme within the maximum period of seven years.

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Study Evaluation Scheme (as per NEP2020)

Effective from the session 2025-26

III Year: V Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	BSB501	Fundamentals of Microbiology	4	0	0	25	75	100	4	Major	Own faculty
2	BSB502	Metabolism-1	4	0	0	25	75	100	4	Major	Own faculty
3	……	**Departmental Elective-1 (DE-1)**	4	0	0	25	75	100	4	Minor	Own faculty
4	BSB503	Biostatistics	3	0	0	25	75	100	3	Multidisciplinary	Any faculty
5	BSB521 SE	Quality control in Clinical Lab	3	0	0	25	75	100	3	SEC	Any Faculty
6	BSB531	Understanding India	2	0	0	25	75	100	2	Value Added Course	Any Faculty
Practical											
7	BSB551	Microbiology Lab	0	0	2	25	75	100	1	Major	Own faculty
8	BSB552	Metabolism -1 lab	0	0	4	25	75	100	2	Major	Own faculty
Total			20	0	6	200	600	800	23		

Hons	Honours
L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination
SEC	Skill Enhancement Courses

Departmental Elective (DE)-1	
Course Code	**Course Name**
BSB511	Hormone Biochemistry
BSB512	Medical Microbiology
	MOOCS/NPTEL/SWYAM/ Other University/College
Biostatistics	https://nptel.ac.in/courses/102101056 NOC:Introduction to Biostatistics, IIT Bombay, Prof. ShamikSen

Note: Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.

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Study Evaluation Scheme (as per NEP2020)

Effective from the session 2025-26

III Year: VI Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	BSB601	Molecular Biology	4	0	0	25	75	100	4	Major	Own faculty
2	BSB602	Metabolism 2	4	0	0	25	75	100	4	Major	Own faculty
3	.....	**Departmental Elective-2(DE-2)**	4	0	0	25	75	100	4	Minor	Own faculty
4	BSB603	IPR, Bioethics and Biosafety	2	0	0	25	75	100	2	Multidisciplinary	Any faculty
5	BSB621SE	Bioinformatics and Drug Designing	3	0	0	25	75	100	3	SEC	Any faculty
6	BSB631	Artificial Intelligence in Life sciences	2	0	0	25	75	100	2	Value added courses	Any faculty
Practical											
7	BSB651	Molecular biology lab	0	0	2	25	75	100	1	Major	Own faculty
8	BSB652	Metabolism-2 Lab	0	0	4	25	75	100	2	Major	Own faculty
9	BSB621AE	Seminar	0	0	2	25	75	100	1	AEC	Any faculty
Total			19	0	8	225	675	900	23		

B Sc in Biochemistry

Hons	Honors
L	Lecture
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination
SEC	Skill Enhancement Courses
AEC	Ability Enhancement Courses

Departmental Elective-2	
Course Code	**Course Name**
BSB611	Evolutions and Behavior
BSB612	Genomics and Proteomics
	MOOCs from SWAYAM/NPTEL

Note: 1. Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.
2. Students who wish to undergo a 3-year UG programme will be awarded UG Degree in the Major discipline after successful completion of three years, securing 120 credits.
3. Students who secure 75% marks and above in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year. They should do a research project or dissertation under the guidance of a faculty member of the University/College. The research project/dissertation will be in the major discipline. The students, who secure 160 credits, including 12 credits from a research project/dissertation, are awarded UG Degree (Honours with Research). Students who wish to undergo only B.Sc. Hons. have to study 12 credit course works as major discipline.

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B Sc.(Hons./Hons. with Research) Biochemistry

Study Evaluation Scheme (as per NEP2020)

Effective from the session 2025-26

IV Year: VII Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	BSB701	Plant Biochemistry	4	0	0	25	75	100	4	Major	Own faculty
2	BSB702	Medicinal Chemistry	4	0	0	25	75	100	4	Major	Own faculty
3	BSB703	Industrial Biochemistry-1	4	0	0	25	75	100	4	Major	Own faculty
4	.....	Departmental Elective-3	4	0	0	25	75	100	4	Minor	Any faculty
5		Minor Elective-3	4	0	0	25	75	100	4	Minor	Any Faculty
Practical											
6	BSB751	Plant biochemistry Lab	0	0	2	25	75	100	1	Major	Own faculty
7	BSB752	Medicinal Chemistry Lab	0	0	2	25	75	100	1	Major	Own faculty
Total			20	0	4	175	525	700	22		

Hons	Honours
L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination

Departmental elactive-3		Minor elective-3	
Sub Code	**Subject Name**	**Sub Code**	**Subject Name**
BSB711	Developmental biology	BSB721	Biophysics
BSB712	Bioprocess Technology	BSB722	Pharmacology
	**MOOCs from SWAYAM/NPTEL		

Note: Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.

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B Sc.(Hons./Hons. with Research) Biochemistry

Study Evaluation Scheme (as per NEP2020)
Effective from the session 2025-26

IV Year: VIII Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Honors Theory											
1	BSB801	Research Methodology	4	0	0	25	75	100	4	Major	Own faculty
2	BSB802	Industrial biochemistry-2	4	0	0	25	75	100	4	Major	Own faculty
3	BSB803	Applied Biochemistry	4	0	0	25	75	100	3	Major	Own faculty
Practical											
4	BSB851	Industrial biochemistry lab	0	0	2	25	75	100	1	Major	Own faculty
		Total	12	0	2	100	300	400	12		
OR, Honors with research											
4	BSB851	Dissertation work	0	0	40	100	300	400	12	Major	Own faculty
Total			0	0	40	100	300	400	12		

B.Sc. (Hons/Hons. with Research) in Biochemistry

Hons	Honours
L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination

Note: 1. Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.

2. A four-year B.Sc. Honors/ B.Sc. Honors. With research degree in the major discipline will be awarded to those who complete a four-year degree programme with 164 credits.

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I Year: I Semester (Theory)
Basics of Human Physiology
Course Code: BSB101

L	T	P	C
4	0	0	4

Course Objectives (CO)

1. To explain the normal functioning of blood and cardiovascular system.
2. To narrate the contribution of respiratory system in physiology.
3. To elucidate the physiological aspects of digestive and excretory system.
4. To describe the physiological response of nerve muscles and physiological principles of endocrine and reproductive system.

UNIT I: General Physiology, and circulatory System

Cell and cell junction. Transport across the cell membrane, Homeostasis. Introduction, Properties , Composition and function of blood , Blood cells types and function, Composition and function of blood plasma and Blood clotting factor, Hemoglobin-structure, normal content, function, types. Erythropoiesis. Erythrocytes sedimentation rate (ESR) and its significance, Hematocrit, PCV, MCV, MCH,MCHC, Blood volume, Prothrombin time, Clotting time, Bleeding time, Blood Group, (ABO and Rh factor), Reticuloendothelial System, Spleen. Lymphatic System, Physiology of Heart, properties of cardiac muscles, Type of Blood circulation, Arteries and veins, Cardiac Cycle and heart sounds. Conductive system of heart,

UNIT II: Respiratory system & Skin

Respiratory System Introduction, Structure, Function and Mechanics of Breathing. Respiration measures (Vital capacity, Total Volume, Reserve volume, Total lung capacity), Mechanism of respiration. Regulation of respiration,
Structure and function of skin.

UNIT IV: Digestive system and Excretory system

Digestive system Overview, Basic physiology of organs of digestive system (Salivary glands and Mouth , Stomach, Pancreas, Liver, Gallbladder, Small and Large Intestine). Physiological functions of Liver. Digestion and Absorption of carbohydrate, fat and proteins
Functional anatomy of Kidneys and nephron, Urine formation, (Glomerular filtration and tubular Reabsorption), Electrolytes: their balances and imbalances.

UNIT V: Endocrine system and Reproductive system

Introduction of Endocrine system, Hormones Physiological Functions of Glucagon, Prolactin, Growth Hormones, insulin, oxytocin, ADH, Adrenal PTH, Thyroxin, calcitonin, Vitamin D.
Introduction of Reproductive Systems in human, Spermatogenesis and Oogenesis.
Physiological functions of Male and female Reproductive Hormones, Placental Hormone (Physiological Function),

UNIT VI: Neuro & Muscle Physiology

Nervous System: Overview, general organization and function of Central nervous system(Brain and Spinal cord) and peripheral nervous system, Neuron. Neuroglia, Receptor, Synapse, Reflexes, Autonomic nervous system- organization & function, Blood brain barrier and CSF,
Special senses- General organization & functions.

Structure and properties of muscle(Skeletal, smooth and cardiac) , Muscle proteins, Mechanism of muscle contraction and relaxation, Neuromuscular Junction.

Suggested book-

1. Essentials of Medical Physiology - K. Sembulingam, Premasembulingam
2. Concise Medical Physiology Sujith K chaudari
3. Ganong's Review of Medical Physiology (reference)
4. Textbook of Medical Physiology: Arthur C Guyton, John E Hall

Course Learning Outcome (CLO)

At the end of the course the student will be able to:

1. Explain the normal functioning of blood and cardiovascular system.
2. Narrate the contribution of respiratory system in physiology.
3. Elucidate the physiological aspects of digestive and excretory system.
4. Describe the physiological response of nerve muscles and physiological principles endocrine and reproductive system.

I Year: I Semester (Theory)
Fundamentals of Biochemistry
Course code: BSB102

L	T	P	C
4	0	0	4

Course objectives (CO)

1. To give basic knowledge of biochemistry.
2. To narrate the composition of carbohydrates, and nucleic acid, their structure, and types.
3. To describe the amino acids and vitamins associated diseases because of their deficiency.
4. To list different types of lipids and their role in different types of membrane formation.

UNIT I: Basics of Biochemistry

History of biochemistry with special reference to contribution of Indian biochemists. Biophysics of Water. Molecular structure of water, hydrogen bonds and physical properties of water, importance of water

UNIT II: Carbohydrates

Monosaccharides - structure of aldoses and ketoses, Ring structure of sugars, Fisher Projection, conformations of sugars, mutarotation, anomers, epimers and enantiomers. Structure of biologically important sugar derivatives, oxidation and reduction of sugars. Formation of disaccharides, reducing and non-reducing, Polysaccharides, homo and hetero-polysaccharides, structure and storage of polysaccharides.

UNIT III: Lipids

Introduction to lipid micelles, monolayers & bilayers, Introduction to storage and structural lipids, various types of lipids – Oils and fats, Triglycerides- structure and function, Phospholipids- structure, classification and functions, biological significance of various types of Phospholipids, Glycolipids and lipoproteins, serum lipids and its significance, Cholesterol and its derivatives.

UNIT IV: Amino acids and vitamins

Chemical properties of amino acids (Zwitter ion, Isoelectric point etc), Structural features and classification, Physical properties, optical properties (Stereoisomerism), uncommon amino acids and their function. Classification of protein, structural organization as primary, secondary, tertiary and quaternary structure of protein and characteristics of the peptide bond. Motifs. Structure and active forms of water soluble and fat-soluble vitamins, sources, deficiency diseases and symptoms.

UNIT V: Nucleic acids structure and functions

Nucleoside, Nucleotides - structure and properties. Nucleic acid structure –Watson - Crick Model of DNA Structure of major species of RNA - mRNA, tRNA and rRNA. Nucleic acid chemistry - UV absorption, effect of acid and alkali on DNA. Other functions of nucleotides.

Suggested Readings:

1. Lehninger, Albert, Cox, Michael M. Nelson, David L. (217) Lehninger principles of biochemistry New York: W. H. Freeman.
2. Voet, D., &Voet, J. G. (2011). Biochemistry. New York: J. Wiley & Sons.
3. Biochemistry –Lubert stryer Freeman International Edition.
4. Biochemistry –Keshav Trehan Wiley Eastern Publications

5. Fundamentals of Biochemistry- J. L. Jain S. Chand and Company
6. Voet &Voet: Biochemistry Vols 1 & 2: Wiley (2004)
7. Murray et al: Harper's Illustrated Biochemistry: McGraw Hill (2003) Elliott and Elliott:
8. Biochemistry and Molecular Biology: Oxford University Press
9. Taiz, L., Zeiger, E., Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition.
10. Hopkins, W.G., Huner, N.P., Introduction to Plant Physiology. John Wiley & Sons,
11. Vander's Human Physiology (2008) 11th ed., Widmaier, E.P., Raff, H. and Strang, K.T. McGraw Hill International Publications, ISBN: 978-0-07-128366-3.
12. Endocrinology (2007) 6th ed., Hadley, M.C. and Levine, J.E. Pearson Education (New Delhi), Inc. ISBN: 978-81-317-2610-5.

Course learning outcome (CLO):

At the end of the course the student will be able to:

1. Understand the basic knowledge of biochemistry.
2. Narrate the composition of carbohydrates and nucleic acid, their structure, and types.
3. Describe the amino acids and vitamins associated diseases because of their deficiency.
4. List different types of lipids and their role in different types of membrane formation.

I Year: I Semester (Theory)
Chemistry
Course code: BSB103

L	T	P	C
4	0	**0**	**4**

Course objective (CO)

1. To make students understand about mole concept
2. To give basic knowledge of atomic structure and molecular structure.
3. To provide students basic knowledge of chemical bonding, chemical thermodynamics, and green chemistry.

UNIT I: Mole concept and ionic equilibrium

General idea about normality, molarity, molality, percentage solutions, mole fraction.W/v and v/v solutions. Concept of pH determinations using indicators, Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and base, pH scale, buffer solutions and their biological importance. Water as universal solvent.

UNIT II: Atomic Structure

Recapitulation of: Bohr's theory and its limitations, dual behavior of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Need of a new approach to Atomic structure, quantum mechanism, and electronic configuration

UNIT III: Chemical Bonding and Molecular Structure

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and salvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Lande equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of, linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures.

UNIT IV: Chemical Thermodynamics

What is thermodynamics? Concept of heat and work, thermodynamic equilibrium, thermodynamic properties, various types of systems and processes. First Law of thermodynamics. Calculation of work (*w*), heat (*q*), changes in internal energy (JU) and enthalpy (J*H*) for expansion or compress ion of ideal gases under isothermal and adiabatic conditions for both reversible and irreversible processes, concept of thermo-chemistry, Second and third Law of thermodynamics.

UNIT V: Green chemistry

Introduction to Green Chemistry: What is Green Chemistry? Need of Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry, Principles of Green Chemistry and Designing a Chemical synthesis, Examples of Green Synthesis/ Reactions and some real world cases, Future Trends in Green Chemistry

Suggested Readings:

1. Barrow, G. M. (2007) Physical Chemistry Tata McGraw-Hill, India.
2. Castellan, G. W.(2004) Physical Chemistry 4th Ed. Narosa, India.

3. Kotz, J. C., Treichel, P. M. & Townsend, J. R. (2009)General Chemistry Cengage Le arning India Pvt. Ltd.: New Delhi
4. Mahan, B. H. (1998)University Chemistry 3rd Ed. Narosa, India.
5. J. D. Lee, A new Concise Inorganic Chemistry, E L. B. S.
6. F. A. Cotton & G. Wilkinson. Basic Inorganic Chemistry, John Wiley.
7. Douglas, McDaniel and Alexader : Concepts and Models in Inorganic Chemistry, John Wiley.
8. James E. Huheey, *Ellen Keiter and Richard Keiter : Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Publication.

Course learning outcome (CLO):

At the end of the course the student will be able to:

1. Understand the basic knowledge of basic chemistry.
2. Able to know about atomic and molecular structure.
3. Elucidate about chemical and ionic bonding.
4. Describe the concept of chemical thermodynamics.
5. Understand about green chemistry.

I Year: I Semester (Theory)
Comprehension & Communication Skills in English
Course code: BSB121AE

L	T	P	C
3	1	0	4

Course objective: The objectives of the course are as follows:

1. To enable the students to acquire the communication skills of listening, speaking, reading and writing through a learning-centered curriculum comprising skills of intensive reading, extensive reading, written communication and oral communication.
2. To provide task-centered teaching-learning materials for students of diverse entry levels so that they eventually attain almost the same level of target behavior.
3. To enable the learner to communicate effectively and appropriately in real life situation.

UNIT I: Comprehension and Textual Analysis
Textual Comprehension: R.K. Narayan: "Toasted English" – Reading comprehension and vocabulary enhancement, Francis Bacon: "Of Studies" – Interpretation, vocabulary, and summarization.
Summarization: Techniques of summarizing a given text or passage

UNIT II: Functional Language Skills
Grammar and Sentence Correction: Identification and correction of incorrect sentences, Functional grammar in context
Core Language Skills: Understanding and application of LSRW (Listening, Speaking, Reading, Writing) + Grammar
Text Analysis: Martin Luther King Jr.: "I Have a Dream" – Textual summarization and critical understanding
Grammar: Degrees of Comparison

UNIT III: Writing Skills
Letter Writing: Format and mechanics of personal and official letters, Effective correspondence techniques
Practical Writing Tasks: Application writing, Welcome speeches and vote of thanks, Paragraph and essay writing, Story writing and review writing, Abstract writing, and journal writing
Creative and Academic Composition: Exposure to various forms of written expression

UNIT IV: Productive Communication Skills
Professional Communication: Preparation of Curriculum Vitae (CV) and job applications, Types, settings, and purposes of interviews, Roles of interviewer and interviewee
Communication Theory: Definition, process, and components of communication
Oral Presentation Skills: Structure, delivery techniques, and audience engagement

UNIT V: Applied Grammar and Usage
Basic Grammar: Use of articles and parts of speech, sentence punctuation and correction
Vocabulary: Synonyms and Antonyms, One-word substitutions, Idioms and phrases, Pair of words (commonly confused/misused)

Sound and Speech Elements: Vowel and consonant sounds, Homonyms and homophones
Stylistic Devices: Figures of speech and their usage in context

Suggested Readings:

1. l. Essential Communication Skills: A Multi-Course for English Communication. MacMillan Publishers India Pvt. Limited.
2. English Grammar & Composition by S.C. Gupta
3. Nurture English Grammar and Composition Books by Target Publications.
4. Toasted English Essay's Books by R.K Narayan.
5. BOOK: I Have a Dream – Martin Luther King.
6. Leech, Cruickshank, And Ivanic's An A-Z of English Grammar & Usage
7. Of Studies books by Francis Bacon.,

Course Learning Outcome (CLO)

At the end of the course the student will be able to:

1. Make good resume and prepare effectively for interview.
2. Perform effectively in group discussions.
3. Explore communication beyond language.
4. Acquire good communication skills and develop confidence.

I Year: I Semester (Theory)
First Aid and Health
Course code: BSB131

L	T	P	C
2	0	0	2

Course Objective (CO)

1. To administering first aid to an adult casualty who is choking.
2. To administering first aid to an adult casualty who is wounded and bleeding.
3. To administering first aid to an adult casualty who is suffering from shock.
4. To provide appropriate first aid for minor injuries (including small cuts, grazes and bruises).

UNIT I- Basic First Aid and technique

Aims of first aid & First aid and the law, Dealing with an emergency, Resuscitation (basic CPR), Recovery position, Initial top to toe assessment, Hand washing and Hygiene, Types and content of a first aid kit, Dressings and Bandages, Fast evacuation techniques (single rescuer), Transport techniques

UNIT II: First aid related with respiratory system, Heart, Blood and Circulation and Wounds and Injuries

Basics of respiration, No breathing or difficult breathing, Drowning, Choking, Strangulation and hanging, Swelling within the throat, Suffocation by smoke or gases and Asthma, Basics of The heart and the blood circulation, Chest discomfort, bleeding, Type of wounds, Small cuts and abrasions, Head, Chest, Abdominal injuries, Amputation, Crush injuries, Shock.

UNIT III: First aid related with; Nervous system and Unconsciousness, Gastrointestinal Tract, Skin, and Burns

Basics of the nervous system, Unconsciousness, Stroke, Fits – convulsions – seizures, Epilepsy, Basics of the gastrointestinal system, Diarrhea, Food poisoning, Basics of the skin, Burn wounds, Dry burns and scalds (burns from fire, heat and steam), Electrical and Chemical burns, Sun burns, heat exhaustion and heatstroke, Frost bites (cold burns), Prevention of burns, Fever and Hypothermia, Animal bites, Road and traffic accidents.

UNIT IV: Basic Sex Education

Overview, ground rules, and a pre-test, Basics of Urinary system and Reproductive system, Male puberty — physical and emotional changes, Female puberty — physical and emotional changes, Male-female similarities and differences, Sexual intercourse, pregnancy, and childbirth, Facts, attitudes, and myths about LGBTQ+ issues and identities, Birth control and abortion, sexual harassment, sexual abuse, and rape, Prevention of sexually transmitted diseases.

UNIT V: Mental Health and Psychological First Aid

Mental Health First Aid, Mental Health Problems in the India, The Mental Health First Aid Action Plan, Understanding Depression and Anxiety Disorders, Crisis First Aid for Suicidal Behavior & Depressive symptoms, Non-Suicidal Self-Injury, Non-crisis First Aid for Depression and Anxiety, Crisis First Aid for Panic Attacks, Traumatic events, Understanding Disorders in Which Psychosis may Occur, Crisis First Aid for Acute Psychosis, Understanding Substance Use Disorder, Crisis First Aid for Overdose, Withdrawal, Using Mental Health First Aid

Suggested Readings

1. Dr. Gauri Goyal, Dr. Kumkum Rajput & Dr. Manjul Mungali. 2020. First Aid and Health, ISBN 978-93-92208-19-5

Course Learning Outcome (CLO)

1. Administer first aid to an adult casualty who is choking.
2. Administer first aid to an adult casualty who is wounded and bleeding.
3. Administering first aid to an adult casualty who is suffering from shock.
4. Providing appropriate first aid for minor injuries (including small cuts, grazes and bruises).

I Year: I Semester (Practical)
Human Physiology Lab
Course code: BSB151

L	T	P	C
0	0	2	1

Course Objectives (CO)

1. The course practical has been designed to make students understand the functioning of organs/ systems of humans so that students can further appreciate the knowledge.
2. To learn measurement of pulse and blood pressure in man.
3. To identify the blood cell after smear preparation.
4. To develop further practical biological skills introduced in Physiology of Organisms

Practicals

1. Overview of protocols and safety measures in the human physiology laboratory.
2. Determination of blood pressure.
3. Elicitation of reflexes & jerks.
4. Clinical assessment of body temperature
5. Assessment of heart rate parameters in varying conditions
6. Measurement and analysis of respiratory rate under varying conditions
7. Separation of plasma and serum from the whole blood.
8. Estimation of haemoglobin concentration
9. Identification of blood group (ABO and Rh typing)
10. Demonstration of pulmonary volumes via online video tutorial

Suggested Readings:

1. Lab Manual - Human Anatomy and Physiology II.pdf (jru.edu.in)
2. HumanAnatomy.pdf (sarajapharmacycollege.com)
3. Anatomy and Physiology I Lab Manual, by De Loris Hesse Daniel McNabney.
4. Essentials of Human Anatomy & Physiology Laboratory Manual Spiral-bound – 10 January 2008, by Elaine N. Marieb (Author)

Course Learning Outcome (CLO)

At the end of the course the student will be able to:

1. Learn measurement of pulse and blood pressure in man.
2. Identify the blood cell after smear preparation.
3. Students will learn General structure of a mammalian/human tissue.
4. Understating of blood cells by differential staining.

I Year: I Semester (Practical)
Biochemistry and Chemistry Lab
Course code: BSB152

L	T	P	C
0	0	2	1

Course objective (CO)

1. To give practical experience to learn safety measures in laboratories.
2. To learn preparation of buffers and solutions.
3. To learn the estimation of different types of biomolecules.

Practicals -

1. Preparation of normal, molar and percent solutions.
2. Preparation of different buffer solutions and measure their pH
3. To identify the carbohydrate by solubility test.
4. To perform Molisch test for the identification of carbohydrates.
5. To perform Benedict test for identification of reducing and non-reducing sugars.
6. To perform Fehling test for identification of aldehyde.
7. To perform iodine test for identification of polysaccharides.
8. Determination of pKa values of amino acids by titration
9. Titrimetric analysis of Vitamin C.
10. Qualitative test for protein.

Suggested Readings:

1. CELL AND MOLECULAR BIOLOGY: A Lab Manual Kindle Edition by K. V. Chaitanya (Author)
2. Molecular Biology -Practical- (ksu.edu.sa)
3. Lab Manual - Biochemistry.pdf (jru.edu.in)

Course Learning Outcome (CLO):

At the end of the course the student will be able to:

1. Explain the safety measures in laboratories.
2. Prepare different types of buffers and solutions.
3. Perform estimation of different types of biomolecules in given sample.

Mahayogi Gorakhnath University, Gorakhpur
Faculty of Health and Life Sciences
Department of Biochemistry, Session 2025-26

B.Sc. (Hons./Hons. with Research) Biochemistry
Study Evaluation Scheme (as per NEP2020)
Effective from the session 2025-26

I Year: II Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	BSB201	Clinical Biochemistry	4	0	0	25	75	100	4	Major	Own faculty
2	BSB202	Genetics and Genetic Engineering	4	0	0	25	75	100	4	Major	Own faculty
3		**Vocational Elective-1**	4	0	0	25	75	100	4	Minor Vocational	Any faculty
4	BSB231	Food, Nutrition and Hygiene	2	0	0	25	75	100	2	Value Added Courses	Other faculty
5	BSB221SE	Computer Application	3	0	0	25	75	100	3	SEC	Any faculty
6	BSB221AE	Communication skill and Personality Development	3	0	0	25	75	100	3	AEC	Any Faculty
Practical											
7	BSB251	Clinical Biochemistry Lab	0	0	2	25	75	100	1	Major	Own faculty
8	BSB252	Genetics Lab	0	0	2	25	75	100	1	Major	Own faculty
Total			20	0	4	200	600	800	22		

Certificate Course in Clinical Biochemistry

Hons	Honours
L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination
AEC	Ability Enhancement Courses
SEC	Skill Enhancement Courses

Vocational Elective-1			
Course Code	**Course Name**	MOOCS/NPTEL/SWYAM/ Other University/College	
BSB221VO	Forensic sciences	BSB221VO Forensic Sciences	https://onlinecourses.swayam2.ac.in/cec25_ge11/preview Prof. Devashish Bose, Department of Criminology and Forensic Sciences Dr. Harsingh Gour Vishwavidyalya, Sagar, M.P.
BSB222VO	Molecular diagnostics		

Note:

1. Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.
2. Students who opt to exit after completion of the first year and have secured 40 credits will be awarded a UG certificate if, in addition, they complete one vocational course of 4 credits during the summer vacation of the first year. These students are allowed to re-enter the degree programme within three years and complete the degree programme within the stipulated maximum period of seven years.

I Year: II Semester (Theory)
Clinical Biochemistry
Course code: BSB201

L	T	P	C
4	0	**0**	**4**

Course objective (CO)

1. To study the fundamental biochemistry related to health.
2. To study the clinical significance of the organ function tests.
3. To study diagnosis of clinical disorder by estimating their biomarkers.
4. To study the importance of water in electrolytes for the body.

UNIT I: Laboratory instruments

Medical laboratory professional. Calibration of pipettes and other volumetric apparatus. General approach to specimen collection, transport and disposal. Anticoagulants, Use of Photometry, Centrifuge, Water bath.

UNIT II: **Fluids for Biochemical Analysis**

Whole Blood composition and level of different cells in normal patients, Biochemical composition of Plasma and serum, Difference between plasma and serum, Urine composition and level of different biomolecules in normal patients, Cerebrospinal fluids (CSF) and the level of different biomolecules in normal patients, Amniotic fluid and their biochemical composition in normal patients.

UNIT III: Biochemical Estimation

Estimation of blood sugar, Glucose tolerance tests (GTT), Glycosylated haemoglobin (HbA1C). Serum Uric acid, Serum lipid determination– cholesterol, triglycerides, HDL, LDL and lipoprotein fractionation. Liver Function Tests: Estimation of Total Protein, Albumin & A/G ratio, ALT, AST, ALP, Estimation of Bilirubin – total and conjugated. Renal function test: Estimation of Blood Urea, Serum Creatinine, Creatinine clearance test.

UNIT IV: Body Water and Electrolytes

Total body water, normal water balance, sodium, potassium, chloride, magnesium, electrolytes, Regulation of water and electrolytes balance, disorders of water and electrolytes balances, dehydration deficiency, causes, symptoms, treatment. pH and acid-base management, Renin-angiotensin system.

UNIT V: Clinical Disorder

Brief study about some clinical disorders such as Diabetes, Fatty liver diseases, Jaundice, Malnutrition, osteoporosis, arthritis, obesity, cardiovascular diseases, myocardial infraction, stroke, heart attack etc.

.

Suggested Readings:

1. Abeles RH, Frey PA and Jeneks WP (1992) Biochemistry, Jones and Bartlett Publishers, Boston.
2. Berg JM, Tymoczko, JL and Stryer L (2002) Biochemistry, 5th Edition, WH Freeman & Co., New York.
3. Cohn EE, Stumph PK, Bruening G and Doi RH (1987) Outlines of Biochemistry, IK Gujral Punjab Technical University M. Sc. MLS (Biochemistry) 5thEdition, John Wiley & Sons, New York.

4. Murray RK, Granner DK, Rodwell VW and Mayes PA (2000) Harper's Biochemistry, 25thEidtion, Applaton and Lange Publications, California, USA.
5. Nelson DL and Cox MM (2001) Lehninger Principles of Biochemistry, 3rd Edition, MacMillon Worth Publishers, New Delhi.
6. Rawn JD (1990) Biochemistry, 2nd Edition, Harpers and Row Publications, New York.
7. Voet D and Voet JG (2001) Biochemistry, 3rd Edition, John Wiley & Sons, New York.
8. Zubey G (1998) Biochemistry, 4th Edition, WMC Brown Publishers, USA.
9. Parveen Bansal, S.N. Das (2014) Biotechnology in Medicine and Herbal Drug Development, Ist edition, Gulab publishers.

Course learning outcomes (CLO)

At the end of the course students will be able to-

1. Describe the fundamental biochemistry related to health.
2. Explain the clinical significance of the organ function tests.
3. Explain diagnosis of clinical disorder by estimating their biomarkers.
4. Study the importance of water in electrolytes for the body.

I Year: II Semester (Theory)
Genetics and Genetic engineering
Course code: BSB201

L	T	P	C
4	0	0	4

Course objective (CO)

1. To understand the concepts of Mendelian Genetics, non allelic interaction, genetic organization of prokaryotic and viral genome.
2. To get knowledge about detail structure of chromosomes, gene mutation and genetic linkage.
3. To understand vectors used in recombinant DNA technology.
4. To know the applications of genetic engineering for making transgenic organisms

UNIT-I: Mendel's laws of inheritance: Introduction to Genetics, Scope and significance of genetics. Simple single factor inheritance (autosomal dominant, autosomal recessive, x-linked dominant, x-linked recessive and Y-linked characters); Multifactorial inheritance; Sex influenced and sex-limited characters; Polygenic inheritance. monohybrid, di-hybrid and tri-hybridcrosses Historical developments in the field of genetics. Mendelian genetics: Mendel's, experimental design, Law of segregation & Principle of independent assortment. Allelic interactions: Concept of dominance, recessiveness, incomplete dominance, co-dominance, Sex determination and sex linkage: Mechanisms of sex determination, sex differentiation, Barr bodies, dosage compensation, genetic balance theory.

UNIT- II: Multiple alleles: Lethal and sub lethal genes; Penetrance and expressivity, epistasis, pleiotropy, interaction with environment, Linkage and Crossing over; Heredity and environment (Twin study). Karyotyping, Chromosome banding, *in situ* hybridization and FISH, chromosome painting, Fluorescence Activated Cell Sorting etc.

UNIT- III: Population studies and its importance: Family studies and pedigree analysis; Estimation of gene, genotype and phenotype frequencies; Randam mating and its consequences; Hardy- Weinberg law; Genetic polymorphism (balanced and transient); Inbreeding – types of consanguineous marriages. Inheritance of Mitochondrial and chloroplast genes, maternal inheritance. Structural and numerical alterations of chromosomes and their genetic implications. Genetic disorder of eye, skin, and hair- Color blindness, Ichthyosis, Albinism, Ectodermal dysplasias, Netherton syndrome, alopecia, hypertrichosis, and trichothiodystrophy

UNIT- IV: Mutations and Mutagens: Mutations (spontaneous / induced, somatic / germinal, forward / reverse, transition /transversions, Silent, missense, nonsense, and frame shift mutations, conditional, leaky)**.** Detection, selection & isolation of microbial mutants**.** Estimation of mutation rates**.** Reversion and suppression of mutations**.** Mutagens – physical, chemical**.** Transposon mutagenesis, site-directed mutagenesis. Structural and numerical alterations of chromosomes and Recombination: Homologous and non-homologous recombination including transposition.

Unit-V: Recombinant DNA Technology

Introduction of human genome project, Basic techniques involved in rDNA technology. Restriction Enzymes, DNA methylation systems in E.coli, other enzymes used in cloning (DNA polymerases, RNA Polymerases, Reverse Transcriptase, Ligases, Taq polymerase etc.) Cloning vectors – Plasmids, λ bacteriophage based, pBR322, pUC18, pGEMT Easy, M13 phage based, phagemids. High capacity vectors: Cosmids, yeast artificial chromosomes, bacterial artificial chromosomes, Ti-plasmid, and retroviral vectors, Covalent linkage of DNA fragments to vector molecules: Linkers, Adapters, homopolymer tailing. Fundamentals of polymerase chain reaction, Types of PCR, application of RDT.

Suggested Readings-

1. Genetics: Analysis of Genes and Genomes by Hartl, Jones
2. Tom Strachan & Andrew P. Read Human Molecular Genetics (3rd Edition), John Wiley &Sons.
3. Ricki Lewis, Human Genetics-Concepts & Applications (3rd Edition), McGraw Hill.
4. T. A. Brown, Genomes, John Wiley & Sons (Asia) PTE Ltd.
5. Scott Freeman & Jon C. Herron, Evolutionary Analysis (5th Edition), Prentice Hall
6. Garner E.J, Simmons, M.J. & Snustad, D.P. Principles of Genetics, John Wiley & Sons Inc, N.Y.
7. Watson, J.D., Hopkins, N. H., Roberts, J. W. Steitz & Weiner, A. M., Molecular Biology of the Genes, The Benjamin/Cummings Publishing Company Inc., Tokyo.
8. William S. Klug & Michael R. Cummings Essentials of Genetics, 5th Ed, Prentice Hall Internationals
9. Daniel L. Hartl & Elizabeth W. Jones, Essential Genetics, 6th Ed., Jones & Bartlett Publishers

Course learning outcome (CLO)

At the end of the course the student will be able to:

1. Understand the concepts of Mendelian Genetics, non allelic interaction, genetic organization of prokaryotic and viral genome.
2. Describe structure of chromosomes, gene mutation and genetic linkage.
3. Understand vectors used in recombinant DNA technology.
4. Know the applications of genetic engineering for making transgenic organisms, polymerase chain reaction and DNA sequencing.

I Year: II Semester (Theory)
Vocational Elective-1
Forensic Science
Course code: BSB221VO

L	T	P	C
4	0	0	4

Course objectives: This is an introductory course on forensic sciences with the following objectives:

1. To familiarize students with the fundamental principles of forensic sciences.
2. To impart knowledge about the injuries and deaths and how they are assessed.
3. To make students understand the process of documentation of crime scenes.
4. To impart the knowledge about the importance of cyber security in forensic sciences.

UNIT I: Principles of forensic sciences

Introduction and principles of forensic science; forensic science laboratory and its organization; tools and techniques in forensic science; branches of forensic science; causes of crime; role of *modus operandi* in criminal investigation.

UNIT II: Injuries and deaths

Classification of injuries and their medico-legal aspects; method of assessing various types of deaths; general and individual characteristics of handwriting; examination and comparison of handwritings and analysis of ink from various samples.

UNIT III: Explosives and ballistics

Classification of firearms and explosives; introduction to internal, external and terminal ballistics; chemical evidence for explosives; process of documentation of crime scene by photography, sketching and field notes.

UNIT IV: Fingerprints, DNA fingerprinting and toxicology

Fundamental principles of fingerprinting; classification of fingerprints; development of fingerprints as science for identification; principle of DNA fingerprinting; application of DNA profiling in forensics; role of the toxicologist; significance of toxicological findings in forensics.

UNIT V: Forensic biology

Nature and importance of biological evidence; significance of hair, semen and blood as biological evidences; types and identification of microbial organisms of forensic significance; identification of wood, leaves, pollens, diatoms and insects as forensic evidence. Investigation Tools, eDiscovery, Evidence Preservation, Search and Seizure of Computers, Introduction to Cyber security.

Suggested Readings:

1. Bhasin, MK and Nath, S 2002.Role of Forensic Science in the New Millennium, University of Delhi, Delhi.
2. James, SH and Nordby, JJ 2005. Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd ed. CRC Press, Boca Raton.
3. Nanda, BB and Tiwari, RK 2001. Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi.
4. Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

5. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (ED.), CRC Press, Boca Raton (1997).
6. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).
7. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).

Course Learning Outcome (CLO): Upon successful completion of this course the student will:

1. Apply the Laboratory skills to participate in the career needs of Forensic community.
2. Become trained in the laboratory skills of different division of Forensic Science.
3. Be able to work with different R&D organizations

I Year: II Semester (Theory)
Vocational Elective-1
Molecular Diagnostics
Course code:BSB222VO

L	T	P	C
4	0	0	4

Course objectives: The course is designed to give an overview and applications of different molecular biology techniques used in disease diagnosis. The specific objectives of the course are:

1. To teach students different molecular techniques used for disease diagnosis.
2. To make students understand the utilization of these techniques in disease diagnosis.
4. To teach the use of different enzyme immunoassay based diagnostic methods.
5. To impart the knowledge about the molecular diagnostic of different human diseases.

UNIT I: Enzyme immunoassays
Comparison of enzymes for enzyme immunoassays; conjugation of enzymes; homogeneous and heterogeneous enzyme immunoassays; immunoblotting; polyclonal or monoclonal antibodies; immunoassays in diagnostic microbiology.

UNIT II: Molecular methods in clinical microbiology
Applications of PCR, RFLP, nuclear hybridization methods; single nucleotide polymorphism and plasmid finger printing in clinical microbiology; micro-dilution and macro-dilution broth procedures; diffusion test procedures.

UNIT III: Advanced methods of microbial diagnosis
Automation in microbial diagnosis; rapid diagnostic approach including technical purification and standardization of antigen and specific antibodies; concepts and methods in idiotypes; antiidiotypes and molecular mimicry and receptors; epitope design and applications.

UNIT IV: Techniques used in molecular diagnostics
Immunodiagnostic tests; immunofluorescence; radioimmunoassay; GLC, HPLC; electron microscopy; flow cytometry and cell sorting.

UNIT V: Molecular biology-based diagnostics
Molecular diagnostics for infectious diseases; molecular testing for Neisseria; molecular diagnosis for HIV-1; genetic counseling and molecular diagnosis; genetic testing: need and uses.

Suggested Reading:

1. Bruns, DE, Ashwood, ER and Burtis, CAF 2007. Fundamentals of Molecular Diagnostics, 1st ed. Elsevier.
2. Tokas, J 2015. Immunology and Molecular Diagnostics. 1st ed. University Science Press.
3. Wilson, K and Walker, J Editors, S 2010. Principles and Techniques of Biochemistry and Molecular Biology, 7th ed. Cambridge University Press.
4. Patrinos, GP, Danielson, PB and Ansorge, W 2009. Molecular Diagnostics, 3rd ed. McMillan.

Course Learning Outcome (CLO): Upon successful completion of this course the student will:

1. Gain an understanding of the principles governing molecular diagnostics.
2. Be able to apply the knowledge and skills gained in the course in developing new molecular diagnostic kits.

I Year: II Semester (Theory)
Food, Nutrition and Hygiene
Course code: BSB231

L	T	P	C
2	0	0	2

Course objective (CO)

1. To learn the basic concept of the Food and Nutrition.
2. To study the nutritive requirement during special condition like pregnancy, lactation and diagnosis.
3. To learn about meal planning.
4. To learn food safety and procedure.

UNIT-I: Concept of Food and Nutrition

Concept of Food and Nutrition (a) Definition of Food, Nutrients, Nutrition, Health, balanced Diet (b) Types of Nutrition- Optimum Nutrition, under Nutrition, Over Nutrition (c) Meal planning- Concept and factors affecting Meal Planning (d) Food groups and functions of food.

UNIT-II: Nutrients: Macro and Micro

Nutrients: Macro and Micro RDA, Sources, Functions, Deficiency and excess of (a) Carbohydrate (b) Fats (c) Protein (d) Minerals Major: Calcium, Phosphorus, Sodium, Potassium Trace: Iron, Iodine, Fluorine, Zinc (e) Vitamins Water soluble vitamins: Vitamin B, C Fat soluble vitamins: Vitamin A, D, E, K (f) Water (g) Dietary Fiber (h) neutraceuticals.

UNIT-III:1000 days Nutrition

1000 days Nutrition (a) Concept, Requirement, Factors affecting growth of child (b) Prenatal Nutrition (0 - 280 days): Additional Nutrients' Requirement and risk factors during pregnancy (c) Breast / Formula Feeding (Birth – 6 months of age) Complementary and Early Diet (6 months – 2 years of age)

UNIT-IV: Community Health Concept

Community Health Concept (a) Causes of common diseases prevalent in the society and Nutrition requirement in the following: Diabetes Hypertension (High Blood Pressure) Obesity Constipation Diarrhea Typhoid (b) National and International Program and Policies for improving Dietary Nutrition (c) Immunity Boosting Food.

Suggested Readings-

1. Singh, Anita, "Food and Nutrition", Star Publication, Agra, India, 2018.
2. 1000Days-Nutrition_Brief_Brain-Think_Babies_FINAL.pdf
3. https://pediatrics.aappublications.org/content/141/2/e20173716
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5750909/
5. Sheel Sharma, Nutrition and Diet Therapy, Peepee Publishers Delhi,2014,First Edition.
6. Suggested equivalent online courses: https://www.udemy.com/course/internationally-accredited-diploma-certificate-in-nutrition Diploma in Human Nutrition-Revised Offered by Alison Statistical Data Representation and Tabulation

Course Learning Outcome (CLO)

At the end of the course, the student will be able to:

1. Understand the basic concept of the food, Nutrition and hygiene
2. Explain nutritive requirement during pregnancy, lactation and diagnosis
3. Prepare meal planning.
4. Mainly understand nutrition concept.

I Year: II Semester (Theory)
Computer Applications
Course code: BSB221SE

L	T	P	C
3	0	0	3

Course Objectives (CO)

1. To describe the basics of computers and computational data analysis
2. To study the basic editing software.
3. To study the software application and packages.

Unit I: Introduction of Computers

Characteristics of Computers, Input, Output, Storage units, CPU, Computer System, Binary number system, Binary to Decimal Conversion, Decimal to Binary Conversion, ASCII Code, Unicode.

.

Unit II: Computer Fundamental and Organization

Fundamental of computer, Block Diagram of computer, Hardware & Software, Memory Organization, Languages, Components & Devices, Computers Applications & Utilization, Operating System. Internet: MS-DOS, MS-Windows, Android, Multimedia and Internet, Cyber Security

Unit III: Software Application and Packages

MS-Office: MS-Word, MS Excel and Power Point, Access: Saving, Closing, Opening, selecting, editing. Finding and replacing, printing documents, formatting, page design and layout. Presentations tools, features and functions, working, with slides, drawing and designing, running and controlling a slide show. excel workbook, data in a cell / formula, functions, Chart and Graphs, Access

Unit IV: Introduction to Internet

Internet, Growth of Internet, Owners of the Internet, Anatomy of Internet, basic Internet Terminology, Net etiquette. Internet Applications – Commerce on the Internet, Governance on the Internet, Impact of Internet on– Crime on/through the Internet.

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Unit V: Information Technology and Society

Indian IT Act, Intellectual Property Rights – issues. Application of information Technology in Railways, Airlines, Banking, Insurance, Inventory Control, Financial systems, Hotel management, Education, Video games, Telephone exchanges, Mobile phones, Information kiosks, special effects in Movies.

.

SUGGESTED READINGS:

1. Veer Bala Rastogi, “Biostatistics: 3rd Edition”, MedTech Science Press, 2022.
2. NSN Rao and NS Murthy, “Applied Statistics in Health Science”, 2nd Edition, Jaypee Brothers Medical Publisher (P) LTD, 2010.
3. S.C. Gupta and V.K Kapoor, “Fundamental of Mathematical Statistics”, S. Chand & Sons, 11th Edition, 2002.
4. P.K. Sinha and Priti Sinha "Computer Fundamentals: Concepts, System and Applications", 8thedition, BPB Publication, 2003.
5. Satish Jain, “IT Tools and Business System”, Revised 2010 Edition, BPB Publication, 2010.
6. S. Sagman, "Microsoft Office. 2000 for Windows", Second Indian Prim, Pearson Education, 2001.

7. C.R. Kothari, Research Methodology: Methods and Techniques, 2004.

Course Objectives and Outcomes (CLO)

At the end of the course, the student will be able to:

1. Explain concept of computers. .
2. Describe the basics of computers and computational data analysis.
3. Study the software application and packages.

I Year: II Semester (Theory)
Communication Skill and Personality Development
Course code: BSB221AE

L	T	P	C
3	0	0	3

Course objectives (CO)

1. To develop the writing and interview skill in students.
2. To develop communication skills and personality development skill.
3. To make good resume and oral presentation preparation for interview.
4. To explore communication beyond language and communicating.

UNIT I: Writing Skills

Letter Writing: Structure, format, and purpose of formal and informal letters
Resume and CV Writing: Essentials of preparing a professional Resume and Curriculum Vitae
Cover Letter: Writing an effective cover letter to accompany a job application
Differences: between Bio-data, Resume, and CV
Report Writing: Format, structure, and purpose of report writing for academic and professional contexts
Paragraph Writing: Techniques for coherent and effective paragraph development

UNIT II: Interview Skills

Introduction to Job Interviews: Importance and relevance of job interviews in professional life, Key factors and objectives of job interviews
Interview Process and Characteristics: Phases of a job interview, Traits of a successful interviewee
Interview Techniques: Common manners and etiquettes to be maintained, frequently asked interview questions and effective responses, Importance of dress code and grooming, Practice through mock interviews, Strategies for success in real interviews

UNIT III: Oral Presentation and Group Communication

Effective Oral Presentation: Steps for planning and delivering confident and impactful presentations, Use of visual and audio tools to enhance delivery
Group Communication Activities: Conducting group presentations and participating in group projects, Group discussions: format, purpose, and strategies, Comparison between group discussion and debate, Storytelling: Narrating a story or incident clearly and engagingly

UNIT IV: Technology-Based Communication

Digital Etiquette (Netiquette): Principles of writing professional and courteous emails
Digital Presentation Tools: Creating and delivering effective PowerPoint presentations
Editing and Writing Tools: Enhancing language and formatting skills using computer software and editing tools.

Suggested readings:

1. Sethi, J & et al. A Practice Course in English Pronunciation, Prentice Hall of India, New Delhi.
2. Sen, Leena. Communication Skills, Prentice Hall of India, New Delhi.
3. Prasad, P. Communication Skills, S.K. Kataria & Sons.
4. Bansal, R.K. and J.B. Harrison. Spoken English, Orient Language.

5. Roach Peter. English Phonetics and Phonology.
6. A.S. Hornby's. Oxford

Course Learning Outcome (CLO)

At the end of the course the student will be able to-

1. Develop the writing and interview skill in students.
2. Develop communication skills and personality development skill.
3. Make good resume and oral presentation preparation for interview.
4. Explore communication beyond language and communicating.

I Year: II Semester (Practical)
Clinical Biochemistry lab
Course code: BSB251

L	T	P	C
0	0	**2**	**1**

Course objective (CO)

1. To enhance the skills of solution preparation for different assays.
2. To study about the estimation of nitrogenous waste content in serum and urine.
3. To understand the process of separation of plasma/serum from blood.
4. To understand the process of estimation of blood glucose level by glucometer.

Practical's

1. Estimation of blood glucose level by glucometer
2. Estimation of blood glucose level by glucose oxidase-peroxidase method.
3. Total count - RBC and WBC. Differential count.
4. Estimation of hemoglobin in blood.
5. Liver function test in serum (AST, ALT, ALP, GGT, total protein, albumin, bilurubin)
6. Kidney function test serum (urea, uric acid, creatinine, BUN)
7. Routine examination of urine (urea, creatinine, sugar, total protein, albumin, ketone bodies)
8. Determination of A/G ratio in serum by biuret method
9. Estimation of serum total cholesterol.
10. Estimation of blood tryglycerides level.

Suggested Readings:

1. Clinical Biochemistry: A Laboratory Guide by Rooma Devi, Aman Chauhan, Simmi Kharb, Chandra Shekhar Pundir

Course Learning Outcome (CLO)

At the end of the course, the student should be able to

1. Enhance the skills of solution preparation for different assays.
2. Discuss about the estimation of nitrogenous waste content in serum.
3. Understand the process of separation of plasma/serum from blood.
4. Understand the process of estimation of blood glucose level by glucometer.

I Year: II Semester (Practical)
Genetics Lab
Course code: BSB252

L	T	P	C
0	0	**2**	**1**

Course objective (CO)

1. To give practical experience to learn safety measures in Laboratories
2. To enhance the skills of solution preparation for karyotype assays.
3. To learn the laws of heredity with practical emphasis on inheritance
4. To gain hand on training to test Ames test for mutagenesis

Practicals

1. Types of chromosomes
2. Demonstration of Sex chromatin in buccal smear.
3. Karyotype preparation.
4. Preparation of polytene chromosomes from salivary gland of Chironomous larvae.
5. Problems on Monohybrid cross
6. Problems on dihybrid ratio in *Drosophila*/maize
7. Problems on Linkage and Recombination
8. Genetics problems based on Transposable elements.
9. Studies on Sex linked inheritance and X-linked recessive inheritance
10. Ames test for mutagenesis

Suggested Readings:

1. Genetics Laboratory Investigations by Thomas Robert Mertens and Robert L. Hammersmith.
2. A practical manual on Fundamentals of Genetics, Compiled by: Shweta Singh Assistant Professor, Department of Agriculture, Faculty of Science and Engineering, Jharkhand Rai University, Namkom.

Course Learning Outcome (CLO)

At the end of the course, the student should be able to

1. Understand the types of chromosome
2. Enhance the skills of solution preparation for karyotype assays.
3. Discuss about the monohybrid and dihybrid cross
4. Would be able to understand (i) Mendel's law (ii) Gene mapping and (iii) Transposable elements and (iv) the process of mutagenesis.

Mahayogi Gorakhnath University, Gorakhpur
Faculty of Health and Life Sciences
Department of Biochemistry, Session 2025-26

B.Sc. (Hons./Hons. with Research) Biochemistry
Study Evaluation Scheme (as per NEP2020)
Effective from the session 2025-26

II Year: III Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	BSB301	Cell Biology	4	0	0	25	75	100	4	Major	Own faculty
2	BSB302	Tools and Techniques in Biochemistry	4	0	0	25	75	100	4	Major	Own faculty
3	BSB303	Food Sciences	4	0	0	25	75	100	4	Major	Own faculty
4	------	**Minor Elective-1**	4	0	0	25	75	100	4	Minor	Any faculty
5	BSB331	Physical Education and Yoga	2	0	0	25	75	100	2	Value Added Courses	Any faculty
Practical											
6	BSB351	Cell biology and histopathology lab	0	0	2	25	75	100	1	Major	Own faculty
7	BSB3532	Tools and Techniques in Biochemistry Lab	0	0	2	25	75	100	1	Major	Own faculty
Total			18	0	4	175	525	700	20		

Hons	Honours
L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination

Minor Elective-1		MOOCS/NPTEL/SWYAM/ Other University/College
Course Code	**Course Name**	
BSB321	Histopathology and Cytology	https://nptel.ac.in/courses/104105139
BSB322	Medical Biotechnology	
BSB301	Cell Biology	https://nptel.ac.in/courses/102103012 Cell Biology, IIT Guwahati Dr. SanjuktaPatra

Note: Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.

Date:_____
VolumeNo.:_____

II Year: III Semester (Theory)
Cell Biology
Course code: BSB301

L	T	P	C
4	0	0	4

Course Objective:

1. The course gives the life activities at cellular and molecular level and basic functions of the various cellular compartments and organelles.
2. It also gives the structural, functional and biochemical details of all cellular activities, cell cycles and signaling and cancerous cells.

UNIT I: Introduction of cell

Introduction and history of Biotechnological science with special reference to contribution of Indian scholars in biological sciences. Structure of animal, plant and bacterial cells, Diversity of cell size and shape, Cell theory. Cell Membrane: Chemical components of biological membranes, organization and Fluid Mosaic Model and membrane transport.

UNIT II: Structure and functions of cellular organelles

Structure and function of cell organelles such as: Lysosomes, Vacuoles, Microbodies, Ribosomes, Mitochondria, Chloroplast, Nucleus, Endoplasmic reticulum, Golgi bodies, Cytoskeletons, Glyoxisomes, Peroxisomes.

UNIT III: Cell cycle and apoptosis

Cell Cycle: G1, S, G2 and M phases, Mitosis and Meiosis: Control points in cell-cycle Cell senescence. Apoptosis (programmed cell death**).** Extrinsic pathways, intrinsic pathways, granzyme mediated apoptosis, all factor involve in apoptosis.

UNIT IV: Cell signaling: Principles and Mechanism of Diffusion and Passive, Active & facilitated Transport, Artificial Membranes (Liposomes) in Drug Delivery, Kinetics of Super-molecular Membrane Assembly (Viruses and Ribosomes).Classes of Cell Receptors, Molecular Mechanism of Cell Signaling via G-protein linked Cell Surface Receptors, Trimeric G-proteins and their regulatory mechanism, Role of Ca++ as an intracellular signal, Ca++ / Calmodulin dependent protein kinase, cAMP- Ca++ Pathway. Signaling via enzyme-linked cell surface receptor, Ras –Proteins and their role in signaling cascade. General principles of cell communication, regulation of signaling pathways, bacterial and plant two component systems, light signaling in plants, bacterial chemotaxis and quorum sensing.

UNIT V:Cancer biology: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis and cancer, therapeutic interventions of uncontrolled cell growth. Cancer – types, molecular basis of colon cancer and breast cancer, lung cancer, leukemia, lymphoma

Suggested Readings:

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). Molecular Biology of the Cell (6thEd.). New York: Garland Science.

2. Cooper, G. M., and Hausman, R. E. (2013). The Cell: A Molecular Approach (6th Ed.). Washington: ASM; Sunderland.
3. Karp, G. Cell and Molecular Biology. Concepts and experiments. John Harris, D.,Wiley& sons, New York.
4. Iwasa J., Marshal W. Karp's Cell Biology (2018) (8th edition) Wiley & Sons, NY
5. Iwasa J., Marshal W. Karp's Cell and Molecular Biology. Concepts and experiments. (2015) (8th edition) Wiley & sons, New York
6. Watson, J. D. Baker TA, Bell, SP Gann, A. Levine, M. Losick R. (2008). MolecularBiology of the Gene (5thed.). Pearson.
7. Lodish, H F. Berk, A. Kaiser, CA, Krieger, M. Bretscher, A. Ploegh, H. Aman, A.Martin, K. (2016). Molecular Cell Biology (8th Ed.). New York: W.H. Freeman.
8. Gupta P.K. Cell and Molecular Biology 2018. 5thedition Rastogi Publication India
9. Gardner EJ, Simmons MJ, Sunstad DP. Principles of Genetics. 8thEdition. John Wiley and Sons.
10. Snustand DP, Simmons MJ. Principles of Genetics. (2016)7thEdition. John Wiley and Sons.
11. Verma PS, Agarwal VK. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. (2004). S Chand and Company Ltd.
12. Satyanarayana U (2020). Biotechnology. Books and Allied (P) Ltd.
13. Singh BD. (2015). Biotechnology: Expanding Horizons (4thedition). Kalyani Publishers
14. Dubey RC. (2014) A Textbook of Biotechnology (5thedition) S Chand and Company Ltd.
15. सिंहबी. डी.(2017)बायोटेक्नोलोजीKalyani Publishers
16. पीकेगुप्ता,कोशिकाविज्ञानऔरआनुवंशिकी, 2015 2nd edition Rastogi Publications
17. सिंहबी. डी. आनुवंशिकीकेआधार. (2017) Kalyani Publishers
18. सोनीके.सी.स्वरंकारगायत्री. आधुनिककोशिकाविज्ञान, 2018 CBC

Course Learning Outcome (CLO) This course introduces the principles of cell biology and genetics. After completion of this course, students will be able to-

1. Learn different areas of cell biology including the structure and functions of cell, its organelles such as mitochondria, nucleus etc. andhow genetic information is transmitted in organism.
2. Understand the role of cytoskeleton and its remodeling including the diseases associate with improper remodeling.
3. Learn how the synthesized proteins are transported to different organelles.
4. Understand the regulation of cell cycle, programmed cell death and Cancer.

II Year: III Semester (Theory)
Tools and Techniques in Biochemistry
Course code: BSB302

L	T	P	C
4	0	0	4

Course objective (CO)

1. To understand the basic principles of different microscopy techniques.
2. To understand the working principles, construction and applications of pH meter, and chromatography techniques.
3. To describe the techniques and applications of centrifugation and electrophoresis for biological sample separation.
4. To recognize how the spectroscopy plays a role in quantitative estimation of biomolecules.

UNIT I: **Common Laboratory Instruments**
Incubators, Hot air oven, Autoclave, anaerobic cultivation apparatus and Biological safety Cabinet, Structure and use of pH meter, pH indicators for measuring pH, Standardization step by step procedure, Ion selective electrodes. Biosensor: basic characteristics feature of ideal biosensor, different types of biosensors

UNIT II: Microscopy: History of Microscopy, Types of microscopy, Principle, Instrument design, methods and application of a compound light microscope, bright field microscope, dark field microscope, Microscopy phase contrast, confocal microscope, fluorescence microscopy, Electron microscopy and scanning tunneling microscopy, Preparation of specimens for electron microscopy.

UNIT III: Chromatography Techniques
TLC and Paper chromatograph, Chromatographic methods for macro molecule separation – types of chromatography, - Gel permeation, Ion exchange, Hydrophobic, Reverse – phase and Affinity chromatography; HPLC.

UNIT IV: Centrifugation and Electrophoresis
Basic principles; Mathematics & theory (RCF, Sedimentation coefficient etc; Types of centrifuge Applications, Osmosis; viscosity, Diffusion and Surface tension. Electrophoretic techniques: electophoretic mobility, Theory and application of polyacrylamide and Agarose gel electrophoresis, Iso-electric Focusing, 2D Electrophoresis, Pulsed field gel electrophoresis (PFGE), capillary electrophoresis.

UNIT V: Spectroscopy Techniques
Spectroscopy Techniques, UV and Visible spectroscopy; interaction of radiation with biomolecules, principle of UV- visible absorption spectrophotometry, Lambert's and Beers Law. Application of UV – visible absorption spectrophotometry in biological science, Fluorescence spectrophotometry and its application in biochemistry.

Suggested Readings:

1. Handbook of medical instruments, R. S Khandpur, 2003. 2nd Edn.Tata McGraw-Hill Publishing Company.
2. Biomedical instrumentation, Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, 1980. 2nd Edn, Prentice-Hall,

3. Medical Instrumentation, John G. Webster, 2003, John Wiley & Sons.
4. Principles of applied Biomedical instrumentation by L.A. Goddes and L.E. Baker, 1989. 3rd Edn. John Wiley India Pvt.Ltd.
5. Introduction to Biomedical Equipment Technology, Carr J. and J, Brown J. M, 2009. 4th Edn. Pearson.
6. Medical electronics and Instrumentation by Sanjay Gupta.

Course Learning Outcomes (CLO)

At the end of the course, the student will be able to:

1. Understand the basic principles of different microscopy techniques.
2. Understand the working principles, construction and applications of pH meter, and chromatography techniques.
3. Describe the techniques and applications of centrifugation and electrophoresis for biological sample separation.
4. Recognize how the spectroscopy plays a role in quantitative estimation of biomolecules.

II Year: III Semester (Theory)
Food Science
Course code: BSB303

L	T	P	C
4	0	0	4

Course Objectives: The objectives of the course are as follows:

1. To teach students about various food processing methods.
2. To impart the basic knowledge of laws regulating food industry.
3. To know the different types of food additives.
4. To understand the different types of food contamination and adulteration and methods of their testing and analysis

UNIT-I: Food Additives and contaminants

Over view of food additives with respect to their technological functions.

Additives used in food preservation such as preservatives, antioxidants, humectants etc. with respect to chemistry and food uses. Additives used as aids in food processing such as Sequestrant, emulsifier, hydrocolloids, non-nutritive sweet, artificial sweeteners, flavour enhancer stabilizers, anticaking and firming agents, flour bleaching and maturing agents, sweeteners, acidulants etc. and their functions in food processing and storage. Safety aspects of Food Additives: Tolerance levels & toxic levels in foods, Legal safeguard, Risks of food additives. Contamination in food: Physical, chemical (heavy metals, pesticide residues, antibiotics, veterinary drug residues, dioxins, environmental pollutants, radionucleides, solvent residues); natural toxins.

UNIT-II: Food Microbiology

Food Microbiology & General principles of Food Hygiene. General principles of food microbiology and over view of food borne pathogens. Over view of sources of microorganisms in food chain (raw materials, water, air, equipment etc.) and microbiological quality of foods. Microbial food spoilage and Food borne diseases. Bio Chemistry of Food Spoilage**:** Factors causing food spoilage during food ripening, vegetable maturation and their control. Post mortem changes in meat and their control. General principles and techniques in microbiological examination of foods. Overview of beneficial microorganisms and their role in food processing and human nutrition.

UNIT-III: Food processing and preservation

Principles of food processing and preservation: Food processing and preservation techniques-Pickling, Drying and dehydration, Evaporation and concentration, Freezing, Chilling, Blanching, Pasteurization, Sterilization, UHT processing, Retort processing, Smoking, Curing, Canning, Bottling, Jellying, Food powders, Minimal processing, Photochemical processes, HPP, Hurdle technology, etc.

UNIT-IV: Food adulteration and methods of their testing and analysis

Type of adulterations used in food and methods of their testing and analysis (Physical and Chemical). Hazardous effects of different adulterations.

UNIT-V: Food safety management system

General principles of food safety management systems including traceability and recall – sanitation, HACCP, Good production and processing practices (GMP, GAP, GHP, GLP, BAP, etc.), Determination of shelf – life of food products transport of perishable food items. Laws related to food packaging and nutrition labeling; food laws and regulations: Codex, HACCP, ISO, FSSAI, etc.

Suggested Readings:

1. Desrosier NW and Desrosier JN, The Technology of Food Preservation, CBS Publication, New Delhi, 19982. Paine FA and Paine HY, Handbook of Food Packaging, Thomson Press India Pvt Ltd, New Delhi- 1992
2. Potter NH, Food Science, CBS Publication, New Delhi, 1998
3. Ramaswamy H and Marcott M, Food Processing Principles and Applications CRC Press,2006
4. Rao PG, Fundamentals of Food Engineering, PHI Learning Pvt Ltd, New Delhi, 2010
5. Toledo Romeo T, Fundamentals of Food Process Engineering, Aspen Publishers, 1999
6. B. Srilakshmi, Food science, New Age Publishers,2002
7. Meyer, Food Chemistry, New Age,2004
8. Bawa. A.S, O.P Chauhan et al. Food Science. New India Publishing agency, 2013
9. Frazier WC and Westhoff DC, Food Microbiology, TMH Publication, New Delhi, 2004
10. Manay, NS and Shadakshara swamy, M 1987. Food Facts and Principles. New Age International (P) Ltd. Publishers, New Delhi.

Course Learning Outcome (CLO): Upon successful completion of this course the student will:

7. Understand about different food processing methods like refrigeration and freezing.
8. Learn about the dehydration techniques with the use of advanced technology of types of dryers.
3. Understand the different types of thermal processing techniques.
4. Learn about the importance of food regulations like Codex, HACCP, ISO, FSSAI, etc. in food packaging and labeling.

II Year: III Semester (Theory)
Minor Elective-1
Histopathology and Cytology
Course code: BSB321

L	T	P	C
4	0	0	4

Course objective (CO)

1. To learn essentials of human histology and human cell cytology.
2. To get knowledge of sample preparation for human histopathology and cytology.
3. To learn about standard and new techniques of cell and tissues specimen preparation for different histological and cytological analysis

UNIT- I: Introduction

Introduction to Histopathology, Exfoliative cytology. Basic steps for Tissue Processing: Fixing, Embedding, Microtomy, Staining, Mounting, methods of decalcification. Laboratory requirements for Histopathology & Cytology: Chemicals & Reagents.

UNIT–II: Histology Equipment's

Microscope, Microtome: Types, Uses, Parts, different types of microtome knives, care & maintenance. Automated tissue processor - components, working &precautions during use, Tissue floating bath. Staining Methods: Hematoxylin & Eosin stain, Reticulin stain, PAP staining Museum Techniques.

UNIT-III: Chemical Pathology

Alterations of biochemical parameters, hormones and other constituents in serum and other body fluids in important diseases. Rationale of planning, collection of specimen, principles, utility and interpretation of such alterations to help diagnosis. Correlation of such biochemical parameters with clinical and morphological aspects of the diseases.

UNIT-IV: Sample preparation

The mounting of pathological specimens: Introduction, Preparation of specimen, Fixation of specimen, Precaution taken for the Fixation of Specimens. Storage of Specimens. Processing and staining of bone marrow sample: Fixation, processing and section cutting of bone, eye ball, Techniques in neuropathology, Neurons staining, Myelin, Neuropathology lab specimen handing.

UNIT-V: Instrument and Equipment's in Cytology

Instruments and equipments used in cytology fixation and fixatives used in cytology, Adhesive and mounting media, cell block and cytosine technique, staining such as PAP, Diff- quick, MGG, H&E short staining, significance of PAP – HPV detaining and restraining of slides slipping.

Suggested Readings:

1. Harshmohan (2017), Textbook of Pathology, 7th edition, Jaypee Publications.
2. Robbins, (2012), Textbook of Pathology, 3rd edition, Elsevier Publications

Course learning outcomes (CLO)

At the end the course, the students should be able to:

1. Learn essentials of human histology and human cell cytology.
2. Get knowledge of sample preparation for human histology and cytology.
3. Learn about standard and new techniques of cell and tissues specimen preparation for different histological and cytological analysis.

II Year: III Semester (Theory)
Minor Elective-1
Medical Biotechnology
Course code: BSB322

L	T	P	C
4	0	0	4

Course objectives: The main objective of this course is to:

1. To empower students with the knowledge of allied biomedical sciences
2. Introduce to create a work force for advanced research
3. Introduce diagnostics in a medical environment.

UNIT I: Methods for diagnosis of human diseases

Karyotyping of human chromosomes, Chromosome banding– G banding and R-banding technique, Inheritance patterns in Man– Pedigree, Diagnosis using monoclonal antibodies- ELISA, DNA/RNA based diagnosis– HBV, HIV.

UNIT II: Inherited disorders

Chromosomal disorders caused due to structural chromosomal abnormalities (Deletions, duplications, Translocations), Chromosomal disorders caused due to numerical chromosomal abnormalities (autosomal and allosomal), Monogenic disorders (autosomal and X-linked diseases), Mitochondrial diseases – LHON, MERRF.

UNIT III: Gene therapy

Gene therapy – *ex-vivo* and *in-vivo* gene therapy; somatic and germline gene therapy; Strategies of gene therapy.

UNIT IV: Therapeutic approaches for human diseases

Gene augmentation – ADA deficiency; Prodrug therapy/suicide gene – glioma, Stem cells – potency definitions; embryonic and adult stem cells; applications of stem cells – cell based therapies and regenerative medicine, Encapsulation technology and therapeutics-Diabetes, DNA based vaccines, subunit vaccines – Herpes Simplex Virus, Recombinant attenuated vaccines– Cholera.

UNIT V: Drug Delivery

Drug delivery: Basic concepts, Drug delivery: Market perspective, Advance drug delivery and targeting, Rate control in drug delivery and targeting: Fundamentals and application to implantable systems, Drug targeting systems: Fundamental and applications to parental drug delivery, Routes of drug delivery, Oral drug delivery, Oral Trans-Mucosal drug delivery, Transdermal drug delivery, Nasal drug delivery, Pulmonary drug delivery, Vaginal drug delivery, Opthalmic drug delivery, CNS drug delivery, Future direction of drug delivery and targeting, Plasmid based gene therapy, Integrating drug discovery and delivery, New generation technologies.

Suggested Readings:

9. Medical Biotechnology-Pratibha Nallari, V.Venugopal Rao-Oxford Press
10. Introduction to Human Molecular Genetics – J.J Pasternak, John Wiley Publishers
11. Human Molecular Genetics –Tom Strachen and A P Read, Bios Scxientific Publishers
12. Molecular Biotechnology, Glick and Pasternak
13. Drug Delivery and Targetting by Anya Hilary, Andrew Lloyd

Course Learning Outcome (CLO): Successful students will be able to:

1. Students will develop an ability to identify, organize and answer problems in Medical Biotechnology.
2. Students will develop an ability to use skills and modern technological tools necessary for medical biotechnological practices
3. Perfrom independent as well as team work to accomplish lab based tasks

II Year: III Semester (Theory)
Physical Education and Yoga
Course code: BSB331

L	T	P	C
2	0	0	2

Course objective (CO)

1. To study the introduction of physical education, concept of fitness and wellness.
2. To study weight management and lifestyle of an individual.
3. To learn about the relation of yoga with mental health and value education.
4. To learn about the aspects of the traditional games of India.

UNIT-I: Physical Education

Meaning Definition, Aim and Objective., Misconception About Physical Education, Need Importance and Scope of Physical Education in the Modern Society, Physical Education Relationship with General Education, Physical Education in India before Independence.

UNIT-II: Concept of Fitness and Wellness

Meaning, Definition and Importance of Fitness and Wellness, Components of Fitness, Factor Affecting Fitness and Wellness.

UNIT-III: Weight Management

Meaning and Definition of Obesity, Causes of Obesity, Management of Obesity, Health problems due to Obesity, Meaning, Definition, Importance of Lifestyle, Factor affecting Lifestyle, Role of Physical activity in the maintains of Healthy Lifestyle.

UNIT-IV: Yoga and Meditation

Historical aspect of yoga, Definition, types scopes & importance of yoga, Yoga relation with mental health and value education, Yoga relation with Physical Education and sports, Definition of Asana, differences between asana and physical exercise, Definition and classification of pranayama, Difference between pranayama and deep breathing.

UNIT-V- Traditional Games of India

Meaning, Types of Traditional Games-Gili- Danda, Kanche, StapuGutte, etc. Importance/ Benefits of traditional Games, How to Design Traditional Games. Recreation in Physical Education, Meaning, Definition of Recreation, Scope and Importance of Recreation, General Principles of Recreation, Types of Recreational Activities, Aerobics and Zumba. (Fir India Movement)

Suggested Readings-

1. Singh, Ajmer, Physical Education and Olympic Abhiyan, “Kalayani Publishers”, New Delhi, Revised Addition, 2006
2. Patel, Shri krishna, Physical Education, “Agrawal Publishers”, Agra, 2014-15
3. Panday, Preeti, Sharirik Shiksha Sankalan, “ Khel Sanskriti Prakashan, Kanpur
4. Kamlesh M.L., “Physical Education, Facts and foundations”, Faridabad P.B. Publications.
5. B.K.S. Yengar, & quot; Light and Yog. Yoga Deepika & quot;, George Allen of Unwin Ltd., London,1981.
6. BrajBilari Nigam, Yoga Power & quot; TheKpath of Personal achievement & quot; Domen and Publishers,
7. New Delhi, 2001.

8. Indira Devi, "Yoga for You &q uot;, Gibbs, Smith Publishers, Salt Lake City, 2002 Domenand Publishers, New Delhi - 2001.
9. Jack Peter, & quot;Yoga Master the Yogic Powers & quot;, Abhishek Publications, Chandigarh, 2004.
10. Janice Jerusalim, & quot; A Guide To Yoga & quot; Parragon Bath, Baiihe-2004.

Course Learning Outcome (CLO):

At the end of the course the student will be able to:

1. Study the introduction of physical education, concept of fitness and wellness.
2. Study weight management and lifestyle of an individual.
3. Learn about the relation of yoga with mental health and value education.
4. Learn about the aspects of the traditional games of India.

II Year: III Semester (Practical)
Cell Biology and Histopathology Lab
Course code: BSB351

L	T	P	C
0	0	2	1

Course objective (CO)

1. To study types of cell division.
2. To learn sample preparation for microtomy study.
3. To identify the glass wares and equipment used in histopathology lab.
4. To understand the preparation of various stains and fixatives used in cytology lab.

Practical -

1. Introduction to safety measures in Laboratories
2. Study of structure of any Prokaryotic and Eukaryotic cell.
3. Microtomy: Fixation, block making, section cutting, double staining of animal tissues like liver, esophagus, stomach, pancreas, intestine, kidney etc.
4. Cell division in onion root tip/ insect (grasshopper) gonads.
5. Study of mitosis and meiosis from permanent slides.
6. Demonstration of glass wares and equipment used in histopathology lab.
7. To prepare alcohol in different concentration.
8. To prepare formalin from stock solution.
9. Preparation of various stains used in cytology
10. Preparation of various cytological fixatives.

Suggested Readings:

1. CELL AND MOLECULAR BIOLOGY: A Lab Manual Kindle Edition by K. V. Chaitanya (Author)
2. Molecular Biology -Practical- (ksu.edu.sa)
3. Basic and Practical Microbiology Lab Manual Paperback 2018, by Mette Ibba (Author), Katherine Elasky (Author)
4. Basic and Advanced Laboratory Techniques in Histopathology and Cytology Hardcover – 3 July 2003, by DEY P (Author)

Course Learning Outcome (CLO)

At the end of the course the student will be able to

1. Explain safety measures in laboratories and the structure of an eukaryotic cell at different magnification, measure the cell length and breadth using micrometry.
2. Understand different stages of Mitosis and meiosis, to isolate chloroplasts and estimate chlorophyll content in plant sample.
3. Identify the glass wares and equipment used in histopathology and cytology lab.
4. Understand the preparation of different concentration of solution and various stains and fixatives used in cytology lab.

II Year: III Semester (Practical)
Tools and Techniques in Biochemistry lab
Course code: BSB3532

L	T	P	C
0	0	2	1

Course Objectives (CO)

1. To study the principles, procedure and care of laboratory instruments.
2. Demonstrate practical skills in different laboratory equipment and their handling like colorimeter, spectrophotometer, Electrophoresis etc.
3. To get detail applications of various instrument and techniques in biochemical field.

Practical's

1. Principles of Colorimetry and spectrophometer: (i) Verification of Beer's- Lambert's law. (ii) To study relation between absorbance and % transmission.
2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter)
3. Estimation of Proteins by Biuret method and Lowry method and draw standard curve by using BSA as standard protein.
4. Separation and identification of amino acids by paper chromatography.
5. Separation and identification of Sugars by TLC (thin layer chromatography).
6. Separation and identification of lipids by TLC (thin layer chromatography).
7. Separation of Amino acids by Ion- Exchange Chromatography.
8. Separation of Amino acids by Gel Filtration Chromatography.
9. Separation of protein (BSA) by SDS-PAGE.
10. Video demonstration of some advance bioanalytical techniques.

Suggested Readings:

1. Lab in Cell Biology, Microbiology and Bioinstrumentation: Laboratory Manual Kindle Edition by Geethalakshmi Sundararaman (Author), Anitha Arumugam (Author)
2. Laboratory Manual for Bioinstrumentation, Biochemistry, Microbiology, Cell Biology and Enzyme Technology For PG and UG students,2018, Publisher: Excellent Publishing House New Delhi India, ISBN: 978-93-86238-53-5

Course learning outcome (CLO)

At the end of the course, the student will be able to:

1. Understand the principles, procedure and care of laboratory instruments.
2. Understand the theory and principles of chromatography, electrophoresis, and spectrophotometry.
3. Explain applications of various instrument and techniques in biochemical field.
4. Demonstrate the application of PAGE and other bioanalytical techniques.

Mahayogi Gorakhnath University, Gorakhpur
Faculty of Health and Life Sciences
Department of Biochemistry, Session 2025-26

B.Sc. (Hons./Hons. with Research) Biochemistry
Study Evaluation Scheme (as per NEP2020)
Effective from the session 2025-26

II Year: IV Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty	Diploma in Biochemistry
						CIE	ESE					
Theory												
1	BSB401	Enzymology	4	0	0	25	75	100	4	Major	Own faculty	
2	BSB402	Immunology and serology	4	0	0	25	75	100	4	Major	Own faculty	
3		**Minor Elective-2**	4	0	0	25	75	100	4	Minor	Own faculty	
4	-----	**Vocational Elective-2**	4	0	0	25	75	100	4	Minor Vocational	Any faculty	
5	BSB431	Human Values and Environmental Ethics	2	0	0	25	75	100	2	Value Added Courses	Any faculty	
Practical												
6	BSB451	Enzymology Lab	0	0	2	25	75	100	1	Major	Own faculty	
7	BSB452	Immunology and serology Lab	0	0	2	25	75	100	1	Major	Own faculty	
8	BSB453SI	Summer Internship	0	0	4	25	75	100	2	Summer Internship	Any lab	
Total			18	0	8	200	600	800	22			

Hons	Honours
L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination

Vocational Elective-2	
Course code	**Course Name**
BSB421VO	Ecology and Environments
BSB422VO	Nanobiotechnology

Minor Elective-2	
Course code	**Course Name**
BSB421	Pharmaceutical Chemistry
BSB422	Polymer chemistry

MOOCS/NPTEL/SWYAM/Other University/College	
Immunology and Serology	https://nptel.ac.in/courses/102103038 Cellular and Molecular Immunology, IIT Guwahati Dr. Sachin Kumar
Enzymology	https://onlinecourses.nptel.ac.in/noc23_bt05/preview Enzyme Sciences and Technology By Prof. Vishal Trivedi, IIT Guwahati

Note:
1. Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.
2. Students who opt to exit after completion of the second year and have secured 80 credits will be awarded the UG diploma if, in addition, they complete one vocational course of 4 credits during the summer vacation of the second year. These students are allowed to re-enter within a period of three years and complete the degree programme within the maximum period of seven years.

II Year: IV Semester (Theory)
Enzymology
Course code: BSB401

L	T	P	C
4	0	0	4

Course objective (CO)

1. To provide a basic understanding of biological catalysis, Mechanism of action of enzymes, structure and functional relationship,
2. To study the enzyme kinetics, coenzymes/co-factors and enzyme inhibition.
3. To study the industrial and clinical uses of enzymes.
4. To understand the concept of clinical enzymology.

UNIT-I: Introduction to Enzymes

Definition and classification of enzymes, Uses of enzymes, Mechanism and characteristics of enzymes, Enzyme specificity, Cofactors, Co-enzyme and Prosthetic group, activators, inhibitors, active site, metalloenzymes, isozymes, monomeric enzymes, oligomeric enzymes and multienzyme complexes, Units of enzyme activity (definition of IU, Katal),enzyme substrate complex, induced fit hypothesis, Reversible and irreversible covalent modification.

UNIT-II: Enzyme kinetics

Michaelis Menten equation. Derivation of Michaelis Menten equation and determination of Km and Vmax values, Substrate inhibition and activation, Effect of pH and temperature on rate of enzyme catalyzed reactions, Allosteric enzymes.

UNIT-III: Enzyme catalysis and inhibition

Enzyme inhibition: reversible and irreversible inhibition, Kinetics of competitive, uncompetitive, non-competitive and mixed inhibition, Mechanism of enzymic action - general acid-base catalysis, covalent catalysis, substrate and allosteric inhibition.

UNIT-IV: Clinical enzymology

Clinical enzymology - Enzymes as thrombolytic agents, anti-inflammatory agents, digestive aids. Therapeutic use of asparaginases, streptokinase. Enzymes and isoenzymes in diagnosis, Principles of diagnostic enzymology, clinical significance of alkaline and acid phosphatase, SGOT, SGPT, LDH, CPK, aspartate aminotransferase, alanine.

UNIT-V: Applied Enzymology:

Application of enzymes in industry, medicine, agriculture, research; Immobilized enzymes. Synthetic or artificial enzymes and enzyme engineering.

Suggested Readings-

1. Palmer T (2001) Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, Horwood Publishing, Chichester, UK
2. Price NC and Stevens L (1999) Fundamentals of Enzymology, 3rd Edition, Oxford University Press Inc., New York
4. Berg JM, Tymoczko, JL and Stryker L (2002) Biochemistry, 5th Edition, WH Freeman & Co., New York
5. Dixon M and Webb EC (1979) Enzymes, 3rd Edition, Academic Press, New York Siegal IH (1975)

Enzyme Kinetics, Wiley Intercedence, USA.

Course Learning Outcomes (CLO)

At the end of the course the student will be able to:

1. Understand about biological catalysis, Mechanism of action of enzymes, structure and functional relationship,
2. Study the enzyme kinetics, coenzymes/co-factors and enzyme inhibition.
3. Study the industrial and clinical uses of enzymes.
4. Understand the concept of clinical enzymology.

II Year: IV Semester (Theory)
Immunology and serology
Course code: BSB402

L	T	P	C
4	0	0	4

Course objective(CO)

1. To study the mechanism and types of immune system.
2. To study about immune diffusion assay and autoimmune disorder.
3. To explain the causes of immunological disorder.
4. To study about MHC complex, Hypersensitivity and immunological techniques.

UNIT-I: Introduction to Immunology,
Infection: definition, classification, sources, methods of transmission, factors predisposing to microbial pathogen city, types of infection diseases. Immunity, Mechanisms of innate immunity, acquired immunity Measurement of immunity, Herd immunity, cell mediated immunity, humoral immunity, active and passive immunity. Antigens – determinants of antigen city, haptens, carrier protein, Adjuvant, biological classes, antibody's structure, classes, abnormal immunoglobulin specificities, Antigen – Antibody reaction: General features, measurement, serological reactions.

UNIT-II: Biology of the B and T lymphocyte: Antigen independent phase of B cell maturation and selection, humoral response – T- dependent and T-independent response, anatomical distribution of B cell populations. Structure and role of T cell receptor, and co-receptor, T cell development, generation of receptor diversity, selection and differentiation. General properties of effector T cells, cytotoxic T cells (Tc), natural killer cells; NKT cells and antibody dependent cellular cytotoxicity (ADCC). Generation of antibody diversity Dreyer-Bennett hypothesis, multigene organization of Ig locus, mechanism of V region DNA rearrangement, ways of antibody diversification.

UNIT-III-MHC complex and antigen presentation
General organization and inheritance of MHC, structure, distribution and role of MHC class I and class II proteins, linkage disequilibrium, pathways of antigen processing and presentation, complement activation and its biological consequences, cytokines and its different roles. Vaccine and its types, immunization,.

UNIT-IV Tolerance, autoimmunity, Immunological Disorder and hypersensitivity
Organ specific and systemic autoimmune diseases, possible mechanisms of induction of autoimmunity, immunological tolerance. Immunological disorders primary and secondary immunodeficiency, SCID, AIDS, Tumor, types of tumors, Various tumor Markers, their significance and method of estimation. Gell and Coombs classification, IgE mediated (Type I) hypersensitivity, antibody mediated cytotoxic (Type II) hypersensitivity, immunecomplex mediated (type III) hypersensitivity and delayed type (Type IV) hypersensitivity.

UNIT-V Immunological techniques
Precipitin curve, Immuno diffusion, one and two dimensional, single radial immuno diffusion, Ouchterlony immuno diffusion. Immuno-electrophoresis: Rocket immuno-electrophoresis; CIE, Graber and William technique. Agglutination: Direct and Indirect, Widal test, VDRL test. Radioimmunoassay: ELISA – Principle, Methodology and applications. Immuno-fluorescence: Direct, indirect and Sandwich, in situ localization by techniques such as FISH and GISH.

Suggested Readings

1. Kuby Immunology by J. Punt, S. Stranford, P. Jones and J. Owen. 8 th edition. W.H. Freeman and Company, USA. 2018.
2. Cellular and Molecular Immunology by A.K. Abbas, A.H. Lichtman and S. Pillai. 9th edition. Elsevier, USA. 2017.
3. Roitt's Essential Immunology by P. Delves, S. Martin, D. Burton and I.M. Roitt. 13th edition.
4. Wiley- Blackwell Scientific Publication, UK. 2017.
5. Immune biology: A short course by R. Coico and G. Sunshine. 7th edition. Wiley- Blackwell
6. Scientific Publication, UK. 2015.

Course learning Outcomes (CLO)

At the end of the course the student will be able t**o-**

1. Study the mechanism and types of immune system.
2. Study about immune diffusion assay and autoimmune disorder.
3. Explain the causes of immunological disorder.
4. Study about MHC complex, hypersensitivity, and immunological techniques.

II Year: IV Semester (Theory)
Minor Elective-2
Pharmaceutical Chemistry
Course code: BSB421

L	T	P	C
4	0	0	4

Course objectives (CO)

1. To study about pharmaceutical chemistry, drug discovery and developmental process.
2. To gain the complete knowledge about drug target interaction.
3. To understand clearly about the basic concepts of organic functional groups and acid base concepts in pharmacology.
4. To have a thorough knowledge about the antibiotics and anthelmintic drug.

UNIT-I: Introduction

Pharmaceutical chemistry introduction and importance, Europian pharmacopeia, Drug Action and Clinical test results – Drug discovery and development process, Sequence of events after drugs administration, list of physic – chemical properties related to drug action, Clinical chemistry and the importance of fundamental chemistry concept and analytical techniques.

UNIT-II: Drug Target Interactions

Structural effects on biological Action role and types of chemical bonding interactions between drug and target binding of neurotransmitters to their receptors, Thalidomide, Lessons as related to chirality of drugs.

UNIT-III: Review of Organic Functional Groups and Acid base Concepts

Functional groups, Electron donating and with drawing groups Acid and base, Henderson – Hasselbacke quation, Estimating pKa and pKb; Heterocycles.

UNIT-IV: Fundamentals of Neurochemistry

Structures, chemical properties, metabolism and action of select neurochemicals including acetylcholine, epinephrine, norepinephrine, dopamine, serotonin, glutamate, GABA, and nitric oxide and of nicotine. Chemistry of Over the Counter (OTC). Inorganic Drugs structures chemical properties and mechanism of action of antiacids (Tums, Pepto-Bismol, Milk of Magnesia), inorganic germicides, imaging agents, and platinum anticancer agents.

UNIT-V: Antimicrobials and Astringents

Antimicrobials and Astringents- Hydrogen peroxide, Potassium permanganate, Chlorinated lime, Iodine, Solutions of Iodine, Povidone-iodine, Boric acid, Borax, Silver nitrate, Mild silver protein, Mercury yellow, Mercuric oxide, Ammoniated mercury. Sulphur and its compounds- Sublimed sulphur, Percipitated sulphur, Selenium sulphide. Astringents- Alum and Zinc Sulphate

Suggested Readings

1. Essentials of Pharmacology basic principles and General Concept 5th Edition (PB 2023), 2021by VN Sharma.
2. Review Of Pharmacology by Gobind Rai Garg & Sparsh Gupta.
3. Essentials of Medical Pharmacology, 2018, by K. D. Tripathi.
4. One Touch Pharmacology 2022 by Ranjan Kumar Patel.

Course Learning Outcomes (CLO)

At the end of the course, the student should be able to:

1. Study about pharmaceutical chemistry, drug discovery and developmental process.

2. Gain the complete knowledge about drug target interaction.
3. Understand clearly about the basic concepts of organic functional groups and acid base concepts in pharmacology.
4. Explain about the antibiotics and anthelmintic drug.

II Year: IV Semester (Theory)
Minor elective-1
Polymer chemistry
Course code: BSB422

L	T	P	C
4	0	0	4

Course objectives (CO)

1. To understand basic importance of polymer.
2. To understand polymer characterizations.
3. To understand polymer processing and properties of commercial polymers.

UNIT-I: Basics Importance of polymers.
Basic concepts: Monomers, repeat units, degree of polymerization Linear, branched and network polymers. Classification of polymers. Polymerization: condensation, addition, radical chain-ionic and co-ordination and co-polymerization. Polymerization conditions and polymer reactions. Polymerization in homogeneous and heterogeneous systems.

UNIT-II: Polymer Characterization:
Polydispersion-average molecular weight concept. Number, weight and viscocity average molecular weights. Polydispersity and molecular weight distribution. The practical significance of molecular weight. Measurement of molecular weight. End-group, viscocity. Light scattering, osmotic and ultracentrifugation methods. Analysis and testing of polymers chemical analysis of polymers. Spectroscopic methods. X-ray diffraction study. Microscopy. Thermal analysis and physical testing-tensile strength. Fatigue, impact. Tear resistance. Hardness and abrasion resistance.

UNIT-III: Structure and Properties Morphology and order in crystalling polymers-
configuration of polymer chains. Crystal structures of polymers. Morphology of crystalline polymers, strain-induced morphology, crystallization and melting. Polymer structure and physical properties-crystalline melting point Tm – melting points of homogeneous series, effect of chain flexibility and other steric factors, entropy and heat of fusion. The glass transition temperature, Relationship between Tm and Tg. Effects of molecular weight. Diluents, chemical structure, chain topology, branching and cross linking. Property requirements and polymer utilization.

UNIT-IV: Polymer Processing Plastic, **elastomers and fibres, compounding. Processing techniques:**
Caledering, die casting, rotational casting, film casting, Injection moulding, blow moulding, extrusion moulding, thermoforming, foaming, reinforcing and fibre spinning.

UNIT-V: Properties of Commerical Polymers
Polythylene, polyvinyl chloride. Polyesters, phenolic resings, epoxy resing and silicone polymers. Functional polymers – fire retarding polymers and electrically conducting polymers. Biomedical polymers – contact lens, dental polymers, artificaial heart, kindnwy, skin and blood cells.

Suggested Readings

1. Textbook of Polymer Science, F.W. Billmeyer Jr. Wiley.
2. Polymer Science, V.R. Gowariker, N.V. Viswanathan and J. Sreedhar, Wiley-Eastern.

3. Functional Monomers and Polymers, K. Takemoto, Y.Inaki and RM. Ottanbrite.
4. Contemporary Polymer Chemistry, H.R. Alcock and F.W. Lambe Prentice Hall.

Course learning outcomes (CLO)

After completion of this course, students will able to

1. Understand basic importance of polymer.
2. Discuss about polymer characterizations.
3. Explain polymer processing and properties of commercial polymers.

II Year: IV Semester (Theory)
Vocational Elective-2
Ecology and Environments
Course code: BSB421VO

L	T	P	C
4	0	0	4

Course objectives: The specific objectives of the course are as follows:

1. To impart basic knowledge about the environment and its allied problems.
2. To teach students about different types of ecosystem.
3. To make students understand the flow of energy in an ecosystem.
4. To increase awareness amongst students about different biogeography and environmental challenges.

UNIT-I: Environment and concept of ecosystem:
The Environment: Physical environment; biotic environment; biotic and abiotic interactions. Geological consideration of Atmosphere, Hydrosphere, Lithosphere; scope of ecology; principles and concepts of ecosystem; structure of ecosystem; strata of an ecosystem; development and evolution of ecosystems.

UNIT-II: Habitat and Niche and Population Ecology:
Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement. Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations.

UNIT-III: Species Interactions, Community Ecology and Ecological Succession:
Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis. Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. Types; mechanisms; changes involved in succession; concept of climax.

UNIT-IV: Ecosystem Ecology and Biogeography:
Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); primary production and decomposition; structure and function of some Indian ecosystems: Forest ecosystems; tropical evergreen forest, tropical deciduous forest, temperate evergreen forest, temperate deciduous forest, tundra and taiga; desert ecosystem; freshwater and marine ecosystems; cybernetics and homeostasis; biological control of chemical environment. Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.

UNIT-V: Applied Ecology:
Environmental pollution and environmental health; detection of environmental pollutants; indicators and detection systems; bio-transformation; plastic, aromatics, hazardous wastes; environmental cleanup: Case studies. global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches. Conservation Biology: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

Suggested Readings

1. Chapman, J.L., Reiss, M.J. 1999. Ecology: Principles and applications (2nd edition) Cambridge

University Press.
2. Divan Rosencraz, Environmental laws and policies in India, Oxford Publication.
3. Ghosh, S.K., Singh, R. 2003. Social forestry and forest management. Global Vision Publishing House
4. Joseph, B., Environmental studies, Tata Mc Graw Hill.
5. Michael Allabay, Basics of environmental science, Routledge Press.
6. Miller, G.T. 2002. Sustaining the earth, an integrated approach. (5thedition) Books/Cole, Thompson Learning, Inc.
7. Mohapatra Textbook of environmental biotechnology IK publication.

Course learning Outcome (CLO): Upon successful completion of this course the student will:

1. Understand the differences between atmosphere, hydrosphere, and lithosphere.
2. Learn about forest, desert, freshwater, and marine ecosystems.
3. Understand the flow of energy in an ecosystem.
5. Know about the role of biotechnology in addressing environmental challenges.

II Year: IV Semester (Theory)
Vocational Elective-2
Nanobiotechnology
Course code: BSB422VO

L	T	P	C
4	0	0	4

Course Objective: The aim of this course is to

1. Provide basic knowledge in the interface between chemistry, physics and biology
2. Introduce nanostructure level with a focus on biotechnological usage.
3. Introduce Techniques of nanomaterial characterization
4. Introduce Drug delivery and Biosensors

UNIT-I: Introduction to Nanobiotechnology:
Nanotechnology basic concepts; Cellular Nanostructures; Nanopores; Bimolecular motors; Chemical, physical and biological properties of biomaterials

UNIT-II: **Techniques of Nano material characterization:**
Preparation and characterization of nanoparticles: nanoparticular carrier system, Electron microscopy Atomic force microscopy

UNIT-III: Nanostructures and Nanosystems:
Carbon nanotubes, Fullerenes, Nanowires, Metallic nanoparticles, Dendrimers, Quantum dots, Ultrasound contrast agents, Nanoarrays, DNA computers, DNA motors, Nanopore technology, Biogenic nanoparticles, Stealth nanoparticles, Virus like nanoparticles.

UNIT-IV: Drug delivery:
Nanoparticular carrier system, micro and nano fluidics, drug and gene delivery system, microfabrication, chip technologies, nano-imaging.

UNIT-V: Biosensors:
Introduction and basic characteristics of biosensors, basic characteristics feature of ideal biosensor, different types of biosensors: Piezo electric sensors; Optical sensors; Calorimetric sensors; Electrochemical sensors, Gold nanoparticles as biosensors.

Suggested Readings:

1. Multilayer Thin Films, Editor(s): Gero Decher, Joseph B. Schlenoff Publisher: Wiley-VCH Verlag GmbH & Co. KGaA ISBN: 3527304401
2. Bionanotechnology: Lessons from Nature Author: David S. Goodsell Publisher: Wiley-Liss ISBN: 047141719X
3. Biomedical Nanotechnology Editor: Neelina H. Malsch Publisher: CRC Press ISBN: 0-8247-2579-

Course Learning Outcome (CLO): Upon successful completion of this course the student will:

1. To apply engineering and physics concepts to the nano-scale and non-continuum domain.
2. Identify and compare state-of-the-art nanofabrication methods and perform a critical analysis of the research literature.
3. Design processing conditions to engineer functional nanomaterials.

II Year: IV Semester (Theory)
Human Values and Environmental Ethics
Course code: BSB431

L	T	P	C
2	0	0	2

Course objective (CO)

1. To study about human value and current practices.
2. To study about the principles of ethics secular and spiritual values in management.
3. To understand about holistic approach in decision making.
4. To get depth knowledge about the ecosystem and environmental laws.

UNIT-I: Human Values

Introduction- Values, Characteristics, Types, Developing Value system in Indian Organization, Values in Business Management, value-based Organization, Trans –cultural Human values in Management. Swami Vivekananda's philosophy of Character Building, Gandhi's concept of Seven Sins, APJ Abdul Kalam view on role of parents and Teachers.

UNIT-II: Present Practices of Human Values

Issues: Corruption and Bribe, Privacy Policing Web and social media, Cyber threats, Online Shopping etc. Remedies UK Bribery Act, Introduction to sustainable policies and practices in Indian Economy.

UNIT-III: Principles of Ethics Secular and Spiritual Values in Management

Introduction-Secular and Spiritual values, features, Levels of value Implementation. Features of spiritual Values, Corporate Social Responsibility- Nature, Levels, Phases and Models of CSR, Corporate Governance. CSR and Modern Business Tycoons Ratan Tata, Azim Premji
and Bill Gates.

UNIT-IV: Ecosystem

Ecosystem: Concept, structure & functions of ecosystem: producer, consumer, decomposer, food web, food chain, energy flow, Ecological pyramids Conservation of Biodiversity- In-situ & Ex- situ conservation of biodiversity, Role of individual in Pollution control, Human Population & Environment, Sustainable Development, India and UN Sustainable Development, Goals Concept of circular economy and entrepreneurship,

UNIT-V: Environmental Laws

Definition of Environmental Laws, International Advancements in Environmental Conservation, Role of National Green Tribunal, Air Quality Index, Importance of Indian Traditional knowledge on environment, Bio assessment of Environmental Quality, Environmental Impact Assessment and Environmental Audit.

Suggested Readings:

1. A foundation course in Human Values and Professional Ethics by RR. Gaur, R. Sangal et.al
2. JUSTICE: What's the Right Thing to Do? Michael J. Sandel.
3. Human Values by A. N. Tripathi New Age International
4. Environmental Management by N.K. Uberoi
5. https://www.un.org/sustainabledevelopment/sustainable-development-goals/
6. https://www.india.gov.in/my-government/schemes
7. https://www.legislation.gov.uk/ukpga/2010/23/contents
8. Daniel Kahneman, Thinking, Fast and Slow; Allen Lane Nov 2011 ISBN: 9780141918921

Course Learning Outcome (CLO):

At the end of the course the student will be able to:

1. Study about human value and current practices.
2. Study about the principles of ethics secular and spiritual values in management.
3. Understand about holistic approach in decision making.
4. Explain about the ecosystem and environmental laws.

II Year: IV Semester (Practical)
Enzymology lab
Course code: BSB451

L	T	P	C
0	0	2	1

Course Objectives (CO)

1. To study enzyme extraction and purification methods.
2. To understand the enzyme inhibition and kinetics.
3. To acquaint with concepts of enzyme immobilization.

Practical-

1. To demonstrate the effect of substrate concentration on enzymes.
2. To demonstrate the effect of pH on enzymes.
3. To demonstrate the effect temperature on enzymes.
4. Variation of enzyme activity with Enzyme concentration.
5. Assay of acid & alkaline Phosphatase and calculation of specific activity.
6. Extraction, partial purification and characterization of an enzyme.
7. Determination of amylase in given sample.
8. Determination of Serum Lipase
9. Determination of Serum Lactate Dehydrogenase (LDH) and Glutamate Dehydrogenase
10. Analyze the action of catalase enzyme

Suggested Readings:

1. Wilson and Wlker (2000), Practical Biochemistry – Principles and Techniques, Cambridge University Press, 770pp.
2. Lab Manual - Biochemistry.pdf (jru.edu.in)

Course learning Outcomes (CLO)

At the end of the course the student will be able to-

1. Study enzyme extraction and purification methods.
2. Understand the enzyme inhibition and kinetics.
3. Explain the concepts of enzyme immobilization.

II Year: IV Semester (Practical)
Immunology and serology Lab
Course code: BSB452

L	T	P	C
0	0	2	1

Course objective (CO)

1. To understand the principle of ELISA and RIA.
2. To study the principle of immunoprecipitation and IgG and IgM estimation.
3. To study the antibiotic sensitivity test.

Practical

1. To perform blood grouping test.
2. To perform Widal test.
3. Viability and cell counting of peritoneal macrophages
4. Phagocytic activity of Macrophages.
5. To perform single radial immune diffusion test.
6. Double immune diffusion test using specific antibody and antigen.
7. To perform IgG & IgM test.
8. To perform Antibiotic sensitivity test
9. To perform DOT-BLOT ELISA
10. To perform ELISA test.

Suggested Readings:

1. Immunology & Serology in Laboratory Medicine Paperback – 30 April 2021 by Mary Louise Turgeon (Author)
2. Immunology & Serology in Laboratory Medicine, 7th Edition - December 16, 2020, Author: Mary Louise Turgeon

Course Learning Outcome (CLO):

At the end of the course the student will be able to

1. Understand the principle of ELISA and RIA.
2. Study the principle of immunoprecipitation and IgG and IgM estimation.
3. Study the antibiotic sensitivity test.

II Year: IV Semester (Practical)
Summer internship
Course code: BSB453SI

L	T	P	C
0	0	4	2

Course Objectives (CO)

1. To improve students listening skills and make their presentation innovative.
2. To improve their ability and understanding to choose their own topic.
3. To guide them to gain useful information from different sources.
4. To provides more detailed information in each domain.
5. To enhance core knowledge about various tools and technologies.

Plan for mini project during Summer Internship

Mini Project helps students to explore and strengthen the understanding of fundamentals through practical application of theoretical concepts. Mini Project help students to boost their skills and widen their horizon of thinking. It acts like a beginners guide to do larger projects later in their career. Preparation of mini project involves following steps.

1. A topic will be given by the guide to the students for the mini project.
2. Student will research about the selected topic online.
3. Student can take suggestions on topic from subject experts.
4. Student will make plan based on topic.
5. Execution of plans.
6. Presentation.

Course Learning Outcomes (CLO)

At the end of the course the student will be able to:

1. Improve their listening skills and make their presentation innovative.
2. Improve their ability and understanding to choose their own topic.
3. Gain useful information from different sources.
4. Provides more detailed information in each domain.
5. Enhance core knowledge about various tools and technologies.

B Sc.(Hons./Hons. with Research) Biochemistry

Study Evaluation Scheme (as per NEP2020)
Effective from the session 2025-26

III Year: V Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	BSB501	Microbiology	4	0	0	25	75	100	4	Major	Own faculty
2	BSB502	Metabolism-1	4	0	0	25	75	100	4	Major	Own faculty
3	……	**Departmental Elective-1 (DE-1)**	4	0	0	25	75	100	4	Minor	Own faculty
4	BSB503	Biostatistics	3	0	0	25	75	100	3	Multidisciplinary	Any faculty
5	BSB521 SE	Quality control in Clinical Lab	3	0	0	25	75	100	3	SEC	Any Faculty
6	BSB531	Understanding India	2	0	0	25	75	100	2	Value added course	Any Faculty
Practical											
7	BSB551	Microbiology Lab	0	0	2	25	75	100	1	Major	Own faculty
8	BSB552	Metabolism -1 lab	0	0	4	25	75	100	2	Major	Own faculty
Total			20	0	6	200	600	800	23		

Hons	Honours
L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination
SEC	Skill Enhancement Courses

Departmental Elective (DE)-1	
Course Code	**Course Name**
BSB511	Hormone Biochemistry
BSB512	Medical Microbiology
	MOOCS/NPTEL/SWAYAM/Other University/College
Biostatistics	https://nptel.ac.in/courses/102101056 NOC: Introduction to Biostatistics, IIT Bombay, Prof. Shamik Sen

Note: Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.

III Year: V Semester (Theory)
Microbiology
Course code: BSB501

L	T	P	C
4	0	0	4

Course objective (CO)

1. To learn and understand the microbial diversity in the living world.
2. To gain knowledge of various (physical and chemical) methods of control of microorganisms and safety measures to be followed while handling microbes.
3. To demonstrate the morphology and physiology of microbes and selection of culture media.
4. To learn collection and transportation of investigative specimens.

Unit I: History of Microbiology

History of development of microbiology as a discipline, Spontaneous generation versus biogenesis, contributions of Anton von Leeuwenhoek, Joseph Lister, Paul Ehrlich, Richard Petri, Charles Chamberland, Edward Jenner, Louis Pasteur, Robert Koch, Martinus W. Beijerinck, Sergei Winogradsky, Alexander Fleming, Elie Metchnikoff and Emil von Behring. Bacterial classification and Nomenclature, classification of bacteria according to Bergey's manual.

Unit II: Diversity of Microbial world and Microbial Cell organization:

Difference between prokaryotic and eukaryotic microorganisms. General characteristics of different groups: Acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Archaea, Algae, Fungi and Protozoa) with emphasis on distribution, occurrence and morphology. Cell-wall: Composition and detailed structure of Gram positive and Gram-negative cell walls, mechanism of Gram's staining. Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell membranes.

Unit III: Microbial Nutrition and Growth:

Nutritional types of microorganisms, growth factors, culture media- synthetic and complex, types of media; isolation of pure cultures, Anaerobic culture methods, Preservation of microorganisms, growth curves, mean growth rate constant, generation time; influence of environmental factors on growth of microbes, effect of pH, temperature, solute, oxygen concentration, pressure and radiations. Sterilization, disinfection and antiseptics. Use of physical methods (heat, low temperature, filtration, radiation) and chemical agents (phenolics, halogens, heavy metals, sterilizing gases, Vapor phase disinfectants) in microbial control.

Unit-IV: Microbes and Environment:

Silent feature of extermophiles (acidophile, akaliphiles, halophiles, thermophiles, psychrophiles, osmophiles), aerobic and anaerobic, phototrophic bacteria, prebiotics and probiotics, gliding bacteria, prosthecate and budding bacteria. Ecological impact of microbes: symbiosis, ruminant symbiosis, nutrient cycles. Quorum sensing

Unit V: Industrial microbiology:

Role of microorganism in natural and artificial system, Microbial process- production, optimization, screening, strain improvement for the production of ethanol, organic acids and antibiotics, basic principles in bioprocess technology, microbial fuel cells.

Suggested Readings:

1. Ananth Narayanan and Paniker's Textbook of Microbiology (R. Ananthanarayan and C. K. Jayaram Paniker)
2. Textbook of microbiology Dr. C P Baveja
3. Prescott / Harley Klein's Microbiology (Joanne Willey, Linda Sherwood, Chris Woolverton)
4. Mackie and McCartney Practical Medical Microbiology (J. Gerald Collee, Andrew G. Fraser, Barrie P Marmion, Anthony Simmons)

Course Learning Outcome (CLO)

At the end of the course, the student will be able to:

1. Learn and understand the microbial diversity in the living world.
2. Explain various (physical and chemical) methods of control of microorganisms and safety measures to be followed while handling microbes.
3. Demonstrate the morphology and physiology of microbes and selection of culture media.
4. Learn collection and transportation of investigative specimens.

III Year: V Semester (Theory)
Metabolism-1
Course code: BSB502

L	T	P	C
4	0	0	4

Course objective (CO)

1. To understand glycolysis and TCA cycle.
2. To understand gluconeogenesis, glycogenesis, glycogenolysis and other important pathways of carbohydrates metabolism.
3. To understand lipid biosynthetic pathways.
4. To understand lipid catabolic pathways.

UNIT-I: Introduction to Intermediary metabolism, glycolysis, TCA cycle:
Auxotrophs, Heterotrophs, Anabolism and Catabolism. Glucose: central role in metabolism of plants, Animals and microorganism. Glycolysis, reactions of glycolysis. Fermentation: anaerobic fate of pyruvate, control of metabolic flux. Regulation of glycolytic pathway. Entry of Galactose, Mannose and fructose into glycolytic pathway .Substrate cycle and their physiological importance. TCA cycle: Overveiw of TCA, Metabolic sources of Acetyl-Coenzyme A. Amphibolic nature, anaplerotic reactions. TCA Cycle inhibitors. Regulation, pyruvate dehydrogenase complex enzyme.

UNIT-II: Other pathways of carbohydrate metabolism:
Gluconeogenesis and its Regulation, Glyoxalate Cycle reactions, Pentose phosphate Pathway, Calvin Cycle, photorespiration, Carbohydrate synthesis, Synthesis of starch, cellulose and peptidoglycan. Glycogen metabolism, Synthesis and breakdown, glycogen synthetase and phosphorylase and their regulation, Glycogen Storage diseases. Metabolic disorders of carbohydrate metabolism.

UNIT-III: Lipid biosynthesis:
Lipid digestion (absorption and transport), Biosynthesis of lipids, fatty acid synthesis in plants and animals and its regulation, Biosynthesis of triacylglycerols, Phospholipids, Cardiolipids, Glycolipids and sphingolipids, cholesterol and steroid hormones, ketone bodies, Prostaglandins, Prosta cyclins,Thrombaxanes and leukotrienes. Metabolic disorders of Lipid metabolism

UNIT-IV: Fatty acids Oxidation/catabolism:
Oxidation of saturated, unsaturated fatty acids in mitochondria, transport of fatty acids to mitochondria. α ώ .β Oxidation. Peroxisomal and glyoxisomal pathways of Fatty acids oxidations. ketone bodies degradation, degradation of cholesterol, bile acids, Ketone Bodies degradation, Arachidonate catabolism, Starve Feed Cycle.

UNIT-V: Mitochondria and Oxidative phosphorylation:
Structure and organization, mitochondrial electron carriers: Ubiquinone, cytochromes and iron sulfur proteins, determination of sequences of electron carriers. position and function of the four complexes of ETC, glycerophosphate shuttle, Redox loops, Q-cycle, proton motive force, the electrochemical potential gradient, thermodynamics of phosphorylation, inhibitors. Mitchells chemiosmotic hypothesis and experimental evidences. Generation of ROS and antioxidant mechanism. Metabolite transporters in mitochondria: ADP-ATP translocase, malate aspartate shuttle and phosphate carrier.ATP Synthase: Subunit structure, F0-F1 rotor stator model, Binding change mechanism of ATP synthesis. Uncouplers, Thermogenesis. Regulation of oxidative phosphorylation, Respiratory control (P/O ratio).

Suggested Readings:

5. Nelson, D.L. and Cox, M.M. (2005); Lehninger Principles of Biochemistry, 4th edition, W.H. Freeman and company, N.Y. USA.
6. Garret, R.H. and Grisham, C.M. (2005) Biochemistry, 3rd Edition. Thomson Learning INC.
7. Voet, D and Voet, J.G, (2009) Biochemistry, John Wiley and Sons, N.Y. USA.

Course learning outcomes (CLO)

At the end of the course students will be able to

1. Explain glycolysis, TCA cycle, gluconeogesis and other carbohydrate metabolic pathways.
2. Understand lipid biosynthetic pathways.
3. Describe lipid catabolic pathways.
4. Know the importance of carbohydrate and lipid metabolism in body.

III Year: V Semester (Theory)
Departmental Elective-1
Hormone Biochemistry
Course code: BSB511

L	T	P	C
4	0	0	4

Course Objective (CO)
The objective of this course is:

1. To introduce hormone, its structure, regulation, biosynthesis, and function.
2. To gain the knowledge about the cell signaling and mechanism of action of hormone in cell signaling.
3. To understand the pathology of endocrine disorder and other organ with endocrine function.

UNIT-I:Introduction
History, endocrine glands, hormones as chemical messengers, stimulus for hormone release: change in homeostasis, sensory stimulus and others.

UNIT-II: Cell signaling & Mechanism of Hormone action:
Receptor study, Binding affinity, specificity, Scatchard plot and purification. G protein linked receptor family ; Signal transduction pathways involving G- proteins , Adenyl cyclases, Ca2+, Phosphoinositides, PI-3 Kinase, DAG, cAMP, cGMP, NO , Protein kinases (A,B,C,G), Phosphoprotein phosphatases & Phosphodiesterases. Receptor tyrosine kinase family- EGF receptor family, Insulin receptor family, & Cytokine/erythropoietin receptor family associated with non receptor Tyrosine kinase (Signal transduction pathways involving : SH2 proteins, ras, IRS-1 , Raf, MEK, MAP kinase, JAK-STAT pathway).

UNIT-III: Intra-cellular Receptors :
Steroid hormone receptors, Thyroid hormone receptors. Sensitisation & Desensitization of receptors; Short term regulation & Long term regulation. Drugs and Toxins affecting cell signaling: Cholera toxin, pertussis toxin, anthrax toxin, Bubonic Plague virulence, Forskolin, theophyllin, Phorbol esters, Seldenafil (Viagra). Hormones regulating Ca2+ Homeostasis: PTH, Vit D, Calcitonin.

UNIT-IV: Hormones
Structures, Receptor type, Regulation of biosynthesis and release (including feed back mechanism). Physiological and Biochemical actions, & Pathophysiology (hyper& hypo secretion). Hypothalmic Hormones: CRH, TRH, GnRH, PRL/PRIH, GHRH/GHRIH. Pituitary Hormones - Anterior Pituitary hormones- Growth hormone, Prolactin, POMC peptide family, LH, FSH, TSH; Posterior Pituitary: Vasopressin, Oxytocin. . Pancreatic Hormones: Insulin, Glucagon, Diabetes type I & II. GI tract Hormones: Gastrin, Secretin, CCK, GIP, Ghrelin. Hormones of Adrenal Cortex: Aldosterone (renin angiotensin system) & cortisol. Hormones of Adrenal Medulla, Epinephrine & norepinephrine. Reproductive Hormones: Male & female Sex hormones. Interplay of hormones during Reproductive cycle, Pregnancy, Parturition, & Lactation. Oral Contraception

UNIT-V: Endocrine disorders and Other organs with endocrine function:
Gigantism, Acromegaly, dwarfs, pigmies; Pathophysiology: Diabetes insipidus. Thyroid Hormone (include biosynthesis) Goiter, Graves disease, Cretinism, Myxedema, Hashimoto's disease. Pathophysiology: Rickets, Osteomalacia, Osteoporosis. Heart (ANP), Kidney (erythropoietin), Liver (Angiotensinogen, IGF-1), Adipose tissue (Leptin, adiponectin). Pathophysiology: Obesity. Growth factors: PDGF, EGF, IGF-I, II, & NGF. Pathophysiology: Addisons disease, Conn's syndrome, Cushings

syndrome.

Suggested Readings:

1. Nelson, D.L. and Cox, M.M.(2005). Lehninger Principles of Biochemistry, W.H. Freeman & Com
2. Widmaier, E.P., Raff, H. and Strang, K.T.(2008).Vander, Sherman, Luciano's Human Physiology, McGraw- Hill Higher Education.
3. Darnell, J., Lodish, H. and Baltimore, D.(2008). Molecular Cell Biology, Scientific American Books.

Course Learning Outcomes (CLO)

At the end of this course, students will able to

1. Understand hormone, its structure, regulation, biosynthesis, and function.
2. Explain about the cell signaling and mechanism of action of hormone in cell signaling.
3. Understand the pathology of endocrine disorder and other organ with endocrine function.

III Year: V Semester (Theory)
Departmental Elective-1
Medical Microbiology
Course code: BSB511

L	T	P	C
4	0	0	4

Course objectives: The objective of this course is:

1. To introduce basic principles and application relevance of microbiological diseases
2. To gain the knowledge about the bacterial agents responsible for infectious diseases.
3. To understand the pathology of the viruses and fungal diseases.
4. To gain the knowledge about laboratory diagnosis

UNIT I: Introduction of medical microbiology:
Introduction: Normal microflora of human body, nosocomial infections, carriers, septic shock, septicemia, pathogenicity, virulence factors, toxins, biosafety levels.

UNIT II: Laboratory diagnosis of pathogenic gram-positive bacteria:
Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy of gram positive bacteria: *S.aureus, S.pyogenes, B.anthracis, C.perferinges, C.tetani, C.botulinum, C.diphtheriaeM.tuberculosis, M. leprae.*

UNIT III: Laboratory diagnosis of pathogenic gram-positive bacteria:
Morphology, pathogenies, symptoms, laboratory diagnosis, preventive measures and chemotherapy caused by gram negative bacteria: *E.coli, N. gonorrhoea, N. meningitidis, P. aeruginosa, S. typhi, S. dysenteriae, Y. pestis, B. abortus, H. influenzae, V. cholerae, M. pneumoniae, T. pallidum M. pneumoniae, Rickettsiaceae, Chlamydiae.*

UNIT IV: Diseases caused by viruses:
Picornavirus, Orthomyxoviruses, Paramyxoviruses, Rhabdoviruses, Reoviruses, Pox virus, Herpes virus, Papova virus, Retro viruses (including HIV/AIDS) and Hepatitis viruses.

UNIT V:Fungal and Protozoan infections:
Dermatophytoses (Trichophyton, Microsporun and Epidermophyton) Subcutaneous infection (Sporothrix, Cryptococcus), systemic infection (Histoplasma, Coccidoides)and opportunistic fungal infections (*Candidiasis, Aspergillosis*), Gastrointestinal infections (Amoebiasis, Giardiasis), Blood-borne infections (Leishmaniasis, Malaria)

Suggested Readings:

1. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.
2. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier. .
3. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

Course Learning Outcome (CLO): Upon successful completion of this course, students should be able to understand:

1. Learn basic principles and application relevance of microbiological diseases.
2. Learn about the bacterial agents responsible for infectious diseases.
3. Understand the pathology of the viruses and fungal disease

III Year: V Semester (Theory)
Biostatistics
Course code: BSB503

L	T	P	C
3	0	0	3

Course objectives:

This is an introductory course on statistics and bioinformatics. The specific objectives of the course are as follows:

1. To teach students the basic principles of statistics, data types and collection of data.
2. To make students understand the various methods of data presentation and measures of central tendency and probability.

Unit I: Introduction to Biostatistics & Data Handling

- Definition, scope, and significance of biostatistics
- Types of data and scales of measurement
- Data collection methods and classification
- Tabulation and frequency distribution
- Diagrammatic and graphical representation of data:

- Line Graphs
- Bar Charts
- Pie Charts
- Histograms
- Frequency Polygons

Unit II: Measures of Central Tendency and Dispersion

- Concepts and applications of statistical measures
- Central Tendency: Mean, Median, Mode
- Dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation, Coefficient of Variation

Unit III: Measures of Relationship

- Correlation: types and interpretation
- Karl Pearson's Coefficient of Correlation
- Spearman's Rank Correlation
- Simple Linear Regression Analysis

Unit IV: Sampling Techniques and Probability

- Population and sample definitions
- Sampling criteria and determination of sample size
- Types of sampling techniques
- Basic Concept of Probability
- Normal Probability Curve
- Concepts of Skewness and Kurtosis

Unit V: Hypothesis Testing & Statistical Software

- Basics of hypothesis formulation
- Types of hypothesis, critical region, errors (Type I and II), significance level, p-value
- Parametric and non-parametric tests:
    - Chi-Square Test (χ^2)
    - Student's t-tests (independent and paired)
    - F-test, Z-test, ANOVA

Suggested Readings:

1. Introduction to Probability & Statistics - Medenhall, Beaver, Beaver 14th Edition
2. Introduction to Probability and statistics for engineers and scientists, S M Ross, 3rd Edition

Course Learning Outcome (CLO):

Upon successful completion of this course the student will:

1. To get introduced to the basic concepts of Bioinformatics and its significance in Biological data analysis.
2. Explain about the methods to characterize and manage the different types of Biological data.
3. Demonstrate a good understanding of descriptive statistics and graphical tools.

III Year: V Semester (Theory)
Quality Control in Clinical Lab
Course code: BSB521SE

L	T	P	C
3	0	0	3

Course Objective (CO)

1. To study the quality control in the clinical laboratory and composition of different body fluids used for investigation.
2. To know good laboratory practices.
3. To demonstrate clinical investigation of different biomolecules.
4. To get knowledge about total quality management.

UNIT I: Introduction of Quality

Quality control, accuracy, precision, specificity, sensitivity and limitation of errors allowable in the laboratory, LJ chart.

UNIT-II Chemistry and composition

Chemistry, composition & functions of lymph, CSF, and synovial fluid, Urine formation, excretion and urine analysis, collection of blood, anti –coagulants, preservatives of blood composition, chemistry& function of specialized tissues like i.e., bone, brain, adipose tissue, etc.

UNIT-III Clinical investigation

Clinical investigation of sugar levels in blood and urine, factors influencing blood glucose level, carbohydrate tolerance tests, glycogen storage diseases, Biosynthesis of bile acid, bile pigments and steroid hormones, plasma lipoprotein, disorders associated with lipid metabolism and its therapeutic intervention, ketone bodies and ketosis.

UNIT-IV Good laboratory practices

General Provisions, Organization and Personnel, Facilities, Equipment, Testing Facilities Operation, Test and Control Articles, Protocol for Conduct of a clinical and Nonclinical Laboratory study, Records and Reports, Disqualification of testing Facilities.

UNIT V-Total Quality Management -

Total Quality Management of Laboratories – internal quality control, EQAS, lab accreditation.

Suggested Readings:

1. Total Quality Management Key Concepts and Case studies, by D.R. Kiran.
2. Fundamentals of quality control and improvement by Amitava Mitra.Quality Control by Dale, H Biester field.

Course Learning Outcome (CLO)-

At the end of the course, the student will be able to:

1. Study the quality control in the clinical laboratory and composition of different body fluids used for investigation.
2. Know good laboratory practices.
3. Demonstrate clinical investigation of different biomolecules.
4. Explain about total quality management.

III Year: V Semester (Theory)
Understanding India
Course code: BSB531

L	T	P	C
2	0	0	2

Course Objectives

1. To expose students to the rich cultural and civilizational background of India.
2. To acquaint students with India's struggle for independence.
3. To provide a foundational understanding of the Indian Constitution.
4. To introduce the patterns of economic development in independent India.

UNIT I: Geographical Features of India

India on the world map and its neighboring countries, Physical features: mountains, plateaus, plains, coasts, islands, Natural resources: vegetation, rivers, soils, and climate

UNIT II: Religious and Artistic Traditions

Religious Traditions: Vedic Age, Buddhism and Jainism, Bhakti and Sufi Movements, Social Reform Movements and Revivalism. Art and Architecture: Indus Valley Town Planning, Rock-Cut Architecture, Temple Architecture Styles, Indo-Islamic and Colonial Architecture, Ajanta Paintings and the Bengal School of Art

UNIT III: India's Freedom Struggle

Revolt of 1857, Formation of the Indian National Congress, Swadeshi Movement, Gandhian Movements, Subhas Chandra Bose and the Indian National Army (INA), Independence and Partition of India

UNIT IV: Constitution of India

The Preamble, Salient Features, Fundamental Rights, Fundamental Duties

UNIT V: Indian Economy

Nature of the Mixed Economy, Role of the Planning Commission, Economic Liberalization after 1991

Suggested Readings

1. Basham, A.L. The Wonder That Was India. New Delhi: Rupa, 1994.
2. Basu, Durga Das. Introduction to the Constitution of India. New Delhi: Lexis Nexis, 2012.
3. Chandra, Bipan et al. India's Struggle for Independence. New Delhi: Penguin, 1989.
4. Chandra, Satish. History of Medieval India. New Delhi: Orient BlackSwan, 2009.
5. Dutt, R. & Sundharam. Indian Economy. New Delhi: S. Chand & Co., 2018.
6. Hussain, Majid. Geography of India, Ed. Tasawwur Husain Zaidi. Noida: McGraw Hill, 2022.
7. Lahiri, Nayanjot. Marshaling the Past: Ancient India and Its Modern Histories. New Delhi: Permanent Black, 2012.

8. Ray, Tirthankar. The Economic History of India 1857–1947. New Delhi: Oxford University Press, 2006.
9. Sharma, R.S. India's Ancient Past. New Delhi: Oxford University Press, 2007.
10. Thapar, Romila. The Penguin History of Early India: From the Origins to AD 1300. New Delhi: Penguin India, 2003.

Course Learning Outcomes (CLOs) : Upon successful completion of this course, students will be able to:

1. Understand the **geographical features** and diversity of India.
2. Gain insights into the **cultural traditions and population dynamics** of the country.
3. Analyze **India's struggle for freedom** and key historical events.
4. Comprehend the **basic structure and features of the Indian Constitution**, including fundamental rights and duties.
5. Develop an overview of the **Indian economy and its post-independence transformation**.

III Year: V Semester (Practical)
Microbiology Lab
Course code: BSB551

L	T	P	C
0	0	2	1

Course objective (CO) The objective of this laboratory course is to provide the students practical skills in basic microbiology and Genetic Engineering

1. To learn different stating techniques for microbes.
2. To prepare different types of culture media used in microbiology.
3. To study the maintenance & preservation of bacterial cultures.
4. To study biochemical methods used for identification of microbes.

Practical

1. Staining methods- simple staining, grams staining, capsule staining, spore staining spirochete staining, Methods of motility testing: hanging drop preparation
2. Preparation of common culture media
3. Sterilization methods
4. Culture methods
5. Cultivation of bacteria and in laboratory
6. Bacterial growth curve
7. Biochemical test used for identification of bacteria.
8. Anaerobic culture methods.
9. Maintenance & preservation of bacterial cultures.
10. Vedio demonstration of genetic engineering, PCR and various sequencing methods.

Suggested Readings-

1. Molecular Biology -Practical- (ksu.edu.sa)
2. Practical Microbiology by D.K. Maheshwari.

Course learning outcome (CLO)

At the end of the course, the student will be able to:

1. Learn different stating techniques for microbes.
2. Learn to prepare different types of culture media used in microbiology.
3. Study the maintenance & preservation of bacterial cultures.
4. Study biochemical methods used for identification of microbes.

III Year: V Semester (Practical)
Metabolism -1 lab
Course code: BSB552

L	T	P	C
0	0	4	2

Course objective (CO)

1. To understand the method of glucose/sugar estimation.
2. To understand the sugar fermentation in microorganisms.
3. To understand the isolation and estimation of lecithin.
4. Determination of iodine and saponification value of lipids.

Practical's

1. Qualitative test for lipids
2 Estimation of pure glucose by Nelson-Somogyi method.
3 Total Reducing Sugar Estimation by Dinitrosalicylate.
4 Estimation of Keto sugar by Roe`s resorcinol Method.
5 Sugar Fermentation in Microorganisms.
6 Demonstrate and interpret the effects of microbial fermentation
7 Isolation of Lecithin and its estimation.
8 Estimation of Glucose 6- P.
9 Determination of iodine value of a lipid.
10 Determination of saponification value of a lipid.

Suggest Readings:

1. Experimental Biochemistry-A student companion-Beedu Sashidhar Rao and Vijay Deshpande.
2. Laboratory Manual in Biochemistry- Jayaraman, J. Wiley Eastern
3. Lab Manual - Biochemistry.pdf (jru.edu.in)
4. Practical Clinical Biochemistry Methods And Interpretations by Ranjna Chawla, Publisher: Jaypee, ISBN:9789389188769, Year:2020

Course learning outcomes (CLO)

After completion of this practical course, student will able to

1. Estimate glucose/sugar level.
2. Explain sugar fermentation in microorganisms.
3. Do isolation and estimation of lecithin.
4. Determine iodine and saponification value of lipids.

Mahayogi Gorakhnath University, Gorakhpur
Faculty of Health and Life Sciences
Department of Biochemistry, Session 2025-26

B Sc.(Hons./Hons. with Research) Biochemistry
Study Evaluation Scheme (as per NEP2020)
Effective from the session 2025-26

III Year: VI Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	BSB601	Molecular Biology	4	0	0	25	75	100	4	Major	Own faculty
2	BSB602	Metabolism-2	4	0	0	25	75	100	4	Major	Own faculty
3	.....	**Departmental Elective-2(DE-2)**	4	0	0	25	75	100	4	Minor	Own faculty
4	BSB603	IPR, Bioethics and Biosafety	2	0	0	25	75	100	2	Multidisciplinary	Any faculty
5	BSB621SE	Bioinformatics and Drug Designing	3	0	0	25	75	100	3	SEC	Any faculty
6	BSB631	Artificial Intelligence in Life Sciences	2	0	0	25	75	100	2	Value added courses	Any faculty
Practical											
7	BSB651	Molecular biology lab	0	0	2	25	75	100	1	Major	Own faculty
8	BSB652	Metabolism-2 Lab	0	0	4	25	75	100	2	Major	Own faculty
9	BSB621AE	Seminar	0	0	2	25	75	100	1	AEC	Any faculty
Total			19	0	8	225	675	900	23		

B Sc in Biochemistry

Hons	Honors
L	Lecture
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination
SEC	Skill Enhancement Courses
AEC	Ability Enhancement Courses

Departmental Elective-2	
Course Code	**Course Name**
BSB611	Evolutions and Behavior
BSB612	Genomics and Proteomics
	MOOCs from SWAYAM/NPTEL

Note:

1. Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.
2. Students who wish to undergo a 3-year UG programme will be awarded UG Degree in the Major discipline after successful completion of three years, securing 120 credits.
3. Students who secure 75% marks or equivalent CGPA and above in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year. They should do a research project or dissertation under the guidance of a faculty member of the University/College. The research project/dissertation will be in the major discipline. The students, who secure 160 credits, including 12 credits from a research project/dissertation, are awarded UG Degree (Honours with Research). Students who wish to undergo only B.Sc. Hons. have to study 12 credit course works as major discipline.

III Year: VI Semester (Theory)
Molecular Biology
Course code: BSB601

L	T	P	C
4	0	0	4

Course objectives: Molecular biology has witnessed a paradigm shift after the discovery of double helical structure of DNA. This course on molecular biology aims to teach the fundamental role of DNA molecule as a blueprint of life. The specific objectives of the course are as follows:

1. To familiarize students with the structure and function of biological system at the molecular level.
2. To impart knowledge about the key components participating in the replication of genetic material.
3. To teach the processes and pathways which replicate, transcribe and translate DNA.
4. To make students understand the different methods of DNA damage, repair and recombination.

UNIT-I: DNA structure and replication

Central dogma of life, DNA as genetic material, cot value, c value paradox, Structure, types of DNA, satellite DNA, DNA transposons, Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, DNA polymerases, The replication complex: Pre-primming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication.

UNIT-II: DNA damage, repair and homologous recombination

DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, translesion synthesis, recombinational repair, nonhomologous end joining. Homologous recombination: models and mechanism.

UNIT-III: Transcription and RNA processing

RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains. Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation. Processing of pre mRNA: 5`cap formation, polyadenylation, concept of introns and exons, RNA splicing.

UNIT-IV: Translation:

Genetic code and its characteristics, Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation. Post translational modifications of proteins.

UNIT-V: Regulation of gene expression and translation

Regulation of gene expression in prokaryotes and eukaryotes: Operon concept (inducible and repressible system): lac and trp operons. Basics of RNA interference, Antisense Technology, CRISPR, Cas9.

Suggested Readings

1. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication.
2. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco.
3. De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia.
4. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc.
5. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
6. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning.
7. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India.

Course Learning Outcome (CLO): Upon successful completion of this course the student will:

1. Understand the structure and function of biological system at the molecular level.
2. Understand molecular mechanisms (replication of genetic material, transcription, RNA processing and translation).
3. Learn different kinds of gene expression regulation.
4. Understand the fundamentals of DNA molecule as a blueprint of life.

III Year: VI Semester (Theory)
Metabolism -2
Course code: BSB602

L	T	P	C
4	0	0	4

Course Objective (CO)

1. To understand amino acids synthetic pathways and precursor functions of amino acids.
2. To understand amino acids catabolic pathways and nitrogen balance and nitrogen assimilation process.
3. To understand nucleotides metabolic pathways.
4. To understand amino acids metabolic disorders and nucleotides metabolic disorders.

UNIT-I: Outlines of Amino Acids metabolism:
Digestion, absorption and uptake of Amino Acids including γ-glutamyl cycle; Transamination, role of PLP, oxidative and nonoxidative deamination, glucose-alanine cycle, urea cycle and inherited defects of urea cycle, Krebs's bicycle.

UNIT-II: Biosynthesis of Amino Acids and Precursor function of Amino acids: Biosynthesis of non-essential amino acids; biosynthesis of Essential amino acids (Only overview-in plants) and their regulation. Biosynthesis of Creatine, Creatine phosphate and creatinine; Creatine phosphate energy shuttle; polyamines (putresine, spermine, spermidine); catecholamines (dopamine, epinephrine, nor-epinephrine); and neurotransmitters such as serotonin, GABA; porphyrin biosynthesis and disorders of porphyrin metabolism.

UNIT-III: Degradation of the carbon skeleton and Nitrogen Balance:
Glucogenic and ketogenic amino acids, catabolic pathways for the 20 standard amino acids; Metabolism of one-carbon units. Positive and negative nitrogen balance, protein quality: complete and incomplete proteins, criteria to assess protein quality, protein calorie malnutrition, Kwashiorkor and Marasmus. Assimilation of inorganic nitrogen in biomolecules.

UNIT-IV: Biosynthesis and degradation of purine and pyrimidine nucleotides: Biosynthesis of IMP; pathways from IMP toAMP and GMP; conversion to triphosphates; regulation of purine nucleotide biosynthesis, salvage pathways; synthesis of coenzymes (NAD+, FMN, FAD, HSCoA), Biosynthesis of pyrimidine nucleotides: Biosynthesis of UMP, conversion of triphosphate and regulation of Biosynthesis of pyrimidine nucleotide synthesis; Deoxy ribonucleotides and synthesis of dTTP; inhibitors of nucleotide metabolism and their use as anti bacterial / anticancer drugs. Degradation of purine and pyrimidine nucleotides.

UNIT-V: Disorders of amino acids and nucleotide metabolism:
Disorders of amino acid metabolism: Phenylketonuria, Alkaptonuria, Maple syrup urine disease, Methylmalonic aciduria, Parkinson's disease, Homocystinuria, and Hartnup's disease. Disorders of nucleic acid metabolism: Lesch Nyhan syndrome, Gout, SCID, Adenosine deaminase deficiency

Suggested Readings:

1. Cox, M.M. and Nelson, D.L.(2008). Lehninger Principles of Biochemistry, W.H. Freeman and Company, New York, USA

2. Voet, D. and Voet, J.G.(2004). Biochemistry, John Wiley and Sons. INC.
3. Devlin, T.M.(2002)Textbook of Biochemistry with clinical correlations, John Wiley and sons, INC.
4. Bowsher, C, Steer, M. and Tobin, A (2008). Plant Biochemistry, Garland science, Taylor and Francis Group, LLC.

Course learning outcomes (CLO)

At the end of the semester, students will able to

1. Explain amino acids synthetic pathways and precursor functions of amino acids.
2. Understand amino acids catabolic pathways and nitrogen balance and nitrogen assimilation process.
3. Aware with nucleotides metabolic pathways.
4. Know the amino acids metabolic disorders and nucleotides metabolic disorders.

III Year: VI Semester (Theory)
Departmental Elective-2(DE-2)
Evolution and Behavior
Course code: BSB611

L	T	P	C
4	0	0	4

Course Objective (CO)

1. To know the origin of cells and unicellular evolution.
2. To understand the concept of molecular evolution.
3. To know the mechanism of population evolution.
4. To make student aware with brain, behavior, and evolution.

UNIT-I: Introduction and **Origin of cells and unicellular evolution:**
Emergence of evolutionary thoughts Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis. Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiement of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.

UNIT-II: Paleontology and Evolutionary History:
The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multi cellular organisms; Major groups of plants and animals; Stages in primate evolution including Homo.

UNIT-III: Molecular Evolution:
Concepts of neutral evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny, classification and identification; Protein and nucleotide sequence analysis; origin of new genes and proteins; Gene duplication and divergence.

UNIT-IV: The Mechanisms:
Population genetics – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.

UNIT-V: Brain, Behavior and Evolution:
Approaches and methods in study of behavior; Proximate and ultimate causation; Altruism and evolution-Group selection, Kin selection, Reciprocal altruism; Neural basis of learning, memory, cognition, sleep and arousal; Biological clocks; Development of behavior; Social communication; Social dominance; Use of space and territoriality; Mating systems, Parental investment and Reproductive success; Parental care; Aggressive behavior; Habitat selection and optimality in foraging; Migration, orientation and navigation; Domestication and behavioral changes.

Suggested Readings:

1. Evolution and Behavior,1st Edition By Lance Workman, Will Reader.

Course learning outcomes (CLO)

At the end of this course, students will able to

1. Know the origin of cells and unicellular evolution.
2. Understand the concept of molecular evolution.
3. Explain the mechanism of population evolution.
4. Aware with brain, behavior, and evolution.

III Year: VI Semester (Theory)
Departmental Elective-2(DE-2)
Genomics and Proteomics
Course code: BSB612

L	T	P	C
4	0	0	4

Course objectives: The broad objective of the course is to make students aware about the importance of the modern methods of genome and proteome analysis and the significance of these on the changing paradigm in genetics, medicine and agriculture. The specific objectives of the course are as follows:

1. To introduce the basic concepts of genomics and next generation sequencing.
2. To acquaint students with various genome databases and their applications.
3. To make students aware about the applications of genomics in various industries.
4. To makes students understand the techniques of proteome analysis diverse applications and benefits of genome and proteome analysis.

UNIT I: Introduction to genomics
Introduction to Genomics, DNA sequencing methods: Maxam & Gilbert; Sanger's method; Next generation sequencing: Pyrosequencing, Nanopore sequencing; Genome Sequencing: Shotgun & Hierarchical (clone contig) methods; Genome sequence assembly software: Newbler.

UNIT II: Genome databases
Web based servers and softwares for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. Selected Model Organism's Genomes and Databases: E.coli, *Mus musculus*, *Homo sapiens*, *Arabidopsis thaliana*; Human genome project.

UNIT III: Application of genomics
Comparative genomics: comparison of genomes; pharmacogenomics: variable drug response of individuals; metagenomics; epigenomics: New tool in studying complex diseases.

UNIT IV: **Introduction to proteomics**
Introduction to Proteomics, Two-dimensional polyacrylamide gel electrophoresis (2D-PAGE): isoelectric focusing and SDS-polyacrylamide gel electrophoresis, staining methods of 2D gels; mass-spectrometry: Matrix Assisted Laser Desorption Ionization Time of Flight (MALDI-ToF); peptide mass fingerprinting; Edman degradation.

UNIT V: Applications of proteomics
Clinical application of proteomics; proteomic biomarkers for disease diagnosis; plasma proteome; cancer proteomics; applications of proteomics in toxicology; plant proteomics in plant development, plant physiology and ecology; interaction proteomics and protein networks.

Suggested Readings:

1. S. B. Primrose and R.M. Twyman - Principles of Genome Analysis and Genomics, 7 th Edition, Blackwell Publishing, 2006.

2. S. Sahai - Genomics and Proteomics, Functional and Computational Aspects, Plenum Publication, 1999.
3. Andrezej K Konopka and James C. Crabbe, Compact Hand Book - Computational Biology, Marcel Dekker, USA, 2004.
4. Pennington & Dunn - Proteomics from Protein Sequence to Function, 1 st edition, Academic Press, San Diego, 1996.
5. Liebler, DC and Yates III, JR 2002. Introduction to Proteomics: Tools for New Biology, 1st ed. Humana Press.

Course Learning Outcome (CLO): Upon successful completion of this course the student will:

1. Understand differentiate between eukaryotic and prokaryotic genomes and will be able to use genome databases.
2. Learn basic concepts of next generation sequencing.
3. Learn techniques used to analyze genome and proteome.
4. Understand the relevance of genomics and proteomics in modern biology.

III Year: VI Semester (Theory)
IPR, Bioethics and Biosafety
Course code: BSB603

L	T	P	C
2	0	0	2

Course Objectives: The objectives of the course are as follows:

1. To understand importance of IPR, bioethics and biosafety.
2. To understand regulatory guidelines and their importance.
3. To understand importance of patent and procedure for patent filling.
4. To understand procedure of assessment of biosafety for biotech foods and ethical implications in biological sciences.

UNIT I: Introduction to IPR

Basic understanding of intellectual property rights; utility of IPRs; different types of IPRs, patents, trademarks, copyright & related rights, industrial design, traditional knowledge, geographical indications; introduction to Indian patent law; world trade organization and its related intellectual property provisions world organizations: GATT, WTO, WIPO and TRIPS agreement, international treaties and conventions on intellectual property.

UNIT II: Protection of IPRs

Intellectual/industrial property and its legal protection in research, design and development. Forms of protection of IPRs: Introduction to copyrights and its applicability; fundamental concepts and importance of trademarks and trade secrets; geographical indications; design layout design of integrated circuits.

UNIT-III: Introduction to Bioethics and Biosafety

Bioethics-Necessity of bioethics, different paradigms of bioethics- National and international ethical issues against the molecular technologies. Institutional, social, Cultural, Business and Consumer issues. Biosafety-Introduction to biosafety and health hazards concerning biotechnology. Introduction to the concept of containment level and good laboratory practices (GLP) and good manufacturing practices (GMP). Implications of biotechnological products and techniques: Bioterrorism, transgenic science, GM crops, GMO/LMO and their release in environment.

UNIT IV: Bioethics towards Biodiversity protection and conservation

Convention on biodiversity, Indian Biodiversity act, Legal implications, Biodiversity and farmers' rights. Human genome project and stem cells research: Introduction, Ethical, legal and social implications of HGP. Stem Cell Research- biosafety and its ethical issues

UNIT V: Food and pharma safety

The GM-food debate and biosafety assessment procedures for biotech foods and related products, including transgenic food crops, Environmental aspects of biotech applications. FlavrSavr Tomato as model case, Biosafety assessment of biotech pharmaceutical products.

Suggested Readings

1. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.
2. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international publishers
3. The law and strategy of Biotechnological patents by Sibley. Butterworth publications.

4. Intellectual property rights – Ganguli – Tat McGraw-Hill
5. Biotechnology-B. D. Singh- Kalyani Publications

Course Learning Outcome (CLO): Upon successful completion of this course the student should be able to:

1. Understand the scope and aspects of Bioethics and biosafety
2. Learn the ethical implications of IPR, biosafety, GLP and GMP, concerns related to GMO's and their regulation.
3. Analyze the safer use of Biotechnology in agriculture, animal husbandry, pharmaceutics, and environment by implanting biosafety regulations.
4. Comprehend the ability to understand biosafety assessment procedure for biotech food, pharmaceuticals and other products.

III Year: VI Semester (Theory)
Bioinformatics and Drug Designing
Course code: BSB621SE

L	T	P	C
3	0	0	3

Course Objectives (CO)

1. To study the basics of Bionfromatics and drug designing.
2. To understand the software used for sequence analysis of biomolecules.
3. To study the protein sequence database like BLAST and FASTA
4. To study about drug designing process.

UNIT-I: Introduction and bioinformatics resources

Bioinformatics tools and resources, the major content of the databases, Literature databases: Nucleic acid sequence databases: Gen Bank, EMBL, DDBJ Genome Databases at NCBI, EBI, and TIGR, SANGER Other Databases of Patterns / Motifs / System Biology (Gene and protein network database and resources) various file formats for bio molecular sequences: GENBANK, FASTA, GCG, MSF, NBRF/PIR etc.

UNIT-II: Sequence analysis

Basic concepts of sequence similarity, identity and homology. Scoring matrices: basic concept of a scoring matrix, PAM and BLOSUM series. Needleman & Wuncsh, Smith & Waterman algorithms for pair wise alignments BLAST and FASTA algorithms. Use of pair wise alignments and Multiple sequence alignment for analysis of Nucleic acid and protein sequences and interpretation of results.

UNIT- III: Protein sequence databases

SWISS PROT, TrEMBL, PIR, PDB Protein-Protein Interactions- PDB & MMDB, Homology Modeling, In-silico generation of novel ligand molecules, Molecular docking, Running docking algorithm Structure Analysis/ H- Bond, Evaluation of results on basis of binding energy

UNIT- IV: Phylogeny

Definitions of homologues, orthologues, paralogues Phylogenetic analysis- Definition and description of phylogenetic trees and various types of trees. Method of construction of Phylogenetic trees distance based method (UPGMA, NJ), Maximum Parsimony and Maximum Likelihood method Structural bioinformatics Chemo informatics, Immuno informatics etc.

UNIT-V: Drug Designing

Drug discovery process, Role of Bioinformatics in drug design, Target identification and validation, Structure-based drug design: Identification and Analysis of Binding sites and virtual screening, Ligand based drug design: Structure Activity Relationship – QSARs and QSPRs, QSAR Methodology,, Pharmacophore mapping, In silico prediction ADMET properties for Drug Molecules, Computer Aided Drug Design (CADD), Development of New Drugs, Factors Affecting development of New Drugs. Concept of prodrugs and soft drugs, Drug Receptors.

Suggested Readings

1. Aurther M lesk (2008) Introduction to Bioinformatics 3rd edition OUP Oxford
2. Philip E. Bourne, Helge Weissig (2003). Structural Bioinformatics (Methods of Biochemical Analysis, Wiley-Blackwell
3. Essential Bioinformatics by Jin Xiong. Texas A&M University Cambridge

4. Data mining in Bioinformatics, Jason Wang ,M.J. Jaki. Hannu T.T.T., Denis. S. Springer International Edition.

Course learning outcomes (CLO)

At the end of the course, the student should be able to-

1. Explain the basics of Bionfromatics and drug designing.
2. Discuss the software used for sequence analysis of biomolecules.
3. Describe the protein sequence database like BLAST and FASTA
4. Explain about drug designing process.

III Year: VI Semester (Theory)
Artificial Intelligence in Life Science
Course code: BSB631

L	T	P	C
2	0	0	2

Course Objective:

1. To learn various concepts of AI Techniques.
2. To learn various applications in Pharmaceutical
3. To apply in drug designing and Precision Medicine
4. To learn about AI in medical imaging, agriculture and synthetic biology

UNIT I: Introduction to AI

Concept of AI, history, current status, scope, agents, environments Biological Intelligence Vs Artificial Intelligence, AI Basics: concepts, terminologies and workflow, ML, DL.

UNIT II: Applications of AI in Pharma:

Applications of AI in the Pharmaceutical Industry, AI-driven applications for drug design, lead optimization, and clinical trials, Artificial Intelligence for Biomarker Discovery

UNIT III: AI in Health and Medicine:

AI in Precision Medicine, AI in shaping the future of Bioinformatics, AI in health diagnostics / Confluence of AI and Smart Devices for Monitoring Health and Disease, AI in medical imaging

UNIT IV : AI in Biotechnology and Life Science

Artificial Intelligence and Synthetic Biology, Transforming Agriculture with AI, AI in biology and bioinformatics

UNIT V : Future and Ethical Concerns of AI

Future Prospects of AI in healthcare and research, Technological advancements and their potential impact on AI in biotech, new trends and opportunities for AI-powered biotech in the future. Risks involved and ethical concerns, Need of regulatory frameworks for AI in biotech

SUGGESTED READING

1. Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach” , 3rd Edition, Prentice Hall.
2. Elaine Rich and Kevin Knight, “Artificial Intelligence”, Tata McGraw Hill
3. Carl Townsend, “Introduction to Prolog Programming”
4. Ivan Bratko, “PROLOG Programming for Artificial Intelligence”, Addison-Wesley, 2nd Edition.
5. Trivedi, M.C., “A Classical Approach to Artifical Intelligence”, Khanna Publishing House, Delhi.
6. David Poole and Alan Mackworth, “Artificial Intelligence: Foundations for Computational Agents”, Cambridge University Press 2010
7. SarojKaushik, “Artificial Intelligence”, Cengage Learning India, 2011

Course Learning Outcomes (CLO)

1. Understand the various concepts of Artificial Intelligence in Biotech & health tech companies globally
2. Understand how New Companies are being built by combining Biotech & Artificial Intelligence
3. Experience how Artificial Intelligence is revolutionizing health care

III Year: VI Semester (Practical)
Molecular Biology lab
Course code: BSB651

L	T	P	C
0	0	2	1

Course objective (CO)

1. Students will learn different techniques of molecular biology
2. To study the procedure for DNA and RNA isolation from patient's blood sample.
3. To analyses genomic DNA by agarose gel electrophoresis.
4. To get familiar with the genetic engineering technique.

Practical-

1. Study of different types of DNA and RNA using micrographs and model/schematic representations.
2. Study of semi-conservative replication of DNA through micrographs / schematic representations
3. Preparation of solution for Molecular Biology experiments.
4. Isolation and estimation of chromosomal DNA from bacterial cells.
5. Isolation and estimation of plasmid DNA by alkaline lysis method
6. Preparation of restriction enzyme digests of DNA sample.
7. Molecular cloning in plasmids.
8. Resolution and visualization of DNA by Agarose Gel Electrophoresis.
9. Estimation of RNA using colorimeter (orcinol reagent) and UV spectrophotometer (A260 measurement).
10. Resolution and visualization of Serum proteins by Polyacrylamide Gel Electrophoresis (SDS-PAGE).

Suggested Readings:

1. Molecular Biology Practical Handbook by Dr. S. Sivaranjani, Dr. S. Ramadevi, V. Ramabhai, P. Everest Helen Rani and A. Gejalakshmi

2. Molecular Biology A Practical Manual by P V G K Sharma (Author)
3. CELL AND MOLECULAR BIOLOGY: A Lab Manual Kindle Edition by K. V. Chaitanya (Author)
4. Molecular Biology -Practical- (ksu.edu.sa)

Course Learning Outcome (CLO)

At the end of the course the student will be able to

1. Identify DNA and RNA in blood sample.
2. Analyze the genomic DNA by agarose gel electrophoresis.
3. Understand the genetic engineering technique.
4. Understand principals and methods of competent cell preparation, restrictiondigestion, gene ligation, gene cloning, and transformation i. e gene manipulation.

III Year: VI Semester (Practical)
Metabolism-2 Lab
Course code: BSB652

L	T	P	C
0	0	4	2

Course objective (CO)

1.To understand qualitative tests of protein and lipids.
2.To understand the process of isolation of egg albumin from egg white and cholesterol from egg yolk.
3.To understand the process of isolation casein from milk.
4.To understand amino acids metabolism in bacteria.

Practicals

1. Total Sugar Estimation by Anthrone Method
2. Amino acid Estimation by Ninhydrin method
3. Estimation of protein concentration by Bradford method.
4. Isolation of egg albumin from egg white.
5. Isolation of cholesterol from egg yolk.
6. Isolation of casein from milk and determination of its isoelectric point.
7. Amino acid metabolism in Bacteria.
8. Isolation of starch from potatoes.
9. Isolation of Mitochondria from rat liver.
10. Effect of inhibitors and uncouplers on ATP synthesis.

Suggest Readings:

1. Experimental Biochemistry-A student companion-Beedu Sashidhar Rao and Vijay Deshpande.
2. Laboratory Manual in Biochemistry- Jayaraman, J. Wiley Eastern
3. Lab Manual - Biochemistry.pdf (jru.edu.in)
4. Practical Clinical Biochemistry Methods And Interpretations by Ranjna Chawla, Publisher: Jaypee, ISBN:9789389188769, Year:2020

Course learning outcomes (CLO)

At the end of this course, students will able to

1. Understand qualitative tests of protein and lipids.
2. Isolate egg albumin from egg white and cholesterol from egg yolk.
3. Do Isolation of casein from milk.
4. Explain amino acids metabolism in bacteria.

III Year: VI Semester (Practical)
Seminar
Code: BSB621AE

L	T	P	C
0	0	**2**	**1**

Course Objectives (CO)

1. To provide attendees with educational sessions.
2. To encompassing the best and most current information in the particular field.
3. To generate activities of professional association.

Process

Seminars provide a platform and a network to the personnel where they can learn from what others are doing, learn about new things, ideas, tricks and important tips related their subject. Conducting seminar emphasizes upon the general guidelines for conduction of seminars. Activity of seminar includes preparation, and implementation of assigned topic by the student. The implementation will be evaluated by the expert.

Course Learning Outcomes (CLO)

At the end of the course the student will be able to:

1. Provide attendees with educational sessions.
2. Encompass the best and most current information in the particular field.
3. Generate activities of professional association.

Mahayogi Gorakhnath University, Gorakhpur
Faculty of Health and Life Sciences
Department of Biochemistry, Session 2025-26

B Sc.(Hons./Hons. with Research) Biochemistry
Study Evaluation Scheme (as per NEP2020)
Effective from the session 2025-26

IV Year: VII Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	BSB701	Plant Biochemistry	4	0	0	25	75	100	4	Major	Own faculty
2	BSB702	Medicinal Chemistry	4	0	0	25	75	100	4	Major	Own faculty
3	BSB703	Industrial Biochemistry-1	4	0	0	25	75	100	4	Major	Own faculty
4	.....	Departmental Elective-3	4	0	0	25	75	100	4	Minor	Any faculty
5		Minor Elective-3	4	0	0	25	75	100	4	Minor	Any Faculty
Practical											
6	BSB751	Plant biochemistry Lab	0	0	2	25	75	100	1	Major	Own faculty
7	BSB752	Medicinal Chemistry Lab	0	0	2	25	75	100	1	Major	Own faculty
Total			20	0	4	175	525	700	22		

Hons	Honours
L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination

Departmental elactive-3		Minor elective-3	
Sub Code	**Subject Name**	**Sub Code**	**Subject Name**
BSB711	Developmental biology	BSB721	Biophysics
BSB712	Bioprocess Technology	BSB722	Pharmacology
	**MOOCs from SWAYAM/NPTEL		

Note: Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.

Date:_____
Volume No.:_____

IV Year: VII Semester (Theory)
Plant Biochemistry
Course code: BSB701

L	T	P	C
4	0	0	4

Course Objective: The objectives of the course will be as follows.

1. To provide detailed information about the basic principles of plant function.
2. To teach the plant-water relationships, principles of plant cell physiology, growth and development.
3. To teach carbon and nitrogen metabolism.
4. To provide information about plant secondary metabolites and their role in plant stress physiology.

UNIT I: Plant water relations and micro and macro nutrients

Plant water relation, Importance of water, water potential and its components; Transpiration and translocation in phloem: Transpiration and its significance; Factors affecting transpiration, girdling experiment; Pressure flow model, Composition of phloem sap. Transport of ions, solutes and macromolecules from soil across cell membrane, active and passive transport, Root pressure and guttation, mechanisms of loading and unloading of photoassimilates. Mineral Nutrition, Criteria of essentiality of elements; Role of essential elements; Symptoms of mineral deficiency in major crops,

UNIT-II: Photosynthesis, Respiration and photorespiration

Light harvesting complexes; PSI, PSII, mechanisms of electron transport; photoprotective mechanisms; CO2 fixation-C3, C4 and CAM pathways. Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway, Chemiosmotic mechanism, P/O ratio, cyanide-resistant respiration, factors affecting respiration.

UNIT-III: Nitrogen metabolism –Physiology and biochemistry of nitrogen fixation, Nitrate assimilation, biological nitrogen fixation (in leguminous and non-leguminous plants), Ammonia assimilation (GS/GOGAT cycle), reductive and transamination, amino acid synthesis.

UNIT-IV: Plant Development, Movements, Dormancy & Responses

Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action of Phytohormones (auxins, gibberellins, Cytokinins, ABA, ethylene), autonomic and paratonic movements, stomatal movement, control and coordination in plants. Photoperiodism (SDP, LDP, Day neutral plants), and biological clocks. Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins, red and far red-light responses on photomorphogenesis, seed physiology and dormancy, Vernalization and senescence.

UNIT-V: Secondary metabolites and Stress physiology

Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles. Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.

Suggested Reading:

1. Sunil D Purohit, K. Ahmed &Gotam K Kukda. Plant Physiology and Biochemistry ISBN #:81-301-0035-5 Edition: 2013 Pages: 368 + VIII Text Book (Hindi).

2. Hopkins, W.G. &Hiiner, N.P. Introduction to Plant Physiology (3rd ed.) 2004, John Wiley & Sons.
3. Pathmanabhan G, Vanangamudi M, Chandrasekaran CN, Sathyamoorthi K, Babu CR, Babu RC, Boopathi. A Handbook On Mineral Nutrition and Diagnostic Techniques for Nutritional Disorders of Crops (pb) ISBN: 9788177543377 Edition: 01Year: 2011 PN Publisher: Agrobios (India)
4. Jain, V.K. Fundamental of Plant Physiology (7th ed.) 2004. S. Chand and Company.
5. Salisbury, F.B. & Ross, C.W. Plant Physiology (4th ed.), 19992, Wadsoworth Publishing Company.
6. Panday, S.N. &Sinha, B.K. Plant Physiology (4th ed.), 2006, Vikas Publishing House Pvt. Ltd.
7. Mukherjee, S. &Ghosh, A. Plant Physiology (2nd ed.), 2005, New Central Book Agency.
8. Chaudhuri, D., Kar, D.K., and Halder, S.A. Handbook of Plant Biosynthetic Pthways 2008, New Central Book. Agencies.
9. Voet, D. and Voet, J.G., Bio-Chemistry (3rd ed.), 2005, John Wiley & Sons.
10. Mathews, C.K., Van Holder, K.E. &Ahren, K.G. Bio-Chemistry (3rd ed.), 2000, Pearson Education.
11. Lehninger Principles of Biochemistry. Sixth Edition. 2013. David L. Nelson, Michael M. Cox. Freeman, Macmillan.
12. Srivastava, HN. 2006. Pradeep's Botany Vol. V. Pradeep Publications, Jalandhar.
13. Verma, SK. Plant Physiology and Biochemistry. S. Chand & Sons, New Delhi.
14. Buchanon, Gruissen and Jones. Plant Physiology & Biochemistry: Biochemistry and Molecular Biology of plants, 2000, I.K. International.

Course Learning Outcome (CLO): Upon successful completion of this course the student should be able to understand:

1. Understand the basics of plant physiology and physiological mechanisms governing plant growth and development
2. Learn the basics of transport in plants and movement of solutes and water
3. Remember the basics of photosynthesis, respiration and hormonal signaling as it impacts plant growth and development
4. Comprehend and increase the awareness and appreciation for plants in environment, as well as to understand their diverse physiological functions.

IV Year: VII Semester (Theory)
Medicinal Chemistry
Course code: BSB702

L	T	P	C
4	0	0	4

Course objectives: The objectives of the course are as follows:

1. To understand the basic concept of medicinal chemistry
2. To make students understand the fundamental concepts of drug metabolism.
3. To teach students about different kinds of drugs
4. To know drugs action on nervous system, cholinergic neurotransmitters, etc.

UNIT I: Introduction to medicinal chemistry

History and development of medicinal chemistry; physicochemical properties in relation to biological action: ionization, solubility, partition coefficient, hydrogen bonding, protein binding, chelation, bioisosterism; optical and geometrical isomerism.

UNIT II: Drug metabolism

Drug metabolism principles: Phase I and Phase II; factors affecting drug metabolism including stereo chemical aspects; causes for drug resistance; genetic principles of drug resistance.

UNIT III: Drugs acting on autonomic nervous system

Adrenergic neurotransmitters: biosynthesis and catabolism of catecholamine; adrenergic receptors (Alpha and Beta) and their distribution.

UNIT IV: Sympathomimetic agents: SAR of sympathomimetic agents

Direct acting: Norepinephrine, Epinephrine, Phenylephrine, Dopamine; indirect acting agents: hydroxy amphetamine; pseudoephedrine; propylhexedrine; agents with mixed mechanism: ephedrine, metaraminol.

UNIT V: Cholinergic neurotransmitters

Biosynthesis and catabolism of acetylcholine; cholinergic receptors (muscarinic and nicotinic) and their distribution; parasympathomimetic agents: SAR of parasympathomimetic agents; direct acting agents: Acetylcholine, Carbachol; indirect acting/cholinesterase inhibitors (Reversible and Irreversible).

Suggested Readings:

1. Lemke, TL, Williams, DA, Roche, VF and Zito, SW 2012.Foye's Principles of Medicinal Chemistry, 7th ed. Lippincott Williams and Wilkins, Philadelphia.
2. Singh, H and Kapoor, VK 1996.Medicinal and Pharmaceutical Chemistry, VallabhPrakashan Publishers, Delhi.
3. Patrick, GL2017. An Introduction to Medicinal Chemistry, 6th ed. Oxford University Press, New York.

Course Learning Outcome (CLO): Upon successful completion of this course the student will:

1. Understand the concepts of drugs and their actions.
2. Learn about the fundamentals of various receptors and signaling processes.

IV Year: VII Semester (Theory)
Industrial Biochemistry-1
Course code: BSB703

L	T	P	C
4	0	0	4

Course objectives: The objectives of the course are as follows:

1. To understand the basic concept of bioprocess technology.
2. To make students understand the fundamental concepts of fermentation for production of different product.
3. To teach students about different kinds of techniques of food processing and preservation.
4. To know action of protein enzymes in industry.

UNIT-I: Bio Process Technology

Bioprocess Technology: Classification of reactors based on geometry, Mode of Operations, State of mixing and energy input. Types of Bioreactors- Stirred Tank, Recycle reactors, discontinuous, semi continuous and continuous. Parameters for Bio process – Bio mass, Substrates, product, O2and CO2, Temperature, agitation. Bio process monitoring with respect to O2 transfer, energy transfer, rate of utilization, efficiency and computer base monitoring**.** Downstream processing, process for product recovery, recycling of residual raw, by product recovery, waste/effluent treatment.

UNIT-II: Fermentation

Primary and secondary of microbes, inoculums preparation, fermentation media, industrial sterilization, strain improvement, metabolic and genetic regulations during fermentations, pure and mix culture fermentations. Products from microorganisms – enzymes (Amylases, Proteases, Pectinases), Primary metabolites (Glu, vit B12), Antibiotics (Penicillin), Pigments (Carotenoids), Sweeteners, Beverages (wine, Beer), Fuels from microbes, microbial polymers and microbial steroid, bio transformations.

UNIT-III: Techniques in Food processing and preservation

Technology of fruits and vegetables processing: Post-harvest technology; minimal processing; commercial canning of fruits and vegetables; processing and preservation of fruit beverages; processing of fruit preserves; commercial processing technology for value addition; artificial ripening. Carbonated fruits beverages, packaged drinking water. Technology of plantation crops, herbs and spices processing: Processing of minor and major spices; extraction of spice oil and oleoresins; post-harvest processing of plantation crops; processing of medicinal and tuber crops. Technology of meat, fish, poultry and egg processing: Meat processing & Preservation, egg processing and preservation; processing of fish and marine products. Technology of cereal processing: Grain storage principles; grain storage structures; wheat milling; paddy processing; parboiling and ageing of rice; barley malting; sorghum, Major & minor millets and oat processing; processing of cereals and millets for food uses. Baking technologies, Technology of legume and oilseed processing: Types of legumes and pulses; nutritional changes during soaking and sprouting of pulses, milling of pulses, methods used for removal of anti-nutritional compounds; oilseed processing. Technology of milk and dairy processing: Recent dairy developments in India; sampling and quality testing of milk; processing technology of dairy products; dairy plant cleaning and sanitization operational details Confectionary and Snacks Technology. Role of ISI Agmark and FDA in food industry.

Unit : IV Industrial Protein Enzymes

Isolation & Purification: Proteins & Enzymes – Source identification, isolation, recovery, concentration. Partial/total purification by salting in, salting out, precipitation, ion exchange, dialysis, ultra filtration,

column chromatography (Gel filtration, Affinity, HPLC). Protein characterization, functional studies, evidence of purity, mass determination mass spectroscopy.

UNIT-V: Production & Application

Therapeutic proteins – whole blood products (RBCs. Platelets, clotting factors &Immunoglobulins), blood derived proteins. Vaccines & Anti – toxoid Technology for measles, poliomyelitis,typhoid, Hepatitis B, AIDS, anti –tetanus. Industrial Enzymes – production & applications of Proteases, Analyses, Lipases, Asparginase, Streptokinase. Hormones – conventional & engineered Insulin, Erythropoetin, Growth hormones. Interferons – production & application of alpha, beta, gamma, Interleukin – 2, TNF, CSF. Non – catalytic industrial proteins – casein, whey proteins, Egg proteins, wheat germ proteins.

Suggested Readings:

1. Industrial Biochemistry by Abdul Ghaffar, Bushra Munir.
2. Recent Advances in Industrial Biochemistry, Muhammad Zaffar Hashmi, Aamer Saeed, Syed Ghulam Musharraf, Wang Shuhong Springer International Publishing, 9 May 2024.

Course Learning Outcome (CLO):

After successful completion of this course the student will able to:

1. Understand the basic concept of bioprocess technology.
2. Understand the fundamental concepts of fermentation for production of different product.
3. Learn about different kinds of techniques of food processing and preservation.
4. To know action of protein enzymes in industry.

IV Year: VII Semester (Theory)
Departmental Elective-3
Developmental Biology
Course code: BSB711

L	T	P	C
4	0	0	4

Course objectives: The course aims to teach the principles and molecular biology of eukaryotic development, from zygote to embryo development and differentiation. The specific objectives of the course are:

1. To understand the history and basic concepts of embryology
2. To become familiar with the process of fertilization, spermatogenesis and oogenesis
3. To understand the process of organogenesis.
4. To understand the molecular basis of development.

UNIT-I: Basic concepts of development : Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development

UNIT-II: Gametogenesis, fertilization and early development: Production of gametes, cell surface molecules in sperm-egg recognition in animals, spermatogenesis and oogenesis; embryo sac development and double fertilization in plants; fertilization: mechanism and types of fertilization; *in-vivo* and IVF different types of eggs on the basis of yolk. zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination. cell movements: epiboly, emboly, extension, invagination, convergence, de-lamination;

UNIT-III: Morphogenesis and organogenesis in animals : Cell aggregation and differentiation in Dictyostelium; axes and pattern formation in Drosophila, amphibia and chick; organogenesis – vulva formation in Caenorhabditis elegans, eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development- larval formation, metamorphosis; environmental regulation of normal development; sex determination.

UNIT-IV: Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in Arabidopsis and Antirrhinum

UNIT-V: Molecular biology of development Role of homeotic genes (*Hox*gene) and maternal effect genes (*bicoid*and*nanos*) in *Drosophila* development; axis specification in amphibians: concept of primary organizer; role of *β-catenin* gene and the origin of Nieuwkoopcentre; vulval induction in *C. elegans*; role of *TBX* 4, *TBX*5 and *Sonic hedgehog* genes in the development of tetrapod limb in vertebrates

Suggested Readings:

1. Balinsky, BI 2012. An introduction to Embryology, 5th ed. Cengage Learning India.
2. Gilbert, SF 2006. Developmental Biology, 8th ed. Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.

3. Kalthoff, 2000. Analysis of Biological Development, 2nd revised ed., McGraw-Hill Publishing Co.

Course Learning Outcome (CLO): Upon successful completion of this course the student will:

1. Understand the differences between the structure of male and female gametes
2. Learn the process of early and late embryonic development including the process of cleavage, blastulation and gastrulation in animals.
3. Understand the role and importance of Hox, bicoid, sonic hedgehog, etc genes in development.

IV Year: VII Semester (Theory)
Departmental Elective-3
Bioprocess Technology
Course code: BSB712

L	T	P	C
4	0	0	4

Course objectives: The specific objectives of the course are as follows:

1. To impart the knowledge of cultivation and growth kinetics of microorganisms.
2. To make students understand the basic concept of sterilization and different parts of a bioreactor.
3. To teach the application of bioprocess technology in industries.
4. To make students understand about thermal death kinetics of microorganisms.

UNIT I: Introduction to bioprocess technology

Introduction to bioprocess technology; range of bioprocess technology and its chronological development; basic principle components of fermentation technology; types of microbial culture and its growth kinetics: batch, fed-batch and continuous culture.

UNIT II: Components of bioreactor and sterilization

Design of bioprocess vessels: significance of impeller, baffles, sparger; types of culture/production vessels; airlift; cyclone Column; packed tower and their application in production processes; principles of upstream processing: media preparation, inocula development and sterilization.

UNIT III: Kinetics of bioprocess

Theories of diffusion; gas liquid mass transfer; introduction to oxygen requirement in bioprocess; mass transfer coefficient; factors affecting KLa,; thermal death kinetics of microorganisms.

UNIT IV: Microbial production of compounds and its downstream processing

Bioprocess measurement and control system with special reference to computer aided process control; introduction to downstream processing; product recovery and purification; microbial production of ethanol, amylase, lactic acid and single cell proteins.

UNIT V: Application of bioprocess engineering in industries

Food industry (baker's yeast production); environmental industry (biological wastewater treatment); medical applications of bioprocess engineering.

Suggested Readings

1. Casida LE. (991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
5. Tom Brody (1999). *Nutritional Biochemistry (2nded.).* Harcourt Braces. ISBN: 9814033251, 9789814033251.
6. James M J.. 2000. Modern Food Microbiology, 6th Ed. Aspen Publishers, Inc., Gaithersburg,Maryland, USA.

7. Frazier WC, and Westhoff DC. Food Microbiology. Fourth edition, MacGraw Hills publication
8. Lopez GFG, Canaas G, Nathan EV. Food Sciences and Food biotechnology.

Course Learning Outcome (CLO): Upon successful completion of this course the student will:

1. Get an overview of the basic concepts of bioprocess technology and process of culture of microorganisms.
2. Understand the parts and functions of the bioreactor.
3. Learn about the thermal death kinetics microorganisms

IV Year: VII Semester (Theory)
Minor Elective-3
Biophysics
Course code: BSB721

L	T	P	C
4	0	0	4

Course objective (CO)

1. To study about electrochemistry, its theory and classifications.
2. To familiarize with the photophysics and optical activities.
3. To understand about the optical and diffraction techniques.
4. To learn about radioactivity and measurement.

UNIT-I: Electrochemistry: Ionization; theories of electrolytic dissociation; classification of electrolytes; Electrolysis; Conductance; solubility product; common ion effect; Ostwald's dilution law; Dielectric Constant

UNIT-II: Photophysics. Nature and measurement of light; Light sources , Optical components and their calibration Radiometry; Actinometry; UV radiation dosimetry with poly sulphonification; Molecular structure and excited states; Physical properties of excited molecules; PhotoPhysical processes; Fluorescence; Photophosphorescence; Internal conversion; Intersystem crossing; Photophysical spectra; Atomic spectra; Optical activity; Photophysical kinetics of biomolecular processes.

UNIT-III: Optical Techniques and Diffraction Techniques. Principle, Instrument design, methods and application of Fluorescence; Polarising, Flowcytometry and Cytophotometry. Crystals, Molecular crystal symmetry, X ray diffraction by crystals, Bragg's Law, von Laue conditions and rotation methods. Calculating electron density and Patterson maps (Fourier transform and structure factors, convolutions), phase model building and evaluation, Newton diffraction, Application to Biology.

UNIT-IV: Some advanced laboratory techniques: Principle, Instrument design, methods and application of UV spectroscopy; Circular Dichroism and optical rotatory dispersion (ORD); Infrared spectroscopy; NMR and ESR spectroscopy, MALDI-TOF.

UNIT-V: Radioactivity and measurement. Radioactivity, Radioactive decay, Isotopes, Biological application of radioisotopes, Detection and measurement of radioactivity, Instruments used for measurement of radiation intensities, Biological effects of radiation and radiation hazards

Suggested Readings

1. Pattabhi. V. and Gautham.N. (2002) Biophysics. Narosa Publishing House, India.
2. Roy, R.N. (2005) A Textbook of Biophysics. New Central Book Agency (P) Ltd.,Calcutta, India

Course learning outcomes (CLO): After completion of this course students will be able to:

1. Understand about electrochemistry, its theory and classifications.
2. Understand the photophysics and optical activity.
3. Understand the optical and diffraction techniques.
4. Learn about the fundamentals of radioactivity and measurement.

IV Year: VII Semester (Theory)
Minor Elective-3
Pharmacology
Course code: BSB722

L	T	P	C
4	0	0	4

Course objective(CO)

1. To study about pharmacology, sources of drugs and route of administration.
2. To familiarize with the term pharmacokinetics and pharmacodynamics.
3. To understand about the drugs acting on CNS and about autocoids.

UNIT-I: General Introduction

Introduction: definition, historical perspective, branches and scope of the subject pharmacology and its relation with other medical disciplines, Nature and sources of Drugs, Drug nomenclature and dosage forms. Routes of pharmacology and its relation with the medical disciplines. Nature and sources of Drug, Route of drugs 'administration, advantages and disadvantages of different routes.

UNIT-II: Pharmacokinetics

Drug absorption, distribution, metabolism, and excretion, bioavailability, First Pass metabolism, excretion and kinetics of elimination, Bioavailability, Biological half-life of drug and its significance, Drug-drug interactions.

UNIT-III: Pharmacodynamics

Principles and mechanism of drug action, Factors affecting drug action. General considerations, pharmacological classification, mechanism of action and uses of following classes of drugs acting on various systems.

UNIT-IV: Drugs acting on CNS

Mechanism of General anesthesia, Stages of anesthesia, General anesthetics (Nitric oxide, halothane), Principles of hypnosis and sedatives: sedative and hypnotics drugs (Phenobarbitone, diazepam), (c) Opioid analgesics (Morphine) (d) CNS stimulants (strychnine, amphetamine).

UNIT-V: Drugs Affecting Autacoids

Inflammation and Gout, Histamine, serotonin & their antagonists, treatment of migraine, PGs, LTs, PAF, NSAIDs, Drug treatment of gout, rheumatoid arthritis & other autoimmune diseases, Drugs Affecting Kidney Function, Diuretics, and Antidiuretics.

Suggested Readings-

1. Essentials of Pharmacology basic principles and General Concept 5thEdition (PB2023),2021 by VN Sharma.
2. Review of Pharmacologyby Gobind Rai Garg & Sparsh Gupta.
3. Essentials of Medical Pharmacology, 2018, byK.D. Tripathi.
4. One Touch Pharmacology 2022 by Ranjan Kumar Patel.DisciplineSpecificElective-1(DSE-1)

Course Learning Outcome(CLO)

At the end of the course the student will be able to:

1. Study about pharmacology, sources of drugs and route of administration.
2. Explain the term pharmacokinetics and pharmacodynamics.
3. Understand about the drugs acting on CNS and about autocoi

IV Year: VII Semester (Practical)
Plant Biochemistry Lab
Course code: BSB751

L	T	P	C
0	0	2	1

Course objective: The objectives of the lab course are as follows:

1. To introduce concepts about plant physiology.
2. To give practical experience to understand the Separation of photosynthetic pigments by chromatography
3. To experience an advanced level to enable a practical understanding of the cardinal importance of plant metabolism in the biosphere
4. To introduce physiology of plants like aerobic respiration in germinating seeds, photosynthesis in aquatic plant etc.

Practicals

1. Demonstration of plasmolysis in *Tradescantia* leaves
2. Determination of water potential of plant tissue
3. Study stomatal distribution on leaf surfaces and calculation of stomatal index
4. Study of ascent of sap in plants
5. Study aerobic respiration in germinating seeds
6. Separation of photosynthetic pigments by paper chromatography
7. Chlorophyll and carotenoid quantification via spectrophotometric analysis
8. Demonstration of photosynthesis in aquatic plant
9. Determine the presence of starch and sucrose in plants
10. Determination of transpiration from foliar surface

Suggested Readings:

1. Practical Plant Biochemistry (1920) by Muriel Wheldale Onslow (Author)
2. A practical manual on Fundamentals of Plant Biochemistry and Biotechnology, Compiled by: Shweta Singh Assistant Professor, Department of Agriculture, Faculty of Science and Engineering, Jharkhand Rai University, Namkom.
3. Laboratory Handbook on Plant Biochemistry by Mamangam Subaraja (Author), G Hema (Author)

Course Learning Outcome (CLO): After successful completion of this lab course, student:

1. Would be able to understand basic of plant physiology and biochemistry.
2. To understand the distribution of stomata on leaf and their photosynthesis.
3. Understand the function of chlorophyll and aerobic respiration.
4. Would be able to determine the presence of starch and sucrose in plants.

IV Year: VII Semester (Theory)
Medicinal Chemistry Lab
Course code: BSB752

L	T	P	C
0	0	2	1

Course objective: The objectives of the Medicinal Chemistry practical course are as follows:

1. General Assay and determination of vitamins, aspirin, ibuprofen etc.
2. Relevant chemical reactions for Synthesis of selected drugs
3. Structural influences on pharmacologic/toxicological/therapeutic profiles.
4. The gained practical knowledge of Medicinal Chemistry

Practicals

1. Assay of thiamine in vitamin B complex tablets.
2. Determination of vitamin C content of commercial tablets.
3. Determination of molarity of acetic acid in vinegar.
4. Isolation of citric acid from lemon.
5. Color spot tests for detection of alkaloids.
6. Synthesis of paracetamol from p-aminophenol.
7. Determination of dissociation constant of benzoic acid
8. Determination of percentage purity of aspirin.
9. Determination of percentage purity of ibuprofen.
10. Determination of percentage purity of sulphamethoxazole.

Suggested Readings:

1. Laboratory Manual For Medicinal Chemistry, Marri Laxman Reddy Institute Of Pharmacy
2. A Practical book of Medicinal Chemistry by Dr. Abhishek Tiwari (Author), Dr. Rajeev Kumar (Author)

Course Learning Outcome (CLO):

After completion of this course students will be able to:

1. Understand the assay and determination of drugs and their actions.
2. Understand the synthesis of drugs.
3. Learn about the fundamentals of alkaloids and drugs.

B Sc. (Hons./Hons. with Research) Biochemistry

Study Evaluation Scheme (as per NEP2020)
Effective from the session 2025-26

IV Year: VIII Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Honors											
1	BSB801	Research Methodology	4	0	0	25	75	100	4	Major	Own faculty
2	BSB802	Industrial biochemistry-2	4	0	0	25	75	100	4	Major	Own faculty
3	BSB803	Applied Biochemistry	4	0	0	25	75	100	3	Major	Own faculty
Practical											
4	BSB851	Industrial biochemistry lab	0	0	2	25	75	100	1	Major	Own faculty
		Total	12	0	2	100	300	400	12		
OR, Honors with research											
4	BSB852	Dissertation work	0	0	40	100	300	400	12	Major	Own faculty
Total			0	0	40	100	300	400	12		

B.Sc. (Hons/Hons. with Research) in Biochemistry

Hons	Honours
L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination

Note:

1. Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.

2. A four-year B.Sc. Honours/ B.Sc. Honours. With research degree in the major discipline will be awarded to those who complete a four-year degree programme with 164 credits.

IV Year: VIII Semester (Theory)
Research Methodology
Course code: BSB801

L	T	P	C
4	0	0	4

Course objective:

1. To introduce the nature of problem to be studied and identifying the related area of knowledge.
2. To analyzing data appropriate to the problem.
3. To reviewing literature to understand how others have approached or dealt with the problem.
4. To know the idea of paper and thesis writing.

UNIT I: Introduction of research methodology:
Meaning of research, objectives of research, types of research, significance of research, problems encountered by researchers in India.

UNIT II: Research problem:
Definition, necessity and techniques of defining research problem, Formulation of research problem, Objectives of research problem.

UNIT III: Research design:
Meaning, need and features of good research design, Types of Research Designs, Basic Principles of Experimental Designs, Design of experiments, and Synopsis design for research topic.

UNIT IV: Editing, Data Collection and Validation:
Primary and secondary data, Methods of collecting primary and secondary data, Importance and methods of editing and data validation.

UNIT V: Paper/Thesis Writing and Report Generation:
Basic concepts of paper their writing and report generation, review of literature, Concepts of Bibliography and References, significance of report writing, steps of report writing, Types of Research reports, Methods of presentation of report.

Suggested Readings

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, EssEss Publications. 2 volumes.
4. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
5. Wadehra, B.L. 2000. Law relating to patents, trade marks, copyright designs and geographical indications. Universal Law Publishing.
6. Anthony, M., Graziano, A.M. and Raulin, M.L., 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.

7. Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York.
8. Coley, S.M. and Scheinberg, C. A., 1990, "Proposal Writing", Sage Publications.
9. Day, R.A., 1992.How to Write and Publish a Scientific Paper, Cambridge University Press.
10. Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications
11. Leedy, P.D. and Ormrod, J.E., 2004 Practical Research: Planning and Design, Prentice Hall.
12. Satarkar, S.V., 2000. Intellectual property rights and Copy right. EssEss Publications.

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

1. Understand the limitations of particular research methods.
2. Develop skills in qualitative and quantitative data analysis and presentation.
3. Develop advanced critical thinking skills

IV Year: VIII Semester (Theory)
Industrial Biochemistry-2
Course code: BSB802

L	T	P	C
4	0	0	4

Course objective (CO)

1. To understand about carbohydrates and lipids of industrial importance
2. To understand the theory of environmental biotechnology
3. To know the concept of nanotechnology and other important industrial technology.

UNIT-I: Carbohydrates of Industrial Importance

Manufacturing and refining of – Cane sugar and bye products of sugar industry. Production of starch, Maltodextrins, cyclodextrins, dextrose and Other sweetners, innulin. Manufacture of pectin & cellulose**.** Manufacturing of Plat polysaccharides (Gum Arabic)**,** Microbial polysaccharides**.** Modified carbohydrates – modified starches, modified celluloses, Agarose, Sepharose.

UNIT-II: Lipids of Industrial Importance

Vegetable Oils: Extraction process as for palm oil, Olive oil, coconut oil, groundnut oil & Soyabean oil and Animal fats**,** Refining processes for oils and fats. Plant Pigments- Extraction processes and applications of chlorophylls, Carotenes, Lycopenes and Turmeric. Extraction and industrial applications of essential oils (Eucalyptus, Wintergreen, Thyme, Clove, Cinnamon)**.** Oleochemicals- Production and application of fatty acids, glycerol, sterols, squalene, lecithin, microbial lipids, surfactants and bio surfactants. Tailored & Modified fats. Manufacture by Lipase – catalysed inter-esterification and bytrans-esterification for the production of Bio-diese (Biofuel) from Jatropha**.** Production & applications of modified lipids – low fat food items, waxes, lubricants.

UNIT-III: Environmental Biotechnology

Air Pollution – classification & effects of air pollutants on human health, Gases containing the oxides of carbon, sulphur and nitrogen, ozone and CFC. Measures to control air pollution and suspended particulate matters in air. Green house effect & Global warming – sources, consequences& remedical measures. Water Pollution- Sources and effects of water pollutants on human health, quality standards for drinking water, waste water treatment and recycling. Concept and significance of BOD, COD and dissolved oxygen**.** Noise Pollution- Sources, measurement, health hazards, prevention & control of noise pollution. Toxins in environment-Chemical toxicology – Biochemical effects of heavy metals (Pb, As, Hg, Cd), pesticides, insecticides, herbicides, weedicides, larvicides, polyaromatic hydrocarbons, dyes, monomeric and polymeric organics. Emerging eco-friendly alternatives for chemical industry –Green chemistry and Green Technology.

UNIT-IV: Nanotechnology

Nano biotechnology- Principle and applications of Nanotechnology. Techniques of Nano material characterization**:** Preparation and characterization of nanoparticles: nanoparticular carrier system, Electron microscopy Atomic force microscopy. Nanostructures and Nanosystems**.** Applications in drug designing, drug delivery & proteinen gineering.

UNIT-V: Other Topics

Biosensors – Construction, uses in industrial and environmental processes and medical applications. Principles, techniques and applications of – Liposome formation, natural & synthetic biofilms. Clinical diagnostics – Diagnostic Kits and their applications. Concept and significance of Bio safety, Bio Hazards and Bio ethics. Concept of QC, QA GMP, GLP in labs & production processes.

Lab/process validation & Accreditation. Maintenance & Management of Lab/Experimental animals and
Animal House CPCEA guidelines.

Suggested Readings:

3. Industrial Biochemistry by Abdul Ghaffar, Bushra Munir.
4. Recent Advances in Industrial Biochemistry, Muhammad Zaffar Hashmi, Aamer Saeed, Syed Ghulam Musharraf, Wang Shuhong Springer International Publishing, 9 May 2024.

Course learning outcomes (CO)
After completion of this course students will able to

1. Understand about carbohydrates and lipis of industrial importance
2. Understand the theory of environmental biotechnology
3. Know the concept of nanotechnology and other important industrial technology.

IV Year: VIII Semester (Theory)
Applied Biochemistry
Course code: BSB803

L	T	P	C
3	0	0	3

Course objective (CO)

1. To understand the methods for measuring nucleic acid and protein interactions.
2. To make students understand the fundamental concepts of plant, animal and microbes tissue culture.
3. To teach students about different types of vaccines.
4. To know about marine biotechnology.

UNIT-I: Methods for measuring nucleic acid and protein interactions – foot printing, CATassay, gel shift analysis. DNA markers in genetic analysis – RFLP, Minisatellites, Microsatellites, PCR based RAPD markers, Chromosomal Walking, Chromosomal jumping. DNA fingerprinting, SNPS, Mapping Genes – Somatic cell hybridization mapping, FISH, Transposon tagging. RNA silencing – siRNAs and anti- sense RNAs their design and applications; shRNA, epigenetic gene silencing.

UNIT-II: Plant tissue culture: Principles, Techniques, Methodology and Application of PTC Culture media – Composition and preparation, Totipotency, Organogenesis and plant regeneration, Somatic embryogenesis, Artificial seeds, Micropropagation. Isolation and culture of protoplasts, Somatic hybridization.Plant cellcultures, Plating efficiency, Production of secondary metabolites through in vitroculture. Gene Transfer and Transgenic for crop improvement

UNIT-III: Animal tissue culture: Principles, Techniques, Methodology and Application of ATC Composition and preparation of culture media, Primary cultures, established/continuous cell lines. Tissue and organ culture. Stem cells – Sources- embryonic stem cells, adult stem cells, cord blood stem cells. Generation of stem cellsby cloning, stem cell differentiation, stem cell plasticity, preservation of stem cells. Organogenesis through stem cells for transplantation. Applications of stem cell therapy-Parkinson's disease and Alzheimer's disease. Transfection using eggs, cultured stem cells and nuclei in development of transgenic animals. Frontiers of contraceptive research, cryopreservation of sex gametes& embryos, Ethical issues in embryo research.

UNIT-IV: Microbial Tissue Cultures and Marine Bio Technology.
Microbial Tissue Culture (MTC)- Principles, Techniques, Methodology and Application of MTC**,** Commercial production of industrially important microbial strains, role of ATCC and microbial cell banks. Microbes as products, Single Cell Protein (SCP) and Yeast(nutrient). Bioremediation, Oil spills, Degradation of waste water, Chemicals and heavy metals, microbial leaching (Cu, Zn, Fe,Ag, Mn, Hg, As, Sb**).** Marine Bio Technology- Principles, Techniques, Methodology and Application of Aqua Culture for Crustacean production. Medical Application of Marine resources – Anticancer and Antiviral compounds, Antimicrobial agents, Marine Toxins. Marine natural product – production of Agar and Carageenan from sea weeds and their application

UNIT-V: Vaccines: Principles of vaccination, Design of vaccines. Conventional vaccines –Whole organism, live and attenuated, purified macromolecules. New generation vaccines- Recombinant antigen vaccines, recombinant vector antigens, DNA vaccines, synthetic vaccines, edible vaccines. Vaccine delivery systems – Liposomes, micelles, ISCOMS. Strategies for developing vaccines for

malaria, HIV and Salmonellosis. Gene therapy –Types and use of rDNA constructs for gene therapy. Microarrays and biochips. Principle and applications of Metabolic engineering.

Suggested Readings:

1. Industrial Biochemistry by Abdul Ghaffar, Bushra Munir.
2. Recent Advances in Industrial Biochemistry, Muhammad Zaffar Hashmi, Aamer Saeed, Syed Ghulam Musharraf, Wang Shuhong Springer International Publishing, 9 May 2024.

Course learning outcomes (CLO)

After completion of this course students will able to

1. Understand the methods for measuring nucleic acid and protein interactions.
2. Understand the fundamental concepts of plant, animal and microbes tissue culture.
3. Learn about different types of vaccines.
4. Know about marine biotechnology.

IV Year: VIII Semester (Practical)
Industrial Biochemistry lab
Course code: BSB851

L	T	P	C
0	0	2	1

Course objective:

1. To impart practical knowledge on standard biochemical parameters used in food, pharmaceutical, and industrial product testing.
2. To develop analytical and quantitative skills through hands-on experiments in biochemical quality assessment.
3. To familiarize students with safety standards, regulatory norms, and protocols used in industrial biochemistry labs.

Experiments:

1. Protein estimation in industrial samples by Biuret/Lowry method
2. Determination of peroxide value of fats and oils
3. Acid value determination of oils
4. Estimation of reducing sugars by DNS method
5. Analysis of artificial sweetener stability under heat/pH conditions
6. Stability and solubility analysis of a model drug (e.g., paracetamol or aspirin)
7. Preservative stability analysis (e.g., benzoate or sorbate under storage conditions)
8. Antibiotic sensitivity test using disc diffusion (Ampicillin)
9. Alcohol content estimation using potassium dichromate method

Course Learning Outcomes (CLOs):

By the end of this lab course, students will be able to:

1. Analyze the chemical properties and quality parameters of fats, oils, and industrial sweeteners using classical and modern methods.
2. Perform and interpret stability studies on drugs, preservatives, and additives under various environmental conditions.
3. Evaluate the antibiotic sensitivity of microbial samples using standard assays (e.g., Kirby-Bauer method).
4. Apply biochemical methods such as protein, sugar, or alcohol quantification in the context of food, fermentation, and pharmaceutical industries.

IV Year: VIII Semester
Dissertation work
Code: BSB852

L	T	P	C
0	0	40	12

Course objective:

1. To understand the process of recognizing a biological question,
2. To learn how to create and validating a hypothesis by executing experiments in the laboratory.
3. To understand the compiling, analysis and interpretation the data.
4. To learn how to write the project and give seminar.

Research Project/Dissertation Work: Each student shall have to do a project work during his/her tenure in 8th Semester in the field of Biochemistry and related areas in reputed Organizations/ Companies/ Laboratories etc. The candidate shall submit the project work towards partial fulfilment of B.Sc. degree in Biochemistry (Hons/Research) under the supervision of a faculty member.

Seminar: Each student shall give seminar on project work/dissertation before the external examiners at the time of general Viva voce examination.

Course Learning Outcomes (CLOs): On completion of this course, the students will be:

1. Understand the basic knowledge of research ethics and biosafety Level.
2. Create research plans/ideas with the help of relevant literature and execute and achieved it in limited time frame.
3. Analyzing the research data and find significance by correlating it with the present problems/challenges.
4. Apply the knowledge and capability required for independent work as a Bachelor of Science in Biochemistry (Hons/Research).
5. Survey the changes and updating of selected topic to know the current research of particular area.
6. Analyze and compile the data of selected topic and interpret the impact on the society and environment.
7. Compile the report of the study and present to the audience with following the ethics.
8. Develop an understanding to review, and compile the data and also developed the presentation skills.

Minimum Credit Requirements to Award Degree under Each Category

S.NO.	Broad Category of Course	Minimum Credit Requirement			
		3 year		4 year	
		As per UGC	MGUG	UGC	MGUG
1	Major (Core)	60	66	80	80
2	Minor Stream	24	24	32	32
3	Multidisciplinary	09	09	09	09
4	Ability Enhancement Courses (AEC)	08	08	08	08
5	Skill Enhancement Courses (SEC)	09	09	09	09
6	Value Added Courses common for all UG	06 - 08	12	06 – 08	12
7	Summer Internship	02 - 04	02	02 – 04	02
8	Research Project / Dissertation			12	12
	Total	120	130	160	164

Credit distribution in each semester

S. NO.	Broad Category of Course	Semester I	Semester II	Semester III	Semester IV	Semester V	Semester VI	Semester VII	Semester VIII A (for B.Sc. Hons.)	Semester VIIIB (for B.Sc. Hons. With research)
1	Major (Core)	10	10	14	10	11	11	14	12	12
2	Minor Stream	------	4	4	8	4	4	8	------	------
3	Multidisciplinary	4	------	------	------	3	2	------	------	------
4	Ability Enhancement Courses (AEC)	4	3	------	------	------	1	------	------	------
5	Skill Enhancement Courses (SEC)	------	3	------	------	3	3	------	------	------
6	Value Added Courses	2	2	2	2	2	2	------	------	------
7	Summer Internship	------	------	------	2	------	------	------	------	------
8	Research Project / Dissertation	------	------	------	------	------	------	------	------	------
	Total	**20**	**22**	**20**	**22**	**23**	**23**	**22**	**12**	**12**
Total credit till VI, VII, and VIII semester							**130**	**152**	**164**	

Letter Grades and Grade Points

The Semester Grade Point Average (SGPA) is computed from the grades as a measure of the student's performance in a given semester. The SGPA is based on the grades of the current term, while the Cumulative GPA (CGPA) is based on the grades in all courses taken after joining the programme of study.

The HEIs may also mention marks obtained in each course and a weighted average of marks based on marks obtained in all the semesters taken together for the benefit of students.

Letter Grade	Grade Point
O (Outstanding)	10
A+ (Excellent)	9
A (Very Good)	8
B+ (Good)	7
B (Above Average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

When students take audit courses, they may be given pass (P) or fail (F) grade without any credits.

Computation of SGPA and CGPA

The UGC recommends the following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

i. The SGPA is the ratio of the sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.

SGPA (Si) = Σ(Ci x Gi) / ΣCi

Where Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th} course.

Example for Computation of SGPA

Semester	Course	Credit	Letter Grade	Grade point	(Credit x Grade)
1	Course 1	3	A	8	3 x 8 = 24
1	Course 1	4	B +	7	4 x 7 = 28
1	Course 1	3	B	6	3 x 6 = 18
1	Course 1	3	O	10	3 x 10 = 30
1	Course 1	3	C	5	3 x 5 = 15
1	Course 1	4	B	6	4 x 6 = 24
		20			139
SGPA					139/20=6.95

ii. The Cumulative Grade Point Average (CGPA) is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

CGPA = Σ(Ci x Si) / Σ Ci

Where Si is the SGPA of the i th semester and Ci is the total number of credits in that semester.

Example for Computation of CGPA

Semester 1	**Semester 2**	**Semester 3**	**Semester 4**	**Semester 5**	**Semester 6**
Credit: 21	Credit: 22	Credit: 25	Credit: 26	Credit : 26	Credit: 25
SGPA : 6.9	SGPA : 7.8	SGPA : 5.6	SGPA : 6.0	SGPA : 6.3	SGPA : 8.0
CGPA= 6.73 (21 x 6.9 + 22 x 7.8 + 25 x 5.6 + 26 x 6.0+ 26 x 6.3+ 25 x 8.0)/145					

The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.