



Date :- 25/04/2025

NOTIFICATION

Sub :- CBCS Syllabi of B. Sc. in Biochemistry (Sem. III & VI)

Ref. :- Decision of the Academic Council at its meeting held on 22/04/2025.

The Syllabi of B. Sc. in Biochemistry (Third and Fourth Semesters) as per **NATIONAL EDUCATION POLICY – 2020 (2024 Pattern)** and approved by the Academic Council as referred above are hereby notified for implementation with effect from the academic year 2025-26.

Copy of the Syllabi Shall be downloaded from the College Website (www.kcesmjcollege.in)

Sd/-
Chairman,
Board of Studies

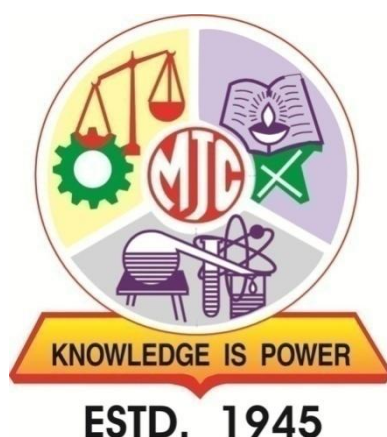
To :

- 1) The Head of the Dept., M. J. College, Jalgaon.
- 2) The office of the COE, M. J. College, Jalgaon.
- 3) The office of the Registrar, M. J. College, Jalgaon.

Knowledge is Power

Khandesh College Education Society's
Moolji Jaitha College, Jalgaon
An "Autonomous College"

Affiliated to
Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon-425001



STRUCTURE AND SYLLABUS

B.Sc. Honours/Honours with Research (S.Y. B.Sc. Biochemistry)

**Under Choice Based Credit System (CBCS)
and
as per NEP-2020 Guidelines**

[w.e.f. Academic Year: 2025-26]

Preface

The cumulative demand for trained and skilled manpower in the area of Biochemistry requires in depth functional knowledge of modern biology through hands-on training to the students. The Moolji Jaitha College (Autonomous) has adopted a department-specific model as per the guidelines of UGC, NEP-2020 and the Government of Maharashtra. The Board of Studies in Biochemistry of the college has prepared the syllabus for the second-year undergraduate of Biochemistry.

The syllabus has been prepared anticipating the requirements of B.Sc. Biochemistry students under CBCS Program. The contents have been drawn to accommodate the widening horizons of the Biochemistry discipline and reflect the changing needs of the students. The detailed syllabus for each paper is appended with a list of suggested readings.

The degree of Bachelor of Science in Biochemistry (Choice Based Credit System) aims to introduce various aspects of Biochemistry and interdisciplinary subjects to the students. The program in Biochemistry as one of the core subject is designed to cultivate a scientific attitude and interest towards the modern areas of Biochemistry in particular and life science in general. This will help the students to become critical and curious in their outlook. The courses are designed to impart the essential basics in Biochemistry, Chemistry, Botany, Microbiology, Zoology and Biotechnology at the initial level of graduation. The basic courses are infused with application in modern life sciences, and awareness on Biochemistry and its influence in human life. The integration of various courses in the program is aimed to develop proficiency in the theory as well as practical experiments, common equipment, laboratory, along with the collection and interpretation and presentation of scientific data in proper manner. Beside this, the students will be equipped with knowledge in the newer areas of Biochemistry and its application in medical science, agriculture, industry, proteomics, genomics, metabolomics, bioinformatics, nano-biotechnology etc. This will create awareness about Biochemistry and contribution of Biochemistry among the society. At the end of the course, the students are expected to have good working knowledge in the field of Biochemistry and in addition knowledge gained from courses of interdisciplinary in nature. Students will surely have an urge to continue higher studies in Biochemistry and contribute significantly in the development.

The present syllabus is restructured anticipating the future needs of Biochemistry with more emphasis on imparting hands-on skills. The main thrust is laid on making syllabus compatible with developments in Education, Research and Industrial sectors. The Theory and Practical course in new restructured course will lead to impart skill-set essentials to further Biochemistry.

Hence, Board of Studies in Biochemistry in its meeting held on 22nd March 2025 resolved to accept the revised syllabus for S. Y. B. Sc. (Biochemistry) based on Choice Based Credit System (CBCS) of UGC, NEP-2020 and the Government of Maharashtra guidelines.

Program Outcomes (PO) for B.Sc. Program:

Program outcomes associated with a B.Sc. degree are as follows:

PO No.	PO
1	Graduates should have a comprehensive knowledge and understanding of the fundamental principles, theories, and concepts in their chosen field of study.
2	Graduates should possess the necessary technical skills and competencies related to their discipline, including laboratory techniques and data analysis.
3	Graduates should be able to identify, analyze, and solve complex problems using logical and critical thinking skills. They should be able to apply scientific methods and principles to investigate and find solutions.
4	Graduates should be proficient in effectively communicating scientific information, both orally and in writing.
5	Graduates should have a basic foundation in research methods and be capable of designing and conducting scientific investigations.
6	Graduates should be able to work effectively as part of a team, demonstrating the ability to collaborate with others, respect diverse perspectives, and contribute to group projects.
7	Graduates should recognize the importance of ongoing learning and professional development. They should be equipped with the skills and motivation to engage in continuous learning, adapt to new technologies and advancements in their field, and stay updated with current research.

Programme Specific Outcome (PSO) for B.Sc. Biochemistry Honours/Honours with Research:

After completion of this program, students are expected to learn/understand the:

PSO No.	PSO
1	Structure, properties, pathways and applications of biomolecules in various fields.
2	Isolation, purification, biochemical mechanisms, regulation and applications of enzymes in various sectors.
3	Isolation, identification and characterization of various microbes from diverse habitats.
4	Principle and applications of various bio-analytical tools and techniques.
5	Physiological Biochemistry and correlate it with clinical applications.
6	Applications of Biochemistry in various industrial sectors such as agriculture, medical, pharmaceuticals, food, cosmetic etc.

Multiple Entry and Multiple Exit options:

The multiple entry and exit options with the award of UG certificate/ UG diploma/ or three-year degree depending upon the number of credits secured;

Levels	Qualification Title	Credit Requirements		Semester	Year
		Minimum	Maximum		
4.5	UG Certificate	40	44	2	1
5.0	UG Diploma	80	88	4	2
5.5	Three Year Bachelor's Degree	120	132	6	3
6.0	Bachelor's Degree- Honours Or Bachelor's Degree- Honours with Research	160	176	8	4

Credit distribution structure for Three/ Four year Honors/ Honors with Research Degree Programme with Multiple Entry and Exit

F.Y. B.Sc.

Year (Level)	Sem	Subject-I (M-1)	Subject-II (M-2)	Subject-III (M-3)	Open Elective (OE)	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT, RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
I (4.5)	I	DSC-1(2T) DSC-2(2P)	DSC-1(2T) DSC-2(2P)	DSC-1(2T) DSC-2(2P)	OE-1(2T)	---	AEC-1(2T) (Eng) VEC-1(2T) (ES) IKS(2T)	CC-1(2T)	22	UG Certificate
	II	DSC-3(2T) DSC-4(2P)	DSC-3(2T) DSC-4(2P)	DSC-3(2T) DSC-4(2P)	OE-2(2T) OE-3(2P)	---	AEC-2(2T) (Eng) VEC-2(2T) (CI)	CC-2(2T)	22	
	Cum . Cr.	8	8	8	6	---	10	4	44	
Exit option: Award of UG Certificate with 44 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor.										

S.Y. B.Sc.

Year (Level)	Sem	Subject-I (M-1) Major*		Subject-II (M-2) Minor #	Subject-III (M-3)	Open Elective (OE)	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
		Mandatory (DSC)	Elective (DSE)	(MIN)							
2 (5.0)	III	DSC-5(2T) DSC-6(2T) DSC-7(2P)	---	MIN-1(2T) MIN-2(2T) MIN-3(2P)	---	OE-4(2T)	SEC-1(2T)	AEC-3(2T) (MIL)	CC-3(2T) CEP(2)	22	UG Diploma
	IV	DSC-8(2T) DSC-9(2T) DSC-10(2P)	---	MIN-4(2T) MIN-5(2P)	---	OE-5(2T)	SEC-2(2T) SEC-3(2P)	AEC-4(2T) (MIL)	CC-4(2T) ⊙ FP(2)	22	
	Cum . Cr.	12	---	10	---	4	6	4	8	44	
Exit option: Award of UG Diploma in Major and Minor with 88 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major & Minor.											

* Student must choose one subject as a Major subject out of M-1, M-2 and M-3 that he/she has chosen at First year

#Student must choose one subject as a Minor subject out of M-1, M-2 and M-3 that he/she has chosen at First year (Minor must be other than Major)

⊙ OJT/Internship/CEP should be completed in the summer vacation after 4th semester

T.Y. B.Sc.

Year (Level)	Sem	Subject-I (M-1) Major		Subject-II (M-2) Minor	Subject-III (M-3)	Open Elective (OE)	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
		Mandatory (DSC)	Elective (DSE)	(MIN)							
3 (5.5)	V	DSC-11(2T) DSC-12(2T) DSC-13(2T) DSC-14(2P) DSC-15(2P)	DSE-1A/B (2T) DSE-2A/B (2P)	---	---	---	VSC-1(2T) VSC-2(2P)	---	OJT/Int (4)	22	UG Degree
	VI	DSC-16(2T) DSC-17(2T) DSC-18(2T) DSC-19(2T) DSC-20(2T) IKS DSC-21(2P) DSC-22(2P)	DSE-3A/B (2T) DSE-4A/B (2P)	---	---	---	VSC-3(2T) VSC-4(2P)	---	---	22	
	Cum . Cr.	24	8	---	---	---	8	---	4	44	
		Exit option: Award of UG Degree in Major with 132 credits OR Continue with Major and Minor									

Fourth Year B.Sc. (Honours)

Year (Level)	Sem	Major Core Subjects		Research Methodology (RM)	VSC, SEC (VSEC)	OE	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
IV (6.0)	VII	DSC-23(4T) DSC-24(4T) DSC-25(4T) DSC-26(2P)	DSE-5A/B (2T) DSE-6A/B (2P)	RM(4T)	---	---	---	---	22	UG Honours Degree
	VIII	DSC-27(4T) DSC-28(4T) DSC-29(4T) DSC-30(2P)	DSE-7A/B (2T) DSE-8A/B (2P)	---	---	---	---	OJT/Int (4)	22	
	Cum. Cr.	28	8	4	---	---	---	4	44	
Four Year UG Honors Degree in Major and Minor with 176 credits										

Fourth Year B.Sc. (Honours with Research)

Year (Level)	Sem	Major Core Subjects		Research Methodology (RM)	VSC, SEC (VSEC)	OE	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
IV (6.0)	VII	DSC-23(4T) DSC-24(4T) DSC-26(2P)	DSE-5A/B (2T) DSE-6A/B (2P)	RM(4T)	---	---	---	RP(4)	22	UG Honours with Research Degree
	VIII	DSC-27(4T) DSC-28(4T) DSC-30(2P)	DSE-7A/B (2T) DSE-8A/B (2P)	---	---	---	---	RP(8)	22	
	Cum. Cr.	20	8	4	---	---	---	12	44	
Four Year UG Honours with Research Degree in Major and Minor with 176 credits										

Sem- Semester, **DSC-** Department Specific Course, **DSE-** Department Specific Elective, **OE/GE-** Open/Generic elective, **VSC-** Vocational Skill Course, **SEC-** Skill Enhancement Course, **VSEC-** Vocation and Skill Enhancement Course, **AEC-** Ability Enhancement Course, **IKS-** Indian Knowledge System, **VEC-** Value Education Course, **T-** Theory, **P-** Practical, **CC-** Co-curricular **RM-** Research Methodology, **OJT-** On Job Training, **FP-** Field Project, **Int-** Internship, **RP-** Research Project, **CEP-** Community Extension Programme, **ENG-** English, **CI-** Constitution of India, **MIL-** Modern Indian Language

- Number in bracket indicate credit
- The courses which do not have practical 'P' will be treated as theory 'T'
- If student select subject other than faculty in the subjects M-1, M-2 and M-3, then that subject will be treated as Minor subject, and cannot be selected as Major at second year.

Details of S.Y. B.Sc. (Biochemistry)

Course	Course Type	Course Code	Course Title	Credits	Teaching Hours/ Week			Marks			
					T	P	Total	Internal		External	
								T	P	T	P
Semester III, Level – 5.0											
DSC-5	DSC	BIC-DSC-231	Fundamentals of Food Biochemistry	2	2	---	2	20	---	30	---
DSC-6	DSC	BIC-DSC-232	Physiological Biochemistry-I	2	2	---	2	20	---	30	---
DSC-7	DSC	BIC-DSC-233	Practical on Food and Physiological Biochemistry	2	---	4	4	---	20	---	30
SEC-1	SEC	BIC-SEC-231	Basic Microbiology	2	2	---	2	20	---	30	---
CEP	CEP	BIC-CEP-231	Community engagement programme	2	---	4	4	50	---	---	---
MIN-1	MIN	BIC-MIN-231	Nutrition Biochemistry	2	2	---	2	20	---	30	---
MIN-2	MIN	BIC-MIN-232	Human Physiology	2	2	---	2	20	---	30	---
MIN-3	MIN	BIC-MIN-233	Practical on Nutritional and Physiological Biochemistry	2	---	4	4	---	20	---	30
OE-4	OE	BIC-OE-231	Manures in Organic Farming-I	2	2	---	2	20	---	30	---
Semester IV, Level – 5.0											
DSC-8	DSC	BIC-DSC-241	Environmental Biochemistry	2	2	---	2	20	---	30	---
DSC-9	DSC	BIC-DSC-242	Physiological Biochemistry-II	2	2	---	2	20	---	30	---
DSC-10	DSC	BIC-DSC-243	Practical on Environmental and Physiological Biochemistry	2	---	4	4	---	20	---	30
SEC-2	SEC	BIC-SEC-241	Microbial Isolation and Identification Techniques	2	2	---	2	20	---	30	---
SEC-3	SEC	BIC-SEC-242	Practical on Microbial Techniques	2	---	4	4	---	20	---	30
FP	FP	BIC-FP-241	Field Project	2	---	4	4	50	---	---	---
MIN-4	MIN	BIC-MIN-241	Ecological Biochemistry	2	2	---	2	20	---	30	---
MIN-5	MIN	BIC-MIN-242	Practical on Ecological Biochemistry	2	---	4	4	---	20	---	30
OE-5	OE	BIC-OE-241	Manures in Organic Farming-II	2	2	---	2	20	---	30	---

Examination Pattern

Theory Question Paper Pattern:

- 30 (External) +20 (Internal) for 2 credits
 - External examination will be of 1½ hours duration
 - There shall be 3 questions: Q1 carrying 6 marks and Q2, Q3 carrying 12 marks each. The tentative pattern of question papers shall be as follows;
 - Q1 Attempt any 2 out of 3 sub-questions; each 3 marks
 - Q 2 and Q3 Attempt any 3 out of 4 sub-question; each 4 marks.

Rules of Continuous Internal Evaluation:

The Continuous Internal Evaluation for theory papers shall consist of two methods:

1. Continuous & Comprehensive Evaluation (CCE): CCE will carry a maximum of 30% weightage (30/15 marks) of the total marks for a course. Before the start of the academic session in each semester, the subject teacher should choose any three assessment methods from the following list, with each method carrying 10/5 marks:

- i. Individual Assignments
- ii. Seminars/Classroom Presentations/Quizzes
- iii. Group Discussions/Class Discussion/Group Assignments
- iv. Case studies/Case lets
- v. Participatory & Industry-Integrated Learning/Field visits
- vi. Practical activities/Problem Solving Exercises
- vii. Participation in Seminars/Academic Events/Symposia, etc.
- viii. Mini Projects/Capstone Projects
- ix. Book review/Article review/Article preparation
- x. Any other academic activity
- xi. Each chosen CCE method shall be based on a particular unit of the syllabus, ensuring that three units of the syllabus are mapped to the CCEs.

2. Internal Assessment Tests (IAT): IAT will carry a maximum of 10% weightage (10/5 marks) of the total marks for a course. IAT shall be conducted at the end of the semester and will assess the remaining unit of the syllabus that was not covered by the CCEs. The subject teacher is at liberty to decide which units are to be assessed using CCEs and which unit is to be assessed on the basis of IAT. The overall weightage of Continuous Internal Evaluation (CCE + IAT) shall be 40% of the total marks for the course. The remaining 60% of the marks shall be allocated to the semester-end examinations. The subject teachers are required to communicate the chosen CCE methods and the corresponding syllabus units to the students at the beginning of the semester to ensure clarity and proper preparation.

Practical Examination Credit 2: Pattern (30+20)

External Practical Examination (30 marks):

- Practical examination shall be conducted by the respective department at the end of the semester.
- Practical examination will be of 3 hours duration and shall be conducted as per schedule.
- Practical examination shall be conducted for 2 consecutive days for 2 hr/ day where incubation conditionis required.
- There shall be 05 marks for journal and viva-voce. Certified journal is compulsory to appear for practical examination.

Internal Practical Examination (20 marks):

- Internal practical examination of 10 marks will be conducted by department as per schedule given.
- For internal practical examination student must produce the laboratory journal of practicals completed along with the completion certificate signed by the concerned teacher and the Head of the department.
- There shall be continuous assessment of 30 marks based on student performance throughout the semester. This assessment can include quizzes, group discussions, presentations and other activities assigned by the faculty during regular practicals. For details refer internal theory examination guidelines.
- Finally 40 (10+30) marks performance of student will be converted into 20 marks.

SEMESTER-III

S.Y. B.Sc. Biochemistry (Major)
Semester-III
BIC-DSC-231: Fundamentals of Food Biochemistry

Total Hours: 30

Credits: 2

Course Objectives	- To accustom students with basic concepts of Food Biochemistry - To study different types of food adulteration - To study various types of food spoilage and food preservation methods	
Course Outcomes	After successful completion of this course, students are expected to: - Calculate energy value of food and its measurement - Explain food adulteration and its types - Understand food spoilage, food allergy and food additives - Discuss various methods of food preservation	
Unit	Contents	Hours
Unit I	Energy value of food and its measurement - Nutritive value of different foods: cereals and millets, pulses, nuts and oils, vegetables, fruits, milk and milk products, eggs, meat, fish and other animal foods, fats and oils, sugar and other carbohydrate food, condiments and spices - Classification of food based on function: energy yielding, body building and protective food - Five food group plan as per ICMR - Energy value of food: carbohydrate, protein, lipid - Energy unit: calorie, kilo calorie, Joule, mega Joule - Physiological energy value of food: loss in digestion and metabolism - Determination of energy value using Bomb calorimeter - Respiratory quotient: definition, RQ for carbohydrate, fat and protein - Relation between RQ and energy output - Specific dynamic action of food (SDA) - Basal Metabolic Rate: definition, determination, factors affecting BMR - Recommended dietary allowance: definition, factors affecting RDA, RDA for adult man	08
Unit II	Food adulterations and food Spoilage - Adulteration: Definition, types- Intentional and incidental - Common adulterants in different foods: Milk and Milk product, vegetable oils, and fats, wheat products, pulses, honey, beverages, spices and condiments. - Food spoilage, factors determining food spoilage- intrinsic, extrinsic modes of processing and preservation, implicit parameters - Micro-organisms involved in food spoilage and food intoxication: bacteria, yeast, molds, and fungi - Food spoilage by enzymes, and insect. - Chemical spoilage: lipid oxidation, enzymatic oxidation, lipolysis - Contamination of food with metals - Parasitic infection, toxicants naturally occurring in some food, insect and rodent contamination of stored food.	07
Unit III	Food preservation and food laws Food preservation: Concept and principle	08

	• Methods of food preservation: • Preservation by low temperature: freezing, chilling/cold storage/refrigeration • Preservation by high temperature: heating below 100°C (pasteurization), heating at 100°C, heating above 100°C • Preservation by drying: conventional air drying, microwave drying, osmotic dehydration, freeze drying, mechanical drying, spray drying, foam-mat drying. • Irradiation: Types- radiation sterilization, radurization, radicidation, thermoradiation; ionizing radiation used for food irradiation- electron beam, x-rays, gamma rays and UV; uses of food irradiation, effect of ionizing radiation on nutrients of food • Chemicals: acids and their salts, nitrites, NaCl, sulphites, dimethyl dicarbonate, phenolic antioxidants. • Food laws and standards: Prevention of food adulteration act 1954; Bureau of Indian Standards, Agmark, Consumer protection act 1986, Hazard analysis critical control point (HACCP).	
Unit IV	Food additives, food allergy and diet modification • Food additives: Concept, importance of food additives, • Examples of food additives: antimicrobial agents, antioxidants, colour and adjuncts, emulsifiers, flavor enhancers, enzymes, sweeteners, non-nutritive and nutritive additives, propellants, aerating agents and gases. • Food allergy: Concept, classification immediate and delayed allergy. Clinical signs and symptoms. • Food as allergen: Animal origin - cow milk, goat milk, egg, fish, meat. Plant origin: cereals, soybean, peanut, other legumes, vegetables, fruits and beverages. • Detection of food allergy: history taking, diet diaries, elimination diet, provocative diet, pulse acceleration test, leukopenic index, x-ray, skin testing. • Therapeutic diet / diet modification in diseases: Definition and types of therapeutic diet. • Concept and significance of balanced diet. • Representative diets in: diabetes mellitus, cardio vascular diseases, anemia with brief rationale for each type of diet.	07
Study Resources	• Simpson B. K. (2012). Food Biochemistry and Processing, 2nd edition, John Wiley & Sons, Inc. • Michael Eskin N.A., Shahidi F. (2012). Biochemistry of Food, 3rd edition, Academic Press • Brody T. (1998). Nutritional Biochemistry, 2nd edition, Academic Press. • Alais C. (2012). Food Biochemistry, Springer Science & Business Media • Swaminathan M. (1998). Essentials of food and Nutrition. Vol I, II, 2nd edition, The Bangalore Printing and Publishing Co. Ltd. • Srilakshmi B. (2006). Food Science 3rd edition, New Age International Pvt. Ltd Publishers. • Vijaya Ramesh K. (2009). Food Microbiology MJP Publishers. • Mirajkar M. and Menon S. (2010). Food Science and Processing Technology, Vol.2 Commercial Processing and Packaging, Kanishka Publishers.	

S.Y. B.Sc. Biochemistry (Major)
Semester-III
BIC-DSC-232: Physiological Biochemistry-I

Total Hours: 30

Credits: 2

Course Objectives	- To study human digestive system - To study human respiratory system - To study human circulatory system - To study human excretory system	
Course Outcomes	After successful completion of this course, students are expected to: - Understand role of various organs and enzymes of digestive system in digestion of food - Explain mechanism of respiration and transport of gases - Discuss mechanism of blood coagulation and basis of blood grouping - Understand mechanism of urine formation and importance of kidney	
Unit	Topic Particular	Hours
Unit I	Digestive System - Digestive system: Structure and functions. - Histology of alimentary tract. - Anatomy and functions of different parts of digestive system: Esophagus, stomach, small intestine, large intestine. - Structure and functions of accessory digestive organs: Salivary glands, liver, Gall bladder, pancreas. - Gastrointestinal hormones: Gastrin, Cholecystokinin, pancreaticozymin, secretin and gastric inhibitory peptide, motilin.	08
Unit II	Respiratory system - Respiration: Definition and functions - Structure and functions of trachea and lungs - Physical properties of lungs: surface tension, elasticity, lung volume and lung capacity. - Respiratory process: - Oxygen transport: oxygen exchange in lungs and transport in tissue, dissociation curve for hemoglobin and factors affecting it - CO₂ concentration (Bohr's effect and significance), pH, temperature, 2,3-diphosphoglycerate. - Carbon dioxide transport: chemical forms in which CO₂ transports, CO₂ transport in tissue (Chloride shift), in RBCs and as carbamino compounds.	07
Unit III	Circulatory system - Definition and functions of blood. - Plasma proteins: specific plasma proteins (albumins, globulins, carrier proteins, acute phase proteins) and their functions. - Structure, functions and life span of RBCs, WBCs and platelets. - Hemoglobin: Structure, types (HbA, HbF, HbS) and functions. - Blood coagulation: Definition, blood clotting factors, extrinsic and intrinsic pathways. - Blood coagulation tests: Bleeding time, clotting time, prothrombin time. - Blood groups: A, B, O and Rh factor, cross matching, compatibility. Blood transfusion	08

Unit IV	Excretory System • Organization of urinary tract. • Anatomy and functions of kidney. • Structure and functions of nephron. • Urine formation: glomerular filtration, tubular reabsorption and tubular secretion. • Characteristics of urine: volume, colour, reaction, specific gravity, turbidity, odour, osmotic pressure. Normal and abnormal constituents of urine. • Role of kidney in fluid and acid-base balance.	07
Study Resources	• Sherwood L. (2010). Human Physiology: From Cells to Systems, 7th edition, Brooks/Cole, Cengage Learning • Silverthorn D. U. (2015). Human Physiology: An Integrated Approach, 7th edition, Pearson • Chatterjee C.C. (2004). Human Physiology, Vol. I, II, 11th edition, Medical Allied Agency. • Guyton A. C. and Hall J. E. (2001). Textbook of Medical physiology, 10th edition, Harcourt Publisher International Company. • Talwar G.P. and Srivastava L. M. (2006). Text Book of Human Biochemistry, 3rd edition, Prentice Hall of India Pvt. Ltd. • Marieb Elaine N. (1996). Essentials of Human Anatomy and Physiology, 9th edition, Pearson International Edition. • Stuart I. F. (1996). Human Physiology, 5th ed, Brown Publisher. • Murray R. K., Granner D. K. and Rodwell V. W. (2006). Harper's Illustrated Biochemistry, 27th Edition, McGraw Hill Publisher. • Suresh R. (2013). Essentials of Human Physiology, Books and Allied (P) Ltd, Kolkata. • Chaudhari. S. K. (2014). Concise Medical Physiology, 6th edition, New Central Book Agency Pvt. Ltd. London. • Das A. (2006). Medical Physiology, 4th edition, Books and Allied (P) Ltd, Kolkata.	

S.Y. B.Sc. Biochemistry (Major)
Semester-III
BIC-DSC-233: Practical on Food and Physiological Biochemistry

Total Hours: 60

Credits: 2

Course Objectives	- To acquaint students with various hematological techniques - To check food adulterants in various food materials. - To examine the urine components and lungs volumes and capacities	
Course Outcomes	After successful completion of this course, students are expected to: - Enumerate RBCs and WBCs and accordingly determine health status - Determine blood groups, bleeding time, clotting time, blood pressure and their clinical significance - Detect normal and abnormal constituents of urine - Detect and identify common food adulterants	
Sr. No.	Contents	Hours
1	Qualitative analysis of some common food adulterants in flours	4
2	Qualitative analysis of some common food adulterants in milk	4
3	Microbial examination of food by TVC method.	4
4	Determination of moisture content in food sample	4
5	Estimation of gluten content of wheat.	4
6	Determination of rancidity in edible oil	4
7	Determination of lungs volumes and capacities	4
8	Enumeration of RBCs for determining health status	4
9	Enumeration of WBCs for determining health status	4
10	Differential counting of WBCs	4
11	Determination of blood groups (A, B, AB, O and Rh) and its significance	4
12	Determination of bleeding time, clotting time and its significance	4
13	Determination of gastric juice acidity	4
14	Recording of blood pressure by sphygmomanometer and its significance	4
15	Detection of normal and abnormal constituents of urine	4
Study Resources	- Wilson, K. and Walker, J. (2003). Practical Biochemistry: Principles and techniques, 5th edition, Cambridge University Press, UK. - Plummer, D. T. (2017). An Introduction to Practical Biochemistry, 3rd edition, Tata McGraw Hill Publishing Company Ltd., New Delhi. - Oser, B. L. (ed.) (1965). Hawk's physiological chemistry, 14th edition, McGraw-Hill Book Company, New York, USA. - Jayaraman, J. (2011). Laboratory Manual in Biochemistry, New Age International (P) Ltd. Publishers, New Delhi. - Sadashivam, S. and Manikam, A. (2018). Biochemical Methods, 3rd edition, New Age International (P) Ltd. Publishers, New Delhi. - Rao, B. S. and Deshpande, V. (2005). Experimental Biochemistry: A student companion, I. K. International Pvt. Ltd., New Delhi.	

***Mandatory to perform any 12 practical from above.**

S.Y. B.Sc. Biochemistry (Major)
Semester-III
BIC-SEC-231: Basic Microbiology

Total Hours: 30

Credits: 2

Course Objectives	- To familiarize students with various media used for microbial isolation - To study various microbial morphological techniques - To explore various microscopic techniques	
Course Outcomes	After successful completion of this course, students are expected to: - Understand various types of media used for microbial isolation - Measure microbial growth by various methods - Study microbial morphology by various staining techniques - Understand micrometry techniques used for microbial size measurement	
Unit	Contents	Hours
Unit I	Morphological characteristics and Staining of microorganisms - Bergey's Manual: Introduction - Morphological characteristic of microorganisms: Form, Size, Elevation, Margin/border, Surface, Opacity, Colour - Staining techniques: principles and procedures (Gram staining, acid fast staining, spore staining, capsule staining, Flagella staining, cell wall staining, metachromatic granules staining). Fungi: Lacto phenol cotton blue, arbuscular mycorrhizal staining. - Measure the size of microorganisms by micrometry by using Ocular micrometer and stage micrometer.	08
Unit II	Classification of microorganisms - Based on energy and response to environmental conditions: Phototroph and chemotroph, organotroph and carbon source: Autotroph and Heterotroph - Major nutritional type of Microorganisms: Chemolithoautotroph, Chemolithoheterotroph, Chemoheterotroph, Chemolithotroph, photolithoautotroph and Photoorganoheterotroph. - Temperature (psychrophiles, mesophiles, thermophiles, extremophiles, thermodurics, psychrotrophs), pH (acidophiles, alkaliphiles), solute and water activity (halophiles, xerophiles, osmophilic), Oxygen (aerobic, anaerobic, microaerophilic, facultative aerobe, facultative anaerobe) and barophilic.	07
Unit III	Sterilization Techniques - Definitions- sterilization, disinfection, antisepsis, sanitization, decontamination, pasteurization, preservation, germicidal and bactericides - Sterilization - Heat- thermal death point, thermal death time, decimal reduction time - Moist heat- mode of action, steam underpressure, Fractional sterilization, Boiling water, Pasteurization and canning - Dry heat- mode of action, incineration, hot air oven - Radiation- ionizing radiations, non-ionizing radiations - Chemical sterilization- ethylene oxide, formaldehyde - Filtration - Factors influencing sterilization. - Disinfection: characteristics of an ideal disinfectant - Disinfectants- phenol and phenolic compounds, alcohol, heavy metals, halogens, dyes, detergents, hydrogen peroxide	08

Unit IV	Microbial growth measurement • Methods of measurement of Microbial Growth: a) Direct Counts: ○ Counting chambers ○ Electronic counters – flow cytometry on membrane filters. b) Viable Counting Methods: ○ Spread plate techniques ○ Pourplate techniques ○ Membrane filter technique ○ Turbidity ○ Most Probable Number (MPN). c) Measurement of cell mass: ○ Dry weight analysis, ○ Measurement of cell components	07
Study Resources	• Madigan M. T., Bender K. S., Buckely D. H., Sattley W. M., Stahl D. A. (2018). Brock Biology of Microorganisms, NY Pearosn publisher. • Talaro K. P. and Chess B. (2000). Foundations In Microbiology 3rd edition, Mc Graw Hill. • Tortora G. J., Funke B. R., Case C. L. (2004). Microbiology An Introduction, 8th edition, pearsonBenjamin-Cummings Pub Co. • Pelczar M. Jr. (2001). Microbiology, Indian edition, Mc Graw Hill. • Willey J., Sherwood L., Woolverton C. J. (2017). Prescott's Microbiology, 10th edition, Mc Graw Hill. • Modi, H. A. (1995). Elementary Microbiology, VolI, EktaPrakashan, Nadiad • Aneja K. R. (2007). Experiments in microbiology, plant pathology and biotechnology, New age international publishers. • Kale V. and Bhusari K. (2010). Practical Microbiology: Principles and Techniques, Himalaya Publishing House. • Rajgopal G. and Toora B. D. (2005). Practical Biochemistry, 2nd edition, Ahuja Publishing House. • Maheshwari D. K. (2002). Practical Microbiology, S. Chand Publishing. • Rajan S. and Christy S. R. (2015). Experimental procedures in Life Sciences, CBS Publishers and Distributors Pvt Ltd.	

S.Y. B.Sc. Biochemistry (Major)
Semester-III
BIC-CEP-231: Community Engagement Programme

Total Hours: 60

Credits: 2

Course Objectives:

- To engage students in activities that promote emotional, social, and intellectual growth, fostering a well-rounded approach to personal and academic development.
- To provide hands-on experiences that complement classroom learning, enabling students to apply their knowledge in socioeconomic problems of real-world.
- To instil a sense of responsibility towards the community by encouraging students to actively participate in social and environmental initiatives, appreciate rural culture, lifestyle, and wisdom.

Course Outcomes:

After successful completion of this course, students are expected to:

- Understand rural and/or urban culture, ethos, and socioeconomic realities.
- Develop a sense of empathy with the local community while appreciating the significant contributions of local communities to society and the economy.
- Learn to value the local community wisdom and identify opportunities for contributing to the community's socioeconomic improvements.

Activities:

- Conduct workshops and interactive sessions on emotional intelligence and social skills.
- Organize debates, discussions, and intellectual challenges that stimulate critical thinking and socioeconomic problem-solving using concern subject.
- Organize field visits where students can work on real-world problems, such as environmental conservation, rural and/or urban planning, or community health.
- Organize internships or service-learning opportunities with local businesses, NGOs, or government agencies.
- Facilitate project-based learning activities that require students to use their academic knowledge to develop solutions to community issues.
- Engage students in community service activities that address local social and environmental issues.
- Organize cultural exchange programs or field trips to rural areas to foster an appreciation of rural culture and wisdom.
- Facilitate collaborative projects involving students, educators, and community members to develop solutions for local challenges, promoting teamwork and collective problem-solving.
- Conduct educational sessions on the status of various agricultural and development programs and the challenges faced by vulnerable households, ensuring inclusivity and accessibility for all students.

Sr. No.	Module Title	Module Content	Assignment submission	Teaching/ Learning Methodology
1	Appreciation of Rural Society	Rural lifestyle, rural society, caste and gender relations, rural values with respect to community, nature and resources, elaboration of "soul of India lies in villages", rural infrastructure.	Prepare a map (physical, visual or digital) of the village you visited and write an essay about inter-family relations in that village.	– Classroom discussions – Field visit – Assignment

2	Understanding rural and local economy and livelihood	Agriculture, farming, land ownership, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural markets, migrant labour.	Describe your analysis of the rural house hold economy, its challenges and possible pathways to address. Circular economy and migration patterns.	– Field visit – Group discussions in class – Assignment
3	Rural and local Institutions	Traditional rural and community organisations, Self-help Groups, Panchayati raj institutions (Gram Sabha, Gram Panchayat, Standing Committees), Nagarpalikas and municipalities, local civil society, local administration.	How effectively are Panchayati Raj and Urban Local Bodies (ULBs) institutions functioning in the village? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual).	– Classroom – Field visit – Group presentation of assignment
4	Rural and National Development Programmes	History of rural development and current national programmes in India: SarvaShikshaAbhiyan, BetiBachao, BetiPadhao, Ayushman Bharat, Swachh Bharat, PM AwaasYojana, Skill India, Gram Panchayat Decentralised Planning, National Rural Livelihood Mission (NRLM), Mahatma Gandhi National Rural Employment Guarantee Act 2005 (MGNREGA), SHRAM, Jal Jeevan Mission, Scheme of Fund for Regeneration of Traditional Industries (SFURTI), AtmaNirbhar Bharat, etc.	Describe the benefits received and challenges faced in the delivery of one of these programmes in the local community; give suggestions about improving the implementation of the programme for the poor. Special focus on the urban informal sector and migrant households.	– Classroom – Each student selects one program for field visit – Written assignment

Note: The modules are suggestive in nature and students can opt any one activities for community engagement program and field project based on topic appropriate to their regional community context.

Some additional suggestive themes for field-based / community engagement activities are listed below:

- Management curriculum may include aspects of micro-financing in a rural context;
- Chemistry syllabus can have a component of conducting water and soil analysis in surrounding field areas;
- Political science syllabus could include a mapping of local rural governance institutions and their functioning.
- Environment education will include areas such as climate change, pollution, waste management, sanitation, conservation of biological diversity, management of biological resources and biodiversity, forest and wildlife conservation, and sustainable development and living
- Understanding panchayats and constitutional mandate of local governance

- Panchayat administration, Gram Sabha, Mahila Sabha, Gram Panchayat Development Plan (GPDP), local planning of basic services.
- Micro-finance, SHGs, system of savings and credit for local business, linkages to banks, financial inclusion.
- Rural – entrepreneurship, opportunities for small business in local communities, access to financial and technical inputs to new entrepreneurs.
- Renewable energy, access to household and community level solar and bio-mass systems for sustainable energy use.
- Participatory Monitoring and evaluation of socio-economic development programmes, and cost-benefit analysis of project proposals.
- Migrant workers' livelihood security and social services.
- Hygiene and sanitation, improving health and personal behaviours, locally manageable decentralised systems and awareness against stubble burning.
- Water conservation, traditional practices of storage and harvesting, new systems of distribution and maintenance.
- Women's empowerment, gender inequality at home, community and public spaces, safety of girls and women, access to skills, credit and work opportunities.
- Child security, safety and good parenting, nutrition and health, learning and training for child care.
- Rural Marketing, market research, designing opportunities for rural artisans and crafts, and new products based on demand assessment.
- Community Based Research in Rural Settings, undertaking research that values local knowledge, systematises local practices and tools for replication and scale-up.
- Peri-urban development of informal settlements, mapping and enumeration, design of local solutions.

Assessment:

- Readings from related literature including e-content and reflections from field visits should be maintained by each student in the form of Field Diary (20 Marks)
- Submission of assignments based on modules assignment submission (details mentioned above) (20 Marks)
- Oral/ Group discussion/ Presentation (10 Marks)

S.Y. B.Sc. Biochemistry (Minor)
Semester-III
BIC-MIN-231: Nutrition Biochemistry

Total Hours: 30

Credits: 2

Course Objectives	- To accustom students with basic concepts of Food Biochemistry - To study different types of food adulteration - To study various types of food spoilage and food preservation methods	
Course Outcomes	After successful completion of this course, students are expected to: - Calculate energy value of food and its measurement - Explain food adulteration and its types - Understand food spoilage, food allergy and food additives - Discuss various methods of food preservation	
Unit	Contents	Hours
Unit I	Energy value of food and its measurement - Nutritive value of different foods: cereals and millets, pulses, nuts and oils, vegetables, fruits, milk and milk products, eggs, meat, fish and other animal foods, fats and oils, sugar and other carbohydrate food, condiments and spices - Classification of food based on function: energy yielding, body building and protective food - Five food group plan as per ICMR - Energy value of food: carbohydrate, protein, lipid - Energy unit: calorie, kilo calorie, Joule, mega Joule - Physiological energy value of food: loss in digestion and metabolism - Determination of energy value using Bomb calorimeter - Respiratory quotient: definition, RQ for carbohydrate, fat and protein - Relation between RQ and energy output - Specific dynamic action of food (SDA) - Basal Metabolic Rate: definition, determination, factors affecting BMR - Recommended dietary allowance: definition, factors affecting RDA, RDA for adult man	08
Unit II	Food adulterations and food Spoilage - Adulteration: Definition, types- Intentional and incidental - Common adulterants in different foods: Milk and Milk product, vegetable oils, and fats, wheat products, pulses, honey, beverages, spices and condiments. - Food spoilage, factors determining food spoilage- intrinsic, extrinsic modes of processing and preservation, implicit parameters - Micro-organisms involved in food spoilage and food intoxication: bacteria, yeast, molds, and fungi - Food spoilage by enzymes, and insect. - Chemical spoilage: lipid oxidation, enzymatic oxidation, lipolysis - Contamination of food with metals - Parasitic infection, toxicants naturally occurring in some food, insect and rodent contamination of stored food.	07
Unit III	Food preservation and food laws - Food preservation: Concept and principle - Methods of food preservation:	08

	• Preservation by low temperature: freezing, chilling/cold storage/refrigeration • Preservation by high temperature: heating below 100°C (pasteurization), heating at 100°C, heating above 100°C • Preservation by drying: conventional air drying, microwave drying, osmotic dehydration, freeze drying, mechanical drying, spray drying, foam-mat drying. • Irradiation: Types- radiation sterilization, radurization, radicidation, thermoradiation; ionizing radiation used for food irradiation- electron beam, x-rays, gamma rays and UV; uses of food irradiation, effect of ionizing radiation on nutrients of food • Chemicals: acids and their salts, nitrites, NaCl, sulphites, dimethyl dicarbonate, phenolic antioxidants. • Food laws and standards: Prevention of food adulteration act 1954; Bureau of Indian Standards, Agmark, Consumer protection act 1986, Hazard analysis critical control point (HACCP).	
Unit IV	Food additives, food allergy and diet modification • Food additives: Concept, importance of food additives, • Examples of food additives: antimicrobial agents, antioxidants, colour and adjuncts, emulsifiers, flavor enhancers, enzymes, sweeteners, non-nutritive and nutritive additives, propellants, aerating agents and gases. • Food allergy: Concept, classification immediate and delayed allergy. Clinical signs and symptoms. • Food as allergen: Animal origin - cow milk, goat milk, egg, fish, meat. Plant origin: cereals, soybean, peanut, other legumes, vegetables, fruits and beverages. • Detection of food allergy: history taking, diet diaries, elimination diet, provocative diet, pulse acceleration test, leukopenic index, x-ray, skin testing. • Therapeutic diet / diet modification in diseases: Definition and types of therapeutic diet. • Concept and significance of balanced diet. • Representative diets in: diabetes mellitus, cardio vascular diseases, anemia with brief rationale for each type of diet.	07
Study Resources	• Simpson B. K. (2012). Food Biochemistry and Processing, 2nd edition, John Wiley & Sons, Inc. • Michael Eskin N.A., Shahidi F. (2012). Biochemistry of Food, 3rd edition, Academic Press • Brody T. (1998). Nutritional Biochemistry, 2nd edition, Academic Press. • Alais C. (2012). Food Biochemistry, Springer Science & Business Media • Swaminathan M. (1998). Essentials of food and Nutrition. Vol I, II, 2nd edition, The Bangalore Printing and Publishing Co. Ltd. • Srilakshmi B. (2006). Food Science 3rd edition, New Age International Pvt. Ltd Publishers. • Vijaya Ramesh K. (2009). Food Microbiology MJP Publishers. • Mirajkar M. and Menon S. (2010). Food Science and Processing Technology, Vol.2 Commercial Processing and Packaging, Kanishka Publishers.	

S.Y. B.Sc. Biochemistry (Minor)
Semester-III
BIC-MIN-232: Human Physiology

Total Hours: 30

Credits: 2

Course objectives	- To study human digestive system - To study human respiratory system - To study human circulatory system - To study human excretory system	
Course outcomes	After successful completion of this course, students are expected to: - Understand role of various organs and enzymes of digestive system in digestion of food - Explain mechanism of respiration and transport of gases - Discuss mechanism of blood coagulation and basis of blood grouping - Understand mechanism of urine formation and importance of kidney	
Unit	Topic Particular	Hours
Unit I	Digestive System - Digestive system: Structure and functions. - Histology of alimentary tract. - Anatomy and functions of different parts of digestive system: Esophagus, stomach, small intestine, large intestine. - Structure and functions of accessory digestive organs: Salivary glands, liver, Gall bladder, pancreas. - Gastrointestinal hormones: Gastrin, Cholecystokinin, pancreaticozym, secretin and gastric inhibitory peptide, motilin.	08
Unit II	Respiratory system - Respiration: Definition and functions - Structure and functions of trachea and lungs - Physical properties of lungs: surface tension, elasticity, lung volume and lung capacity. - Respiratory process: - Oxygen transport: oxygen exchange in lungs and transport in tissue, dissociation curve for hemoglobin and factors affecting it - CO₂ concentration (Bohr's effect and significance), pH, temperature, 2,3-diphosphoglycerate. - Carbon dioxide transport: chemical forms in which CO₂ transports, CO₂ transport in tissue (Chloride shift), in RBCs and as carbamino compounds.	07
Unit III	Circulatory system - Definition and functions of blood. - Plasma proteins: specific plasma proteins (albumins, globulins, carrier proteins, acute phase proteins) and their functions. - Structure, functions and life span of RBCs, WBCs and platelets. - Hemoglobin: Structure, types (HbA, HbF, HbS) and functions. - Blood coagulation: Definition, blood clotting factors, extrinsic and intrinsic pathways. - Blood coagulation tests: Bleeding time, clotting time, prothrombin time. - Blood groups: A, B, O and Rh factor, cross matching, compatibility. Blood transfusion	08

Unit IV	Excretory System • Organization of urinary tract. • Anatomy and functions of kidney. • Structure and functions of nephron. • Urine formation: glomerular filtration, tubular reabsorption and tubular secretion. • Characteristics of urine: volume, colour, reaction, specific gravity, turbidity, odour, osmotic pressure. Normal and abnormal constituents of urine. • Role of kidney in fluid and acid-base balance.	07
Study Resources	• Sherwood L. (2010). Human Physiology: From Cells to Systems, 7th edition, Brooks/Cole, Cengage Learning • Silverthorn D. U. (2015). Human Physiology: An Integrated Approach, 7th edition, Pearson • Chatterjee C.C. (2004). Human Physiology, Vol. I, II, 11th edition, Medical Allied Agency. • Guyton A. C. and Hall J. E. (2001). Textbook of Medical physiology, 10th edition, Harcourt Publisher International Company. • Talwar G.P. and Srivastava L. M. (2006). Text Book of Human Biochemistry, 3rd edition, Prentice Hall of India Pvt. Ltd. • Marieb Elaine N. (1996). Essentials of Human Anatomy and Physiology, 9th edition, Pearson International Edition. • Stuart I. F. (1996). Human Physiology, 5th ed, Brown Publisher. • Murray R. K., Granner D. K. and Rodwell V. W. (2006). Harper's Illustrated Biochemistry, 27th Edition, McGraw Hill Publisher. • Suresh R. (2013). Essentials of Human Physiology, Books and Allied (P) Ltd, Kolkata. • Chaudhari. S. K. (2014). Concise Medical Physiology, 6th edition, New Central Book Agency Pvt. Ltd. London. • Das A. (2006). Medical Physiology, 4th edition, Books and Allied (P) Ltd, Kolkata.	

S.Y. B.Sc. Biochemistry (Minor)
Semester-III

BIC-MIN-233: Practical on Nutrition and Physiological Biochemistry

Total Hours: 60

Credits: 2

Course Objectives	- To study common food adulterants in food sample - To examine micro-organisms in food sample - To analyse the content of the food for proteins, fatty acids and fiber - To accustom students with blood grouping, bleeding and clotting time - To examine the urine components	
Course Outcomes	After successful completion of this course, students are expected to: - Perform the qualitative analysis of adulterants in the food sample. - Perform the bacteriological analysis of food - Determine blood groups, bleeding time, clotting time, blood pressure and their clinical significance - Detect normal and abnormal constituents of urine	
Sr. No.	Contents	Hours
1	Determination of gastric juice acidity	4
2	Qualitative analysis of some common food adulterants in milk	4
3	Qualitative analysis of some common food adulterants in spices	4
4	Determination of rancidity in edible oil	4
5	Microbial examination of food by TVC method	4
6	Determination of moisture content in food sample	4
7	Estimation of saponification value of the given oil sample	4
8	Determination of blood groups (A, B, AB, O and Rh) and its significance	4
9	Cross matching of blood and its significance	4
10	Determination of bleeding time and its significance	4
11	Determination of clotting time and its significance	4
12	Recording of blood pressure by sphygmomanometer and its significance	4
13	Physical examination of urine	4
14	Detection of normal constituents of urine	4
15	Detection of abnormal constituents of urine	4
Study Resources	- Wilson, K. and Walker, J. (2003). Practical Biochemistry: Principles and techniques, 5th edition, Cambridge University Press, UK. - Plummer, D. T. (2017). An Introduction to Practical Biochemistry, 3rd edition, Tata McGraw Hill Publishing Company Ltd., New Delhi. - Oser, B. L. (ed.) (1965). Hawk's physiological chemistry, 14th edition, McGraw-Hill Book Company, New York, USA. - Jayaraman, J. (2011). Laboratory Manual in Biochemistry, New Age International (P) Ltd. Publishers, New Delhi. - Sadashivam, S. and Manikam, A. (2018). Biochemical Methods, 3rd edition, New Age International (P) Ltd. Publishers, New Delhi. - Rao, B. S. and Deshpande, V. (2005). Experimental Biochemistry: A student companion, I. K. International Pvt. Ltd., New Delhi.	

***Mandatory to perform any 12 practical from above.**

S.Y. B.Sc. Biochemistry (Open Elective)
Semester-III
BIC-OE-231: Manures in Organic Farming-I

Total Hours: 30

Credits: 2

Course objectives	- To accustom students with different types of organic manures - To attune students with green manuring - To make students aware about soil amendments and biodynamic formulations	
Course outcomes	After successful completion of this course, students are expected to: - Acquire a knowledge on various manures used in organic farming. - Acquire skills in making and application of different manures. - Explain the preparation and uses of biodynamic formulations. - Understand the importance of green manuring	
Unit	Topic Particular	Hours
Unit I	Organic Manures - Nutrient requirements in organic farming; limiting nutrient losses. - Manures – definition, Bulky Organic Manures (BOM), Concentrated Organic Manures (COM). - Organic manures: Farm Yard Manure (FYM), Enrichment of FYM. - Compost, methods of composting (Bangalore, Indore, Coimbatore, NADEP methods)	08
Unit II	Green Manures - Green manuring, Classification of green manures (GM). - Nutrient status of various green manures. - Advantages of GM, Desirable characteristics of leguminous GM crops. - Recycling of organic residues, Classification of organic residues	07
Unit III	Soil Amendments - Soil improvements and soil amendments. - Salinity, alkalinity, acidity, types of amendments. - Reclamation of problematic soil using organic manures.	08
Unit IV	Biodynamic Formulations - Biodynamic agriculture, biodynamic formulation-500 (BD-500) – method of preparation and application. - Biodynamic formulation 501(BD-501); Cow-pat pit (CPP) – preparation and application. - Potash mobilizing and Sulphur mobilizing microorganisms; Arbuscular mycorrhizal fungi. - Growth promoting substance excreting microorganisms – methods of application.	07
Study Resources	- Anand B. Masthihole and L. Nalina (2016) Organic Farming. Agrimoon.Com - Buckman, H.O. and N.C. Brady. 1990. Nature and properties of soil, The McMillan Co, New York, Indian Publishers – Eurasia Publishing House (P) Ltd., Ram Nagar, New Delhi. - Das, P.C. 1993. Manures and Fertilizers, Kalyani Publishers, New Delhi	

SEMESTER-IV

S.Y. B.Sc. Biochemistry (Major)
Semester-IV
BIC-DSC-241: Environmental Biochemistry

Total Hours: 30

Credits: 2

Course Objectives	- To study types of pollutions and pollutants - To explore the concept of bioenergy - To study biodegradation and bioremediation	
Course Outcomes	After successful completion of this course, students are expected to: - Understand the concept of pollution and pollutants - Understand the concept of bioenergy - Explain biodegradation and bioremediation - Understand mode of action of pesticides and its impact on environment	
Unit	Contents	Hours
Unit I	Pollution and environmental problems - Pollution: Concept of pollution and pollutants and its current status. - Introduction, effect and control of; water pollution, land pollution, noise pollution and air pollution. - Greenhouse effect and global warming. Greenhouse gases. Measures to control greenhouse effect. - Ozone layer: Importance of ozone layer. Depletion of ozone, ozone hole, effects of ozone depletion. Measures to control ozone depletion. - Acid rain: Introduction, effects and measures to control acid rain.	08
Unit II	Bioenergy - Bioenergy: Introduction. Biomass for energy production: Concept, chemical nature, sources, utilization. - Biogas: Introduction, substrates, process, microbial production of biogas, factors affecting biogas production, advantages. Limitations for large scale production. - Introduction to hydrogen as a biofuel. Production of bio-hydrogen by photosynthetic bacteria and fermentation. - Energy rich crops: Sugar and starch crops, wood rich plants and petroleum plants.	07
Unit III	Biodegradation and bioremediation - Xenobiotics: Concept - Biodegradation: Concept, microorganisms for biodegradation and bioremediation. Enzyme system for biodegradation. Factors affecting biodegradation. - Bioremediation: Concept, types, advantages and disadvantages. Types of reaction in bioremediation. - Bioremediation of contaminated soil, waste land and ground water	08
Unit IV	Environmental toxicology - Toxins: Concept and types. Introduction, sources and remedies of metal toxins (arsenic, mercury). - Pesticides: Introduction, classification on the basis of mode of entry, mode of action and chemical nature. Application of pesticides. Environmental effects of pesticides. - Impact of pesticide on organisms.	07

	• Bio and chemical warfare agents: Anthrax, plague, small pox, sarin, chlorine, hydrogen cyanide, Sulphur mustard, lewisite and ricin	
Study Resources	• Hamilton E. (2017). Environmental Biochemistry, Larsen and Keller Education. • Krauss G-J., Nies D. H. (2015). Ecological Biochemistry: Environmental and Interspecies Interactions, Wiley-Blackwell • Sterner O. (2010). Chemistry, Health and Environment, 2nd edition, Wiley-Blackwell • Harborne J. (2014). Introduction to Ecological Biochemistry, 4th edition, Academic Press • Ibanez J. G., Hernandez-Esparza, M., Doria-Serrano, C., Fregoso-Infante, A., Singh, M. M. (2007). Environmental Chemistry: Fundamentals, Springer. • Satyanarayana U. (2009). Biotechnology, Books and Allied (P) Ltd., Kolkata. • Santra S.C. (2010). Environmental Science, New Central Book Agency (P) Ltd, Kolkata. • De A. K. (2010). Environmental Chemistry, 7th edition, New Age International Publishers, New Delhi. • Jogdand S.N. (2005). Environmental Biotechnology, 2nd edition, Himalaya Publishing House, Mumbai. • Rana A. K. and Rana M. K. (2011). Environment and Ecology, Global Vision Publishing House, New Delhi. • Saha T. K. (2014). Ecology and Environmental Biology, Books and Allied (P) Ltd, Kolkata. • Satake M., Mido Y., Yasuhisa H., Taguchi S., Sethi M. S. and Iqbal S. A. (1997). Environmental Toxicology, Discovery Publishing House, New Delhi.	

S.Y. B.Sc. Biochemistry (Major)
Semester-IV
BIC-DSC-242: Physiological Biochemistry-II

Total Hours: 30

Credits: 2

Course Objectives	- To study human nervous and reproductive system - To study human endocrine system - To study biochemistry of various specialized tissues	
Course Outcomes	After successful completion of this course, students are expected to: - Discuss mechanism of synaptic transmission - Learn molecular events during fertilization - Explain mechanism of hormone action - Understand mechanism of taste perception and olfaction	
Unit	Contents	Hours
Unit I	Nervous system - Nervous system: Introduction to central and peripheral nervous system. - Nervous tissue: Structure, functions and types of neurons (uni-, di- and multi polar, myelinated and non-myelinated); Nerve impulse generation and transmission - Synapse: Definition, classification, properties, types (structural basis: axo-dendritic, axoaxonic, axo-somatic; functional basis- chemical and electrical synapse). Mechanism of synaptic transmission. - Neurotransmitters: Definition and classification - Reflex action: Definition, types (conditioned and unconditioned). - Reflex arc: Definition, components and types.	08
Unit II	Reproductive system - Male reproductive system: Anatomy. Histology and functions of testis. Structure of sperm, spermatogenesis, hormonal control of spermatogenesis. Semen. Accessory glands: seminal vesicles, prostate, bulbourethral gland. - Female reproductive system: Anatomy and histology. Ovary: anatomy, histology and functions. Maturation of Graafian follicle and ovum. Menstrual cycle. - Hormones secreted by gonads: Chemistry and functions of androgen, testosterone, estrogen and progesterone. - Fertilization: Definition and molecular events during fertilization	07
Unit III	Endocrine system - Endocrine system: Introduction to endocrine and exocrine glands. - Hormones: Concept and definition, - General characteristics and properties of hormones - Mode of action of hormones: Endocrine, paracrine and autocrine. - Molecular mechanism of hormone action: protein, peptide, lipid/steroid hormones. - Pituitary gland: Anatomy: adenohypophysis and neurohypophysis. Functions of growth hormone, prolactin, FSH, LH, TSH, ACTH, MSH, vasopressin and oxytocin. - Thyroid gland: Anatomy and histology. Thyroid hormones and their functions (T3, T4 and thyroxine). Parathyroid gland: anatomy and histology. Functions of parathormone. - Endocrine pancreas: Anatomy and histology. Functions of insulin and glucagon. - Adrenal gland: Anatomy and histology. Functions of epinephrine, nor-epinephrine, gluco-corticoid, mineral-corticoid, sex hormones/sex steroid.	08

	• Pineal gland: Anatomy and histology. Functions of melatonin.	
Unit IV	Biochemistry of specialized tissue • Taste (gustation): Histology of tongue, papillae, taste buds. Taste sensations and constitution related to taste: sweet, bitter, sour, salt. Mechanism of taste perception. Factors affecting taste sensation. • Smell (olfaction): Olfactory receptors, physiology of olfaction, pathways of olfactory impulses. • Skin: Structure and functions. Glands in skin: sweat, eccrine and sebaceous gland. Mechanism of secretion of sweat, types of sweating, pigmentation of skin. • Muscles: Structure and functions of striated and unstriated muscles. Mechanism of muscle contraction and relaxation. Role of actin, myosin, troponin, tropomyosin, titin, nebulin, Ca^{2+} in muscle contraction and relaxation.	07
Study Resources	• Sherwood L. (2010). Human Physiology: From Cells to Systems, 7th edition, Brooks/Cole, Cengage Learning • Silverthorn D. U. (2015). Human Physiology: An Integrated Approach, 7th edition, Pearson • Chatterjee C.C. (2004). Human Physiology, Vol. I, II, 11th edition, Medical Allied Agency. • Guyton A. C. and Hall J. E. (2001). Textbook of Medical physiology, 10th edition, Harcourt Publisher International Company. • Talwar G.P. and Srivastava L. M. (2006). Text Book of Human Biochemistry, 3rd edition, Prentice Hall of India Pvt. Ltd. • Marieb Elaine N. (1996). Essentials of Human Anatomy and Physiology, 9th edition, Pearson International Edition. • Stuart I. F. (1996). Human Physiology, 5thed, Brown Publisher. • Murray R. K., Granner D. K. and Rodwell V. W. (2006). Harper's Illustrated Biochemistry, 27th Edition, McGraw Hill Publisher. • Suresh R. (2013). Essentials of Human Physiology, Books and Allied (P) Ltd, Kolkata. • Chaudhari S. K. (2014). Concise Medical Physiology, 6th edition, New Central Book Agency Pvt. Ltd. London. • Das A. (2006). Medical Physiology, 4th edition, Books and Allied (P) Ltd, Kolkata.	

S.Y. B.Sc. Biochemistry (Major)
Semester-IV

BIC-DSC-243: Practical on Environmental and Physiological Biochemistry

Total Hours: 60

Credits: 2

Course Objectives	- To perform pollution detection in waste water - To determine physiochemical properties of water and soil - To make students aware about various blood tests significance and functioning of various sense organs	
Course Outcomes	After successful completion of this course, students are expected to: - Analyze wastewater for DO, BOD and COD - Analyze soil and water for various parameters - Explain functioning of various sense organs - Perform various physiological tests	
Sr. No.	Contents	Hours
1	Determination of dissolved oxygen	4
2	Analysis of wastewater for BOD.	4
3	Analysis of wastewater for COD.	4
4	Determination of total hardness of water by EDTA method.	4
5	Determination of acidity and alkalinity of water.	4
6	Determination of pH value of the soil sample.	4
7	Determination of salt concentration in the soil by conductometry.	4
8	Quantification of chloride in water by silver nitrate method.	4
9	Examination of the Olfactory Nervefunction	4
10	Examination of the Different Types of Tastes	4
11	β -HCG test for pregnancy detection	4
12	Determination of pulse rate	4
13	Determination of ESR	4
14	Estimation of blood chloride	4
15	Examination of sensory function of peripheral nervous system	4
Study Resources	- InduShekharThakur . Environmental Biotechnology -Basic concepts and Applications. I.K International Publishing house Pvt LTD., Second Edition 2012. - Pandey.S.N and Misra. S.P. Environment and Ecology.Ane Books Pvt LTD., Ane's Student Edition 2011. - Nandini, N. (2009). Handbook on water quality monitoring and Assessment. Sapna Book House, Bengaluru. - Sawyer, C. N. and Mc Carty, P. L. (1978). Chemistry for Environmental Engineering. Mc Graw – Hill International. - Saxena M M. (1990). Environmental Analysis: Water, Soil and Air. Edition, 2. Publisher, Agro Botanical Pub. - Standard Methods for Examination of Water and Wastewater. (2017). APHA – WEF. - Trivedi, P. K. and Goel, P. K. (1984). Chemical and Biological Methods of Water Pollution Studies. Environmental Publication. - Zhang, C. (2007). Fundamentals of environmental sampling and analysis. John	

	Wiley & Sons. • Wilson, K. and Walker, J. (2003). Practical Biochemistry: Principles and techniques, 5th edition, Cambridge University Press, UK. • Plummer, D. T. (2017). An Introduction to Practical Biochemistry, 3rd edition, Tata McGraw Hill Publishing Company Ltd., New Delhi. • Oser, B. L. (ed.) (1965). Hawk's physiological chemistry, 14th edition, McGraw-Hill Book Company, New York, USA. • Jayaraman, J. (2011). Laboratory Manual in Biochemistry, New Age International (P) Ltd. Publishers, New Delhi. • Sadashivam, S. and Manikam, A. (2018). Biochemical Methods, 3rd edition, New Age International (P) Ltd. Publishers, New Delhi. • Rao, B. S. and Deshpande, V. (2005). Experimental Biochemistry: A student companion, I. K. International Pvt. Ltd., New Delhi.	
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***Mandatory to perform any 12 practical from above.**

S.Y. B.Sc. Biochemistry (Major)
Semester-IV
BIC-SEC-241: Microbial Isolation and Identification Techniques

Total Hours: 30

Credits: 2

Course Objectives	- To acquaint students with various biochemical techniques used for microbial identification - To study microbial isolation on various media - To study microbial screening and preservation methods	
Course Outcomes	After successful completion of this course, students are expected to: - Understand principle and procedure of various biochemical tests used for identification of microorganism - Use selective agar and differential media for isolation of microorganisms - Screen industrially economically important microorganisms - Understand microbial preservation techniques	
Unit	Contents	Hours
Unit I	Isolation of microorganisms - Types of media: Culture Media- solid and broth, selective, differential and enrichment media. - Media used for isolation of microorganisms like bacteria, fungi, actinomycetes, yeasts and cyanobacteria. - Characteristic of bacteria, fungi, actinomycetes, yeasts and cyanobacteria. - Isolation techniques: Concept of isolation techniques: streak plate method, pour plate method, spread plate methods and anaerobic bacterial isolation by candle jar method and fungi isolation by slide culture technique.	08
Unit II	Biochemical tests for Identification of microorganisms - Concepts, principles and procedures: - Catalase Test - Starch hydrolysis test - Coagulase Test - Oxidase Test - Methyl Red / Voges-Proskauer (MR/VP) - Kligler's Iron Agar (KIA) - Nitrate Broth - Urease test - Casein hydrolysis - Tyrosine hydrolysis - Indole production - TSI test - Sugar fermentation acid and gas production test.	07
Unit III	Microbial isolation on different media - Selective agar test: - Mannitol Salt Agar (MSA) - Blood Agar Plates (BAP) - Bile Esculin Agar - Nitrate Broth - Spirit Blue agar - MacConkey agar - Simon's Citrate Agar - Sulfur Indole Motility Media (SIM) - Motility Agar - Selective and differential media:	08

	○ Eosin Methylene blue (<i>E. coli</i>) ○ Xylose lysine deoxycholate agar (<i>Salmonella</i> and <i>Shigella</i>) ○ Mannitol salt agar (<i>Staphylococcus</i> and <i>Micrococcus</i>) ○ Cetrimide agar (<i>Pseudomonas</i>) ○ Azide Dextrose Broth (<i>Streptococcus</i>) ○ <i>Ashby's</i> Mannitol Agar (<i>Azotobacter</i>) ○ Yeast extract mannitol agar (<i>Rhizobium</i>)	
Unit IV	Preservation of microorganisms • Preservation in continuous metabolic active state: ○ Short-term preservation (Agar slants, Agar stabs), ○ Periodic transfer in fresh media ○ Long-term preservation (Glycerol stocks, Gelatin discs, Mineral oil, Storage in soil), • Suspended metabolic state: ○ Freeze drying (Lyophilization) ○ Drying in vacuum ○ Cryopreservation ○ Storage in silica gel • Quality control of preserved stock cultures	07
Study Resources	• Madigan M. T., Bender K. S., Buckely D. H., Sattley W. M., Stahl D. A. (2018). Brock Biology of Microorganisms, NY Pearson publisher. • Talaro K. P. and Chess B. (2000). Foundations In Microbiology 3rd edition, Mc Graw Hill. • Tortora G. J., Funke B. R., Case C. L. (2004). Microbiology An Introduction, 8th edition, pearson Benjamin-Cummings Pub Co. • Pelczar M. Jr. (2001). Microbiology, Indian edition, Mc Graw Hill. • Willey J., Sherwood L., Woolverton C. J. (2017). Prescott's Microbiology, 10th edition, Mc Graw Hill. • Modi, H. A. (1995). Elementary Microbiology, VolI, EktaPrakashan, Nadiad • Aneja K. R. (2007). Experiments in microbiology, plant pathology and biotechnology, New age international publishers. • Kale V. and Bhusari K. (2010). Practical Microbiology: Principles and Techniques, Himalaya Publishing House. • Rajgopal G. and Toora B. D. (2005). Practical Biochemistry, 2nd edition, Ahuja Publishing House. • Maheshwari D. K. (2002). Practical Microbiology, S. Chand Publishing. • Rajan S. and Christy S. R. (2015). Experimental procedures in Life Sciences, CBS Publishers and Distributors Pvt Ltd.	

S.Y. B.Sc. Biochemistry (Major)
Semester-IV
BIC-SEC-242: Practical on Microbial Techniques

Total Hours: 60

Credits: 2

Course Objectives	- To familiarize students with various media used for microbial isolation - To study various microbial morphological techniques and biochemical tests - To execute microbial isolation and screening methods	
Course Outcomes	After successful completion of this course, students are expected to: - Prepare various microbial media - Isolate microorganism by various methods - Perform various microbial morphological techniques and biochemical tests - Screen enzyme and antibiotic producing microorganism	
Sr. No.	Contents	Hours
1	Media preparation-general, selective, differential	4
2	Isolation and colony morphology study of microorganism by streak plate technique	4
3	Enumeration of bacteria by Spread plate method	4
4	Enumeration of bacteria by Pour plate method	4
5	Differential bacterial staining: Gram staining	4
6	Cell wall staining of micro-organisms	4
7	Capsule staining of micro-organisms	4
8	Bacterial flagella staining	4
9	Determination of microorganism size by micrometry	4
10	Biochemical tests: IMViC test	4
11	Biochemical tests: Sugar fermentation test	4
12	Enzyme detection test: Urease test	4
13	Enzyme detection test: Catalase test	4
14	Screening of enzyme producing microorganisms	4
15	Screening of antibiotic producing microorganisms	4
Study Resources	- Plummer D. T. (2005). An Introduction to Practical Biochemistry, TATA McGraw-Hill. - Sadasivam S. and Manickam A. (2008). Biochemical Methods, 3rd edition, New Age International Publishers. - Rao B. S. and Deshpande V. (2005). Experimental Biochemistry: A Student Companion, I.K. International Pvt. Ltd., New Delhi. - Sawhney S. K. and Singh R. (2011). Introductory practical Biochemistry, Narosa Publication House Pvt. Ltd. - Jayaraman J. (1981). Laboratory Manual in Biochemistry, New Age International Publishers - Aneja K. R. (2007). Experiments in Microbiology, Plant Pathology and Biotechnology, New Age International Publishers. - Kale V. and Bhusari K. (2010). Practical Microbiology: Principles and Techniques, Himalaya Publishing House. - Godkar P. B. and Godkar D. P. (2003). Textbook of Medical Laboratory Technology, Second Edition, Bhalani Publishing House. - Rajgopal G. and Toora B. D. (2005). Practical Biochemistry, 2nd edition, Ahuja	

	Publishing House. • Maheshwari D. K. (2002). Practical Microbiology, S. Chand Publishing. • Rajan S. and Christy S. R. (2015). Experimental Procedures in Life Sciences, CBS Publishers and Distributors Pvt. Ltd.	
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***Mandatory to perform any 12 practical from above.**

S.Y. B.Sc. Biochemistry (Major)
Semester-IV
BIC-FP-241: Field Project

Total Hours: 60

Credits: 2

Objectives

- To provide students with practical exposure in rural and urban socioeconomic context.
- To develop students abilities to apply subject knowledge to address real world problems
- To foster critical thinking and innovative approaches to solve socioeconomic issues.

Outcomes

After successful completion of this course, students are expected to:

- Participate actively in filed projects that benefit local communities and promote sustainable development practices.
- Analyse the socio economic data using appropriate methods showcasing improved problem-solving skills, technical proficiency.
- Demonstrate the ability to apply theoretical knowledge to real-world situations effectively and exhibit communication skills.

Course structure

The course is divided in to four probable phases

I] Orientation and preparation

- Introduce to the course, objectives and expectation
- Overview of socioeconomic development issues in rural and urban context
- Training on working methodology and data collection techniques
- Review existing literature related to topic to understand the background and context.

II] Work plan and Field visit

- Visit the potential sites to get a sense of the environment and logistical requirements.
- Create a detailed project plan outlining the steps, timeline, resources needed, and roles of team members.
- Obtain necessary approvals (Ethical/ local authorities/organizations/communities)
- Gather materials and resources (recording devices, cameras, notebooks and supplies)
- Conduct Preliminary Survey, choose appropriate methods for data collection and analysis (e.g., surveys, interviews, observations).

III] Data collection and analysis

- Pilot test to identify issues with data collection.
- Collect data systematically, ensuring consistency and accuracy.
- Keep detailed records of all data (field notes, recordings, photographs etc)
- Organize and analyse the data (manual/ software)

IV] Interpretation and Reporting

- Interpret your findings in the context to objectives.
- Write and submit a comprehensive report detailing your methodology, findings, analysis, and conclusions. (Include visuals - charts, graphs, and photographs).
- Prepare a presentation to share findings with peers/ instructors/ community.

Assessment

- Field work participation, field note book, team work etc. (10 Marks)
- Data Collection and Analysis (15 Marks)
- Field project report (15 Marks)
- Presentation of Findings (10 Marks)

S.Y. B.Sc. Biochemistry (Minor)
Semester-IV
BIC-MIN-241: Ecological Biochemistry

Total Hours: 30

Credits: 2

Course Objectives	- To study types of pollutions and pollutants - To explore the concept of bioenergy - To study biodegradation and bioremediation	
Course Outcomes	After successful completion of this course, students are expected to: - Understand the concept of pollution and pollutants - Understand the concept of bioenergy - Explain biodegradation and bioremediation - Understand mode of action of pesticides and its impact on environment	
Unit	Contents	Hours
Unit I	Pollution and environmental problems - Pollution: Concept of pollution and pollutants and its current status. - Introduction, effect and control of; water pollution, land pollution, noise pollution and air pollution. - Greenhouse effect and global warming. Greenhouse gases. Measures to control greenhouse effect. - Ozone layer: Importance of ozone layer. Depletion of ozone, ozone hole, effects of ozone depletion. Measures to control ozone depletion. - Acid rain: Introduction, effects and measures to control acid rain.	08
Unit II	Bioenergy - Bioenergy: Introduction. Biomass for energy production: Concept, chemical nature, sources, utilization. - Biogas: Introduction, substrates, process, microbial production of biogas, factors affecting biogas production, advantages. Limitations for large scale production. - Introduction to hydrogen as a biofuel. Production of bio-hydrogen by photosynthetic bacteria and fermentation. - Energy rich crops: Sugar and starch crops, wood rich plants and petroleum plants.	07
Unit III	Biodegradation and bioremediation - Xenobiotics: Concept - Biodegradation: Concept, microorganisms for biodegradation and bioremediation. Enzyme system for biodegradation. Factors affecting biodegradation. - Bioremediation: Concept, types, advantages and disadvantages. Types of reaction in bioremediation. - Bioremediation of contaminated soil, waste land and ground water	08
Unit IV	Environmental toxicology - Toxins: Concept and types. Introduction, sources and remedies of metal toxins (arsenic, mercury). - Pesticides: Introduction, classification on the basis of mode of entry, mode of action and chemical nature. Application of pesticides. Environmental effects of pesticides. - Impact of pesticide on organisms. - Bio and chemical warfare agents: Anthrax, plague, small pox, sarin, chlorine, hydrogen cyanide, Sulphur mustard, lewisite and ricin	07

Study Resources	• Hamilton E. (2017). Environmental Biochemistry, Larsen and Keller Education. • Krauss G-J., Nies D. H. (2015). Ecological Biochemistry: Environmental and Interspecies Interactions, Wiley-Blackwell • Sterner O. (2010). Chemistry, Health and Environment, 2nd edition, Wiley-Blackwell • Harborne J. (2014). Introduction to Ecological Biochemistry, 4th edition, Academic Press • Ibanez J. G., Hernandez-Esparza, M., Doria-Serrano, C., Fregoso-Infante, A., Singh, M. M. (2007). Environmental Chemistry: Fundamentals, Springer. • Satyanarayana U. (2009). Biotechnology, Books and Allied (P) Ltd., Kolkata. • Santra S.C. (2010). Environmental Science, New Central Book Agency (P) Ltd, Kolkata. • De A. K. (2010). Environmental Chemistry, 7th edition, New Age International Publishers, New Delhi. • Jogdand S.N. (2005). Environmental Biotechnology, 2nd edition, Himalaya Publishing House, Mumbai. • Rana A. K. and Rana M. K. (2011). Environment and Ecology, Global Vision Publishing House, New Delhi. • Saha T. K. (2014). Ecology and Environmental Biology, Books and Allied (P) Ltd, Kolkata. • Satake M., Mido Y., Yasuhisa H., Taguchi S., Sethi M. S. and Iqbal S. A. (1997). Environmental Toxicology, Discovery Publishing House, New Delhi.	
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S.Y. B.Sc. Biochemistry (Minor)
Semester-IV
BIC-MIN-242: Practical on Ecological Biochemistry

Total Hours: 60

Credits: 2

Course Objectives	- To perform various environmental pollution detection methods - To acquaint students with various physiochemical properties of waste water - To perform various physiochemical properties of contaminated soil	
Course Outcomes	After successful completion of this course, students are expected to: - Analyze wastewater for BOD/COD - Analyze soil and water for various parameters - Analyze water for acidity, alkalinity and hardness - Analyse water for phosphorous, carbonate, nitrate content etc.	
Sr. No.	Contents	Hours
1	Determination of dissolved oxygen	4
2	Analysis of waste-water for BOD.	4
3	Analysis of wastewater for COD.	4
4	Determination of total hardness of water by EDTA method.	4
5	Determination of available chlorine in bleaching powder.	4
6	Determination of pH value of the soil sample.	4
7	Determination of salt concentration in the soil by conductometry.	4
8	Determination of acidity of water.	4
9	Determination of alkalinity of water.	4
10	Quantification of chloride in water by silver nitrate method.	4
11	Estimation of phosphorus in soil by Fiske –Subbarow method.	4
12	Determination of residual chlorine in the given water sample.	4
13	Determination of total solids in the given sample of water.	4
14	Determination of carbonate and bicarbonate in the water sample.	4
15	Determination of nitrate concentration in the given water sample.	4
Study Resources	- InduShekharThakur . Environmental Biotechnology -Basic concepts and Applications. I.K International Publishing house Pvt LTD., Second Edition 2012. - Pandey.S.N and Misra. S.P. Environment and Ecology.Ane Books Pvt LTD., Ane’s Student Edition 2011. - Nandini, N. (2009). Handbook on water quality monitoring and Assessment. Sapna Book House, Bengaluru. - Sawyer, C. N. and Mc Carty, P. L. (1978). Chemistry for Environmental Engineering. Mc Graw – Hill International. - Saxena M M. (1990). Environmental Analysis: Water, Soil and Air. Edition, 2. Publisher, Agro Botanical Pub. - Standard Methods for Examination of Water and Wastewater. (2017). APHA – WEF. - Trivedi, P. K. and Goel, P. K. (1984). Chemical and Biological	

	Methods of Water Pollution Studies. Environmental Publication. • Zhang, C. (2007). Fundamentals of environmental sampling and analysis. John Wiley & Sons.	
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***Mandatory to perform any 12 practical from above.**

S.Y. B.Sc. Biochemistry (Open Elective)
Semester-IV
BIC-OE-241: Manures in Organic Farming-II

Total Hours: 30

Credits: 2

Course Objectives	- To accustom students with symbiotic and non-symbiotic micro-organisms and their role as biofertilizers - To make students aware about different types of earthworm used in vermicomposting - To make students able to prepare vermicompost	
Course Outcomes	After successful completion of this course, students are expected to: - Acquire a critical knowledge on role of earth worms in making organic matter from biodegradable wastes. - Understand the biology of some important species of earth worms used in vermiculture. - Acquire skills on production of vermicompost. - Explain benefits and problems with vermiculture and vermicompost.	
Unit	Contents	Hours
Unit I	Symbiotic Biofertilizers - General account about the microbes used as biofertilizer - Advantages of Biofertilizers over chemical fertilizers - Isolation, identification, mass multiplication, carrier based inoculants: - Rhizobium (Symbiotic association with leguminous plants) - Frankia (Actinorrhizal symbiosis with non-leguminous plants) - Cyanobacteria/blue green algae (Anabaena azollae) (Symbiotic association with aquatic fern Azolla) - Mycorrhiza (Symbiotic association with plant roots)	08
Unit II	Non-symbiotic Biofertilizers - Isolation, identification, mass multiplication, carrier based inoculants: - Azospirillum - Azotobacter - Phosphate solubilizing microbes	07
Unit III	Introduction to vermiculture - Vermiculture - definition, meaning, history, economic importance, value in maintenance of soil structure, role as four R's of recycling (reduce, reuse, recycle and restore). - Role in bio transformation of the residues generated by human activity and production of organic fertilizers. - The matter and humus cycle (product, qualities). ground population, transformation process in organic matter. - Useful species of earthworms, local and exotic species of earthworms; complementary activities of auto-evaluation; key to identify the species of earthworms	08
Unit IV	Vermicomposting - Small scale earthworm farming for home gardens - earthworm compost for home gardens. - Conventional commercial composting - earthworm composting larger scale (pit, brick and, heap systems, and Kadapa slab method). - Earthworm farming, extraction (harvest), vermicomposting harvest and processing. - Vermiwash collection, composition and use.	07

	• Enemies of earthworms, sickness and worm's enemies; frequent problems – prevention and fixation. • Benefits of vermicompost	
Study Resources	• Bhatt J.V. & S.R. Khambata (1959) “Role of Earthworms in Agriculture” Indian Council of Agricultural Research, New Delhi • Edwards, C.A. and J.R. Lofty (1977) “Biology of Earthworms” Chapman and Hall Ltd., London. • Lee, K.E. (1985) “Earthworms: Their ecology and Relationship with Soils and Land Use” Academic Press, Sydney. • Wallwork, J.A. (1983) “Earthworm Biology” Edward Arnold (Publishers) Ltd. London. • Kevin, A and K.E.Lee (1989) “Earthworm for Gardeners and Fisherman” (CSIRO, Australia, Division of Soils).	

Skills acquired and Job prospects for the Biochemistry students

Biochemistry is the molecular basis of life. Degree program in Biochemistry teaches students the way several lifeless chemicals combine to produce a functional living organism. A significant attraction of the course is the ability to combine in-depth scientific knowledge with practical laboratory skills and the career opportunities in all sectors.

After successful completion of three years degree course in Biochemistry, student will be well versed with laboratory skills and transferable skills.

Laboratory Skills:

- Laboratory safety practices as well as aseptic techniques
- Accurate weighing and reagent preparation
- Skillful handling of basic and advanced instruments
- Calibration of basic instruments like pH meter, micropipettes etc
 - Advanced techniques like; Chromatography, Electrophoresis
 - Spectrometry, Polymerase Chain Reaction (PCR)
 - Plant Tissue Culture, Animal Tissue Culture
- Collection, organization and presentation of data
- Analysis, Logical thinking and interpretation of results

Transferable Skills:

During the course student will develop skills other than laboratory skills that are transferable across the number of career areas which include;

- Analytical skill, Observational skill
- Planning and Time management
- Mathematical and IT skills
- Creative thinking, Problem solving
- Report writing skill, Presentation skill

Job Opportunities:

After successful completion of B.Sc. in Biochemistry, student may continue further studies like M.Sc. in Biochemistry and then Ph.D. in Biochemistry and make career in research field. Students have opportunities in private as well as public (Government) sectors.

Private Sector:

Biochemist can work in quality control, quality assurance and R & D divisions of companies like-Biotech companies, Pharmaceutical companies, Chemical manufacturing companies, Food and Drink (includes brewing), Health and Beauty Care, Medical Instrument companies, Agricultural companies, Research Companies and Laboratories etc.

Public Sector:

Blood Service, Cancer research institutes, Environmental Pollution Control, Forensic Science, Hospitals, National Blood Services, Overseas Development, Public Health Entities, Public Health Laboratories, Agriculture and fisheries etc.

Job profiles:

Biochemist, Biologist, Biomedical Scientist, Biotechnologist, Chemical Examiners, Chemist, Clinical Scientist, Food Scientist, Forensic Scientist, Laboratory Technician, Microbiologist, Research Associates, Research Officers, Research Scientist etc.

Opportunities in higher studies

After successful completion of B.Sc. in Biochemistry, student may continue further studies like M.Sc. in Biochemistry / Biotechnology and pursue higher studies. Even students can pursue other courses where graduation is essential.

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