GURU NANAK COLLEGE (AUTONOMOUS)

(Affiliated to University of Madras and Accredited at A++ Grade By NAAC)
Guru Nanak Salai, Velachery, Chennai - 600042

SCHOOL OF SCIENCES

B.Sc. Advanced Zoology and Biotechnology

(SEMESTER PATTERN WITH CHOICE BASED CREDIT SYSTEM)

Syllabus

(For the UG Batch of 2024-27 and thereafter)

LOCF - LEARNING OUTCOME BASED CURRICULUM FRAMEWORK

Preamble

1. About the Programme

B.Sc., Advanced Zoology and Biotechnology is as a branch of biological sciences which is widely preferred because of the advantage in terms of Research orientation, wild life conservation environmental relation. The course helps to understand the aspects of animal science disciplines including growth and development, genetics, anatomy, comparative nutrition and environmental physiology. It caters to the challenging demands of the learners in the emerging field of Biotechnology by developing an inclusive learning environment. Students with a B.Sc. degree in Advanced Zoology and Biotechnology may be employed as Research Assistants, Environmental Managers, Quarantine Officers, Pest Management Officers, IFS, Collection Managers of Aquaria and Zoological Gardens,Primary and Secondary Teachers (with suitable teaching qualifications), Museum Curators (with suitable Postgraduate Degrees), Research Scientists (with suitable Postgraduate Degrees), University Academics (with suitable Postgraduate degrees). On the whole, the student is benefitted with the kind of knowledge that helps them personally as an individualof the Society and also to pursue either in Academics or use the knowledge accumulated for competitive exams and a professional career in relevant field.

2. Vision

To inculcate the highest values of life science education, respect for nature and concern for ethical values among the students through good and scientific educational practices

3. Mission

1. To educate the students on the contemporary advancements in Zoology.
2. To appreciate and acquire knowledge on the taxonomic, functional and evolutionary status of various groups of animals and its role in the environment.
3. To impart global perspective and skills among students.
4. To make industry ready students for leading-edge jobs.
5. To develop research aptitude and scientific temperament thereby leaping to excellence

4. Program Educational Outcomes (PEOs)

PEO 1: Values of Life, Ethics & Social Concern

The graduates exhibit truth, loyalty, and love as integral moral principles, thereby contributing to a society characterized by enhanced well-being and fundamental goodness in behavior.

PEO 2: Employability & Entrepreneurship

The graduates apply analytical, logical, and critical problem-solving skills in professional contexts, elevating employability and cultivating entrepreneurial capabilities through upskilling.

PEO 3: Regional/National/Global Relevance & Competency

The graduates foster advanced analytical skills and a heightened appreciation for current Regional/National/Global perspectives, enabling informed and sustainable decision-making in a dynamic environment.

PEO 4: Skill Enhancement, Self-Directed & Lifelong Learning

The graduates independently engage in skill-based learning, utilizing infrastructure and opportunities for continuous upskilling, enabling self-evaluation and lifelong excellence attainment.

PEO 5: Research Skills & Innovation

The graduates proficiently apply scientific reasoning, fostering creativity, strategic thinking, and effective problem-solving skills. They demonstrate a core competency in generating innovative ideas for advancements and inventions.

5. Programme Outcomes (POs)

PO 1: Instill scientific and analytical reasoning to empower students towards critical thinking thereby enriching inter/multi-disciplinary knowledge.

PO 2: Encourage self-regulated learning leading to problem-solving skills and adaptability.

PO 3: Incorporate experiential learning opportunities and engage in tangible situations to develop essential life skills.

PO 4: Enhance application skills by interconnecting academia and professional realm to achieve employability.

PO 5: Foster research abilities to address everyday challenges, make impactful contributions, and participate in shaping a better future for the society.

6. Programme Specific Outcomes (PSOs)

PSO 1: Understand biological principles at the levels of molecules, cell, system, organism, and ecosystem to appreciate the complexities of evolutionary processes and animal behaviour.

PSO 2: Acquire broad knowledge in Invertebrate, Chordate, Cell and Molecular Biology, Genetics, Evolution, Animal Physiology, Biochemistry, Ecology, Developmental Biology, Immunology, Microbiology, Clinical Laboratory Technique, Biostatistics, Biotechnology and Nanotechnology.

PSO 3: Integrate critical thinking and scientific knowledge to design, perform, record, and analyze experiments on concepts and emerging trends in Zoology

PSO 4: Enhance effective communication, analytical and presentation skills to collaborate with diverse stakeholders

PSO 5: Impart knowledge and vital training to improve opportunities for employment, entrepreneurship, higher education, and life science research.

7. PEO – PO mapping

	PEO 1	**PEO 2**	**PEO 3**	**PEO 4**	**PEO 5**
PO 1	2	3	3	3	3
PO 2	3	3	3	3	3
PO 3	3	3	3	3	3
PO 4	3	3	3	3	3
PO 5	3	3	3	3	3

8. PO – PSO mapping

	PO 1	PO2	PO3	PO4	PO5
PSO 1	3	3	3	3	3
PSO 2	3	3	3	3	3
PSO 3	3	3	3	3	3
PSO 4	3	3	3	3	3
PSO 5	3	3	3	3	3

9. Choice Based Credit System (CBCS)

The College follows the CBCS with Grades under the Semester pattern. Each course is provided with a credit point based on the quantum of subject matter, complexity of the content and the hours of teaching allotted. This is done after a thorough analysis of the content of each subject paper by the members of the Board of Studies and with the approval of the Academic Council. Students are also offered a variety of Job oriented Elective, Multidisciplinary skill-based courses as part of the curriculum. Students can earn extra credits by opting for Massive Open Online Courses (MOOCs) and Certificate Courses.

The evaluation method under CBCS involves a more acceptable grading system that reflects the personality of the student. This is represented as Cumulative Grade Point Average (CGPA) and Grade Point Average (GPA) which are indicators of the Academic Performance of the student. It provides students with a scope for horizontal mobility and empowers them with the flexibility of learning at their convenience.

Eligibility for Admission

Candidates admitted to the first year of the UG programme should have passed the higher Secondary Examinations (Academic or Vocational Stream) conducted by the Government of Tamil Nadu or an examination accepted as equivalent thereof by the Syndicate of the University of Madras. Students applying for the PG programme should have taken the UG degree in the relevant subject from a recognized university as per the norms of the University of Madras.

Duration of the Course

The UG programme is of three years duration with six semesters and the PG programme is of two years duration with four semesters. The period from June to November is termed as the

odd semester and the period from December to April is referred to as the even semester. Each semester must compulsorily have 90 working days before the students appear for the final End Semester Exam.

Course of Study

The main course of study for the Bachelor's Degree shall consist of the following:

Foundation Courses

PART - I: Tamil/ Hindi /Sanskrit/French
PART - II: English

Core Courses

PART - III: Consisting of (a) Main subject (b) Allied Subjects (c) Elective subjects related to the main subject of study and project work.

PART – IV

Those who have not studied Tamil up to XII standard and have taken a non- Tamil language under Part – I, shall opt for Basic Tamil in the first two semesters.

Those who have studied Tamil up to XII standard, and taken a non -Tamil language under Part – I, shall opt for Advanced Tamil in the first two semesters.

Others, who do not come under either of the clauses mentioned above, can choose a Non-Major Elective (NME) in the first two semesters.

Soft Skills (I, II, III & IV Semesters)

Self-Study (Compulsory) Course (III Semester)

Environmental Studies (IV Semester)

Value Education (V Semester)

Summer Internship (After IV Semester)

PART - V: Compulsory Extension Services

A Student shall be awarded one credit for compulsory extension service. A student must enroll in NSS / NCC /Sports & Games/ Citizen Consumer Club / Enviro Club or any other service organization in the College and should put in compulsory minimum attendance of 40 hours, which shall be duly certified by the Principal of the College. If a student lacks 40 hours compulsory minimum attendance in the extension services in any Semester, s/he shall have to compensate the same, during the subsequent Semesters.

Course Structure

The UG programme consists of 15-19 Core courses with 3-4 credits for each paper, 3 Elective courses and 4 Allied courses with 4-5 credits for each paper in addition to 4 Soft Skill courses with two credits each. Internship as a compulsory component carries 2 credits. The B.Com. (Hons) course has 31 core courses of 4 credits each and project with 8 credits.

The MBA programme has 15 core courses including project work with 4 credits, 6 elective courses with 3 credits, 2 extra disciplinary courses with 3 credits, Four Soft Skill courses with two credits each.

The MCA programme has 15 core courses of 2-4 credits, 5 Elective courses of 3 credits, 2 Extra- disciplinary courses of 3 credits and a project work of 17 credits.

Internship training is a compulsory component for all the UG & PG programmes.

10. Consolidated Credit Structure for all the 3 years

Course Component		**No. of Paper**	**Credits**
Part I	Languages	4	12
Part II	English	4	12
Part III	Core (Including Practical)	15	60
	Elective	3	15
	Allied (Including Practical)	4	20
	Mini Project	1	2
Part IV	Non-Major Electives	2	4
	Soft Skills	4	8
	Self-Study (Compulsory Course)	1	2
	Internship	1	2
	EVS	2	2
	Value Education	1	2
Part V	Extension activity	-	1
	Total		**142**

11. Credit Distribution for Each Semester

Semester I		Subject	Hrs / Week	Credit	Marks		Total
Course Component					Internals	Externals	
Part I	Language	Language - I	6	3	50	50	100
Part II	English	English - I	4	3	50	50	100
Part III	Core I	Animal Diversity I - Invertebrata	6	4	50	50	100
	Core Practical I	**Practical I:** Invertebrata and Chordata	2	*	*	*	*
	Allied I	Botany I	6	3	50	50	100
	Allied Practical	**Allied Practical:** Allied Botany Practical	2	*	*	*	*
Part IV	Non-Major Elective - I	Basic Tamil - I / Advanced Tamil - I/ Aquaculture	2	2	50	50	100
	Soft Skills - I	Communication and Personality Development	2	2	50	50	100
Total			**30**	**17**			
Semester II		**Subject**	**Hrs / Week**	**Credit**	**Marks**		**Total**
Course Component					**Internals**	**Externals**	
Part I	Language	Language - II	6	3	50	50	100
Part II	English	English - II	4	3	50	50	100
Part III	Core II	Animal Diversity II - Chordata	6	4	50	50	100
	Core Practical I	**Practical I:** Invertebrata and Chordata	2	4	50	50	100
	Allied II	Botany II	6	3	50	50	100
	Allied Practical	**Allied Practical:** Allied Botany Practical	2	4	50	50	100
Part IV	Non-Major Elective - II	Basic Tamil - II / Advanced Tamil - II / Biocomposting for Entrepreneurship	2	2	50	50	100
	Soft Skills - II	Interview and Resume Writing	2	2	50	50	100
Total			**30**	**25**			
Semester III		**Subject**	**Hrs / Week**	**Credit**	**Marks**		**Total**
Course Component					**Internals**	**Externals**	
Part I	Language	Language - III	6	3	50	50	100

Part II	English	English - III	4	3	50	50	100
Part III	Core III	Cell and Molecular Biology	6	4	50	50	100
	Core Practical II	**Practical II:** Cell and Molecular Biology, Genetics and Evolution	2	*	*	*	*
	Mini Project	**Mini Project**	2	2	50	50	100
	Allied III	Chemistry I	5	3	50	50	100
	Allied Practical	**Allied Practical:** Allied Chemistry Practical	3	*	*	*	*
Part IV	Soft Skill - III	Digital Proficiency and Multimedia Skills	2	2	50	50	100
	Self-study (Compulsory Course)	Indian Heritage and Knowledge System / Contemporary World and Sustainable Development	*	2	50	50	100
Total			**30**	**19**			

Semester IV		**Subject**	**Hrs / Week**	**Credit**	**Marks**		**Total**
Course Component					**Internals**	**Externals**	
Part I	Language	Language - IV	6	3	50	50	100
Part II	English	English - IV	4	3	50	50	100
Part III	Core III	Genetics and Evolution	6	4	50	50	100
	Core Practical II	**Practical II:** Cell and Molecular Biology, Genetics and Evolution	2	4	50	50	100
	Allied IV	Chemistry II	5	3	50	50	100
	Allied Practical	**Allied Practical:** Allied Chemistry Practical	3	4	50	50	100
Part IV	Soft Skill - IV	Foundations of Quantitative Aptitude	2	2	50	50	100
	EVS	Environmental Studies	2	2	50	50	100
Total			**30**	**25**			

Semester V		**Subject**	**Hrs / Week**	**Credit**	**Marks**		**Total**
Course Component					**Internals**	**Externals**	
Part III	Core V	Developmental Biology	4	4	50	50	100
	Core VI	Biotechnology and Genetic Engineering	4	4	50	50	100
	Core VII	Animal Physiology	4	4	50	50	100

	Core VIII	Biostatistics, Computer Applications and Bioinformatics	4	4	50	50	100
	Core Practical III	**Practical III:** Animal Physiology, Biochemistry, Developmental Biology and Immunology	4	*	*	*	*
	Core Practical IV	**Practical IV:** Environmental Biology, Biotechnology and Microbiology	4	*	*	*	*
	Elective - I	Wildlife Conservation **(IDE)**	5	5	50	50	100
Part IV	Value Education	Value Education	1	2	50	50	100
	Internship	Internship	*	2	*	*	*
Total			**30**	**25**			

Semester VI		**Subject**	**Hrs / Week**	**Credit**	**Marks**		**Total**
Course Component					**Internals**	**Externals**	
Part III	Core IX	Environmental Biology and Environmental Biotechnology	4	4	50	50	100
	Core X	Biochemistry	4	4	50	50	100
	Core XI	Microbiology and Immunology	4	4	50	50	100
	Core Practical III	**Practical III:** Animal Physiology, Biochemistry, Developmental Biology and Immunology	4	4	50	50	100
	Core Practical IV	**Practical IV:** Environmental Biology, Biotechnology and Microbiology	4	4	50	50	100
	Elective - II	Clinical Laboratory Techniques	5	5			
	Elective - III	Economic Entomology and Pest Management	5	5	50	50	100
Part V	Extension Activity	Participation in NSS / NCC / Enviro Club, etc	*	1	*	*	*
Total			**30**	**31**			
Grand Total			**180**	**142**			

Examination

Continuous Internal Assessment (CIA) will be for 50 percent and

End Semester Examination (ESE) will be for 50 percent.

Continuous Internal Assessment (CIA)

Every semester will have a mid-semester examination which will be conducted on completion of 45 working days in each semester. A Model exam for three hours duration will be conducted on completion of 80 working days in each semester. For the courses coming under Part IV, ESE will be conducted in MCQ pattern. Internship credits will be given in semester V after verification of documents by the respective Heads.

The schedule for these tests is as follows:

CIA	Schedule	Syllabus Coverage
Mid Semester Examination	After **45** working days of the Semester	60%
Model Examination	After **80** working days of the Semester	95%

The components for the CIA (Theory & Practicals) are as follows:

Internal Components			
Assessment Type	**Nature**	**Maximum Marks**	**% of Weightage**
CIA	Mid Semester Examination	50	10
Model	Model Examination	100	10
	Assignment		10
	Class activities		15
	Attendance		5
Total			**50**

The class activity relates to a programme of accepted innovative techniques such as Seminar, Quiz, Portfolio creation, PowerPoint presentation, Objective tests, Role play, Group discussion, Case Study etc. The mode of evaluation of the class activity will be fixed before the commencement of the semester and an approval will be obtained from the Head of the programme/wing. The students will be informed of the various methods of evaluation once the semester begins.

A record of all such assessment procedures will be maintained by the department and is open for clarification. Students will have the right to appeal to the Principal in case of glaring disparities in marking. CIA marks for practical subjects will be awarded by the respective faculty based on the performance of the student in the model practical examination, observation notebook, submission of record books, regularity and attendance for the practical classes. The attendance particulars for practical classes will be maintained by the concerned faculty. The marks for attendance will be awarded as per the following:

% of General Attendance	Marks Awarded
90-100	5
75-89	4
60-74	3
<60	0

End Semester Examinations (ESE)

After the completion of a minimum of 90 working days each semester, the End Semester Examinations will be conducted. Examinations for all UG and PG programmes will be held for all courses in November / December and April / May. Practical examinations will be conducted only during the end of the odd / even semester before, during or after the commencement of the theory exam. The schedule for ESE Practicals will be notified by the Controller of Examinations in consultation with the Dean (Academics)

12. Mode of Evaluation

METHODS OF EVALUATION		
Internal Evaluation	Mid Sem Exam (10)	50 Marks
	Model Exam (10)	
	Assignment (10)	
	Class activity (15)	
	Attendance (5)	
External Evaluation	End Semester Examination	50 Marks
Total		100 Marks

13. Method of Assessment

Remembering (K1)	• The lowest level of questions requires students to recall information from the course content • Knowledge questions usually require students to identify information in the textbook. • Suggested Keywords: **Choose, Define, Find, How, Label, List, Match, Name, Omit, Recall, Relate, Select, Show, Spell, Tell, What, When, Where, Which, Who, Why**
Understanding (K2)	• Understanding off acts and ideas by comprehending organizing, comparing, translating, interpolating and interpreting in their own words. • The questions go beyond simple recall and require students to combined at altogether • Suggested Keywords: **Classify, Compare, Contrast, Demonstrate, Explain, Extend, Illustrate, Infer, Interpret, Outline, Relate, Rephrase, Show, Summarize, Translate**
Application (K3)	• Students have to solve problems by using / applying a concept learned in the classroom. • Students must use their knowledge to determine a exact response. • Suggested Keywords: **Apply, Build, Choose, Construct, Develop, Experiment with, Identify, Interview, Make use of, Model, Organize, Plan, Select, Solve, Utilize**
Analyze (K4)	• Analyzing the question is one that asks the students to breakdown something into its component parts. • Analyzing requires students to identify reasons causes or motives and reach conclusions or generalizations. • Suggested Keywords: **Analyze, Assume, Categorize, Classify, Compare, Conclusion, Contrast, Discover, Dissect, Distinguish, Divide, Examine, Function,**

	Inference, Inspect, List, Motive, Relationships, Simplify, Survey, Take part in, Test for, Theme
Evaluate (K5)	• Evaluation requires an individual to make judgment on something. • Questions to be asked to judge the value of an idea, a character, a work of art, or a solution to a problem. • Students are engaged in decision-making and problem–solving. • Evaluation questions do not have single right answers. • Suggested Keywords: **Agree, Appraise, Assess, Award, Choose, compare, Conclude, Criteria, Criticize, Decide, Deduct, Defend, Determine, Disprove, Estimate, Evaluate, Explain, Importance, Influence, Interpret, Judge, Justify, Mark, Measure, Opinion, Perceive, Prioritize, Prove, Rate, Recommend, Rule on, Select, Support, Value**
Create (K6)	• The questions of this category challenge students to get engaged in creative and original thinking. • Developing original ideas and problem-solving skills • Suggested Keywords: **Adapt, Build, Change, Choose, Combine, Compile, Compose, Construct, Create, Delete, Design, Develop, Discuss, Elaborate, Estimate, Formulate, Happen, Imagine, Improve, Invent, Make up, Maximize, Minimize, Modify, Original, Originate, Plan, Predict, Propose, Solution, Solve, Suppose, Test, Theory**

SEMESTER I

CORE I: ANIMAL DIVERSITY I – INVERTEBRATA

PROGRAMME: B.Sc. Advanced Zoology and Biotechnology	**BATCH:** 2024
PART: III	**COURSE COMPONENT:** Core - I
COURSE NAME: Animal Diversity I – Invertebrata	**COURSE CODE:**
SEMESTER: I	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 90
THEORY	

COURSE OBJECTIVE

To familiarize with the basic concepts of invertebrates and to acquire knowledge on the evolutionary significance, functional adaptations and economic importance of invertebrates

COURSE OUTCOMES (COs)

1. Learn about the fundamental ideas of the animal kingdom, the principles, classification, and nomenclature, and investigate the systemic, functional morphology and economic significance of the phylum Protozoa.
2. Recognize the economic importance of Phylum Porifera and Coelenterata, and investigate the biological and evolutionary significance of the canal system, skeletal system in sponges, corals and coral reefs, polymorphism, and nematocyst.
3. Recognize the morphology, life cycle and parasitic adaptations of helminths and identify economically, medically and veterinary important helminth groups.
4. Assess the distinctive characteristics and economic significance of the Phylum Annelida, Arthropoda, and Mollusca.
5. Learn about the unique characteristics of the phylum Echinodermata and investigate the invertebrate feeding, sensing, and reproduction mechanisms.

Unit I **15 Hrs**

Introduction to Animal kingdom and basis of classification - Principles of taxonomic characteristic and nomenclature

Phylum Protozoa: General characteristics and classification up to order

Type Study: *Plasmodium*

General Topics: Nutrition in Protozoa, Locomotion in Protozoa, Protozoan diseases in humans

Unit II **18 Hrs**

Phylum Porifera: General Characteristics and classification up to order

Type Study: *Sycon*

General Topics: Canal system of sponges, Skeletal system in sponges, Economic importance of Porifera

Phylum Coelenterata: General characteristics and classification up to order
Type Study: *Obelia* and *Aurelia*
General Topics: Economic importance of corals and coral reef, Polymorphism, Nematocyst and Evolutionary significance

Unit III **18 Hrs**

Phylum Platyhelminthes: General characteristics and classification up to order
Type Study: *Taenia solium* and *Fasciola hepatica*

Phylum Nematodes: General Characteristics and classification up to order
Type Study: *Ascaris*
General Topics: Parasitic adaptation in helminths, Nematode parasites in humans

Unit IV **21 Hrs**

Phylum Annelida - General characteristics and classification up to order
Type Study: *Pheretima*
General Topics: Metamerism in Annelida, Excretory organ in Annelida, Economic importance of annelids
Phylum Arthropoda: General characteristics and classification up to order
Type study: *Penaeus monodon / indicus*
General Topics: Crustacean larval form and its significance, *Peripatus* and its affinities, Mouth parts in insects, Respiratory organ in arthropods, Social life in insects

Phylum Mollusca: General characteristics and classification up to order
Type Study: *Pila*
General topics: Foot in Mollusca, Torsion in Mollusca and Economic importance of Mollusca

Unit V **18 Hrs**

Phylum Echinodermata: General characteristics and classification up to order
Type Study: *Asterias*
General Topics: Water vascular system, Larval forms
Comparative account on functional anatomy of feeding, nervous system and reproduction in invertebrates

PRESCRIBED BOOKS

1. Kotpal, R.L. (2005). Invertebrates, Rastogi Publications, Meerut.
2. Jordan, E.L. and Verma, P.S. (2009). Invertebrate Zoology S. 14th Edition Chand & Co. New Delhi.
3. Ekambaranatha Ayyar, M. and Ananthakrishnan, T.N. (2019). Manual of Zoology Volume I Part 1 & Part 2 Invertebrata, Ananda Book Depot.

REFERENCE BOOKS

1. Chaudhry, S. (2003). Fundamental Invertebrate Zoology, S. Vikas & Co. Fatehpura, Jalandhar.
2. Parker, T. J., and Haswell, W.A. (1990). Text Book of Zoology, Invertebrates, Vol. I edited by Marshall, A.J. and Williams, W.D., CBS Publication & Dist., Delhi.
3. Ruppert, E.E., Fox, R.S., Barnes, R. D. (2003). Invertebrate Zoology: A Functional Evolutionary Approach. 7th Edition, Cengage Learning, India.
4. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis. 3rd Edition, Blackwell Science.
5. Barrington, E.J.W. (2012). Invertebrate Structure and Functions. II Edition, EWP Publishers.
6. T.C. Majpuria. (1990). Invertebrate Zoology, Pradeep Pub. Kitab Mahal.
7. Pechenik, J. A. (2015). Biology of the Invertebrates. 7th Edition, McGraw-Hill Education.

E-LEARNING RESOURCES

1. https://www.nationalgeographic.com/animals/invertebrates
2. https://bit.ly/3kABzKa
3. https://www.nio.org/
4. https://greatbarrierreef.org
5. https://www.pbslearningmedia.org/resource/ed490f06-d5c5-4816-bfc2-75beb2f54011/worlds-most-awesome-invertebrate/

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	2	1	1
II	2	1	2
III	3	1	1
IV	3	2	1
V	2	2	1
TOTAL	**12**	**7**	**6**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	**3**	**3**	**3**	**3**	**3**

PSO-CO-question paper mapping

CO NO.	COURSE OUTOCME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO 1	Learn about the fundamental ideas of the animal kingdom, the principles, classification, and nomenclature, and investigate the systemic, functional morphology and economic significance of the phylum Protozoa.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 2	Recognize the economic importance of Phylum Porifera and Coelenterata, and investigate the biological and evolutionary significance of the canal system, skeletal system in sponges, corals and coral reefs, polymorphism, and nematocyst	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 3	Recognize the morphology, life cycle and	PSO 1, PSO 2,	K1, K2, K3,

	parasitic adaptations of helminths and identify economically, medically and veterinary important helminth groups	PSO 3, PSO 4, PSO 5	K4, K5, K6
CO 4	Assess the distinctive characteristics and economic significance of the Phylum Annelida, Arthropoda, and Mollusca.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 5	Learn about the unique characteristics of the phylum Echinodermata and investigate the invertebrate feeding, sensing, and reproduction mechanisms.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

SEMESTER II

CORE II: ANIMAL DIVERSITY II – CHORDATA

PROGRAMME: B.Sc. Advanced Zoology and Biotechnology	**BATCH: 2024**
PART: III	**COURSE COMPONENT:** Core - II
COURSE NAME: Animal Diversity II – Chordata	**COURSE CODE:**
SEMESTER: I	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 90
THEORY	

COURSE OBJECTIVE

To understand the diversity of chordates and its interaction with the environment

COURSE OUTCOMES (COs)

1. Classify, Identify and recall the distinctive features and affinities of various subphyla.
2. Appreciate the importance of fish migration, accessory respiratory organs and parental care and gain an understanding on the functional anatomy of Scoliodon.
3. Acquire knowledge on the functional anatomy of amphibians and reptiliia and appreciate parental care in amphibians and learn to distinguish between poisonous and non-poisonous snakes.
4. Recognize the importance of dentition and the evolutionary significance of aves and mammals with specific structural adaptations.
5. Explore the diversity of chordates in various domains and gain an understanding of the comparative anatomy of the jaw suspension, brain, and heart in vertebrates.

Unit I **20 Hrs**

General characteristic and outline classification of Phylum Chordata - Origin of Chordata
Protochordates: General characters and Classification up to order

Hemichordata: *Balanoglossus*

Urochordata: *Herdmania*

Cephalochordate: *Amphioxus*

General Topics: Affinities of Urochordata and Cephalochordata – Retrogressive metamorphosis in Urochordata

Unit II **15 Hrs**

Agnatha: General characters and classification
Type Study: *Petromyzon*

Pisces: General characters and classification up to order
Types Study: *Scoliodon*

General Topics: Accessory respiratory organs in fishes, Types of fins, Migration in fishes, Parental care in fishes

Unit III **20 Hrs**

Amphibian: Origin of Tetrapoda - General characters and classification up to order
Type Study: *Rana*
General Topic: Parental care in Amphibians

Reptilia - General characters and classification up to order
Type Study: *Calotes*
General Topics: Poison apparatus and biting mechanism in snakes, poisonous and non - poisonous snakes, Mesozoic reptiles

Unit IV **20 Hrs**

Aves - General characters and classification up to order
Type Study: *Columba livia*
General Topics - *Archaeopteryx*, Flight adaptation and Migration in birds, Palates in birds

Mammals: General characters and classification up to order
Type Study: *Oryctolagus*
General Topics: Dentition in mammals, Adaptive radiation in mammals

Unit V **15 Hrs**

Comparative anatomy of the vertebrate heart and brain, Jaws suspension in vertebrates, Distribution of vertebrates in different realms

PRESCRIBED BOOKS

1. Dhami, P.S., Dhami, J.K. (1982). Chordate Zoology, Dinesh Publishers, Jalandhar.
2. Kotpal. R. L. A. (2009). Modern Text Book of Zoology-Vertebrates - Rastogi publications.
3. Jordan, E. L., and Verma. P.S. (2002). Chordate Zoology. S. Chand publication
4. Ekambaranath Iyer, and Ananthakrishnan, T.N. (2000). A Manual of Zoology. Vol. II, S. Viswanathan and Co.
5. Ganguly, Sinha, Bharati Goswami, and Adhikari, (2004). Biology of Animals. Vol. II, New central book Agency (P) Ltd.
6. Nigam, H.C., 1983. Zoology of Chordates, Vishal Publications, Jalandhar - 144008, 942.

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1. Bhamrah, H.S., and Juneja, K. (1990). An Introduction to Fishes. Anmol Publications, New Delhi
2. Parker, T.J., and Haswell, W.A. A Text Book of Zoology Vol. II. Vertebrates. Latest edition, CBS Publishers, Delhi edited by Late A.J. Marshall & Williams, W.D.

3. Dodson, E.O. (1976). A Text Book of Zoology, CBS Publishers & Distributors, Delhi.
4. Young, J. Z. (2004). The Life of Vertebrates. 3rd Edition, Oxford university press.
5. Parker T.J. and Haswell W.A. (1972). Textbook of Zoology Vertebrates. 7th Ed., Volume II.
6. Pough, H. (2018). Vertebrate Life. 10th Edition, Pearson International.
7. Darlington P.J. (1966). The Geographical Distribution of Animals, R.E. Krieger Pub. Co.
8. Hall B.K., and Hallgrimsson B. (2008). Strick Berger's Evolution. 4th Edition. Jones and Bartlett Publishers Inc.
9. William S. Beck, Karel, F., Liem, and George Gaylord Simpson. (2000). Life: An Introductionto Biology. Harper Collins Publishers, New York.
10. Hickman, C.P. Jr., Hickman, F. M., and Roberts, L.S. (1984). Integrated Principles of Zoology, 7th Edition, Times Mirror / Mosby College Publication. St. Louis. 1065 pp.
11. Newman, H.H. (1981). The Phylum Chordata. Satish Book Enterprise, Agra – 282 003, 477 pp.
12. Waterman, Allyn J. et al., (1971). Chordate Structure and Function, Mac Millan & Co., New York, 587 pp.

E-LEARNING RESOURCES

1. http://tolweb.org/Chordata/2499
2. https://www.nhm.ac.uk/
3. https://bit.ly/3Av1Ejg
4. https://www.allaboutbirds.org/news/#
5. https://www.fishbase.de/home.htm
6. https://www.worldbirdnames.org/new/
7. https://pubmed.ncbi.nlm.nih.gov/37072061/
8. https://www.embibe.com/exams/adaptive-radiation/

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	2	2	1
II	3	1	1
III	2	2	1
IV	3	1	2
V	2	1	1
TOTAL	**12**	**7**	**6**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	**3**	**3**	**3**	**3**	**3**

PSO-CO-question paper mapping

CO NO.	COURSE OUTOCME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO 1	Classify, Identify and recall the distinctive features and affinities of various subphyla.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 2	Appreciate the importance of fish migration, accessory respiratory organs and parental care and gain an understanding on the functional anatomy of Scoliodon.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 3	Acquire knowledge on the functional anatomy of amphibians and reptiliia and appreciate parental care in amphibians and learn to distinguish between poisonous and non-poisonous snakes.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6

CO 4	Recognize the importance of dentition and the evolutionary significance of aves and mammals with specific structural adaptations.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 5	Explore the diversity of chordates in various domains and gain an understanding of the comparative anatomy of the jaw suspension, brain, and heart in vertebrates.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

CORE PRACTICAL I: INVERTEBRATA AND CHORDATA

PROGRAMME: B.Sc. Advanced Zoology and Biotechnology	**BATCH:** 2024
PART: III	**COURSE COMPONENT:** Core Practical - I
COURSE NAME: Practical I: Invertebrata and Chordata	**COURSE CODE:**
SEMESTER: I	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 60
PRACTICAL	

COURSE OBJECTIVES

To understand the basic structure and functions of different groups of animals and to develop observational and scientific skills through identification, dissection and mounting.

COURSE OUTCOMES (COs)

1. Identify and classify animals based on special identifying characters
2. Relate the structure and function of biologically important animals
3. Compare and distinguish the dissected internal organs of invertebrates and chordates
4. Prepare and develop the mounting procedure of invertebrates and chordates
5. Gain knowledge on the distribution, diversity and significance of various groups of economically important animals through field visit

Dissection

Invertebrata

Cockroach

1. Morphological Characters
2. Digestive system
3. Nervous system

Prawn / Shrimp

1. Morphological Characters
2. Identification of Prawn and Shrimp Species
3. Digestive System
4. Nervous System

Chordata

Any Bony Fish

1. Morphological Characters
2. Digestive system

Mounting

1. Mouthparts of Cockroach
2. Mouthparts of Mosquito
3. Mouthparts of House fly
4. Honeybee Sting Apparatus
5. Prawn: Appendages
6. Earthworm: Body Setae and Penial Setae
7. Scales: Ctenoid, Placoid, Cycloid
8. Types of Fins: Homocercal, Heterocercal, Diphycercal

Spotters

A - Classify giving reasons up to order

1. *Paramecium*
2. *Scypha*
3. *Obelia*
4. *Taenia Solium*
5. *Ascaris*
6. *Neanthes*
7. *Penaeus*
8. *Asterias*
9. *Balanoglossus*
10. *Amphioxus*
11. *Scoliodon sorrakowah*
12. *Rana hexadactyla*
13. *Calotes versicolor*
14. *Columba livia*
15. *Oryctolagus cuniculus*

B - Draw labelled sketches

16. *Obelia medusa*
17. *Nereis T.S.*
18. *Bipinnaria larva*
19. *Amphioxus T.S*
20. Quill feather

C - Comment on Biological significance

21. Entamoeba
22. *Paramecium – Conjugation*
23. *Plasmodium*
24. *Physalia*
25. *Ascaris*
26. *Heteronereis*
27. *Peripatus*

28. *Nauplius larva*
29. *Rotifers*
30. *Copepods*
31. *Artemia*
32. *Sacculina on crab*
33. *Sea anemone on Hermit crab*
34. *Vipera russelli (Russel's viper)*
35. *Pteropus*

D – Relate structure and function

36. Sponge – Spicules
37. Sponge – Gemmule
38. Taenia – Scolex
39. Neanthes – Parapodium
40. Penaeus – Petasma
41. Starfish - Tube foot
42. Snake- Poison apparatus
43. Quill feather

E - Osteology / Palate in Birds / DentitionOsteology – Frog

44. Skull and lower jaw
45. Vertebral column
46. Pectoral girdle
47. Pelvic girdle
48. Forelimb
49. Hind limb

Palate in Birds

50. Pigeon – Palate
51. Crow – Palate
52. Duck – Palate

Dentition

53. Rabbit – Dentition
54. Dog – Dentition

Experiments / Field Visit / Study Tour

1. Observation of Protista in pond water sample
2. Collection, Identification and Morphometric study of fishes from various habitat
3. Project report - Social behaviour of any insect, Animal behaviour
4. Report on field visit for studying the adaptation of animals (Study tour)

PRESCRIBED BOOKS

1. Ekambaranatha Iyyar, and Ananthakrishnan, T. N. (1995). A Manual of Zoology Vol. I (Part 1, 2) S. Viswanathan, Chennai.

2. Ganguly, Sinha, and Adhikari, (2011). Biology of Animals: Volume I, New Central Book Agency, 3rd Revised Edition, 1008 pp.
3. Sinha, Chatterjee, and Chattopadhyay, (2014). Advanced Practical Zoology. Books & Allied Ltd. 3rd Revised Edition, 1070PP.
4. Lal, S. S. (2016). Practical Zoology Invertebrate. Rastogi Publications.
5. Verma, P. S. (2010). A Manual of Practical Zoology: Invertebrates, S Chand, 497pp.
6. Lal, S. S. (2009). Practical Zoology Vertebrate. Rajpal and Sons Publishing, 484pp.

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1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W., and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, 3rd Edition, Blackwell Science.
2. Barnes, R.D. (1982). Invertebrate Zoology, 5th Edition. Holt Saunders International Edition.
3. Barrington, E. J. W. (1979). Invertebrate Structure and Functions. 2nd Edition, E.L.B.S. and Nelson
4. Boradale, L.A., and Potts, E.A. (1961). Invertebrates: A Manual for the Use of Students. Asia Publishing Home.
5. Lal, S.S. (2005). A Text Book of Practical Zoology: Invertebrate. Rastogi, Meerut.

E-LEARNING RESOURCES

1. https://australian.museum/learn/animals/fishes/fish-scales/
2. https://www.nationalgeographic.com/animals/invertebrates/
3. https://genent.cals.ncsu.edu/bug-bytes/mouthparts/
4. https://www.researchgate.net/publication/337849135_Form_and_Function_of_Insect_Mouthparts
5. http://eprints.cmfri.org.in/17874/1/CMFRI%20Training%20Manual%20No.%2036_2023_Megarajan%20Sekar.pdf
6. http://eprints.cmfri.org.in/15053/1/Rotiferrs%20as%20live%20Feed_Course%20Manual_CAU_Tripura_2020.pdf
7. https://www.marinebio.org/creatures/marine-invertebrates/
8. https://www.fisheries.noaa.gov/invertebrates#by-species

SEMESTER III

CORE III: CELL AND MOLECULAR BIOLOGY

PROGRAMME: B.Sc. Advanced Zoology and Biotechnology	**BATCH:** 2024
PART: III	**COURSE COMPONENT:** Core - III
COURSE NAME: Cell and Molecular Biology	**COURSE CODE:**
SEMESTER: II	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 90
THEORY	

COURSE OBJECTIVE

To understand the various techniques used to study the structures and purposes of basic components of cells, especially macromolecules, membranes and organelles

COURSE OUTCOMES (COs)

1. Understand the fundamental features of prokaryotic and eukaryotic cells and methods used to examine them. Gain knowledge on different models of plasma membrane.
2. Understand the cell structure and function and the metabolic processes of Endoplasmic reticulum, Golgi complex, Microbodies, Mitochondria and Ribosomes.
3. Discuss the structure and function of nucleus and nucleolus. highlight the steps involved in cell cycle and cell division and outline theprocess of cell autophagy.
4. Describe the structure and functions of DNA and RNA.
5. Highlight the steps involved in Cancer and cell cycle, Stem cell therapy. Acquire knowledge on Microtechniques and Cytochemical techniques.

Unit I **20 Hrs**

History of Cell biology – Diversity of cell shape and size - Cell theory – Comparison of Prokaryotic cell and Eukaryotic cell – ultra structure of animal cell

Plasma membrane: Different models of plasma membrane - Trilaminar model, Bimolecular leaflet model, Lattice model, Micellar model, Fluid mosaic model, Membrane transport (active, passive and facilitated), Definition - Cell Signalling, Type and Receptor profile.

Unit II **15 Hrs**

Cell organelles: Cytoplasm – Composition and function.

Endoplasmic Reticulum: Morphology - Chemical composition - Morphological differentiation and functions.

Golgi Complex: Morphology - Chemical composition - Relationship with other cell components and its function with special reference to cell secretion.

Microbodies: Structure - Chemical composition - Functions and origin of Peroxisomes and Glyoxysomes.

Mitochondria: Morphology including vital examination - Light and ultramicroscopic structures - Structural variations with regard to functions - Chemical composition - Role in cell physiology - Mitochondria as semi - autonomous organoids.

Ribosomes: Structure and biogenesis (Prokaryotes and Eukaryotes).

Unit III **20 Hrs**

Nucleus and Nucleolus: Structure and function – Structure of chromosome – Euchromatin and heterochromatin – Giant chromosome (polytene and lamp brush) - Cell cycle and cell stages – Cell division and their significance.

Centrioles: Basal bodies – Cilia – Flagella – Microtubules - Amoeboid movement

Lysosomes: Morphology – Chemistry - Polymorphism in relation to cytosis and cell autophagy.

Unit IV **20 Hrs**

Molecular Biology – Nucleic acid – Structure of DNA and RNA (rRNA, tRNA, mRNA) – DNA replication - Repair and recombination: Unit of replication – enzymes involved in replication, Replication origin and replication fork – DNA damage and repair mechanism – DNA transcription and translation. Central Dogma of Protein synthesis

Unit V **15 Hrs**

Advanced studies in molecular technology: Cancer Biology – Characteristics of cancer cell, carcinogens – Oncogenes - Tumour suppressor gene - Cancer and cell cycle - Virus induced cancer - Metastasis – Stem cell therapy.

Tools and Techniques: Microscope: Principles of Microscopy – Components and application of Compound Microscope - Cytological study of living Cell, Microtechniques (Fixation, stain, staining methods, vital staining) – Cytochemical techniques – Cell Fractionation – Homogenization and Centrifugation – Isolation of cellular components.

PRESCRIBED BOOKS

1. Verma P.S., Agarwal V.K. (2010). Molecular Biology. S Chand Publication.
2. De Robertis, EDP, De Robertis, E.M.F. (1995). Cell Biology and Molecular Biology. 8th Edition. W.B. Saunders Co., Philadelphia.
3. Rastogi, S. C. (2019). Cell Biology, New Age International (P) Ltd., Publishers.
4. Veerakumari, L. (2019). Bioinstrumentation. MJP Publisher.

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1. Alberts, B. Bray, D., Lewis, J., Raff, M., Roberts, K., and Watson, J.D. Molecular Biology of the Cell Gerland Publ. Inc., New York.

2. Darnell, J., Lodish, J.H., and Beltimore, D. Molecular Cell Biology, Oxford & IBH Publishing Co., New Delhi.
3. Gerald Karp, Janet Iwasa, Wallace Marshall. (2018). Karp's Cell Biology. John Wiley &Sons; 8th Edition, Global.
4. S.C. Rastogi. (2010). Cell and Molecular Biology, New Age Publishers; Third edition.
5. Cooper, G.M., Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition, ASM Press and Sinauer Associates.
6. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Robert Keith and Watson James.(2008) Molecular Biology of the Cell. V Edition, Garland publishing Inc., New York and London.
7. Kleinsmith, L. J. & Kish, V. M. (1995). Principles of Cell and Molecular Biology. 2e, Harper Collins. College Pubs

E-LEARNING RESOURCES

1. http://www.microscopemaster.com/organelles.html
2. https://rsscience.com/cell-organelles-and-their-functions/
3. https://www.khanacademy.org/test-prep/mcat/cells/eukaryotic-cells/a/organelles-article
4. https://microbenotes.com/cell-organelles/
5. https://www.khanacademy.org/science/ap-biology/gene-expression-and-regulation/dna-and-rna-structure/a/nucleic-acids
6. https://www.nature.com/scitable/topicpage/discovery-of-dna-structure-and-function-watson-397/
7. https://opentextbc.ca/biology/chapter/9-1-the-structure-of-dna/
8. https://www.genome.gov/genetics-glossary/Deoxyribonucleic-Acid
9. https://rwu.pressbooks.pub/bio103/
10. https://www.e-booksdirectory.com/details.php?ebook=9382
11. https://www.ccmb.res.in/

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	2	2	1
II	2	1	1
III	3	1	1
IV	3	1	1
V	2	2	2
TOTAL	**12**	**7**	**6**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	2	3	3	3	3
CO 4	3	3	2	3	3
CO 5	3	3	3	3	3
Ave.	**2.8**	**3**	**2.8**	**3**	**3**

PSO-CO-question paper mapping

CO NO.	COURSE OUTOCME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO 1	Understand the fundamental features of prokaryotic and eukaryotic cells and methods used to examine them. Gain knowledge on different models of plasma membrane.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 2	Understand the cell structure and function and the metabolic processes of Endoplasmic reticulum, Golgi complex, Microbodies, Mitochondria and Ribosomes.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 3	Discuss the structure and function of nucleus and nucleolus. highlight the steps involved in cell cycle and cell division	PSO 1, PSO 3, PSO 5	K1, K2, K3, K4, K5, K6

	and outline theprocess of cell autophagy.		
CO 4	Describe the structure and functions of DNA and RNA.	PSO 1, PSO 2, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 5	Highlight the steps involved in Cancer and cell cycle, Stem cell therapy. Acquire knowledge on Microtechniques and Cytochemical techniques.	PSO 1, PSO 2, PSO 3, PSO4, PSO 5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

SEMESTER IV

CORE IV: GENETICS AND EVOLUTION

PROGRAMME: B.Sc. Advanced Zoology and Biotechnology	**BATCH:** 2024
PART: III	**COURSE COMPONENT:** Core - IV
COURSE NAME: Genetics and Evolution	**COURSE CODE:**
SEMESTER: IV	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 90
THEORY	

COURSE OBJECTIVE

To gain knowledge on the fundamental concepts of Genetics and Evolution

COURSE OUTCOMES (COS)

1. Understand Mendel's law and predict the outcome of crosses including the use of Punnett square.
2. Describe sex-linked characteristics and their transmissions, linkage and crossing over, nuclear and extra nuclear inheritance.
3. Understand the gene concept, mutation and Chromosomal aberration.
4. Understand the key concept of Hardy Weinberg law, Sex-linked gene in human, Pedigree analysis and genetic counselling.
5. Compare and Discuss Lamarckism and Darwinism, living and extinct fossils, evolution of man, genetic drift, genetic load, parallel evolution and adaptative radiation in mammals.

Unit I **20 Hrs**

History and Scope of Genetics - Mendelism: Mendel's Experiments, Backcross or testcross, phenotype and Genotype – Monohybrid cross - Dihybrid cross, Trihybrid and Polyhybrid crosses – Interaction of genes – Epistasis - Incomplete Dominance and Co-dominance -– Complementary factors (*Lathyrus odoratus*) - Supplementary factors (Maize) - Inhibitory and lethal factors - Multiple alleles (drosophila, coat colour in rabbit, blood group inheritancein man) - Erythroblastosis Foetalisis

Unit II **20 Hrs**

Linkage: Morgan's Experiment -Theories of linkages - Factors affecting linkage – Sex linked inheritance in *Drosophila* and Man

Crossing Over: Types – Mechanism - Cytological evidence - Significance and factors affecting crossing over – Chromosome mapping

Sex Determination: Basis of sex determination (Genetic and Environmental) - Sex determination in *Drosophila* and Man – Mechanism of dosage compensation – Sex linked characters – Sex limited genes.

Cytoplasmic inheritance: Kappa particles in *Paramecium*, CO_2 sensitivity in *Drosophila* and milk factor in mice

Nuclear and Extra-nuclear Inheritance – Antibiotic resistance in *Chlamydomonas*, mitochondrial mutation in *Saccharomyces* and human disorder - Infective hereditary in *Paramecium* – Maternal effect – Shell coiling in snail

Unit III **15 Hrs**

Gene and Gene Concept - Fine structure of gene – Cistron, Muton and Recon – Regulation of gene expression – Operon concept – Lac operon – Genetic code

Mutation – Molecular basis of mutation – Gene mutation – Chromosomal aberration – Mutagenesis

Unit IV **20 Hrs**

Population and Applied genetics

Hardy Weinberg law – Gene frequency and factors affecting gene frequency – Sex linked gene in human – Animal breeding - Inbreeding and out breeding, Heterosis - Hybrid vigour, Eugenics, Euphenics and Euthenics - Pedigree analysis – Human karyotyping and variations – Probability – Application in genetics - Inheritance disorder in man – metabolic disorder – Genetic counselling

Unit V **15 Hrs**

Origin of life

History of evolution – Significance of evolutionary biology – Theories on origin of life – support of Oparin's hypothesis – Urey Miller experiment - Biogenesis and abiogenesis - Fossilization - Dating of Fossil – Living and Extinct Fossils – Phylogenetic evolution.

Principles and Nature of Evolution

Lamarckism and Neo-Lamarckism – Darwinism and Neo-Darwinism – Mutation theory - Mimicry & Colouration – Batesian and Mullerian - Convergent, Divergent and Parallel Evolution – Co-evolution - Adaptive radiation in mammals - Isolating mechanisms – Different types – Species concept – Definition and origin of species – Allopatric and Sympatric speciation – Genetic drift – Founder's Principle – Genetic load - Geological time scale – Mass Extinction – Cultural evolution of man

PRESCRIBED BOOKS

Genetics

1. Gupta, P K. Genetics, Rastogi Publishers, Meerut.
2. Gupta, P K. Cytology Genetics, and Molecular Biology; Rastogi Publishers, Meerut.
3. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. 5th Edition. John Wiley and Sons In.
4. Guptha G. K. (2013). Genetics - Classical to Modern. Rastogi publishers, Meerut.
5. Veer Bala Rastogi. (2019). Text Book of Genetics. Medtech.
6. Verma P.S., and Agarwal V.K. (2006). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand and Company Ltd.
7. Verma P. S., and Agarwal, V. K. (2018). Genetics, S. Chand and Company Pvt. Ltd.

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1. Verma, P.S. and V.K. Agarwal (2002). Concept of Evolution, S. Chand & Co., Ram Nagar,New Delhi
2. Stirton, R.A. Time, Life and Man. C.B.S. Publishers & Distribution, Delhi.
3. Colbert, E.H. Evolution of Vertebrates, C.B.S. Publishers & Distribution, Delhi.

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1. Goodenough U., Genetics. 3rd Edition, Washington University, Saunders College Publishing.
2. Swanson, O.P., Timothy Herz, and William, J. Young. Cytogenetics - The Chromosome in Division, Inheritance and Evolution. Prentice Hall.
3. Gardner, B.S., and Smustad, D.P. Principles of Genetics. John Wiley and Sons. 6th Edition.
4. Winchester, A.M. Genetics - A Survey of the Principles of Heredity, Oxford & IBH Publishing Co., New Delhi.
5. Klug, W.S., Cummings, M.R., Spencer, C. A. (2012). Concepts of Genetics. 10th Edition. Benjamin Cumming
6. Pierce B. A. (2012). Genetics - A Conceptual Approach. 4th Edition. W. H. Freeman and Company
7. Russell, P. J. (2009). Genetics - A Molecular Approach. 3rd Edition. Benjamin Cummings
8. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. Introduction to Genetics Analysis. 9th Edition. W. H. Freeman and Co.
9. Cooper, Geoffrey M., (2018). The Cell: A Molecular Approach, 8th Edition, Oxford University Press.
10. Fletcher, H., and Hickey I. (2015). Genetics, 4th Edition. G S Taylor and Francis Group, New York and London.
11. Lodish, Harvey, Arnold Berk *et al*., (2007). Molecular Cell Biology. 6th Edition, W. H. Freeman.

12. Strickberger M. W., (1995). Genetics, Prentice Hall India Learning Private Limited.

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1. Dobzhansky, T., Genetics and the Origin of Species. Columbia, Univ. Press, New York.
2. Mayr, E., Systematics and the Origin of Species, Columbia Univ. Press, New York.
3. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007).Evolution. Cold Spring Harbour Laboratory Press.
4. Barnes, C.W. (1988). Earth, Time and Life. John Wiley & Sons, New York
5. Bendall, D. S. (ed.) (1983). Evolution from Molecules to Man. Cambridge University Press,U.K.
6. Bull J.J., and Wichman, H.A. (2001). Applied Evolution. Annu. Rev. Ecol. Syst. 32:183-217.
7. Campbell, N. A., and Reece J. B. (2011). Biology. 9th Edition, Pearson, Benjamin,Cummings.
8. Chattopadhyay Sajib. (2002). Life Origin, Evolution and Adaptation. Books and Allied (P)Ltd. Kolkata, India.
9. Douglas, J. F. (1997). Evolutionary Biology. Sinauer Associates.
10. Dadson E.O. (1960). Evolution: Process and Product. Reinhold Pub.

E-LEARNING RESOURCES

1. https://go.nature.com/2XE8V1q
2. https://www.ndsu.edu/pubweb/~mcclean/plsc431/mendel/mendel1.htm
3. https://microbenotes.com/types-of-mutations/
4. https://cooplab.github.io/popgen-notes/
5. https://www.genome.gov/genetics-glossary/Sex-Linked
6. https://www.vedantu.com/biology/mutagens
7. https://www.nature.com/scitable/topicpage/genetic-mechanisms-of-sex-determination-314/
8. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7368598/
9. https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_(Boundless)/19%3A_The_Evolution_of_Populations/19.01%3A_Population_Evolution/19.1B%3A_Population_Genetics
10. https://www.khanacademy.org/science/ap-biology/natural-selection/population-genetics/a/genetic-drift-founder-bottleneck
11. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7368598/
12. https://openoregon.pressbooks.pub/mhccmajorsbio/part/introduction-to-evolution/https://www.google.co.in/search?q=history+and+scope+of+genetics&sca_esv
13. https://www.khanacademy.org/science/ap-biology/natural-selection/natural-selection-ap/a/darwin-evolution-natural-selection

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	3	2	2
II	2	1	1
III	2	1	1
IV	2	1	1
V	3	2	1
TOTAL	**12**	**7**	**6**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	3	3
CO 2	3	2	3	3	3
CO 3	2	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	2	3
Ave.	**2.8**	**2.8**	**3**	**2.8**	**3**

PSO-CO-question paper mapping

CO NO.	COURSE OUTOCME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO 1	Understand Mendel's law and predict the outcome of crosses including the use of Punnett square.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 2	Describe sex-linked characteristics and their transmissions, linkage and crossing over, nuclear and extra nuclear inheritance.	PSO 1, PSO 2, PSO 3, PSO4, PSO 5	K1, K2, K3, K4, K5, K6
CO 3	Understand the gene concept, mutation and Chromosomal aberration.	PSO 1, PSO 2, PSO 5	K1, K2, K3, K4, K5, K6
CO 4	Understand the key concept of Hardy Weinberg law, Sex-linked gene in human, Pedigree analysis and genetic counselling.	PSO 1, PSO 2, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 5	Compare and Discuss Lamarckism and Darwinism, living and extinct fossils, evolution of man, genetic drift, genetic load, parallel evolution and adaptative radiation in mammals.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

CORE PRACTICAL II: CELL AND MOLECULAR BIOLOGY, GENETICS AND EVOLUTION

PROGRAMME: B.Sc. Advanced Zoology and Biotechnology	**BATCH:** 2024
PART: III	**COURSE COMPONENT:** Core Practical - II
COURSE NAME: Practical II: Cell and Molecular Biology, Genetics and Evolution	**COURSE CODE:**
SEMESTER: IV	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 60
PRACTICAL	

COURSE OBJECTIVE

To provide the students practical skills in cell and molecular biology, genetics and evolution.

COURSE OUTCOMES (COs)

1. Understand the use and handling of microscope and appreciate the usage of ocular, stage micrometer and camera lucida.
2. Develop proficiency to understand the nature and types of blood cells and identify various stages in cell divisions.
3. Gain knowledge on various types of cells and tissues by viewing through prepared slides.
4. Identify and discuss human karyotyping
5. Understand the significance of living fossils and know the contributions of famous evolutionists.

Cell and Molecular Biology

1. Micrometry – Components and use of microscopes – Light microscope, CameraLucida, Stage and Ocular micrometer.
2. Blood smear preparation – Differential Count of WBC
3. Counting of RBC and WBC using Hemocytometer (Demonstration)
4. Mounting of Buccal epithelium and observing living cells using vital staining
5. Mitosis in onion root tip squash
6. Meiosis in grasshopper testis squash
7. Isolation of DNA and RNA
8. Study of prepared slides of histology
   a) Columnar epithelium
   b) Ciliated epithelium
   c) Glandular epithelium
   d) Connective tissue
   e) Cartilage T.S.
   f) Bone T.S.

g) Cardiac tissue
h) Striated muscle
i) Non-striated muscle
j) Nervous tissue
k) Ovary T.S.
l) Testis T.S.

Genetics

1. Experiments using beads or seeds to study the Mendel's laws and gene interactions
2. Pedigree Analysis
3. Observation of Common Mutants of *Drosophila (*white eye, red eye, normal wing and vestigial wing)
4. Preparation of mount of salivary gland chromosomes of *Chironomus* larva
5. Identification of human blood groups
6. Studies of Human Karyotype – Normal (Male and Female), Abnormal (Down Syndrome, Turner and Klinefelter Syndrome)

Evolution

1. Study of fossils from models/pictures
2. Identify the Scientist and mention their contribution
3. Report on Extinct, Endangered and Vulnerable Species

PRESCRIBED BOOKS

1. Surya Nandan Meena, Milind Naik, (2019). Advances in Biological Science Research: A Practical Approach. Academic Press, New York, USA.
2. Michael Perlin, William Beckerson, Adarsh Gopinath, (2017). Cell, Genetics, and Molecular Biology: A Lab Manual (First Edition), Cognella Inc., USA.
3. Saxena, J., Baunthiyal, M., Ravi, I., (2015). Laboratory Manual of Microbiology, Biochemistry and Molecular Biology, Scientific Publishers, India.
4. Bansal, M.P., (2013). Molecular Biology and Biotechnology: Basic experimental Protocols, The Energy and Resources Institute (TERI), New Delhi, India.
5. Chaitanya, K.V., (2013). Cell and Molecular Biology: A Lab Manual, PHI Learning Pvt. Ltd., New Delhi, India.
6. Dadson, E.O. (1960). Evolution: Process and Product. Reinhold Pub.

REFERENCE BOOKS

1. Andreas Hofmann, Samuel Clokie, (2018). Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, UK.
2. Bancroft, J.D. and Gamble, M. (2007). Theory and Practice of Histological Techniques. 6th Edition, Churchill Livingstone.
3. Ian Freshney, R. (2010). Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, John Wiley & Sons, USA.

4. John Kiernan. (2008). Histological and Histochemical Methods: Theory and Practice, 4th edition, Cold Spring Harbor Laboratory Press.
5. Kerr, J. (2013) Functional Histology, Elsevier 6. Kiernan, J.A. (2008). Histological & Histochemical Methods: Theory & Practice, 4th Edition. Cold Spring Harbor Laboratory Press.
6. Leonard Davis, Mark Dibner, James Battey, (2012). Basic Methods in Molecular Biology, Elsevier Science Publishing Co., NY, USA.
7. Luiz Carlos. (2005). Basic Histology: Text and Atlas (11th Ed). Mc Graw Hill Medical.
8. Robert F. Schleif, Pieter C. Wensink, (2012). Practical Methods in Molecular Biology, Springer - Verlag, NY, USA.
9. Ross, M.H., Kaye, G.I., and Pawlina, W. (2002). Histology: A Text and Atlas, 4th Edition. Lippincott Williams & Wilkins.
10. Sarah Stauffer, Aaron Gardner, Wilko Duprez, Dewi Ayu Kencana Ungu, Philip Wismer, (2018). Labster Virtual Lab Experiments: Basic Genetics, Springer Publishers, NY, USA.

E-LEARNING RESOURCES

1. https://cbii-au.vlabs.ac.in/
2. https://www.sciencecourseware.org/BiologyLabsOnline/protected/PedigreeLab/
3. https://learn.genetics.utah.edu/
4. https://www.jove.com/
5. https://vlab.amrita.edu/?sub=3&brch=77
6. https://media.hhmi.org/biointeractive/vlabs/transgenic_fly/index.html
7. https://www.ibiology.org/biology-techniques/

SEMESTER V

CORE V: DEVELOPMENTAL BIOLOGY

PROGRAMME: B.Sc. Advanced Zoology and Biotechnology	**BATCH:** 2024
PART: III	**COURSE COMPONENT:** Core - V
COURSE NAME: Developmental Biology	**COURSE CODE:**
SEMESTER: V	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 60
THEORY	

COURSE OBJECTIVE

To create an awareness to the students about the theories, concepts and basics of Developmental Biology and to provide in-depth knowledge on Applied and Human Embryology.

COURSE OUTCOMES (COs)

1. Describe and illustrate the significance of cellular processes in embryonic development.
2. Relate the factors that contribute to the developmental process, construct fate maps and illustrate the steps in morphogenesis and organogenesis.
3. Correlate the involvement of specific cell types in the formation of specific organs and explain the importance of morphogens.
4. Distinguish between the different types of developmental mechanisms in various organisms and appraise the species-based differences in development.
5. Justify and validate the role of environment and genetics in influencing embryonic development.

Unit I **12 Hrs**

Gametogenesis and Fertilization: Basic concepts of developmental biology. Structure and Types of Spermatozoa - Mammalian egg - Egg membranes - Types of egg. Spermatogenesis – Oogenesis - **Fertilization** – Mechanism, Theories and significance – Parthenogenesis.

Unit II **12 Hrs**

Blastulation & Gastrulation

Cleavage - Planes and Patterns, Factors controlling cleavage - Fate map and its construction. Blastulation – Types of blastula. Morphogenetic movements - Gastrulation of frog and chick.

Unit III **12 Hrs**

Organogenesis: Development of Brain, Eye and Heart in frog. Development of Pro, Meso and Metanephric Kidneys. Placentation in Mammals

Unit IV **12 Hrs**

Applied Embryology: Organizer concept – Structure – Mechanism of induction and competence. Nuclear transplantation - teratogenesis – Regeneration: types - events and factors. Embryonic stem cells - Induced pluripotent stem cells and its role and significance.

Unit V **12 Hrs**

Human Embryology: Reproductive organs, Menstrual cycle and menopause – Pregnancy - Trimesters – Development, Sexual Dysfunctions, Sexually Transmitted Diseases, Foetal Membranes, Erythroblastosis foetalis -Twins – Types. Infertility – Micromanipulation of test tube baby - Assisted Reproductive Technology – Embryo transfer – Amniocentesis.

PRESCRIBED BOOKS

1. Jain. P.C. (2007). Elements of Developmental Biology. 6th Edition. Rastogi Publications.
2. Lewis Wolpert (2007). Principles of Development. 3rd Edition, Oxford University Press, New Delhi, India.
3. Subramoniam, T. (2003). Developmental Biology, Narosa Publishing House, New Delhi, India.
4. Verma, P.S., Agarwal, V. K. (2010). Chordate Embryology: Developmental Biology, S. Chand & Company, New Delhi., India.

REFERENCE BOOKS

1. Gilbert, S. F. (2010). Developmental Biology, Sinauer Associates, Massachusetts, USA.
2. Balinsky, B. I. (1970). Introduction to Embryology, Philadelphia and London, UK.
3. Berril, N. J. (1971). Developmental Biology, McGraw Hill, New York, USA.
4. Russ Hodge, (2010). Developmental Biology. Facts on File, Inc., New York, USA.
5. Carlson, Bruce, M. (2009). Human Embryology and Developmental Biology, Elsevier, Philadelphia, USA
6. Scott F. Gilbert, (2006). Developmental Biology, Sinauer Associates Inc., U.S.; 8th Revised Edition
7. Gibbs. (2006). Practical Guide to Developmental Biology. Oxford University Press.
8. Werner. A. Muller. (2008). Developmental Biology. Springer.
9. Wolpert, L. (1998). Principles of Development. Oxford University Press, N. Y.

E-LEARNING RESOURCES:

1. https://www.ncbi.nlm.nih.gov/books/NBK10052/
2. https://www.cdc.gov/ncbddd/developmentaldisabilities/facts.html
3. https://anatomypubs.onlinelibrary.wiley.com/doi/full/10.1002/dvdy.20468
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5293490/

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	3	1	2
II	3	1	1
III	2	1	1
IV	2	2	1
V	2	2	1
TOTAL	**12**	**7**	**6**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	3	3
CO 2	3	3	3	2	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	**3**	**3**	**3**	**2.8**	**3**

PSO-CO-question paper mapping

CO NO.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO 1	Describe and illustrate the significance of cellular processes in embryonic development.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 2	Relate the factors that contribute to the developmental process, construct fate maps and illustrate the steps in morphogenesis and organogenesis.	PSO 1, PSO 2, PSO 3, PSO 5	K1, K2, K3, K4, K5, K6
CO 3	Correlate the involvement of specific cell types in the formation of specific organs and explain the importance of morphogens.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 4	Distinguish between the different types of developmental mechanisms in various organisms and appraise the species-based differences in development.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 5	Justify and validate the role of environment and genetics in influencing embryonic development.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

CORE VI: BIOTECHNOLOGY AND GENETIC ENGINEERING

PROGRAMME: B.Sc. Advanced Zoology and Biotechnology	**BATCH:** 2024
PART: III	**COURSE COMPONENT:** Core - VI
COURSE NAME: Biotechnology and Genetic Engineering	**COURSE CODE:**
SEMESTER: V	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 60
THEORY	

COURSE OBJECTIVE

Introduction to the tools of recombinant DNA technology, genetic engineering techniques, applications in healthcare, agriculture, and environment, as well as the emerging field of nanotechnology.

COURSE OUTCOMES (COs)

1. Analyze the global impact of biotechnology in improving healthcare through advancements in diagnostics, therapeutics, and personalized medicine.
2. Apply recombinant DNA technology steps, enzymes, cloning vector classifications, and host expression systems, facilitating competency in molecular biology techniques.
3. Master genetic engineering techniques for DNA manipulation and gene library construction, advancing their skills in molecular biology.
4. Understand animal biotechnology basics, including cell culture and transgenic animals, and their applications in medicine and agriculture, while considering ethical implications.
5. Gain insight into nanotechnology, including natural biopolymers and artificial nanoparticles, and understand their applications in medicine, medical devices, and biomimicry for self-cleaning surfaces.

Unit I **5 Hrs**

Scope and importance of biotechnology - Fields of biotechnology – History of biotechnology — Global impact of biotechnology in healthcare, aquaculture, agriculture and environment – Biotechnology in global and Indian scenario – Applications of Biotechnology

Unit II **20 Hrs**

Steps involved in recombinant DNA technology - Tools in Recombinant DNA technology: Enzymes – Nucleases: Exo and Endonuclease, DNase & RNase, DNA ligase, Alkaline Phosphatase, DNA polymerase, Reverse transcriptase, T4 polynucleotide kinase, terminal transferase, and homopolymer tailing.

Classification of Cloning Vectors: Based upon copy number, function - Cloning vector - Insertional vector, replacement vector, shuttle vector and expression vector system - Vectors -

pBR322, pUC vectors, Ti plasmid vector system - Bacteriophage: Salient feature and vector system - λ WES vectors, Charon vector, M13 vector system, Baculoviral vector system, pBluescript vector and YAC system - Host expression system selection - *E. coli* and *Saccharomyces cerevisiae* - Host system

Unit III **20 Hrs**

Techniques of Genetic Engineering: DNA isolation - Selection of vector system - Insertion of target DNA - Various transformation techniques of vector system into host system: Transformation, transduction, microinjection, cell fusion, liposome, electroporation - Screening and selection of recombinant cells - Selectable markers- Ap^r gene, Lac Z gene, HGPRT gene - Colony hybridization method and immunological test – Gene Library construction: Genomic Library and cDNA Library

Unit IV **8 Hrs**

Animal Biotechnology: History of animal cell culture – Requirements for animal cell culture– culture media and substrate – steps involved in animal tissue culture (isolation, disaggregation, establishment of cell culture) – Importance of Transgenic animals (mice, cow, sheep, hen, fish, silk worm) – Overview of tissue engineering - Skin construct for wound healing - Bioethics in animal genetic engineering - Knock out mice – Recombinant Vaccines – Gene therapy (in-vivo and ex-vivo), Production of recombinant proteins – Monoclonal antibodies – Insulin and Growth hormones – Medicine – Hepatitis vaccine production

Unit V **12 Hrs**

Nanotechnology: Definition – Natural biopolymers - Construction and importance: Chitosan, collagen, silk, keratin, gelatin and their applications. Types of artificial nanoparticles and their applications - Importance of nanotechnology in the field of medicine (gold, silver and bioceramics - hydroxyapatite, eye lens), medical devices (cell on microchip, Micro array: DNA, RNA and Protein), Biomimicry - peacock and Butterfly wing effect, Bat, Gecko effect, termites-hill, lotus leaf effect - self-cleaning

PRESCRIBED BOOKS

1. Dubey, RC., (1993). A Textbook of Biotechnology. S. Chand Publication.
2. Dubey, RC., (2014). Advanced Biotechnology. S. Chand Publication.
3. Purohit Mathur, (1999). Biotechnology Fundamental and Applications. Botanica Publications
4. Terence A. Brown. (2006). Gene cloning and DNA Analysis: An Introduction. (Wiley-Blackwell).
5. Bernard, R. Glick., Cheryl, L. Patten, (2017). Molecular Biotechnology, Principles and Applications of Recombinant DNA, 5th Edition, ASM Press.
6. Shanmugam, S., (2011). Nanotechnology. MJP Publishers.

7. Rakesh Rathi, Nanotechnology, S. Chand & Co.
8. Parthasarathy, B. K. (2007). Nanotechnology in Life Science. Gyan Books.

REFERENCE BOOKS

1. Shah, H. A., and Tokeer Ahmad, (2011). Principles of Nanoscience and Nanotechnology. Narosa Publishing House.
2. Brown. T. A., (2010). Gene Cloning and Introduction. Wiley Blackwell.
3. Brown, J. A. (2001). Genetics – A Molecular Approach. 3rd Edition, Nelson Tornes.
4. Old, R. W., and Primrose, S.B. (1994). Principles of Gene Manipulation. 5th Edition, Blackwell Scientific Publications.
5. John. R. W. Masters. (2000). Animal Cell Culture – A Practical Approach. 3rd Edition. Oxford Univ. Press.
6. Glick, B.R., and Jack, J. Pasternak, (1994). Molecular Biotechnology. ASM press.
7. Ramdoss, P. (2009). Animal Biotechnology: Recent Concepts and Developments. MJP Publishers.
8. Sambrook, J., Russell, D.W. (2001). Molecular Cloning: A Laboratory Manual (Cold Spring Harbour Laboratory Press).
9. Tuan Rocky, S. (1997). Recombinant Gene Expression Protocols (Edition Illustrated, Publisher Springer).
10. Subbiah Balaji, (2010). Nanotechnology. MJP Publishers.
11. Kumar, (2010). Principles of Nanotechnology. Sci. Tech. Publications (India).
12. Murty, B.S., Shankar. P., Baldev Raj, B. B., Rath, and James Murday. (2013). Textbook of Nanoscience and Nanotechnology

E-LEARNING RESOURCES

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8751662/
2. https://bio.libretexts.org/Bookshelves/Genetics/Genetics_Agriculture_and_Biotechnology_(Suza_and_Lee)/01%3A_Chapters/1.11%3A_Recombinant_DNA_Technology
3. https://microbenotes.com/vector-molecular biology/#:~:text=The%20selection%20of%20vectors%20thus,from%20one%20cell%20to%20another.
4. https://microbenotes.com/animal-cell-culture/
5. https://www.understandingnano.com/medicine.html

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	1	1	1
II	3	1	1
III	2	2	1
IV	3	2	2
V	3	1	1
TOTAL	**12**	**7**	**6**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	2	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	**3**	**3**	**3**	**2.8**	**3**

PSO-CO-question paper mapping

CO NO.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Analyze the global impact of biotechnology in improving healthcare through advancements in diagnostics, therapeutics, and personalized medicine.	PSO 1, PSO 2, PSO 3, PSO 5	K1, K2, K3, K4, K5, K6
CO2	Apply recombinant DNA technology steps, enzymes, cloning vector classifications, and host expression systems, facilitating competency in molecular biology techniques.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO3	Master genetic engineering techniques for DNA manipulation and gene library construction, advancing their skills in molecular biology.	PSO 1, PSO2, PSO3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO4	Understand animal biotechnology basics, including cell culture and transgenic animals, and their applications in medicine and agriculture, while considering ethical implications.	PSO 1, PSO2, PSO3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO5	Gain insight into nanotechnology, including natural biopolymers and artificial nanoparticles, and understand their applications in medicine, medical devices, and biomimicry for self-cleaning surfaces.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyze, K5= Evaluate, K6= Create

CORE VII: ANIMAL PHYSIOLOGY

PROGRAMME: B.Sc. Advanced Zoology and Biotechnology	**BATCH:** 2024
PART: III	**COURSE COMPONENT:** Core - VII
COURSE NAME: Animal Physiology	**COURSE CODE:**
SEMESTER: V	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 60
THEORY	

COURSE OBJECTIVE

To introduce students to the fundamentals of physiology, integrate their knowledge of the subject from molecular to organismal levels, and provide them with an understanding of how an animal's organ systems are regulated using a conceptual model of feedback to explain homeostasis.

COURSE OUTCOMES (COs)

1. Recognize the scope of physiology and the fundamentals of homeostasis. Comprehend the mechanisms underlying digestion and gastrointestinal disorders.
2. Explain and interpret the physiology of circulation and respiration and its related disorders.
3. Understand the physiological process of excretion, osmoregulation and thermoregulation.
4. Understand the physiology of muscles, nerves and reproductive system.
5. Acquire in-depth knowledge of endocrinology with classification of hormones, mode of actions, physiological function, feedback controls and related disorders.

Unit I **8 Hrs**

Introduction to Physiology: Definition - History - Branches and scope of physiology - Principles of homeostasis

Digestion: Definition and types of digestion - Digestion and absorption of carbohydrates, proteins and lipids in man - Nervous and hormonal control of digestion - Gastro-intestinal disorders

Unit II **12 Hrs**

Circulation: Structure of human heart – Blood: Composition and functions - Blood clotting mechanism - Theories and disorders of blood clotting - Origin and conduction of heart beat - Cardiac cycle - Heart sounds - Cardiac output and Stroke volume - Regulation of heart beat.

Pulse and Blood pressure: Definition and its clinical significance. ECG: Principle and its significance - Cardiovascular diseases: Arrhythmia, Coronary Artery Diseases (CAD),

Myocardial infarction, Heart failure, Cardiomyopathy, Rheumatic Heart disease, Stroke - Angiogram - Angioplasty – ESR

Respiration: Structure and functions of respiratory tract and Lungs. Respiratory pigments: Definition, types and its functions. Transport of respiratory gases: oxygen and carbondioxide transport - Respiratory volumes and capacities - Respiratory quotient

Respiratory disorders: hypoxia, hypocapnia and hypercapnia, asphyxia, carbon monoxide poisoning, bronchitis, asthma - Physiological effects of smoking - Oxygen therapy and Artificial Respiration

Unit III **8 Hrs**

Excretion: Excretory products: Definition - Classification of animals based on excretory products - Structure and functional anatomy of human kidney – Nephron - Physiology of urine formation - Hormonal regulation of excretion.

Renal failure - Dialysis - Kidney transplantation

Osmoregulation: Osmoregulators and Osmoconformers - Mechanism of Osmoregulation in freshwater and marine fishes and crustaceans.

Thermoregulation: Temperature regulation in poikilotherms and homeotherms - Physiology of hibernation, aestivation and diapause

Unit IV **20 Hrs**

Muscle: Definition, types and properties of muscles - Contractile proteins - Ultrastructure of skeletal muscles - Mechanisms and theories of muscle contraction - Physiological and biochemical changes during muscle contraction - Simple muscle twitch, muscle fatigue, tetanus, rigor mortis

Neural conduction: Structure of a neuron and its types - Nerve impulse – Definition, resting membrane potential, action potential - Neurotransmitters and its significance - Conduction of nerve impulse - Synaptic transmission, neuromuscular junctions - Reflex action and reflex arc

Nerve disorders – Epilepsy, Alzheimer's disease, Parkinson's disease

Reproductive Physiology: Male and female reproductive organs. Physiology of male and female reproductive system.

Unit V **12 Hrs**

Endocrine System

Hormones: Salient features, Classification and Regulation of their secretion - Modes of hormone action: signal transduction pathway for steroidal and non-steroidal hormones - Homoeostasis and Feedback mechanism

Endocrinology: Endocrine glands – Structure, secretions, functions and disorders of endocrine glands of vertebrates – Pituitary, Thyroid, Parathyroid, Adrenal, Islets of Langerhans.

PRESCRIBED BOOKS

1. Guyton, A.X. (1986). Text Book of Medical Physiology, 7th Edition, Saunders Company.
2. Gerard, J. Tortora., Bryan Derrickson. (2000). Principles of Anatomy and Physiology. JohnWiley & Sons, Inc.
3. Verma, P.S., Agarwal, V.K., and Tyagi, B.S. (1995). Text Book of Animal Physiology. S. Chand & Co.
4. Rastogi, S.C. (1977). Essentials of Animal Physiology. New Age International (P) Ltd., Publisher.
5. Shenbulingam, K., and Prema Shenbulingam. (1999). Essentials of Medical Physiology. Jaypee Brothers Medical Publishers (P) Ltd.
6. Berry, A.K. (1998). A Text Book of Animal Physiology and Biochemistry. Emkay Publications, New Delhi, 320 pp.

REFERENCE BOOKS

1. Best, J.P. (1985). Best and Taylor's Physiological Basis of Medical Practice. 11th Edition, William and Wilkins.
2. Ganong, W.F. (2003). Review of Medical Physiology. McGraw Hill, New Delhi.
3. Schmidt-Nielson K. (2002). Animal Physiology. Prentice Hall India Ltd.
4. Hoar, W.S. (1983). General and Comparative Physiology, Adaptation and Environment. 3rd Edition, Cambridge University Press.
5. Widmaier, E.P., Raff, H., and Strang, K.T. (2008) Vander 's Human Physiology. 11th Edition, McGraw Hill
6. Pat Willmer., Graham Stone, and Ian Johnston. (2000). Environmental Physiology of Animals. Blackwell Publishing Company.
7. Golds Worthy, G.J., Robinson, J., and Mordue, W. (1981). Endocrinology. John Wiley and Sons, New York.
8. Hill, W.R., Wyse, G.A., and Anderson, M. (2016). Animal Physiology. 4th Edition. Sinauer Associates is an imprint of Oxford University Press, USA, 828 pp.
9. Prosser, C.L., (1985). Comparative Animal Physiology, Satish Book Enterprise, Agra - 282 003, 966 pp.
10. Sarada Subrahmanyam, Madhavan Kutty, K., & Singh H.D., (2018). Text Book of Human Physiology, S. Chand and Co, New Delhi.
11. Singh, H.R., and Kumar, N. (2017). Animal Physiology and Biochemistry, Vishal Publishing Company, Jalandhar, 864 pp.
12. Wood, D.W., (1968). Principles of Animal Physiology, Edward Arnold Ltd., London., 342 pp.

E-LEARNING RESOURCES:

1. https://openstax.org/details/books/anatomy-and-physiology-2e
2. https://www.khanacademy.org/science/health-and-medicine/human-anatomy-and-physiology
3. https://epgp.inflibnet.ac.in/
4. https://maxanim.com/physiology/
5. https://www.visiblebody.com/
6. https://teachmephysiology.com/
7. https://www.innerbody.com/htm/body.html
8. https://libguides.schoolcraft.edu/c.php?g=675692&p=4761013
9. https://open.umn.edu/opentextbooks/textbooks/169
10. https://human.biodigital.com

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
			TOTAL	**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	2	1	1
II	2	1	2
III	3	2	1
IV	3	2	1
V	2	1	1
TOTAL	**12**	**7**	**6**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	**3**	**3**	**3**	**3**	**3**

PSO-CO-question paper mapping

CO NO.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO 1	Recognize the scope of physiology and the fundamentals of homeostasis. Comprehend the mechanisms underlying digestion and gastrointestinal disorders.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 2	Explain and interpret the physiology of circulation and respiration and its related disorders.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 3	Understand the physiological process of excretion, osmoregulation and thermoregulation.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 4	Understand the physiology of muscles, nerves and reproductive system	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 5	Acquire in-depth knowledge of endocrinology with classification of hormones, mode of actions, physiological function, feedback controls and related disorders.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyze, K5= Evaluate, K6= Create

CORE VIII: BIOSTATISTICS, COMPUTER APPLICATIONS AND BIOINFORMATICS

PROGRAMME: B.Sc. Advanced Zoology and Biotechnology	**BATCH:** 2024
PART: III	**COURSE COMPONENT:** Core - VIII
COURSE NAME: Biostatistics, Computer Applications and Bioinformatics	**COURSE CODE:**
SEMESTER: V	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 75
THEORY AND PROBLEM	

COURSE OBJECTIVE

To introduce the key concepts of biostatistics and how to use them to analyze biological data and draw conclusions from analyzed data, as well as to familiarize students with data science so that they can perform data analysis using statistics. Using a multidisciplinary approach, the course also assists the student in mastering the rapidly evolving field of bioinformatics.

COURSE OUTCOMES (COs)

1. Remember the general concepts and to know about the diagrammatic representations and graphical representations of a data.
2. Understand how to calculate the mean deviation, standard deviation, correlation coefficient, chi-square analysis, student 't' test and ANOVA using the formula.
3. Apply, explore and understand how to use the **R** documentation.
4. Analyze and facilitate students to understand the basic concepts and the different data structures in **R**.
5. Impart and evaluate a deep knowledge on Bioinformatics and databases.

Unit I **15 Hrs**

Introduction to Biostatistics - Types of data, Collection, Classification and Tabulation of the Primary data, Secondary Data, Discrete data and Continuous data, Diagrammatic and Graphical representation of grouped data - Frequency Distribution (univariate and bivariate) -Cumulative frequency distribution and their graphical representation, Histogram frequency polygon - Concept of central tendency -Measures of dispersion

Unit II **15 Hrs**

Normal distribution – Theories of probability - Hypothesis testing - Student's t-test - Chi-square analysis – Correlation - Types and Rank Correlation - Regression Analysis - ANOVA

Unit III **15 Hrs**

Computer network- Introduction - Types (LAN, MAN, WAN) - Social networks - Uses of Internet

Introduction – R Features: How to run R - Variables - Basic data types - Operators - Data structure - Vectors - Data frames - Lists - Matrices - Arrays, Factors

Unit IV **15 Hrs**

R Programming Structure – Control statements – Loops – R Functions – Input / Output accessing the keyboard and monitor, reading and writer files - R graphics – R Plot, Line R, Scatterplot R, Pie Charts, R Bars

Unit V **15 Hrs**

Overview of Bioinformatics: Definition, Scope, Development and Major tasks - Databases Characteristics - Categories of databases-Nucleotide sequence database-EMBL, GenBank and DDBJ- Protein sequence database- SWISS-PROT, UniProt- Structure database - PDB, SCOP - Introduction to sequence analysis tool - Sequence alignment - BLAST- Applications of bioinformatics.

PRESCRIBED BOOKS

1. Sandip Rakshit. Statistics with R Programming. McGraw Hill Education.
2. R for Dummies. Rie de Vries Publisher, John Wiley & Sons
3. Kiran Pandya, Statistical Analysis in Simple Steps Using R. SAGE Publications Limited.
4. Jared, P., Lander. R for Everyone. Pearson Education Publisher.
5. Paul Teetor. R Cookbook, Oreilly.
6. Gareth James. An Introduction to Statistical Learning: With Applications in R. SpringerPublisher.
7. "R in Action, Rob Kabacoff, Manning"
8. Bioinformatics: Methods and Applications: genomics, proteomics and drug discovery by S.C. Rastogi

REFERENCE BOOKS

1. Arora, P.N., and Malhotra, P.K., (1996). Biostatistics (Himalaya Publishing House, Mumbai).
2. Sokal and Rohlf, (1973). Introduction to Biostatistics (Toppan Co. Japan).
3. Evens, W. J., Grant, G. R. (2005). Statistical Methods in Bioinformatics: An Introduction (Springer).
4. Sinha, P.K. (2004). Computer Fundamentals (BPB).
5. Suresh, K. Basandra (2008). Computers today (Galgotia Publications Pvt. Ltd., New Delhi).
6. Bioinformatics Data Skills: R Cookbook

E-LEARNING RESOURCES

1. https://ncert.nic.in/textbook/pdf/kest104.pdf
2. https://nios.ac.in/media/documents/SecMathcour/Eng/Chapter-25.pdf
3. https://www.analyticsvidhya.com
4. https://www.statisticssolutions.com
5. https://www.raybiotech.com
6. https://www.mycompiler.io/online-r-compiler
7. https://www.r-project.org/about.html
8. https://www.geeksforgeeks.org/data-structures-in-r-programming/
9. https://www.bioinformatics.org/
10. https://medium.com/@mayantamilian/flow-a-web-platform-analyse-bioinformatics-data-8f2799cf7951
11. https://omicstutorials.com/biologists-guide-to-bioinformatics-databases-tools-and-cross-platform-analyses/

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	1(Theory) + 2 (Problem)	1	2
II	2	1	1 (Problem)
III	3	1	1
IV	2	2	1
V	2	**2**	1
TOTAL	**12**	**7**	**6**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	2	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	**2.8**	**3**	**3**	**3**	**3**

PSO-CO-question paper mapping

CO NO.	COURSE OUTOCME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO 1	Remember the general concepts and to know about the diagrammatic representations and graphical representations of a data.	PSO 1, PSO 2, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 2	Understand how to calculate the mean deviation, standard deviation, correlation coefficient, chi-square analysis, student 't' test and ANOVA using the formula.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 3	Apply, explore and understand how to use the **R** documentation.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5,	K1, K2, K3, K4, K5, K6
CO 4	Analyze and facilitate students to understand the basic concepts and the different data structures in **R**.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 5	Impart and evaluate a deep knowledge on Bioinformatics and databases.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

SEMESTER VI

CORE IX: ENVIRONMENTAL BIOLOGY AND ENVIRONMENTAL BIOTECHNOLOGY

PROGRAMME: B.Sc. Advanced Zoology and Biotechnology	**BATCH:** 2024
PART: III	**COURSE COMPONENT:** Core - IX
COURSE NAME: Environmental Biology and Environmental Biotechnology	**COURSE CODE:**
SEMESTER: VI	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 60
THEORY	

COURSE OBJECTIVE

To educate the students about the basic environmental phenomena and enable them to understand the adaptations of the animals to their environment and to study about the conservation of resources via the recycling of waste materials and bioremediation of industry effluents.

COURSE OUTCOMES (COs)

1. Create an awareness to the students about the concepts and basics of Environmental Biology and Environmental Biotechnology.
2. Provide students about the idea of biogeochemical cycles and energy flow in ecosystems.
3. Make an awareness of the freshwater habitat, marine habitat and natural resources conservation.
4. Provide an adequate explanation to students about pollution and population ecology.
5. Give an idea about the bioremediation of industry effluent and vermicomposting

Unit I **12 Hrs**

Ecology: Definition - Subdivision and scope of ecology - Ecological factors - Temperature and light as ecological factors.

Ecosystem: Definition – Types of Ecosystem - Components of ecosystem - Grazing and detritus type of food chain - Food web and trophic levels - Ecological pyramids - Pyramids of number - Biomass and Energy

Unit II **12 Hrs**

Energy flow: Flow of energy through a food chain in relation to laws of thermodynamics.

Biogeochemical Cycles: Nitrogen and Phosphorous cycle

Laws of limiting factor- Liebig's law of minimum, Shelford's law of tolerance and concept of limiting factors.

Ecological Niche: Concept of ecological niche - **Ecological succession** – Definition - Types of succession

Unit III **10 Hrs**

Freshwater Habitats: Lentic and lotic

Marine Habitat: Zonation - Intertidal sandy shore, intertidal muddy shore, rocky shore – Deep sea adaptation

Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones

Population Ecology: 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.

National and International Environmental Organizations - Red Data Book - Wildlife management – Conservation of biodiversity.

Unit IV **13 Hrs**

Environmental Biotechnology

Bioremediation of Environmental Pollutants in soil and water – oils, heavy metals and detergents – Microbial biodegradation of Xenobiotic compounds – Bioremediation - concepts and application – Biotreatment of dye industrial waste – source and origin of dyes. Treatment technologies of dyes – Bioplastics: Biopols (PHB), Biolac (Polylactic acid)

Unit V **13 Hrs**

Non-conventional source – Biomasses as a source of bioenergy – types of biomass – plant, animal and microbial biomass – Various industrial effluent treatment methods – sugar,distillery, dairy, tannery and pharmaceutical industries – Biogas from solid waste – composting and vermicomposting

PRESCRIBED BOOKS

1. Mayr, E., Principles of Systematic Zoology. McGraw-Hall, New York.
2. Kreb, J.C., Ecology. Harper & Row, Publ., New York.
3. Odum, E.P., Fundamentals of Ecology. Saunders College Publishers, Philadelphia.
4. George, L.C., Elements of Ecology. Johnes Wiley, New York.
5. Kendeigh, S.C., Ecology with Special Reference to Animals. Prentice-Hall of India, New Delhi
6. Smith, Ecology. Harper & Row Publishers, New York.
7. Kormondy, Concepts of Ecology. Prentice Hall of India, New Delhi.
8. Jogdand, G. N. (1995). Environmental Biotechnology. Himalaya Publishers.
9. Colinvaux, P. A. (1993) Ecology. 2nd Edition, Wiley, John and Sons, Inc.
10. Stiling, P. D. (2012) Ecology Companion Site: Global Insights and Investigations. McGraw Hill Education.

REFERENCE BOOKS

1. Saha, T.K. (2010). Ecology and Environmental Biology. Books and Allied, Kolkata.
2. Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth system Approach, Oxford University Press, UK.
3. Agarwal, S. K. (1998). Environmental Biotechnology, APH Publishers
4. Alan Scragg. (1999). Environmental Biotechnology, Longman Environmental Biotechnology: Concepts and Application" by Jordening H J and Winter J n Publication.
5. Evans, G. M., and Furlong, J. C. Environmental Biotechnology: Theory and Application.
6. Bhattacharya, B. C. and Banerjee, R. Environmental Biotechnology.
7. Indu Shekhar Thakur. Environmental Biotechnology: Basic Concepts and Applications
8. Mohapatra, P K. Textbook of Environmental Biotechnology

E-LEARNING RESOURCES:

1. https://www.khanacademy.org/
2. https://www.pmfias.com/
3. https://onlinelibrary.wiley.com/doi/abs/10.1002/rem.20057
4. https://www.intechopen.com/chapters/70661
5. https://www.frontiersin.org/articles/10.3389/fagro.2023.1183691
6. https://onlinelibrary.wiley.com/doi/abs/10.1002/jobm.202100225
7. https://www.degruyter.com/document/doi/10.1515/9783111016825/html
8. https://bio.libretexts.org/
9. https://ecologyandevolution.cornell.edu/

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	3	1	2
II	3	1	1
III	2	1	1
IV	2	2	1
V	2	2	1
TOTAL	**12**	**7**	**6**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	3	3
CO 2	3	3	2	3	3
CO 3	3	2	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	**3**	**2.8**	**2.8**	**3**	**3**

PSO-CO-question paper mapping

CO NO.	COURSE OUTOCME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO 1	Create an awareness to the students about the concepts and basics of Environmental Biology and Environmental Biotechnology.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 2	Provide students about the idea of biogeochemical cycles and energy flow in ecosystems	PSO 1, PSO 2, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 3	Make an awareness of the freshwater habitat, marine habitat and natural resources conservation.	PSO1, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 4	Provide an adequate explanation to students about pollution and population ecology.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 5	Give an idea about the bioremediation of industry effluent and vermicomposting.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

CORE X: BIOCHEMISTRY

PROGRAMME: B.Sc. Advanced Zoology and Biotechnology	**BATCH: 2024**
PART: III	**COURSE COMPONENT:** Core - X
COURSE NAME: Biochemistry	**COURSE CODE:**
SEMESTER: VI	**MARKS:**100
CREDITS: 4	**TOTAL HOURS: 60**
THEORY	

COURSE OBJECTIVE

To introduce students to the fundamental concepts of biochemistry and its interdisciplinary nature, as well as to help them understand the physical and chemical properties of molecules, metabolic pathways and their status in biological systems.

COURSE OUTCOMES (COs)

1. Understand the basic concepts of formation of biomolecules and comprehend the structure, classification of carbohydrates and their role in biological system
2. Identify the structure, classification and biological significance of proteins, amino acids, nucleic acids and lipids
3. Gain an understanding of the fundamentals of bioenergetics and metabolism and develop a thorough understanding of the regulation of different metabolic pathways and their associated disorders
4. Acquire fundamental knowledge on enzymes and their importance in biological reaction and to understand significance of enzyme kinetics, enzyme regulation and inhibition.
5. Gain competence in nutraceuticals, functional foods, pigments, xenobiotics and antioxidants, phytochemistry and pharmacognosy

Unit I **12 Hrs**

Biochemistry: Scope and significance of biochemistry – Fundamental properties of elements, their role in formation of biomolecules and in chemical reactions within living organisms. Units of Measurement.

Water – Unique property of water as universal solvent and its importance in biological system,

Biomolecules

Carbohydrates: Structure, Classification, Properties and Biological functions – Interconversion of sugars – Glycoproteins and glycolipids and their importance in biological system.

Unit II **12 Hrs**

Biomolecules: Proteins and Amino acids: Amino acids – Structure, classification and properties – Essential and non-essential amino acids – Peptide bonds – Ramachandran Plot –

Structural hierarchy of proteins – primary, secondary, tertiary and quaternary structures - Proteins – Classification, properties – Globular and fibrous proteins – Structure and functions of hemoglobin, myoglobin, collagen, elastin and keratin

Lipids: Structure, classification, properties and biological significance – Fatty acids – saturated and unsaturated fatty acids - Essential and non-essential fatty acids - Triglycerides – Cholesterol and Plant sterols

Nucleic Acids: Purines and Pyrimidines – Structure and properties – Nucleosides – Nucleotides – DNA and RNA – Biological significance.

Unit III **12 Hrs**

Metabolism: Definition - Catabolism Vs Anabolism - Stages of catabolism, compartmentalization of metabolic pathways - Regulation of metabolism

Bioenergetics – Free energy, free energy change, exergonic and endergonic reactions - High energy compounds – ATP – Substrate level and Oxidative Phosphorylation

Carbohydrate Metabolism: Carbohydrate metabolism: Glycogenesis, Glycogenolysis, Gluconeogenesis and Glycolysis; Krebs cycle, Electron Transport Chain, Oxidative phosphorylation - Regulation of carbohydrate metabolism – Hexose Monophosphate Shunt (HMP) - Disorders of Carbohydrate Metabolism – Diabetes mellitus, Galactosemia, Fructosemia and Glycogen Storage Disease

Lipid Metabolism: Fatty acid biosynthesis and regulation **–** Biosynthesis of triacylglycerol, phospholipids – Metabolism of cholesterol - Fatty acid oxidation – β-oxidation, its energetics and regulation – Ketone bodies – Formation, utilization and excretion – Biosynthesis of Triacylglycerol and phospholipids - Lipid storage diseases and fatty liver

Protein Metabolism: Transamination, Deamination, Decarboxylation, Urea cycle and its regulation; Fate of C-skeleton of Glucogenic and Ketogenic amino acids – Regulation of protein metabolism – Disorders of amino acids - Tyrosinemia, Cystinuria, Homocystinuria, Ornithine Transcarbamylase deficiency

Metabolism of Nucleic Acids: Synthesis and Degradation of Purines and Pyrimidines - Synthesis of Nucleotides and its regulation

Unit IV **12 Hrs**

Enzymes: Definition, Nomenclature, Classification, Properties, Biological functions - Ribozymes – Abzymes - Mechanism of enzyme action: Lock and key hypothesis, induced fit theory - **Enzyme kinetics**: Definition, Michaelis Menten equation, Line Weaver Burk Plot - Significance of K_m and V_{max} - Enzyme inhibition and Regulation - Factors affecting enzyme activity.

Co-enzymes - Multienzyme complex – Pyruvate dehydrogenase – Isoenzymes – Lactate Dehydrogenase (LDH) - Immobilized enzymes – Principles and Applications: Enzymes as a marker in clinical diagnosis – Industrial Applications of enzymes

Unit V **12 Hrs**

Special Topics (Brief Account) - Nutraceuticals and Functional Foods – Natural pigments and their applications – Metabolism of xenobiotics and detoxification – Free radicals and anti-oxidants - Phytochemistry and Pharmacognosy

PRESCRIBED BOOKS

1. Jain, J.L. *et.al.*, (2005). Fundamentals of Biochemistry. S. Chand & Co, New Delhi.
2. Ambika Shanmugam. Fundamentals of Biochemistry for Medical Students. Wolters Kluwer (India) Pvt. Ltd., New Delhi
3. Satyanarayana, U., Chakrapani, U. (1999). Biochemistry. Books and Allied (P) Ltd.
4. Lehninger A.L., Nelson D.L., Cox M.M. (2005). Principles of biochemistry (W. H. Freeman,USA).

REFERENCE BOOKS

1. Stryer, L. J. M., Berg, J.L., Tymoczko. (2001). Biochemistry (W.H. Freeman and Company, New York).
2. Rawn, J.D. (1989). Biochemistry (Neil Patterson).
3. Voet, D., Voet, J.G. (2004). Biochemistry (John Wiley & Sons).
4. Voet, D., Voet, J.G. and Pratt, C.W. (2008). Fundamentals of Biochemistry: Life at themolecular level (John Wiley & Sons).

E-LEARNING RESOURCES:

1. https://www.khanacademy.org/search?page_search_query=Biochemistry
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9654660/
3. https://openstax.org/books/anatomy-and-physiology-2e/pages/24-2-carbohydrate-metabolism
4. https://www.egyankosh.ac.in/bitstream/123456789/71047/1/Unit-8.pdf
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3249911/

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
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C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	2	1	1
II	2	1	1
III	2	2	2
IV	3	2	1
V	3	1	1
TOTAL	**12**	**7**	**6**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	2	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	**3**	**3**	**3**	**2.8**	**3**

PSO-CO-question paper mapping

CO NO.	COURSE OUTOCME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO 1	Understand the basic concepts of formation of biomolecules and comprehend the structure, classification of carbohydrates and their role in biological system	PSO 1, PSO 2, PSO 3, PSO 5	K1, K2, K3, K4, K5, K6
CO 2	Identify the structure, classification and biological significance of proteins, amino acids, nucleic acids and lipids	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 3	Gain an understanding of the fundamentals of bioenergetics and metabolism and develop a thorough understanding of the regulation of different metabolic pathways and their associated disorders	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 4	Acquire fundamental knowledge on enzymes and their importance in biological reaction and to understand significance of enzyme kinetics, enzyme regulation and inhibition	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 5	Gain competence in nutraceuticals, functional foods, pigments, xenobiotics and antioxidants, phytochemistry and pharmacognosy	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

CORE XI: MICROBIOLOGY AND IMMUNOLOGY

PROGRAMME: B.Sc. Advanced Zoology and Biotechnology	**BATCH:** 2024
PART: III	**COURSE COMPONENT:** Core - XI
COURSE NAME: Microbiology and Immunology	**COURSE CODE:**
SEMESTER: VI	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 60
THEORY	

COURSE OBJECTIVE

To acquaint students with the basic concepts and applications of microbiology and immunology and to develop the abilities to integrate microbiological and immunological concepts.

COURSE OUTCOMES (COs)

1. Understand the history, relevance of microbiology, classification of microorganisms, and acquire knowledge on the bacterial growth, nutritional requirements of microorganisms, and microbial culture techniques.
2. Understand the cause of various bacterial and viral disease and prevention.
3. Appreciate the role of microbes in food, dairy, soil, water and gain knowledge on the fermentation process and production of commercially important products.
4. Annotate the fundamental concepts of immunity and contributions of the organs and cells in immune response and immunity.
5. Demonstrate an understanding of antigens, antibodies complement system, major histocompatibility complex, autoimmune disease, vaccine and acquire knowledge on various immunological techniques

Unit I **12 Hrs**

History and Scope of Microbiology – Whittaker's classification of microorganisms – Ultra structure of bacteria – Salient features and classification of microbes (Bacteria, Virus, Actinomycetes and Fungi). Bacterial growth and nutritional requirements – Culture techniques and Types of culture media – Media preparation – Sterilization techniques – Preservation – Staining (Gram's staining).

Unit II **12 Hrs**

Medical Microbiology – Study of common bacterial and viral diseases in man: Causative organisms, mode of transmission, pathogenicity, symptoms and preventive measures - Bacterial diseases - Typhoid, Tuberculosis, Leprosy, Syphilis - Viral diseases - Influenza, Poxviruses (Chicken pox) Hepatitis- B, AIDS –

Unit III **12 Hrs**

Food Microbiology –Microbial food spoilage, food poisoning, physico-chemical methods in food preservation.
Dairy Microbiology - Pasteurization, Fermented milk products (Curd and Cheese).

Industrial Microbiology - Basic design of fermentor, industrial fermentation of ethanol, penicillin and enzymes (Cellulase, Lipase, Proteases, Amylase).

Soil Microbiology - Common soil microbes – Plant growth promoting microbes (bacteria and endophytic fungus) – Siderophores – Phosphatase, IAA, biofertilizer

Water Microbiology: Microbiology of drinking water - Water-borne diseases

Unit IV **12 Hrs**

Immunology: Scope of Immunology - **Types of Immunity** - Innate and Acquired - **Cell and Organ** – Structure and Functions - Origin and Differentiation – Significance - **Immune response** - Humoral and Cell mediated immune response - Mechanism- Primary and Secondary immune response.

Unit V **12 Hrs**

Antigens – Definition, Classification of antigens, functional attributes of antigens, factors influencing antigens.

Antibody - Immunoglobulins - Structure, types, distribution and immunological functions

Complement System – Classical, Alternative and Lectin pathways.

Major Histocompatibility Complex (MHC) – Classes and immunological significance - Classes Hypersensitivity - Types with examples.

Autoimmune Diseases - Concept and types - Organ transplantation- Types of graft, Mechanism of allograft rejection.

Vaccines - Types, Vaccination schedule.

Immunological Techniques in Clinical Diagnosis

PRESCRIBED BOOKS

Microbiology

1. Jacquelyn, G. Black, Laura, J. Black, (2005). Microbiology: Principles and Exploration. Wiley
2. Subhash Chandra Parija, (2009). Textbook of Microbiology and Immunology. Elsevier-Reed Elsevier India Pvt. Ltd.
3. Dubey, R. C. and Maheshwari, D.K. (2005). A Text Book of Microbiology. S. Chand & Co.Ltd., New Delhi.

4. Tortora, Funke, and Case. (2006). Microbiology - An Introduction. Pearson Education.
5. Pelczar, Jr. M.J., Chan, E.C.S., and Kreig, N.R. (2001). Microbiology. McGraw Hill Inc. NewYork.
6. Aneja, K.R., Experiments in Microbiology, Plant Pathology, Tissue culture and Mushroom Cultivation, New Age International, New Delhi.
7. Atlas, R.M., Microbiology – Fundamentals and Applications, MacMillan Publishing Company, New York.
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Immunology

1. Kuby, J., Punt, J., Stranford, S., Jones, P., and Owen, J. (2018). Immunology. 8th Edition, W.H. Freeman Publishing, New York, 944 PP.
2. Roitt, M., Peter, J., Delves, Seamus, J., Martin, and Dennis, R., Burton. (2017). Essential Immunology, 13th Edition, Wiley-Blackwell Publishing, USA, 576 PP.
3. Rao, C.V. (2006). Immunology. Narosa Publishing House, New Delhi.

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1. Alexopoulos, C.J., and Mims, C.W., Introductory Mycology. New Age International, New Delhi.
2. Joanne, M. Willey, Linda, M. Sherwood, and Christopher, J. Woolverton, (2008). Microbiology. McGraw-Hill International Edition.
3. Sundara Rajan, S. (2002). College Microbiology. Vol. I to IV, Vardhana Publications, Bangalore – 560 095.
4. Thomas M. Bell. (1965). An Introduction to General Virology. William Heinemann Medical Books, London.
5. Alexander N. Glazer., and Hiroshi Nikaido. (1994). Microbial Biotechnology: Fundamentals of Applied Microbiology. W.H. Freeman and Co., New York.
6. Salle, A.J. Fundamental Principles of Bacteriology. Tata McGraw-Hill Publishing Company Limited, New Delhi.
7. Stuart Hogg. (2005). Essential Microbiology. John Wiley & Sons Ltd.
8. Stainer, R.Y., Ingraham J.L., Wheelis M.L. and Painter P.R., (1999) General Microbiology. Macmillan Education Ltd. London.
9. Rittmann, B.E., and McCarty, P.L., (2001). Environmental Biotechnology: Principles and Applications. McGraw-Hill, New York.
10. Edward Alcamo, (1995). Microbiology. Wiley Publishing Inc.
11. Thomas J Montville, Karl R. Mathews, (2005). Food Microbiology: An Introduction. ASM Press, Washington, DC.
12. Benson Harold, J. Microbiological Applications. WCB McGraw – Hill, New York.

13. Brock, T.D., and Madigan, M.T. Biology of Microorganisms. Prentice Hall of India Private Limited.
14. Collins, C.H., Patricia, M., and Lyne, J. M. (1995). Collins and Lynes Microbiological Methods. 7th Edition. Grange, Butter Worth, Oxford.
15. Cappucino, J. G., and Sherman, N. (1996). Microbiology, A Laboratory Manual 4th Edition. Benjamin Cumings Inc. California.
16. Madigan, M. T., Martinko, J. M., and Parker, J. (2012). Brock Biology of Microorganism. 11th Edition, Prentice Hall International Inc. London.

Immunology

1. Abbas, K. Abul, and Lechtman, H., Andrew. (2003) Cellular and Molecular Immunology. 5th Edition, Saunders Publication.
2. Kannan, I. (2007). Immunology. MJP Publishers, Chennai.
3. Kenneth Murphy, and Casey Weaver. Janeway's Immunobiology, 9th Edition, Garland Science
4. Turner, C.D., and Bagnars, W.B. (1976) General Endocrinology, Saunders Company.
5. Chakravarthy, A. K. (1996). Immunology, Tata McGraw-Hill, New Delhi.
6. Abul, A., Andrew, Lichtman. H., Shiv. P. (2014). Cellular and Molecular Immunology, 8th Edition, Published by W.B. Saunders, 544 PP.
7. Chapel, H., Haeney, M., Misbah, S., and Snowden, N. (2006). Essentials of Clinical Immunology. 5th Edition, Blackwell Publishing, 368 PP.

E-LEARNING RESOURCES

1. https://www.medicine.mcgill.ca/physio/vlab/immun/backg.html
2. https://www.ncbi.nlm.nih.gov/books/NBK27156/
3. https://www.ncbi.nlm.nih.gov/books/NBK27156/
4. https://core.ac.uk/download/pdf/10863427.pdf
5. https://www.roitt.com/pdf/Online_Chapter.pdf
6. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6723656/
7. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4844621/
8. https://egyankosh.ac.in/bitstream/123456789/12425/1/Unit-4.pdf
9. https://vlab.amrita.edu/?sub=3&brch=73
10. https://learn.chm.msu.edu/vibl/
11. https://mvi-au.vlabs.ac.in/
12. https://virtuallab.tlc.ontariotechu.ca/intro.php
13. https://www.merlot.org/merlot/viewMaterial.htm?id=79694

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	3	2	1
II	2	1	1
III	2	1	1
IV	3	2	2
V	2	1	1
TOTAL	**12**	**7**	**6**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	3	3
CO 2	3	3	3	2	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	**3**	**3**	**3**	**2.8**	**3**

PSO-CO-question paper mapping

CO NO.	COURSE OUTOCME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO 1	Understand the history, relevance of microbiology, classification of microorganisms, and acquire knowledge on the bacterial growth, nutritional requirements of microorganisms, and microbial culture techniques.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 2	Understand the cause of various bacterial and viral disease and prevention.	PSO 1, PSO 2, PSO 3, PSO 5	K1, K2, K3, K4, K5, K6
CO 3	Appreciate the role of microbes in food, dairy, soil, water and gain knowledge on the fermentation process and production of commercially important products.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 4	Annotate the fundamental concepts of immunity and contributions of the organs and cells in immune response and immunity.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO 5	Demonstrate an understanding of antigens, antibodies complement system, major histocompatibility complex, autoimmune disease, vaccine and acquire knowledge on various immunological techniques.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

ELECTIVE II: CLINICAL LABORATORY TECHNIQUES

PROGRAMME: B.Sc. Advanced Zoology and Biotechnology	**BATCH:** 2024
PART: III	**COURSE COMPONENT:** Elective - II
COURSE NAME: Clinical Laboratory Techniques	**COURSE CODE:**
SEMESTER: VI	**MARKS:**100
CREDITS: 5	**TOTAL HOURS:** 75
THEORY	

COURSE OBJECTIVE

Mastering the foundational principles and methodologies of Clinical Laboratory Techniques, which is essential for accurate diagnostic testing and patient care.

COURSE OUTCOMES

1. Gain comprehensive understanding and adherence to ethical standards, safety protocols, and professional conduct in clinical laboratory settings, ensuring effective management and operation.
2. Demonstrate proficiency in operating and maintaining common laboratory equipment essential for accurate diagnostic testing and research in clinical laboratory settings.
3. Expertise in the comprehensive process of blood specimen collection, preservation, analysis, and interpretation, enabling accurate diagnosis and patient care in clinical laboratory settings.
4. Acquire proficiency in conducting a range of diagnostic tests for liver function, urine analysis, and microscopic examination of bodily fluids, ensuring accurate assessment of renal and gastrointestinal health in clinical laboratory settings.
5. Develop skills in analyzing semen samples to provide valuable insights into male fertility and reproductive health.

Unit I **15 Hrs**

Introduction – Scope of the subject - Basic laboratory principles - Code of conduct of medical laboratory personnel - Use of the laboratory - Organization of clinical laboratory and role of medical laboratory technician - Medical laboratory professional and professionalism in laboratory workers - Clinical Laboratory records - Clinical borne infection and personnel hygiene - Common causes of accidents in lab – laboratory safety – Biomedical waste.

Unit II **15 Hrs**

Common Laboratory Equipment's**:** Incubator, Hot Air Oven, Water Bath - Anaerobic Jar, Centrifuge, Autoclave, Colorimeter, pH meter, Haemoglobinometer, Hemocytometer, Microtome,

Unit III **15 Hrs**

Basic steps for drawing a blood specimen - requirement of blood collection - Blood collection - Phlebotomy - Sampling errors - Collection and preservation of biological fluids - Anticoagulants - Preservation of samples - Chemical preservatives - Process of analyzing the specimens - The laboratory report.

Total Cell Count – RBC, WBC, platelets and absolute eosinophil count - Estimation of hemoglobin PCV and Erythrocyte Indices - M.C.V. - M.C.H - M.C.H.C (Methods andprocess of estimation) - Erythrocyte Sedimentation Rate (E.S.R.) - Westergren Method - Factors influencing sedimentation - Laboratory factors which influence ESR - Importance of ESR reticulocyte count - Differential Count - Bleeding time - clotting time - prothrombin time

Unit IV **15 Hrs**

Liver function test - Examination of Urine – Collection of urine – Urine Routine, Blood Sugar routine

Microscopic Examination of Urine: Kidney function test - Crystals found in urine (uric acid and urates, Calcium oxalates, Cystine, Drug crystals, Ammonium magnesium phosphates, Calcium carbonate) - Casts in urine - Cells in urine - RBC, pus cells, epithelial cells, spermatozoa, bacteria and tumour cells Examination of stool - physical, chemical and microscopic examination

Unit V **15 Hrs**

Semen analysis - Physical, chemical and microscopic examination - Sperm count, motility and its interpretation; Pregnancy test

PRESCRIBED BOOKS

1. Satyanarayan, U. Biochemistry. Books and Allied (P) Ltd. Kolkata-India
2. Ramanic Sood, Laboratory Technology (Methods and Interpretation). 4th Edition J.P. Bros, NewDelhi
3. Mukharji Medical Laboratory Techniques. Vol - I, II & III, 5th Edition. Tata McGraw-Hill,Delhi.
4. Satish Gupta, Short Text Book of Medical Laboratory for Technician. J.P. Bros, New Delhi.
5. Godker, P. B., and Darshan, P., Godker. (2011). Text Book of Medical Laboratory Technology, Mumbai.

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1. Teitz, Clinical Chemistry. W.B. Saunders Company Harcourt (India) Private Limited, NewDelhi.
2. Kaplan, Clinical Chemistry, Mosby Company, St. Louis Washington, D.C. Toronto.
3. Fischbach, (2005). Manual of Lab and Diagnostic Tests, Lippincott Williams Wilkins, NY

4. Gradwohls, (2000). Clinical Laboratory Methods and Diagnosis. (ed) Ales C. Sonnen Wirth and Leonard Jarret, M.D.B.I., New Delhi.
5. Ochei, J., and Kolhatkar, (2002). Medical Laboratory Science Theory and Practice, Tata McGraw-Hill, New Delhi.
6. Kanai, L., Mukherjee, (2007). Medical Laboratory Technology. Vol. I, Tata McGraw - Hill.
7. Manoharan, A., and Sethuraman, (2003). Essential of Clinical Heamatology. Jeypee Brothers, New Delhi.
8. Richard, A., McPherson, Mathew, R., Pincus. (2007). Clinical and Management by Laboratory Methods, Elsevier, Philadelphia. Published by Tata McGraw-Hill Education Pvt. Ltd.,
9. Ochei. J., A. Kolhatkar (2000). Medical Laboratory Science: Theory and Practice, Published by Tata McGraw-Hill Education Pvt. Ltd, 1st Edition.

E-LEARNING RESOURCES

1. https://vikaspedia.in/energy/environment/waste-management/bio-medical-waste-management/bio-medical-waste-and-its-segregation
2. https://www.mccmdclinic.org/overview-of-common-laboratory-equipments/
3. https://www.testing.com/tests/complete-blood-count-cbc/
4. https://www.cdc.gov/kidneydisease/publications-resources/kidney-tests.html
5. https://my.clevelandclinic.org/health/diagnostics/21520-semen-analysis

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	2	1	1
II	2	2	1
III	3	2	2
IV	3	1	1
V	2	1	1
TOTAL	**12**	**7**	**6**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	2	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	**3**	**3**	**3**	**2.8**	**3**

PSO-CO-question paper mapping

CO NO.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO 1	Gain comprehensive understanding and adherence to ethical standards, safety protocols, and professional conduct in clinical laboratory settings, ensuring effective management and operation.	PSO 1, PSO 2, PSO 3, PSO 5	K1, K2, K3, K4, K5, K6
CO 2	Demonstrate proficiency in operating and maintaining common laboratory equipment essential for accurate diagnostic testing and research in clinical laboratory settings	PSO 1, PSO 2, PSO 3, PSO 4 PSO 5	K1, K2, K3, K4, K5, K6
CO 3	Expertise in the comprehensive process of blood specimen collection, preservation, analysis, and interpretation, enabling accurate diagnosis and patient care in clinical laboratory settings.	PSO 1, PSO 2, PSO 3, PSO 4 PSO 5	K1, K2, K3, K4, K5, K6
CO 4	Acquire proficiency in conducting a range of diagnostic tests for liver function, urine analysis, and microscopic examination of bodily fluids, ensuring accurate assessment of renal and gastrointestinal health in clinical laboratory settings.	PSO 1, PSO 2, PSO 3, PSO 4 PSO 5	K1, K2, K3, K4, K5, K6
CO 5	Develop skills in analyzing semen samples to provide valuable insights into male fertility and reproductive health.	PSO 1, PSO 2, PSO 3, PSO 4 PSO 5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyze, K5= Evaluate, K6= Create

ELECTIVE III: ECONOMIC ENTOMOLOGY AND PEST MANAGEMENT

PROGRAMME: B.Sc. Advanced Zoology and Biotechnology	**BATCH:** 2024
PART: III	**COURSE COMPONENT:** Elective - III
COURSE NAME: Economic Entomology and Pest Management	**COURSE CODE:**
SEMESTER: VI	**MARKS:**100
CREDITS: 5	**TOTAL HOURS:** 75
THEORY	

COURSE OBJECTIVE

Understand the principles and practices of economic entomology and pest management for sustainable agriculture and environmental conservation

COURSE OUTCOMES

1. Demonstrate proficiency in identifying economically significant insect orders and mastering methods for collecting, mounting, and preserving insects.
2. Develop integrated pest management strategies informed by insect morphology, reproductive biology, and ecological dynamics to balance pest control with conservation efforts.
3. Demonstrate proficiency in identifying and assessing pest populations, enabling them to develop effective pest management strategies tailored to specific agricultural contexts.
4. Identify and manage diverse agricultural and household pests for sustainable crop protection and public health.
5. Learn various pest control methods, including integrated approaches and biological agents, to protect crops while minimizing environmental harm

Unit I **12 Hrs**

Entomology – Introduction - **Salient features of Insects** - Classification of insects up to orders (Economical important groups) - Methods of collecting, mounting and preservation of insects

Unit II **15 Hrs**

Morphology of Insects - Segmentation in insect - Structure of head, antennae, thorax, legs and wings - Various types of mouth parts

Reproduction and development: Embryonic and post-embryonic development - Types of metamorphosis - Role of Neuroendocrine system in development.

Beneficial and harmful insects - Economic importance of honeybees, silkworm and lac insect – Parasitic and predatory insects

Unit III **13 Hrs**

Pests: Origin and history – Definition - Classification of pests - Pest status - Pest population dynamics - Types of crop losses

Unit IV **15 Hrs**

Bionomics / Ecology and Management

Crop and Stored grain pests: Most common insect pests of the following plants and their control measures: 1. Rice, Cholam and Pulses 2. Sugarcane 3. Cotton 4. Groundnut, Gingelly and Coconut 5. brinjal, Tomato and Lady's finger 6. Cardamom, Chilies, tea and Coffee 7. Mango and Citrus. (Brief Account on any three pests)

Medically important and household pests: Fleas, mosquitoes, housefly, sandfly, cockroach, and termites

Unit V **20 Hrs**

Integrated pest management (IPM): – Definition – Principle - Components of IPM and advantages – Strategies for integrated pest management: Mechanical, Physical, Cultural

Biological Control – Principle - Bio-control agents (Parasitoids, predators and pathogens (NPV, Bacteria, Fungi and nematodes) - Merits and demerits (Brief account)
Biopesticides (Neem, Pongamia, Tulsi)

Chemical Control - Classification of insecticide - Conventional insecticides - Insecticide adjuvants and formulations - Control with reference to Chlorinated hydrocarbons – Organophosphates, Carbamates, Botanical, Synthetic pyrethroids – Fumigants -Insect Growth Regulator (IGR) compounds & Pheromones

Genetic Control - Sterile insect techniques (SIT)- Sterile insect release method (SIRM)- Radio-sterilization and chemo-sterilization, Hybrid sterility and other strategies of Genetic control (Brief account)
Pesticides and environmental pollution – Precautions in handling pesticides Role of biotechnology in pest management (Brief account)

PRESCRIBED BOOKS

1. David, B., and Ananthakrishnan, T.N. (2006). General and Applied Entomology, Second edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, India.
2. Vasanthraj David, B., and Ramamurthy, V. V. (2012). Elements of Economic Entomology, 7th Edition, Namrutha Publications, Chennai.
3. Nayar, K. K., Ananthakrishnan, T.N. and David, B.V. (1992). General and Applied Entomology. Tata McGraw-Hill Publishing Co., Ltd., New Delhi.
4. David, B.V. (1992). Pest Management and Pesticides Indian Scenario, Namratha Publications, Madras.

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1. David, B.V. and T. Kumarasamy, (1984). Elements of Economic Entomology, Popular Book Depot, Madras
2. Metcalf, C.L. and W.P. Flint, (1973). Destructive and Useful Insects. 4th Edition, Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
3. Roya D.N., and A.W.A. Brown (Eds), (1981). Entomology Medical and Veterinary. 3rd Edition, The Bangalore Printing and Publishing Company, Bangalore.
4. Imms, A. D. A General Text Book of Entomology. Chapman and Hall, UK.
5. Chapman, R. F. (1998). The Insects: Structure and Function. Cambridge University Press, UK.
6. Snodgrass, R. E. Principles of Insect Morphology. Cornell Univ. Press, USA
7. Borror, D. J., Triplehorn, C. A., and Johnson, N. F. Introduction to the Study of Insects. M Saunders College Publication, USA
8. Tembhare, D.B. (2012). Modern Entomology, Himalaya Publishing House Pvt, Ltd, Mumbai
9. Dennis, S. Hill. (2005). Agricultural Insect Pests of the Tropics and their Management, Cambridge University Press.
10. Pedigo, L.P. (1996) Entomology and Pest Management. Prentice Hall, New Delhi.
11. Pradhan, S. Insect Pest of Crops. National Book Trust, New Delhi.
12. Abishek Shukla, D. (2009). A Hand Book of Economic Entomology, Vedamse Books, New Delhi.
13. Ministry of Agriculture, Government of India, (1995). Manual on Integrated Pest Management in Rice and Cotton.

E-LEARNING RESOURCES

1. http://www.faculty.ucr.edu/~legneref/biotact/bc-51b.htm
2. https://www.studocu.com/in/document/mahatma-jyotiba-phule-rohilkhand-university/applied-and-economic-zoology/harmful-and-beneficial-insects/44681655
3. https://www.ippc.int/static/media/files/publication/en/2017/06/ISPM_08_1998_En_2017-05-23_PostCPM12_InkAm.pdf
4. https://www.agric.wa.gov.au/pest-insects/insect-pests-stored-grain
5. https://eos.com/blog/integrated-pest-management/

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	2	1	1
II	3	2	1
III	2	1	1
IV	2	1	1
V	3	2	2
TOTAL	**12**	**7**	**6**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	2	3
CO 2	3	3	3	2	3
CO 3	3	3	3	2	3
CO 4	2	3	3	2	3
CO 5	3	3	3	2	3
Ave.	**3**	**3**	**3**	**2**	**3**

PSO-CO-question paper mapping

CO NO.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO 1	Demonstrate proficiency in identifying economically significant insect orders and mastering methods for collecting, mounting, and preserving insects.	PSO 1, PSO 2, PSO 3, PSO 5	K1, K2, K3, K4, K5, K6
CO 2	Develop integrated pest management strategies informed by insect morphology, reproductive biology, and ecological dynamics to balance pest control with conservation efforts.	PSO 1, PSO 2, PSO 3, PSO 5	K1, K2, K3, K4, K5, K6
CO 3	Demonstrate proficiency in identifying and assessing pest populations, enabling them to develop effective pest management strategies tailored to specific agricultural contexts.	PSO 1, PSO 2, PSO 3, PSO 5	K1, K2, K3, K4, K5, K6
CO 4	Identify and manage diverse agricultural and household pests for sustainable crop protection and public health.	PSO 1, PSO 2, PSO 3, PSO 5	K1, K2, K3, K4, K5, K6
CO 5	Learn various pest control methods, including integrated approaches and biological agents, to protect crops while minimizing environmental harm	PSO 1, PSO 2, PSO 3, PSO 5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyze, K5= Evaluate, K6= Create

CORE PRACTICAL III: ANIMAL PHYSIOLOGY, BIOCHEMISTRY, DEVELOPMENTAL BIOLOGY AND IMMUNOLOGY

PROGRAMME: B.Sc. Advanced Zoology and Biotechnology	**BATCH:** 2024
PART: III	**COURSE COMPONENT:** Core Practical - III
COURSE NAME: Practical III: Animal Physiology, Biochemistry, Developmental Biology and Immunology	**COURSE CODE:**
SEMESTER: VI	**MARKS:**100
CREDITS: 4	**TOTAL HOURS: 60**
PRACTICAL	

COURSE OBJECTIVES

To provide competent lab skills in Animal Physiology, Biochemistry, Developmental Biology and Immunology.

COURSE OUTCOMES (COs)

1. Recall the principles and applications of instruments used in physiology, biochemistry and immunology.
2. Infer the effect of temperature on the digestive enzymes of cockroach, human saliva and ciliary activity of freshwater mussel.
3. Identify the nitrogenous waste products of animals and evaluate oxygen consumption in fishes with reference to their body weight.
4. Develop skills about quantitative and qualitative determination of biomolecules, blood, urine and milk and in preparation of starch, gluten and casein.
5. Identify and recall the distinct features and biological functions of different stages of chick embryo, developmental stage in frog, placenta and endocrine glands

Animal Physiology

1. Survey of digestive enzymes in Cockroach
2. Study of human salivary activity in relation to temperature
3. Study of Ciliary Activity in Freshwater Mussel in relation to temperature
4. Estimation of oxygen consumption in fishes with reference to body weight
5. Detection of nitrogenous waste products in fish tank water, bird excreta and Mammalian kidney
6. Preparation of Hemin crystals
7. Determination of bleeding time and clotting time
8. Measurement of blood pressure using sphygmomanometer
9. Measurement of oxygen consumption of cockroach using Respirometer. (Demonstration)
10. Use of Kymograph
11. Histological Slides - Mammalian pituitary, thyroid, pancreas, adrenal gland

Biochemistry

1. Qualitative analysis of protein and lipids
2. Qualitative analysis of sugar (Glucose, Fructose, Lactose and Starch)
3. Estimation of total protein by Lowry's method (Demonstration)
4. Estimation of carbohydrates by Anthrone reagent (Demonstration)
5. Qualitative analysis of human urine for sugar
6. Preparation of starch from potato (Demonstration)
7. Preparation of casein from milk (Demonstration)
8. Preparation of gluten from wheat flour (Demonstration)
9. Chromatographic techniques – Paper and TLC (Demonstration)
10. Determination of pH in milk

Developmental Biology

Study of the following prepared slides, museum specimens and materials.

1. Section of testis and ovary showing the maturation stages of gametes.
2. Slides of mammalian Sperm and Ovum.
3. Study of Egg types – Frog's egg, Hen's egg.
4. Slides of cleavage stages, blastula, gastrula and neurula of frog.
5. Slides of different stages of chick embryo. 18 Hours (primitive streak stage), 24 hours, 48 hours, 72 hours and 96 hours.
6. Placenta of Sheep, Pig and Man.

Immunology

1. Immunoelectrophoresis
2. Antigen - antibody reactions – Agglutination, Precipitation ring test. (Demonstration)
3. ABO, Rh typing
4. Hemagglutination, Yeast agglutination and Hemagglutination -inhibition assay

PRESCRIBED BOOKS

1. Surya Nandan Meena, Milind Naik, (2019). Advances in Biological Science Research: A Practical Approach, Academic Press, New York, USA.
2. Agarwal R A., Anil K Srivastava., Kaushal Kumar., (1978). Animal Physiology and Biochemistry, S. Chand & Co. Ltd., New Delhi Publishing., 377 PP.
3. Saxena J., Baunthiyal M., Ravi I., (2015). Laboratory Manual of Microbiology, Biochemistry and Molecular Biology, Scientific Publishers, India.
4. Chaitanya K.V., (2013). Cell and Molecular Biology: A Lab Manual, Phi Learning Pvt. Ltd., New Delhi, India.
5. Andreas Hofmann, Samuel Clokie, (2018). Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, UK.

REFERENCE BOOKS

1. Andreas Hofmann, Samuel Clokie, (2018). Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, UK.

2. Leonard Davis, Mark Dibner, James Battey, (2012). Basic Methods in Molecular Biology, Elsevier Science Publishing Co., NY, USA.
3. Robert F. Schleif, Pieter C. Wensink, (2012). Practical Methods in Molecular Biology, Springer-Verlag, NY, USA.
4. Ian Freshney R., (2010). Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, John Wiley & Sons, USA.

E-LEARNING RESOURCES

1. https://www.jove.com/
2. https://vlab.amrita.edu/?sub=3&brch=77
3. http://cbii-au.vlabs.ac.in/
4. https://media.hhmi.org/biointeractive/vlabs/transgenic_fly/index.html
5. https://www.ibiology.org/biology-techniques/
6. https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering

CORE PRACTICAL IV: ENVIRONMENTAL BIOLOGY, BIOTECHNOLOGY AND MICROBIOLOGY

PROGRAMME: B.Sc. Advanced Zoology and Biotechnology	**BATCH:** 2024
PART: III	**COURSE COMPONENT:** Core Practical - IV
COURSE NAME: Practical IV: Environmental Biology, Biotechnology and Microbiology	**COURSE CODE:**
SEMESTER: VI	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 60
PRACTICAL	

COURSE OBJECTIVES

To introduce students to the laboratory techniques related to Environmental Biology, Biotechnology and Microbiology

COURSE OUTCOMES (COs)

1. Understand the principle, methodology, significance and estimation of oxygen, salinity, carbon dioxide, carbonates, bicarbonates and calcium in the given water samples.
2. Identify and recall the important characters of animals adapted to various ecological habitat.
3. Demonstrate skills in handling equipment related to environmental biotechnology and microbiology.
4. Understand the protocols and procedures to isolate and identify microbes, milk quality test, screening of lipase and amylase and antibiotic sensitivity test.
5. Develop observational and scientific skill through field study and industrial visit.

Environmental Biology

1. Estimation of O_2, salinity, pH, free CO_2, Carbonates and bicarbonates, Calcium in water samples
2. Use of Rain gauge, Maximum & minimum thermometer, Hygrometer, Anemometer and Barometer
3. Analysis of phytoplankton and zooplankton in fresh water and marine water
4. Adaptations of aquatic and terrestrial animals based on a study of museum specimens - rocky, sandy, muddy shore animals, flying and burrowing animals
5. Study of natural ecosystem and field report of the visit

Biotechnology

1. Demonstration of PCR technique
2. Separation of proteins by Native and SDS-PAGE

3. Demonstration of Blotting techniques
   a) Southern blot
   b) Northern blot
   c) Western blot
4. **Instrumentation** – Components and application of instruments – Homogenizer, Centrifuge, Electrophoresis, Colorimeter, Spectrophotometer, pH meter.
5. Project report on animal cell culture / Visit to any Biotechnology Institute

Microbiology

1. Staining - Simple staining, Gram staining
2. Media Preparation for microbial culture
3. Preparation of Solid media – Nutrient agar, Mac Conkey's agar (Demonstration)
4. Preparation of Liquid media – Nutrient broth, Peptone water (Demonstration)
5. Biochemical characterization and Identification of Microbes - E. *coli* (Demonstration)
6. Antibiotic sensitivity test (Demonstration)
7. Examination of algae in freshwater bodies (Demonstration)
8. Milk quality test-methylene blue reductase test, Urea test (Demonstration)
9. Screening for Lipase and amylase producing bacteria (Demonstration)
10. Identification of fungus by using Lactophenol cotton blue staining (Demonstration)
11. **Instruments** –Autoclave, Hot air oven, Laminar air flow, Incubator, Fermentor
12. **Microscopy** – Light Microscope, Phase Contrast Microscopy
13. **Spotters** – *E. coli*, *Staphylococcus aureus*, *Penicillium*, *Rhizopus*, *Aspergillus niger*, *Aspergillus flavus*, *Streptomyces*, *Lactococcus lactis*, Parasite - cyst and eggs

PRESCRIBED BOOKS

1. Widmaier, E.P., Raff, H. and Strang, K.T. (2008). Vander's Human Physiology, XI Edition., McGraw Hill., 770 PP.
2. Bansal M.P., (2013). Molecular Biology and Biotechnology: Basic Experimental Protocols. The Energy and Resources Institute (TERI), New Delhi, India.
3. Atlas R.M., Microbiology – Fundamentals and Applications. Macmillan Publishing Company, New York.
4. Bishop, ML., Fody, E.P., Schoeff, L.E. (2010). Clinical Chemistry: Principles, Procedure, Correlations. Wolters Kluwer, India, 298 PP.
5. Burtis, C.A. and Ashwood, E.R. (2008). A Text Book of Fundamentals of Clinical Chemistry and Molecular Diagnostics. Elsevier, Philadelphia.
6. Roitt, M., Peter, J., Delves, Seamus, J., Martin, and Dennis, R. Burton (2017). Essential Immunology. 13th Edition, Wiley-Blackwell Publishing, USA, 576 PP.
7. Abhijit Dutta. (2009). Experimental Biology: A Laboratory Science, Narosa, New Delhi.
8. Michael, P. (1984). Ecological Methods for Field Visit and Laboratory Investigation. Tata McGraw - Hill, New Delhi.

9. APHA (1992). Standard Methods for the Examination of Water and Waste Water. American Public Health Association, Washington D.C.

REFERENCE BOOKS

1. Hoar, W.S. (1983). General and Comparative Physiology. Prentice Hall of India, New Delhi., 928 PP.
2. Prosser, C.L. (1985). Comparative Animal Physiology, Satish Book Enterprise, Agra - 282 003, 966 PP.
3. Wood, D.W. (1968). Principles of Animal Physiology, Edward Arnold Ltd, London, 342 PP.
4. Guyton, A.C., and Hall, J.B. (2011). Text Book of Medical Physiology, 9th Edition, W.B. Sanders Company, Prism Books (Pvt.) Ltd., Bangalore, 1064 PP.
5. Collins, C.H., Patricia, M., and Lyne, J.M. (1995). Collins and Lynes Microbiological Methods. 7th Edition. Grange, Butter Worth, Oxford.
6. Eugenia, (2008). Environmental Biotechnology and Cleavers Bioprocesses, London.
7. Ramesh, R., and Anbu, M. (1996). Chemical Methods for Environmental Analysis of Water and Sediment. Macmillan India Limited, Chennai.

E-LEARNING RESOURCES

1. https://vlab.amrita.edu/?sub=3&brch=63
2. https://www.asbmb.org/education/online-teaching/online-lab-work
3. https://open.umn.edu/opentextbooks/textbooks/687
4. https://ivl1-au.vlabs.ac.in/List of experiments.html
5. https://mvii-au.vlabs.ac.in/List%20of%20experiments.html
6. https://mbvi-au.vlabs.ac.in/
7. https://biotech01.vlabs.ac.in/List%20of%20experiments.html

INTERDISCIPLINARY ELECTIVE

INTERDISCIPLINARY ELECTIVE (IDE) - I
WILDLIFE CONSERVATION

PROGRAMME: For all UG Students	**BATCH: 2024**
PART: III	**COURSE COMPONENT:** IDE (Elective) - I
COURSE NAME: Wildlife Conservation (IDE)	**COURSE CODE:**
SEMESTER: V	**MARKS:100**
CREDITS: 5	**TOTAL HOURS:** 75
THEORY	

COURSE OBJECTIVE

To Gain insight into core principles of wildlife conservation, including population estimation techniques, health management strategies, legal frameworks, and protective measures, with a special focus on India's diverse wildlife and conservation initiatives.

COURSE OUTCOMES (COs)

1. Analyze the economic importance of wildlife and its contribution to various sectors such as tourism, agriculture, and pharmaceuticals.
2. Gain proficiency in various wildlife population estimation techniques, field equipment usage, and remote sensing applications for effective wildlife management and conservation.
3. Develop a comprehensive understanding of wildlife health management, including the identification and mitigation of infectious diseases, as well as strategies for addressing human-wildlife conflicts through effective damage control measures.
4. Grasp the fundamentals of wildlife management, legislation, conservation projects, and community involvement for effective wildlife protection and biodiversity conservation.
5. Grasp the essentials of wildlife protection, covering conservation approaches such as parks, zoos, sanctuaries, and genetic resource preservation.

Unit I **15 Hrs**

Introduction to wildlife and its conservation. Economic importance and Need for conservation - Definition of wildlife – Causes of wildlife depletion – Endangered species – Threatened and Rare species - India as a mega wildlife diversity country- Gulf of Mannar – Marine ecosystem sanctuary – Mangrove ecosystem - National Biodiversity Authority

Unit II **15 Hrs**

Population Estimation: Basic concepts and application – Direct Count (Block Count, Transect Methods, Point Counts, Visual Encounter Survey, Waterhole Survey) – Indirect Count (Call Count, Track and Signs, Pellet Count, Pug Mark) – Tagging - Wildlife Photography: Types of camera, camera traps - Field equipments – Altimeter, Pedometer, Field Compass, Binoculars, Radio Collaring, GPS, GIS - Remote sensing in wildlife management

Unit III **15 Hrs**

Wildlife health care and human wildlife confliction - Infectious wildlife diseases – Viral (Rabies) – Bacterial (Anthrax) – Basic reasons for conflicts - Damage caused by wild animals and control measures

Unit IV **15 Hrs**

Wildlife Management and Legislation – Wildlife Protection Act 1972, IUCN, CITES, NBA, Project tiger, Project elephant – Wildlife trade and regulation - Biodiversity Act 2000 - Ecotourism and Eco restoration - Anti-poaching operations – Village Forest Council (VFC)

Unit V **15 Hrs**

Wildlife Protection – Definition – *in-situ* and *ex-situ* conservation – Zoos and Zoological Parks – National Parks and Sanctuaries (Aringar Anna Zoological Park, Guindy National Park, Srivilliputtur Wildlife Sanctuary, Vedanthangal Bird Sanctuary, Mudumalai and PeriyarTiger Reserves, Nilgiris Biosphere Reserve) – National Bureau of Plant genetic resources, Fish genetic resources and animal genetic resources

Exercises (Optional)

- Visit to National Zoological Parks and Sanctuaries
- Study on wetlands or about high-altitude fauna

PRESCRIBED BOOKS

1. Saharia, V.B. (1987). Wildlife in India. Nataraj Publications, Dehradun.
2. A Book on Wildlife Protection Act 1972, Lawmann
3. A Book on the Red Data Books by IUCN.

REFERENCE BOOKS

1. The Eye of the Elephant: An Epic Adventure in the African Wilderness by Delia Ownes
2. The Book of Indian Birds by Salim Ali.
3. Analysis and Management of Animal Population by Byron. K. Williams

E-LEARNING RESOURCES

1. https://mospi.gov.in/sites/default/files/reports_and_publication/cso_social_statices_division/CHAPTER_Three_13feb14.pdf
2. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000014ER/P000276/M025035/ET/1511247842Paper_6_Module_36_PC_Puneeta_Wildlife_etext.pdf
3. https://www.worldwildlife.org/stories/what-is-human-wildlife-conflict-and-why-is-it-more-than-just-a-conservation-concern
4. https://testbook.com/ias-preparation/wildlife-protection-act-1972
5. https://www.geeksforgeeks.org/wildlife-sanctuary/

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	2	1	1
II	3	2	1
III	2	1	1
IV	2	1	1
V	3	2	2
TOTAL	**12**	**7**	**6**

ALLIED

ALLIED ZOOLOGY I

PROGRAMME: For B.Sc. Plant Biology and Plant Biotechnology	**BATCH:** 2024
PART: III	**COURSE COMPONENT:** Allied Theory - I
COURSE NAME: Allied Zoology I	**COURSE CODE:**
SEMESTER: I	**MARKS:**100
CREDITS: 3	**TOTAL HOURS: 90**
THEORY	

COURSE OBJECTIVES

To educate students on the systemic and functional morphology of both invertebrates and vertebrates

COURSE OUTCOME (COs)

1. Gain knowledge on cellular organization, morphology, anatomy and life history of Protozoa, Porifera, Coelenterata and Platyhelminthes.
2. Discuss the morphology, anatomy, larval forms and distinctive characters of Phylum Annelida, Arthropoda, Mollusca and Echinodermata.
3. Gain knowledge on affinities of Prochordates and understand the functional anatomy of Pisces.
4. Understand the morphology and anatomy of class Amphibia and Reptilia.
5. Compare and contrast between class Aves and Mammalia.

Unit I **20 Hrs**

Introduction: Invertebrata - General characters and classification
Protozoa: Type study - *Plasmodium vivax*
Porifera: Type study - *Scypha* (Sycon)
Coelenterata: Type study - *Obelia geniculata*
Platyhelminthes: Type study - *Taenia solium*
Nematoda: Type study - *Ascaris*

Unit II **20 Hrs**

Annelida: Type study - Leech
Arthropoda: Type study - Prawn
Mollusca: Type study - *Unio* (External morphology and Respiratory system)
Echinodermata: Type study - Starfish (External morphology and Water vascular system)

Unit III **20 Hrs**

Chordata: General characters and Classification
Prochordates: *Amphioxus* (Structure)

Vertebrates

Pisces: Type study - Shark

Unit IV **15 Hrs**

Amphibia: Type study - Frog (External morphology, Digestive system, Circulatory System and Reproductive system)

Reptilia: Type study - Calotes (External morphology, Digestive system, Circulatory System and Reproductive system)

Unit V **15 Hrs**

Aves: Type study - Pigeon (External morphology and Respiratory system)

Mammalia: Type study - Rabbit (External morphology and Circulatory system)

PRESCRIBED BOOKS

Invertebrata

1. Dhami, P.S., and Dhami, J.K., Invertebrate Zoology. S. Chand and Co. New Delhi.
2. Kotpal, R.L. (2005). Invertebrates. Rastogi Publications, Meerut.
3. Ekambaranatha Ayyar, M., and Ananthakrishnan, T.N. (1993). Outlines of Zoology, Vol. I, Part I and II, Viswanathan and Co. Madras.

Chordata

1. Dhami, P.S., Dhami, J.K., (1982). Chordate Zoology, Dinesh Publishers, Jalandhar.
2. Kotpal, R.L. (2005). Text Book of Zoology – Vertebrates. CBS Publishers, Delhi.
3. Jordan, E. L., and Verma, P.S. (2002). Chordate Zoology. S. Chand Publication.
4. Ekambaranath Iyer. (2000). A Manual of Zoology, Vol. II. S. Viswanathan and Co.

REFERENCE BOOKS

Invertebrata

1. Parker, T.J. and Haswell, W.A. (1990). Text Book of Zoology, Invertebrates, Vol. I edited byMarshall, A.J. and Williams, W.D., CBS Publication and Dist., Delhi.
2. Ruppert, E.E., Fox, R.S., Barnes, R. D. (2003). Invertebrate Zoology: A Functional Evolutionary Approach. 8th Edition, Cengage Learning, India.
3. Barrington, E.J.W. (2012). Invertebrate Structure and Functions. II Edition, EWP Publishers.
4. Majpuria, T.C. (1990). Invertebrate Zoology, Pradeep Pub. Kitab Mahal.

Chordata

1. Bhamrah, H.S., and Juneja, K. (1990). An Introduction to Fishes, Anmol Publications, New Delhi.
2. Parker, T.J., and Haswell, W.A., A Text Book of Zoology, Vol. II - Vertebrates. Latest Edition,CBS Publishers, Delhi edited by Late A.J. Marshall & Williams, W.D.
3. Dodson, E.O. (1976). A Text Book of Zoology, CBS Publishers & Distributors, Delhi.

E-LEARNING RESOURCES

1. www.iaszoology.com
2. https://www.nationalgeographic.com/animals/invertebrates
3. https://bit.ly/3kABzKa
4. https://www.nio.org/
5. https://greatbarrierreef.org
6. https://www.pbslearningmedia.org/resource/ed490f06-d5c5-4816-bfc2-75beb2f54011/worlds-most-awesome-invertebrate/
7. http://tolweb.org/Chordata/2499
8. https://www.nhm.ac.uk/
9. https://bit.ly/3Av1Ejg
10. https://www.allaboutbirds.org/news/#

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	3	1	2
II	3	2	1
III	2	2	1
IV	2	1	1
V	2	1	1
TOTAL	**12**	**7**	**6**

PSO-CO-question paper mapping

CO No.	COURSE OUTCOME	COGNITIVE LEVEL (K1 to K6)
CO 1	Gain knowledge on cellular organization, morphology, anatomy and life history of Protozoa, Porifera, Coelenterata and Platyhelminthes.	K1, K2, K3, K4, K5, K6
CO 2	Discuss the morphology, anatomy, larval forms and distinctive characters of Phylum Annelida, Arthropoda, Mollusca and Echinodermata.	K1, K2, K3, K4, K5, K6
CO 3	Gain knowledge on affinities of Prochordates and understand the functional anatomy of Pisces.	K1, K2, K3, K4, K5, K6
CO 4	Understand the morphology and anatomy of class Amphibia and Reptilia.	K1, K2, K3, K4, K5, K6
CO 5	Compare and contrast between class Aves and Mammalia	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyze, K5= Evaluate, K6= Create

ALLIED ZOOLOGY II

PROGRAMME: For B.Sc. Plant Biology and Plant Biotechnology	**BATCH:** 2024
PART: III	**COURSE COMPONENT:** Allied Theory - II
COURSE NAME: Allied Zoology II	**COURSE CODE:**
SEMESTER: II	**MARKS:**100
CREDITS: 3	**TOTAL HOURS:** 90
THEORY	

COURSE OBJECTIVES

To provide an overview on the fundamental concepts and scope of various branches of zoology

COURSE OUTCOMES (COs)

1. Understand the structure and functions of cells and cellular components and acquire knowledge on the principles of genetics and genetic disorders.
2. Illustrate the significance of cellular processes in embryonic development of various organisms and understand the applied aspects of developmental biology and biotechnology.
3. Understand the basic principles of physiology and interpret the physiological process of various organs and their interaction between them.
4. Discuss the fundamental concepts in ecology and assess the inter-relationship between biotic and abiotic factors in an ecosystem
5. Acquire knowledge on the principles, processes and concepts of evolution.

Unit I **15 Hrs**

Cell Biology: Structure of animal cell - Mitochondria - Nucleus and nucleolus - Golgi bodies - Cell cycle and cell division – Ageing of cell

Genetics: Laws of Mendelism - Molecular structure of Genes - Gene concept - Gene function - X and Y – linked inheritance - Karyotype study - Pedigree analysis - Syndromes: Autosomal (Down Down's syndrome and Edward's syndromes) - Sex chromosomal (Turnerssyndrome and Klinefelter's syndrome) - Genetic disorders (Sickle cell anemia, Phenyl ketonuria and Cleft lip) - Genetic counselling

Unit II **20 Hrs**

Developmental Biology: Gametogenesis – Fertilization - Types and pattern of cleavage – Blastulation – Gastrulation in chick: Morphogenetic movements (Epiboly and emboly) - Organizers and Embryonic induction (Brief account) - Applied Aspects of Developmental Biology: Stem cells – *In vitro* fertilization (IVF)

Biotechnology: Scope and application of biotechnology - Cloning experiments in animals and man - Bioethics

Unit III **20 Hrs**

Human Physiology: History and scope of physiology - Principles of Homeostasis - Digestion and absorption of Carbohydrates, Proteins and Fats

Excretion: Structure and functions of kidney and nephron - Physiology of urine formation - Kidney failure, Dialysis and transplantation

Circulation: Structure of heart - Origin and conduction of heart beat - Cardiac cycle - Composition and functions of blood - Blood pressure and pulse pressure - Heart diseases: Ischemia, Myocardial infarction, Rheumatic heart disease, Stroke

Endocrine Glands: Hormones - Feedback mechanism - Structure, biological action and disorders of pituitary gland, thyroid gland, Islets of Langerhans, adrenal gland and sex organs

Unit IV **20 Hrs**

Ecology: Definition and Principles - Ecosystem: Definition and components of ecosystem (Abiotic factors and Biotic factors) - Primary and secondary production - Food chain - Food web - Trophic levels - Energy flow - Ecological pyramids - Animal relationships (Symbiosis, Commensalism, Mutualism, Antagonism, Predation, Parasitism and Competition)

Unit V **15 Hrs**

Evolution: Lamarckism and Neo-Lamarckism - Darwinism and Neo-Darwinism - Speciation, mimicry and coloration – Fossils - Evolution of man

PRESCRIBED BOOKS

1. Verma, P.S., and Agarwal, V.K. (2010). Reprint, Cell Biology, Genetics, Molecular Biology,Physiology, Evolution and Ecology, S. Chand and Co., New Delhi – 110 055.
2. Sambasiviah, I., Kamalakara Rao, A.P., Augustine Chellapa, S. (1983). Text Book of Animal Physiology, S. Chand and Co, New Delhi.
3. Verma, P.S., Agarwal, V.K., and Tyagi, B.S. (1995). Text Book of Animal Physiology. S.Chand & Co.
4. Rastogi, S.C. (1977). Essentials of Animal Physiology. New Age International (P) Ltd., Publisher.
5. Verma, P.S. and Agarwal, V.K. (1983). Animal Ecology. S. Chand and Co, New Delhi.
6. Verma, P.S. and Agarwal, V.K. and Tyagi, B.S. (1991). Chordate Embryology. S. Chand and Co, New Delhi.
7. Rastogi, V.B., and Jayaraj, M.S. (2000). Text Book of Genetics, Kedarnath Ramnath Publishers, Meerut.

REFERENCE BOOKS

1. Gopalakrishnan, T.S. Itta Sambasivaiah, and Kamalakararao, A.P. (1984) Principles of Organic Evolution. Pearl publications, Chennai.
2. De Robertis, EDP, De Robertis, E.M.F. (1995). Cell Biology and Molecular Biology. 8th Edition, W.B. Saunders Co., Philadelphia.
3. Klug, W. S., Cummings, M. R., and Spencer, C. Concepts of Genetics, 12th Edition. New Jersey, Pearson Education.
4. Guyton and Hall, (2000). Text Book of Medical Physiology, 10th Edition, Elsevier, New Delhi.
5. Tortora, G.J., and Derrickson B. (2016). Principles of Anatomy and Physiology. John Sons, Inc. 1232 pp.
6. Dubey, R. C., (2014). A Text Book of Biotechnology, S. Chand & Co Ltd, Ram Nagar, New Delhi.

E-LEARNING RESOURCES

1. https://www.khanacademy.org/test-prep/mcat/cells/eukaryotic-cells/a/organelles-article
2. https://microbenotes.com/cell-organelles/
3. https://www.khanacademy.org/science/ap-biology/gene-expression-and-regulation/dna-and-rna-structure/a/nucleic-acids
4. https://anatomypubs.onlinelibrary.wiley.com/doi/full/10.1002/dvdy.20468
5. https://www.innerbody.com/htm/body.html
6. https://open.umn.edu/opentextbooks/textbooks/169
7. https://human.biodigital.com
8. https://ecologyandevolution.cornell.edu/

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
			TOTAL	**100**

BREAK UP OF QUESTIONS

UNITS	SECTION - A	SECTION - B	SECTION - C
I	2	2	1
II	3	1	1
III	3	2	3
IV	2	1	1
V	2	1	1
TOTAL	**12**	**7**	**6**

PSO-CO-question paper mapping

CO NO.	COURSE OUTCOME	COGNITIVE LEVEL (K1 to K6)
CO 1	Understand the structure and functions of cells and cellular components and acquire knowledge on the principles of genetics and genetic disorders.	K1, K2, K3, K4, K5, K6
CO 2	Illustrate the significance of cellular processes in embryonic development of various organisms and understand the applied aspects of developmental biology and biotechnology.	K1, K2, K3, K4, K5, K6
CO 3	Understand the basic principles of physiology and interpret the physiological process of various organs and their interaction between them.	K1, K2, K3, K4, K5, K6
CO 4	Discuss the fundamental concepts in ecology and assess the inter-relationship between biotic and abiotic factors in an ecosystem	K1, K2, K3, K4, K5, K6
CO 5	Acquire knowledge on the principles, processes and concepts of evolution.	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyze, K5= Evaluate, K6= Create

ALLIED ZOOLOGY PRACTICAL

PROGRAMME: For B.Sc. Plant Biology and Plant Biotechnology	**BATCH:** 2024
PART: III	**COURSE COMPONENT:** Allied Practical - I
COURSE NAME: Allied Zoology Practical	**COURSE CODE:**
SEMESTER: I	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 60
PRACTICAL	

COURSE OBJECTIVES

To introduce to fundamental ideas on dissection, mounting and identification of various biological specimens.

COURSE OUTCOMES (COs)

1. Identify and classify animals based on distinctive characters
2. Understand the biological significance of the specimen.
3. Discuss and distinguish the morphology and anatomy of Invertebrate and Chordate specimen through dissection.
4. Learn about the preparation of mounting of economically important animals
5. Identify and interpret various stages of cell division and understand the principles and applications of instrumentation

Dissection

Invertebrata: Cockroach – Digestive System, Nervous System
Chordata: Fish (Any Bony Fish) – Digestive System

Mounting

1. Mouth parts of cockroach
2. Mouth parts of Mosquito
3. Prawn: Appendages
4. Placoid Scale
5. Ctenoid scale

Spotters

Invertebrata

1. *Plasmodium*
2. *Sycon*
3. *Obelia geniculate*
4. *Taenia solium* (Entire)
5. *Taenia solium* (Transverse section)
6. Leech (Entire)
7. Leech (Transverse section)
8. Fresh water mussel

Chordata

9. *Amphioxus*
10. Shark (Placoid scale)
11. Pigeon (Feathers)
12. Rabbit

Cell Biology

13. Mitosis (any one stage)
14. Meiosis (any one stage)

Genetics

15. Human Karyotype (Normal and Abnormal)

Developmental Biology

16. T.S. of Mammalian Testis
17. T.S. of Mammalian ovary

Animal Physiology

18. Sphygmomanometer

Ecology

19. Animal Relationship – Sea anemone on hermit crab, Ascaris

PRESCRIBED BOOKS

1. Sinha, Chatterjee, and Chattopadhyay, (2014). Advanced Practical Zoology, Books & Allied Ltd., 3rd Revised Edition, 1070 pp.
2. Lal, S. S. (2016). Practical Zoology - Invertebrate, Rastogi Publications.
3. Verma, P. S. (2010). A Manual of Practical Zoology: Invertebrates. S Chand, 497 pp.
4. Lal, S. S. (2009). Practical Zoology – Vertebrate. Rajpal and Sons Publishing, 484 pp.

REFERENCE BOOKS

1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W., and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, 3rd Edition, Blackwell Science.
2. Barnes, R.D. (1982). Invertebrate Zoology. 5th Edition, Holt Saunders International Edition.
3. Barrington, E.J.W. (1979). Invertebrate Structure and Functions. 2nd Edition, E.L.B.S. and Nelson.
4. Boradale, L.A., and Potts, E.A. (1961). Invertebrates: A Manual for the Use of Students. Asia Publishing Home.
5. Lal, S.S. (2005). A Text Book of Practical Zoology: Invertebrate, Rastogi, Meerut.

NON-MAJOR ELECTIVES

NON-MAJOR ELECTIVE - I
AQUACULTURE

PROGRAMME: For all UG Students	**BATCH:** 2024
PART: IV	**COURSE COMPONENT:** Non-Major Elective - I
COURSE NAME: Aquaculture	**COURSE CODE:**
SEMESTER: I	**MARKS:**100
CREDITS: 2	**TOTAL HOURS:** 30
THEORY	

COURSE OBJECTIVE:

To gain a broad understanding of the key principles of aquaculture and an in-depth knowledge of the techniques involved in aquaculture practices

COURSE OUTCOMES:

1. Examine the physico-chemical properties of the water bodies and acquire knowledge on designing of different culture systems.
2. Understand the importance of aquaculture practice and different types of aquaculture practices in India with special reference to exotic and major carps and the various techniques involved in the construction of fish ponds and their management.
3. Give an insight into the importance of integrated fish farming methods.
4. Grasp basic idea about the importance of live feed in culture systems and also composition of supplementary feed.
5. Identify and categorize the fish and shrimp diseases in the Aquaculture and apply the knowledge on preservation and export through agencies.

Unit I **6 Hrs**

History of aquaculture – Purpose and importance of aquaculture – Physical and chemical characteristics features of water bodies (Freshwater brackish water and marine water) – Types of culture systems (Traditional, intensive, semi-intensive and extensive), Pond, Cage, RAS.

Unit II **6 Hrs**

Selection criteria for cultivable species – Site selection for fish farming – Construction of fish and Prawn / Shrimp culture ponds – Types of fish ponds (breeding pond, hatchery unit, brooders pond, nursery pond, stocking pond and rearing pond) – Maintenance and management of different ponds - Feeds for cultivable species – Natural, supplementary and artificial feeds - Post-harvest technology – organic farming.

Unit III **6 Hrs**

Types of culture – Cage Culture, Pen culture - Monoculture, Monosex culture and poly culture – Integrated fish farming (paddy cum fish culture, paddy cum prawn culture and Duckcum pig cum fish culture) – Induced breeding in Indian major carps - Biofloc fish farming.

Unit IV **6 Hrs**

Culture of air-breathing fishes (Mullet and cat fish) - Sewage fed fish culture – Culture of pearl oyster and edible oyster.

Unit V **6 Hrs**

Culture of marine and freshwater prawns /shrimps – Present status of shrimp farming in India - Common fish diseases (bacterial, fungal, viral and parasitic diseases) – Prevention and treatment – Fishing technology (Crafts and gears) – Preservation and processing of fish and prawn – Agencies involved in aquaculture – CAA, NFDB, ICAR, MPEDA, RGCA

Activity - Field Visit and Submission of Report

Visit to Aquaculture farm / industry

PRESCRIBED BOOKS

1. Santhanam, R., Sukumaran, N., and Natarajan. A Manual of Fresh Water Aquaculture. Oxford and IBH Publishing Co. Pvt. Ltd., Mumbai.
2. Yadav, B.N. Fish and Fisheries, Daya Publishing House, Delhi.
3. Shanmugam, K. (1990). Fishery Biology and Aquaculture, Hindustan Pub. Corporation, NewDelhi.

REFERENCE BOOKS

1. Mathew Landan, (1991). Introduction to Aquaculture. John Wiley and Sons Inc.
2. Sinha, V.R.P. (1993). Acompendium of Aquaculture Technologies for Developing Countries. Oxford and IBH Publishing Company Pvt. Ltd.
3. Jhingran, V.G. (1991). Fish and fisheries of India. Hindustan Publishing Corporation, Delhi.
4. Pillay, T.V.R. Aquaculture Principles and Practices, Fishing new Books, Blackwell Science Ltd., Oxford.
5. Kurian, C.V. and Sebastein. Prawn and Prawn Fisheries of India. Hindustan Publishing House, New Delhi.
6. Elvire Balugal, A. (1984). Aquaculture Systems and Practices – A selected Review, Daya Publishing House, New Delhi.

E-LEARNING RESOURCES

1. https://marine-aquaculture.extension.org/oyster-culture/
2. https://www.noaa.gov/stories/what-is-aquaculture
3. https://agritech.tnau.ac.in/fishery/fish_ifs.html
4. https://www.biomin.net/species/aquaculture/shrimp-diseases/
5. https://www.nfdb.gov.in/PDF/Biofloc%20booklet%20v6.pdf
6. https://www.ras-aquaculture.com/post/introduction-to-biofloc-system

NON-MAJOR ELECTIVE II
BIOCOMPOSTING FOR ENTREPRENEURSHIP

PROGRAMME: For all UG Students	**BATCH: 2024**
PART: IV	**COURSE COMPONENT:** Non-Major Elective - II
COURSE NAME: Biocomposting for Entrepreneurship	**COURSE CODE:**
SEMESTER: I	**MARKS**:100
CREDITS: 2	**TOTAL HOURS:** 30
THEORY	

COURSE OBJECTIVE:

To highlight the importance of Biocomposting and acquire skills for entrepreneurship.

COURSE OUTCOMES:

1. Gain knowledge about the process of Biocomposting.
2. Learn about different types of biocomposting technology
3. Demonstrate an understanding of Biocomposting techniques for various end applications like solid waste management, industrial waste recycling using sugarcane bagasse, etc.
4. Develop proficiency in setting up Biocompost units and bins for waste reduction.
5. Gain knowledge about the economic cost of establishing small Biocompost units as a cottage industry.

Unit I **6 Hrs**

Biocomposting – Definition, types and ecological importance.

Unit II **6 Hrs**

Types of Biocomposting technology – Field pits / ground heaps / tank / large-scale / batch and continuous methods

Unit III **6 Hrs**

Preparation of Biocompost pit and bed using different amendments

Unit IV **6 Hrs**

Applications of Biocompost in soil fertility maintenance, promotion of plant growth, value added products, waste reduction, etc.

Unit V **6 Hrs**

Economics of establishment of a small biocompost unit – Project proposal for Self - Help Group (Income and employment generation).

Practical

- Preparation procedures for Biocompost pit.
- Selection of Biocompost material, separation of Compostable and Non-compostable materials.
- Packing and marketing of Biocompost.
- Field visit to Biocomposting unit.

PRESCRIBED BOOKS

1. Bikas R. Pati, and Santi, M. Mandal. (2016). Recent Trends in Composting Technology.
2. Van der Wurff, A.W.G., Fuchs, J.G., Raviv, M., Termorshuizen, A.J. (Editors) (2016). Handbook for Composting and Compost Use in Organic Horticulture. Bio Greenhouse Cost Action FA 1105, www.biogreenhouse.org.

E-LEARNING RESOURCES

1. http://deskuenvis.nic.in/sub_theme.asp?theme=4
2. https://agritech.tnau.ac.in/org_farm/orgfarm_composting_coir.html

SOFT SKILLS

SOFT SKILL I: COMMUNICATION SKILLS AND PERSONALITY DEVELOPMENT SKILLS

PROGRAMME: For all UG Students	**BATCH:** 2024- 2025 Onwards
PART: IV	**COURSE COMPONENT:** Soft Skill - I
COURSE NAME: Communication Skills and Personality Development Skills	**COURSE CODE:**
SEMESTER: I	**MARKS: 100**
CREDITS: 2	**TOTAL HOURS:** 30

COURSE OBJECTIVE

To build communication skills for personal and professional development.

COURSE OUTCOMES (COs)

1. Students will demonstrate the ability to actively listen to others, understand diverse perspectives, and paraphrase key points accurately, enhancing their comprehension skills in various personal and professional contexts.
2. Students will be able to articulate thoughts, ideas, and information clearly and concisely, using appropriate language and structure to convey messages effectively in both written and verbal communication.
3. Students will develop confidence in expressing opinions, asserting boundaries, and advocating for themselves and others, leading to enhanced self-assurance and effectiveness in interpersonal and group communication.
4. Students will learn to adapt their communication style and approach based on the audience, context, and purpose of communication, fostering flexibility and versatility in interacting with diverse individuals and groups.
5. Students will acquire techniques for resolving conflicts, managing disagreements, and negotiating mutually beneficial outcomes through effective communication strategies, promoting constructive problem-solving and collaboration in personal and professional settings.

Unit I Types of Communication **6 Hrs**

Verbal Communication - Nonverbal Communication - Visual Communication - Written Communication - Interpersonal Communication - Group Communication - Mass Communication - Digital Communication- Barriers – Language- Cultural- Psychological- Semantic- Technological Barriers

Unit II Etiquette & Ethical Practices in Communication **6 Hrs**

Active Listening - Respectful Language - Clarity and Conciseness – Truthfulness- Professionalism-Tone -Timeliness - Constructive Feedback - Confidentiality - Cultural Sensitivity - - Emotional Intelligence-Social Intelligence- Social Etiquettes-Accountability

Unit III Self-Actualization **6 Hrs**

SWOC Analysis- Self Regulation-Self Evaluation, Self-Monitoring, Self- Criticism, Self-Motivation, Self-awareness and Reflection

Unit IV Leadership and Teamwork **6 Hrs**

Leadership Skills: Leadership styles- Goal-setting and decision-making- Motivation and influence- Team Dynamics: Team building activities- Conflict resolution- Collaborative problem-solving

Unit V Stress and Time Management **6 Hrs**

Definition of Stress, Types of Stress, Symptoms of Stress, Stress coping ability, Stress Inoculation Training, Time Management and Work-Life Balance: Self-discipline Goal-setting

RECOMMENDED TEXTBOOKS

1. Goleman, Daniel (2006) *Emotional Intelligence*, Bantam Books
2. Linden, Wolfgang (2004) *Stress Management- From Basic Science to Better Practice*- University of British Columbia, Vancouver, Canada.
3. Hasson, Gill (2012) *Brilliant Communication Skills*. Great Britain: Pearson Education.
4. Monippally, Matthukutty, M. *Business Communication Strategies*. New Delhi: Tata McGraw Hill Publishing Company Ltd., 2001.
5. Raman, Meenakshi & Sangeetha Sharma (2011*) Communication Skills*, Oxford University Press.

REFERENCE BOOKS

1. N. Krishnaswamy *Current English for College* (1st Edition) - Trinity Press
2. Wood, Julia T (2015) *Interpersonal Communication: Everyday Encounters* 8th Edition, Cengage Learning.

E-LEARNING RESOURCES

1. http://www.albion.com/netiquette/corerules.html
2. http://www.englishdaily626.com/c-errors.php
3. https://www.helpguide.org/articles/relationships-communication/nonverbal-communication.htm
4. https://www.communicationtheory.org/verbal-vs-non-verbal-communication-with-examples/
5. https://letstalkscience.ca/educational-resources/backgrounders/digital-citizenship-ethics
6. https://www.switchboard.app/learn/article/teamwork-leadership-skills

SOFT SKILL II: INTERVIEW SKILLS AND RESUME WRITING

PROGRAMME: For all UG Students	**BATCH:** 2024-25 Onwards
PART: IV	**COURSE COMPONENT:** Soft Skill - II
COURSE NAME: Interview Skills and Resume Writing	**COURSE CODE:**
SEMESTER: II	**MARKS:** 100
CREDITS: 2	**TOTAL HOURS:** 30

COURSE OBJECTIVE

To equip the students to acquire the relevant skills for better employability.

COURSE OUTCOMES (COs)

1. Students will gain an overall understanding of the concept, the purpose, and the objectives of an interview
2. Students will become aware of the various types of interviews and the nuances of each one of them
3. Students will understand and equip themselves with the techniques and strategies required to ace an interview
4. Students will be able to draft a biodata /CV/Resume in the proper format
5. Students will embark on acquiring the relevant skills and will learn to leverage them effectively for better employability

Unit I Introduction to Interview Skills 6 Hrs

Definition- meaning- concept of interview –Purpose- Objectives of interview-Characteristic features of job interviews

Unit II Types of Interview 6 Hrs

Traditional one on one job interview- Panel interview- Behavioral Interview-Group interview-Phone Interview- Preliminary Interview-Patterned Interview Depth Interview, Stress Interview, Exit Interview- Interview through tele and video conferencing

Unit III Interviews: Techniques and Strategies 6 Hrs

Preparing for the Interview Process- Before the interview-During the interview-After the interview -Tips to ace an interview -Commonly asked questions in interview -Do’s and Don’ts of interview - Reasons for rejections

Unit IV Preparing Biodata / CV / Resume 6 Hrs

Essential characteristics of a job Application-Difference between Biodata- CV-Resume-covering letter-Tips to draft an application

Unit V Leveraging Employability Skills 6 Hrs

Personality Development-Organizational skills-Time Management–Stress Management-Effective Communication Skills -Reasoning Ability-Verbal Ability- Group Discussion-Technical skills -Presentation skills

RECOMMENDED TEXTBOOKS

1. Monipally, Matthukutty M. (2017). *Business Communication: From Principles to Practice*
2. Peter, Francis. (2012). *Soft Skills and Professional Communication*. New Delhi: Tata McGraw Hill.

REFERENCE BOOKS

1. Higgins, Jessica JD (2018)*10 Skills for Effective Business Communication: Practical Strategies from the World's Greatest Leaders*
2. Nicholas, Sonji (2023) *Interviewing: Preparation, Types, Techniques, and Questions,* Pressbooks
3. Storey, James (2016) *The Art of The Interview: The Perfect Answers to Every Interview Question*

E-LEARNING RESOURCES

1. https://careermobilityoffice.cs.ny.gov/cmo/documents/Resume%20&%20Interviewing%20Handout.pdf
2. https://edu.gcfglobal.org/en/interviewingskills/interview-etiquette/1/
3. https://findjobhub.com/en/types-of-interviews
4. https://egyankosh.ac.in/bitstream/123456789/23411/1/Unit-2.pdf
5. https://bharatskills.gov.in/pdf/E_Books/CTS/ES/English/ES_Part_1_62%20hour_English.pdf
6. https://bharatskills.gov.in/pdf/E_Books/CTS/ES/English/ES_Part2_58hour_English.pdf

SOFT SKILL III: DIGITAL PROFICIENCY AND MULTIMEDIA SKILLS

PROGRAMME: For All Non-IT Students	**BATCH:** 2024-27
PART: IV	**COURSE COMPONENT:** Soft Skill - III
COURSE NAME: Digital Proficiency and Multimedia Skills	**COURSE CODE:**
SEMESTER: III	**MARKS:**100
CREDITS: 2	**TOTAL HOURS:** 30
PRACTICAL	

(Common to Non-IT Students)

COURSE OBJECTIVES

To equip students with essential computing skills.

COURSE OUTCOMES

1. Design document using salient features of MS-Word.
2. Utilize MS-Excel to manipulate data and prepare dynamic presentation using MS-Power Point.
3. Develop a static web page using HTML.
4. Exhibit proficiency in multimedia creation using GIMP.
5. Demonstrate expertise in data visualization with Raw Graphs.

Unit I **6 Hrs**

MS-Word: Creating, Editing, Formatting and Printing of Documents - Headers and Footers - Spell check- Insert/Draw Tables, Table Auto format – Page Borders and Shading - Mail Merge.

MS-Excel: Creating a new worksheet – Entering, editing and formatting the text, numbers – Formatting cells.

Unit II **6 Hrs**

Inserting Rows/Columns - Changing column widths and row heights – Freezing Titles, splitting screen - Formulae for calculation - Changing font sizes and colours, Sort.

MS-PowerPoint: Creating a Presentation - Inserting and Deleting Slides in a Presentation – Adding Text/Clip Art/Pictures - Slide Transition – Custom Animation.

Unit III **6 Hrs**

Web designing using HTML: Basic tags – heading tags – paragraph, bold, italic, underline tags – font tags – ordered and unordered list – inserting images – hyperlinks.

Unit IV **6 Hrs**

Multimedia applications using GIMP: Interface and Drawing Tools in GIMP- Applying Filters - Creating and handling multiple layers - Using Stamping and Smudging tools - Importing pictures.

Unit V **6 Hrs**

Data visualization using Raw Graphs: Importing and exploring data - Basic chart types - mapping - customizing visualizations - Exporting visualizations.

E-LEARNING RESOURCES

1. https://www.javatpoint.com/ms-word-tutorial
2. https://www.w3schools.com/excel/
3. https://www.tutorialspoint.com/html/
4. https://www.gimp.org/tutorials/
5. https://www.rawgraphs.io/learning

SOFT SKILL IV: FOUNDATIONS OF QUANTITATIVE APTITUDE

PROGRAMME: For all UG Students	**BATCH:** 2024-27 onwards
PART: IV	**COURSE COMPONENT:** Soft Skill - IV
COURSE NAME: Foundations of Quantitative Aptitude	**COURSE CODE:**
SEMESTER: IV	**MARKS:**100
CREDITS: 2	**TOTAL HOURS:** 30
THEORY AND PROBLEMS	

COURSE OBJECTIVE

Develop learners' problem-solving skills and critical thinking abilities in the context of recruitment aptitude tests.

COURSE OUTCOMES (COs)

1. The learner will be able to recognize, describe and represent patterns and relationships, as well as to solve problems using algebraic language and skills.
2. To learn about factors and multiples that numbers have in common with each other.
3. The student will analyse monthly profit and loss statements for a school store and calculate profit margin percentages.
4. Students learn what different types of interest are, where it occurs in real life and understand the concept of simple and compound interests.
5. The learner will draw, interpret and compare pie charts, bar charts and frequency diagrams.

Unit I: Number system and Number series 6 Hrs

Numbers: Numbers and their classification, test for divisibility of numbers, General properties of divisibility, division and remainder, remainder rules.

Number Series: Number series, three steps to solve a problem on series, two-line number series, sum rules on natural numbers.

Unit II: HCF and LCM of Numbers 6 Hrs

Factors, Multiples, Principal of Prime factorization, Highest Common Factor (HCF) and Least Common Multiple (LCM), Product of two numbers, Difference between HCF and LCM.

Unit III: Percentage, Profit and Loss 6 Hrs

Percentage: Introduction, fraction to rate percent, rate percent to fraction, rate percent of a number, express a given quantity as a percentage of another given quantity, convert a percentage into decimals and convert a decimal into percentage.

Profit and Loss: Gain/Loss and % gain and % loss, relation among Cost price, Sale price, Gain/Loss and % gain and % loss.

Unit IV: Simple Interest and Compound Interest **6 Hrs**

Simple Interest: Definition, effect of change of *P, R and T* on Simple Interest, amount.

Compound Interest: Introduction, conversion period, basic formula, to find the Principal/Rate/Time, Difference between Simple Interest and Compound Interest.

Unit V: Data interpretation **6 Hrs**

Tabulation, Bar Graphs, Pie Charts, Line Graphs, average.

PRESCRIBED BOOK

1. Quantitative Aptitude by R.S. Agarwal

REFERENCE BOOKS

1. Quantitative Aptitude by Abhijit Guha, Fourth Edition.
2. Quantitative Aptitude by Ramandeep Singh.

E - LEARNING RESOURCES

1. https://byjus.com/maths/numeral-system/#:~:text=crore%20is%207.-,International%20Numeral%20System,8%20%E2%80%93%20Ones
2. https://byjus.com/maths/hcf-and-lcm/
3. https://byjus.com/maths/profit-loss-percentage/
4. https://www.vedantu.com/jee-main/maths-difference-between-simple-interest-and-compound-interest
5. https://sites.utexas.edu/sos/guided/descriptive/descriptivec/frequency/

ENVIRONMENTAL STUDIES

ENVIRONMENTAL STUDIES

PROGRAMME: For all UG Students	**BATCH:** 2024-27 onwards
PART: IV	**COURSE COMPONENT:** EVS
COURSE NAME: Environmental Studies	**COURSE CODE:**
SEMESTER: IV	**MARKS:**100
CREDITS: 2	**TOTAL HOURS:** 30
THEORY	

Unit I

The Multidisciplinary nature of environmental studies Definition; Scope and importance, Need for public awareness.

Unit II

Natural Resources: Renewable and non-renewable resources: Natural resources and associated problems.

a) **Forest resources:** Use and Over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
b) **Water resources:** Use and over-utilization of surface and ground water, floods, drought, conflicts over water dams benefits and problems.
c) **Mineral resources:** Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
d) **Food resources:** World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
e) **Energy resources:** Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, Case studies.
f) **Land resources:** Land as a resource, land degradation, man induced landslides, soil erosion and desertification. - Role of an individual in conservation of natural resources. - Equitable use of resources for sustainable lifestyles.

Unit III

Ecosystems - Concept of an ecosystem. - Structure and function of an ecosystem - Producers, consumers and decomposers.

Energy flow in the ecosystem - Ecological succession - Food chains, food webs and ecological pyramids.

Introduction, types, characteristic features, structure and function of the following ecosystem: -

a) Forest ecosystem
b) Grassland ecosystem
c) Desert ecosystem
d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit IV

Biodiversity and its Conservation

- Introduction - Definition: genetic, species and ecosystem diversity.
- Biogeographical classification of India.
- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.
- Biodiversity at global, National and local levels.
- India as a mega-diversity nation.
- Hot-spots of biodiversity.
- Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.
- Endangered and endemic species of India.
- Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit V

Environmental Pollution

Definition - Causes, effects and control measures of:

- Air pollution
- Water pollution
- Soil pollution
- Marine pollution
- Noise pollution
- Thermal pollution
- Nuclear hazards

Solid waste Management: Causes, effects and control measures of urban and industrial wastes Role of an individual in prevention of pollution - Pollution case studies.

Disaster management: floods, earthquake, cyclone and landslides.

Unit VI

Social Issues and the Environment

- From Unsustainable to Sustainable development
- Urban problems related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rehabilitation of people; its problems and concerns - Case studies.
- Environmental ethics: Issues and possible solutions
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust - Case studies
- Wasteland reclamation
- Consumerism and waste products
- Environment Protection Act

- Air (Prevention and Control of Pollution) Act
- Water (Prevention and Control of Pollution) Act
- Wildlife Protection Act.
- Forest Conservation Act
- Issues involved in enforcement of environmental legislation
- Public awareness

Unit VII

Human Population and the Environment

- Population growth, variation among nations
- Population Explosion-Family welfare Programme
- Environment and human health
- Human Rights
- Value Education
- HIV/AIDS
- Women and Child Welfare
- Role of information Technology in Environment and human health - Case Studies.

Unit VIII

Field Work (Practical)

- Visit to a local area to document environmental assets-river/forest/grassland/ hill/mountain.
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds.
- Study of simple ecosystems-pond, river, hill slopes, etc.

VALUE EDUCATION

VALUE EDUCATION

PROGRAMME: For all UG Students	**BATCH:** 2024-27 onwards
PART: IV	**COURSE COMPONENT:** Value Education
COURSE NAME: Value Education	**COURSE CODE:**
SEMESTER: V	**MARKS:**100
CREDITS: 2	**TOTAL HOURS:** 30
THEORY	

Unit I

EDUCATION AND VALUES

Definition, Concept, Classification, Theory, Criteria and Sources of values Aims and objectives of value education Role and Need for value education in the contemporary society, Role of education in transformation of values in society Role of parents, teachers, society, peer group and mass media in fostering values

Unit II

VALUE EDUCATION AND PERSONAL DEVELOPMENT

Human Values: Truthfulness, Sacrifice, Sincerity, Self-Control, Altruism, Scientific Vision, relevancy of human values to good life. Character Formation towards Positive Personality.

Modern challenges of adolescents: emotions and behavior Self-analysis and introspection: sensitization towards gender equality, differently abled, Respect for - age, experience, maturity, family members, neighbors, strangers, etc.

Unit III

HUMAN RIGHTS AND MARGINALIZED PEOPLE

Concept of Human Rights – Principles of human rights – human rights and Indian constitution – Rights of Women and children – violence against women – Rights of marginalized People – like women, children, minorities, transgender, differently abled etc.

Social Issues and Communal Harmony Social issues – causes and magnitude - alcoholism, drug addiction, poverty, unemployment – communal harmony –concept –religion and its place in public domain –secular civil society.

Unit IV

VALUE EDUCATION TOWARDS NATIONAL AND GLOBAL DEVELOPMENT

- Constitutional Values: (Sovereign, Democracy, Socialism, Secularism, Equality, Justice, Liberty, Freedom, Fraternity)
- Social Values: (Pity and Probity, Self-Control, Universal Brotherhood).
- Professional Values: (Knowledge Thirst, Sincerity in Profession, Regularity, Punctuality, Faith).

- Religious and Moral Values: (Tolerance, Wisdom, character).
- Aesthetic Values: (Love and Appreciation of literature, fine arts)
- Environmental Ethical Values
- National Integration and international understanding.
- Need of Humanistic value for espousing peace in society. Conflict of cross-cultural influences, cross-border education

Unit V

- Guru Nanak Devji's Teachings
- Relevance of Guru Nanak Devji's teachings' relevance to Modern Society
- The Guru Granth Sahib
- The five Ks
- Values and beliefs
- Rights and freedom (Right of equality, Right to Education, Right to Justice, Rights of women, Freedom of religion, Freedom of culture, Freedom of assembly, Freedom of speech)
- Empowerment of women
- Concept of Langar
- Eminent Sikh personalities

REFERENCE BOOKS

1. Dr. Abdul Kalam. My Journey-Transforming Dreams into Actions. Rupa Publications, 2013.
2. Steven R Covey, 8th Habit of Effective People (From Effectiveness to Greatness), Free Press, New York, 2005.
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SELF STUDY COURSES

INDIAN HERITAGE AND KNOWLEDGE SYSTEM

PROGRAMME:	**BATCH:** 2024-27
PART: IV	**COURSE COMPONENT:** Self Study Course
COURSE NAME: INDIAN HERITAGE AND KNOWLEDGE SYSTEM	**COURSE CODE:**
SEMESTER: III	**MARKS:**100
CREDITS: 2	
QUESTION PATTERN: MCQ	
THEORY	

Course Objective:

To delve into Indian Heritage, this course focuses on South Indian cultures and ancient knowledge like Yoga, Ayurveda, and Siddha, shaping the Nation's identity.

Course Outcomes:

1. Develop a comprehensive understanding among students of Indian heritage, its richness and diversity, and its role in shaping the nation's cultural identity.
2. Gain an enhanced insight into the artistic, architectural, and literary achievements of South India and other regions, fostering a sense of pride in Indian cultural heritage.
3. Enhance students' cultural literacy by gaining insights into traditional practices preserved through folklore across India.
4. Acquire knowledge among students of ancient Indian sciences for holistic well-being, promoting physical, mental, and spiritual health.
5. Develop a deeper understanding of the interconnectedness of spiritual, medicinal, and artistic dimensions within Indian Heritage systems.

UNIT I: Introduction to Indian Heritage

- **Concept of Heritage:** Definition, the importance of studying heritage, and its diverse forms.
- **Cultural Landscape of India:** Overview of major cultural zones in India, with a focus on South India.

  Key Concepts: Cultural heritage, diversity, tangible heritage (e.g., monuments), intangible heritage (e.g., traditions, practices).

UNIT II: Cultural Tapestry of South India

- **Literature:** The classical Tamil literature of *Sangam poetry,* the epic Kannada works like the *"Kuvempu Ramayana,"* the Telugu compositions of *Annamacharya,* and the poetic Malayalam works of Kerala's rich literary tradition.
- **Painting:** The intricate gold leaf work of *Tanjore* painting, the intricate patterns of *Mysore* painting, hand-painting or block-printing of Kalamkari.
- **Theatre:** The ancient art form of *Koothu* and the elaborate dance-dramas of *Bhagavata Mela* in Tamil Nadu, and the colourful folk theatre of *Yakshagana* in Karnataka.

- **UNESCO Indian Heritage Sites:** *Great Living Chola Temples* artistry, *Hampi*-Virupaksha Temple and the Vijaya Vittala Temple, *Mahabalipuram*- a treasure trove of Pallava art, *Mysore Palace*-Indo-Saracenic architecture, *Periyar National Park*-Western Ghats, *Kanchipuram*-City of Thousand Temples

UNIT III: Tamil Nadu Folklores

- **Origins and Significance:** Historical background of Tamil Nadu folklore and its cultural significance.
- **Folk Dances:** Exploration of traditional Tamil folk dances like *Karakattam, Kolattam,* and *Kummi.*
- **Folk Music:** Overview of folk music traditions in Tamil Nadu, including *Parai Attam and Villu Paatu.*
- **Rituals and Festivals:** Understanding the role of folklore in Tamil Nadu's rituals and festivals- *Pongal and Jallikattu.*
  Key Concepts: Karakattam, Kolattam, Parai Attam, Villu Paatu, Tamil folk tales, cultural rituals.

UNIT IV: Unveiling the Knowledge Systems

- **Cultural Landscape of India:** Overview of major cultural zones in India, with a focus on South India.
- **Yoga:** Exploring the various aspects of Yoga - its philosophy, Eight Limbs, practices (e.g., Asanas, Pranayama), and benefits for physical and mental well-being.
- **Ayurveda:** Understanding the core principles of Ayurveda - its focus on holistic health, diagnosis, and treatment methods.
  Key Concepts: Yoga philosophy, Asanas, Pranayama, Tridosha theory (Ayurveda), Doshas (Vata, Pitta, Kapha), Panchakarma, herbal medicine, Ayurvedic lifestyle.

UNIT V: Siddha Tradition and Other Knowledge Systems

- **Siddha Tradition:** Origins, philosophy, medicinal practices, and spiritual aspects.
- **Other Important Knowledge Systems:** Jyotish Shastra (Indian astrology), Natya Shastra (Treatise on performing arts).
  Key Concepts: Siddha literature, alchemy, and spirituality in Siddha tradition. Pancha Boothas (Siddha), herbal remedies, Planetary influences, elements of classical Indian dance and music, and aesthetics in Natya Shastra.

CONTEMPORARY WORLD AND SUSTAINABLE DEVELOPMENT

PROGRAMME: For all UG Programmes	**BATCH:** 2024-27
PART: IV	**COURSE COMPONENT:** Self Study Course
COURSE NAME: CONTEMPORARY WORLD AND SUSTAINABLE DEVELOPMENT	**COURSE CODE:**
SEMESTER: III	**MARKS:**100
CREDITS: 2	
QUESTION PATTERN: MCQ	
THEORY	

Course Objective:

To delve into global dynamics, this course highlights Asia and India's pivotal role in achieving global sustainability objectives.

Course Outcomes:

1. Gain a comprehensive understanding of the key actors, institutions, and dynamics shaping the contemporary world order.
2. Acquire the ability to analyze the political, economic, and security challenges within major Asian regions, fostering informed perspectives on these critical issues.
3. Study the recent wars to develop critical thinking skills to assess the root causes, human costs, and potential solutions to contemporary conflicts.
4. Gain a deeper understanding of the principles and challenges of sustainable development, empowering them to advocate for responsible solutions at local, national, and international levels.
5. Equip to critically evaluate India's contributions to the SDGs, particularly through specific programs implemented in Tamil Nadu, and assess their effectiveness in achieving sustainable development goals.

UNIT I: Global Governance and Institutions

- **State & Non-State Actors:** Definition, types (nation-states, failed states), functions.
  Key Actors: International states, Intergovernmental organizations (IGOs), nongovernmental organizations (NGOs), multinational corporations (MNCs).
- **United Nations (UN):** Structure, key organs (General Assembly, Security Council), functions, WB, & others.
  Key Concepts: United Nations General Assembly, United Nations Security Council.
- **Regional Organizations:** European Union (EU), African Union (AU), North Atlantic Treaty Organization (NATO)
  Key Concepts: European Union Commission, African Union Commission, North Atlantic Treaty Organization.
- **International Law and Treaties:** Significance, role in addressing global challenges.
  Key Concepts: International Court of Justice, International Criminal Court, Geneva Conventions.

UNIT II: Contemporary Asia

Major Geographical Regions

- **Middle East:** Characterized by rich oil reserves, Complex political dynamics, and ongoing conflicts.

Key countries: Iran, Iraq, Israel, Saudi Arabia, Syria, Turkey

- **Southeast Asia:** Rapid economic growth, Challenges- maritime security and environmental degradation.
  Key countries: Indonesia, Malaysia, Philippines, Singapore, Thailand, Vietnam
- **Far East:** Major economic powerhouses and Potential flashpoints.
  Key countries: China, Japan, North Korea, South Korea
- **Rise of China:** Political-South China Sea, Territorial disputes and Competition for Resources. Economic- China's Belt and Road Initiative (BRI)
- **Major Economic Centers: Singapore-** Global financial hub, **Hong Kong-** Special Administrative Region of China, **United Arab Emirates (UAE)-** Diversified economy driven by oil and gas, tourism, and trade.

Regional Organizations:

- Association of Southeast Asian Nations (ASEAN)
- South Asian Association for Regional Cooperation (SAARC)
- Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC)
- Asia-Pacific Economic Cooperation (APEC)
- Shanghai Cooperation Organization (SCO)

UNIT III: Recent Wars of the World

- **Syrian Civil War (2011-present):** Bashar al-Assad regime, Syrian opposition groups, ISIS.
  Key Concepts: Origins of the conflict, humanitarian crisis, foreign intervention, refugee crisis.
- **Yemeni Civil War (2015-present):** Houthi rebels, Yemeni government, Saudi-led coalition.
  Key Concepts: Proxy war dynamics, humanitarian crisis, role of Iran and Saudi Arabia, UN peace efforts.
- **Ukraine Conflict (2014-present)**: Ukrainian government, Russian-backed separatists, Russia.
  Key Concepts: Annexation of Crimea, Donbas region conflict, Minsk agreements, NATO-Russia tensions.
- **Ethiopia Civil War (2020-present):** Ethiopian government, Tigray People's Liberation Front (TPLF), Eritrean forces.
  Key Concepts: Tigray conflict, humanitarian crisis, regional implications, efforts for ceasefire and peace talks.
- **Nagorno-Karabakh War (2020):** Armenia, Azerbaijan, Russia.
  Key Concepts: Conflict over Nagorno-Karabakh region, ceasefire agreement, role of Turkey, peace negotiations.
- **Myanmar Civil War (2021-present):** Myanmar military (Tatmadaw), ethnic armed groups, and Civilian resistance.
  Key Concepts: Coup aftermath, Rohingya crisis, ethnic conflicts, ASEAN mediation efforts.

UNIT IV: Sustainable Development Goals

- **Definition of Sustainable Development:** Balancing economic, social, and environmental needs.
  Key Concepts: United Nations Development Programme (UNDP), World Wildlife Fund (WWF), Sustainable Development Solutions Network (SDSN).
- **UN Sustainable Development Goals (SDGs):** Overview, targets.
  Key Concepts: United Nations, national governments, NGOs, private sector.
- **Challenges and Opportunities:** Achieving sustainability, global cooperation.

Key Concepts: United Nations, national governments, civil society organizations, multinational corporations.

UNIT V: India's Role in Achieving Sustainable Development Goals (SDGs) with Tamil Nadu Initiatives

Addressing Basic Needs:

- **Goal 1: No Poverty**
  - National Rural Employment Guarantee Act (NREGA)
  - Kalaignar Kanchi Thalaiyalar Scheme
  - Ungal Thozhil Udhayanam (UTOY)
- **Goal 2: Zero Hunger**
  - National Food Security Act (NFSA)
  - Nutritious Noon Meal Programme
  - Annadhanam Scheme
  - Amma Unavagam
- **Goal 3: Good Health and Well-being**
  - National Health Mission (NHM)
  - Health Insurance of Tamil Nadu
  - Chief Minister's Comprehensive Health Insurance Scheme
  - Maruthuva Mitri
  - Amma Mini Clinics

Ensuring Essential Services:

- **Goal 4: Quality Education**
  - Sarva Shiksha Abhiyan (SSA)
  - Rashtriya Madhyamik Shiksha Abhiyan (RMSA)
  - Namakkal District Library Scheme
  - Pudhumai Penn Scheme under Higher Education Assurance Scheme (HEAS)
  - Free Coaching for Competitive Exams
- **Goal 6: Clean Water and Sanitation**
  - Swachh Bharat Mission (Clean India Mission)
  - National Rural Drinking Water Programme (NRDWP)
  - Jal Jeevan Mission Tamil Nadu
  - Namakku Naathey Scheme
  - Kudimaramathu Scheme
- **Goal 7: Affordable and Clean Energy**
  - National Solar Mission
  - Tamil Nadu Solar Energy Policy
  - Green House Scheme

Building Sustainable Communities:

- **Goal 11: Sustainable Cities and Communities**
  - Smart Cities Mission
  - Atal Mission for Rejuvenation and Urban Transformation (AMRUT)
  - Adi Dravidar Housing Scheme
- **Goal 13: Climate Action**
  - National Action Plan on Climate Change (NAPCC)
  - International Solar Alliance
  - Tamil Nadu Wind Energy Policy 2019
- **Goal 17: Partnerships for the Goals**
  - Development Assistance Programmes (DAPs)
  - International Development Cooperation (IDC)