QUEEN MARY'S COLLEGE

(AUTONOMOUS)

CHENNAI

DEPARTMENT OF ZOOLOGY

M.Sc. ZOOLOGY

CO – K, PO MAPPED SYLLABUS

FROM 2021-22 ONWARDS

DEPARTMENT OF ZOOLOGY

MINUTES OF THE BOARD OF STUDIES MEETING HELD ON 24.03.21

The board of studies meeting was held on 24.03.2021 at 02.30pm to revise the syllabi for M.Sc. Zoology. The following changes were made in the syllabi

1. Mapping of the syllabi has been done in accordance with LOCF, K, CO, PO, PSO MAPPING for all courses.
2. Few changes were made in the Practical papers
   i) Practical I : Minor phyla were included
   ii) Practical IV : Fish feed preparation was included.

Corrections suggested by the subject experts and approved by the Board were carried out in the revised curriculum.

The following members participated in the meeting

1. Dr. Malathi E. — Chair person.
Associate professor and Head,
Department of Zoology,
Queen Mary's College, Chennai.

2. Dr. K. Sivakumari — University Nominee.
Associate Professor and Head,
Department of Zoology,
Presidency College, Chennai.

3. Dr.B.Uma — Subject Expert.
Associate professor and Head
Department of Zoology,
Bharathi Women's College

4. Mr. J. Richardson — Subject Expert
Associate professor
Department of Zoology,
Govt. Arts College,
Nandanam Chennai.

5. Dr. E. Malini — Internal member
Asst. Professor,
Department of Zoology,
Queen Mary's College, Chennai

6. Dr. Bavani Govindarajulu, — Internal member
Asst .Professor,
Department of Zoology,
Queen Mary's College, Chennai

7. Dr. M. Basheera John, — Internal member
Asst .Professor,
Department of Zoology,
Queen Mary's College, Chennai

8. Dr. J. Beula Padmavathy, — Internal member
Asst .Professor,
Department of Zoology,
Queen Mary's College, Chennai

9. Dr. S. Lekha, — Internal member
Asst .Professor,
Department of Zoology,
Queen Mary's College, Chennai

10. Dr. M. Sendhil Vadivu, — Internal member
Asst. Professor,
Department of Zoology,
Queen Mary's College, Chennai

11. Dr. G.B. Brindha Devi, — Internal member
Asst. Professor,
Department of Zoology,
Queen Mary's College, Chennai.

12. Miss. N.Ramya shree, OSA
Research Scholar
Department of Zoology,
Queen Mary's College, Chennai

13. Miss. Divya Student representative
II M. Sc., Zoology,
Department of Zoology,
Queen Mary's College, Chennai

14. Miss. Rubini Student representative
II M. Sc., Zoology
Department of Zoology,
Queen Mary's College, Chennai

CONTENTS

LIST OF PAPERS WITHCREDITS FOR THE PROPOSED NEW SYLLABI (PG)

S. NO	SEMESTER	C /E	TITLE OF THE PAPERS IN THE NEW SYLLABUS	NO. OF CREDITS	CODE	MARKS	
						EXT	INT
SEMESTER- I							
1	I	C	EVOLUTION AND DIVERSITY OF INVERTEBRATES	4	PC5541	75	25
2	I	C	CELL MOLECULAR BIOLOGY AND GENETICS	4	PC5542	75	25
3	I	C	DEVELOPMENTAL BIOLOGY	4	PC5543	75	25
4	I	C	MICROBIOLOGY AND IMMUNOLOGY	4	PC5544	75	25
5	I	C	PRACTICAL – I INVERTEBRATA AND CHORDATA	4	PC5545	75	25
SEMESTER- II							
6	II	C	EVOLUTION AND DIVERSITY OF CHORDATES	4	PC5546	75	25
7	II	C	BIOCHEMISTRY AND BIOPHYSICS	4	PC5547	75	25
8	II	C	PRACTICAL – II CYTOGENETICS, DEVELOPMENTAL BIOLOGY, BIOCHEMISTRY, MICROBIOLOGY AND IMMUNOLOGY	4	PC5548	75	25
9	II	DE	ELECTIVE-I –PARASITOLOGY	3	PE5517	75	25
10	II	DE	ELECTIVE II – ENTOMOLOGY	3	PE5518	75	25
11	II	EDE	ORNAMENTAL FISHERIES	3	PD5508	75	25
SEMESTER- III							
12	III	C	ANIMAL BIOTECHNOLOGY AND BIOETHICS	4	PC5549	75	25
13	III	C	RESEARCH METHODOLOGY	4	PC5550	75	25
14	III	C	PRACTICAL – III PHYSIOLOGY, BIOTECHNOLOGY, BIOINFORMATICS AND BIOSTATISTICS	4	PC5551	75	25
15	III	DE	ELECTIVE III - BIOINFORMATICS AND BIOSTATISTICS	3	PE5519	75	25
16	III	DE	ELECTIVE - IV AQUACULTURE	3	PE5520	75	25
17	III	EDE	EDE - MATERNITY AND CHILD CARE	3	PD5509	75	25
SEMESTER- IV							
18	IV	C	ANIMAL PHYSIOLOGY	4	PC5552	75	25
19	IV	C	ENVIRONMENTAL BIOLOGY AND TOXICOLOGY	4	PC5553	75	25
20	IV	C	PROJECT	4	PC5554	75	25
21	IV	C	PRACTICAL IV ENVIRONMENTAL BIOLOGY, AQUACULTUTRE AND MEDICAL LABORATORATY TECHNIQUES	4	PC5555	75	25
22	IV	DE	ELECTIVE-V - MEDICAL LABORATORY TECHNIQUES	3	PE5521	75	25

SOFT SKILL SUBJECTS

S.NO	SEM	TITLE OF THE PAPERS IN THE NEW SYLLABUS	NO. OF CREDITS	CODE	MARKS	
					EXT	INT
1	I	LANGUAGE LAB Soft skill - I	2	PSS15	75	25
2	II	PERSONAL SKILLS Soft skill - II	2	PSS16	75	25
3	III	SOCIAL SKILLS Soft skill - III	2	PSS17	75	25
4	IV	EMPLOYABILITY SKILLS Soft skill - IV	2	PSS1	75	25
INTERNSHIP						
1	II	INTERNSHIP	2	PINII	100	-

CHOICE BASED CREDIT SYSTEM FOR P.G

2021 - 2022

Total number of papers - 27 ; 91 credits

TYPE OF PAPER	NO.OF PAPERS	CREDITS PER PAPER	CREDITS
CORE	15	4	60
CORE ELECTIVE	5	3	15
OTHER DEPARTMENT ELECTIVE	2	3	6
SOFT SKILL	4	2	8
INTERNSHIP	1	2	2

- Out of 7 elective papers 5 elective papers will be offered by parent department (II, III and IV Semester)
- The remaining 2 elective papers will be offered to all Other PG students in the college (II and III Semester)
- ***Week - 6 working day order Semester – 15 such weeks**

S. NO.	CORE/ELECTIVE	HRS/WEEK*	NO. OF WEEKS*	TOTAL HOURS / SEMESTER*
1	Core	06	15	90
2	Elective	04	15	60

- Number of Units in the syllabus of core papers 05
- Number of Units in the syllabus of elective papers 05
- Maximum marks per paper 100
- **Total marks 2200**

QUANTIFICATION: END SEMESTER EXAMINATION

DEPARTMENT OF ZOOLOGY

QUESTION PAPER PATTERN
(EFFECTIVE FROM THE ACADEMIC YEAR 2021 - 2022)

CORE and ELECTIVE PAPERS **Maximum Marks: 100**

Internal Assessment: 25 **External Valuation: 75**

Part – A
5 x 2 = 10 marks
Answer all the questions

Question	Unit
1	I
2	II
3	III
4	IV
5	V

Part – B
5 x 4 = 20 marks
Answer all the questions

Question	Unit
6(a) or 6(b)	I
7(a) or 7(b)	II
8(a) or 8(b)	III
9(a) or 9(b)	IV
10(a) or 10(b)	V

Part - C
3 x 15 = 45 marks
Answer any 3 questions out of 5

Question	Unit
11	I
12	II
13	III
14	IV
15	V

INTERNAL EVALUATION METHODOLOGY FOR ALL THE PROGRAMS:

- ✓ Quiz programme or e-Quiz
- ✓ Periodical class tests
- ✓ Assignments – OBJECTIVE / ESSAY
- ✓ Problem solving assignments (INDIVIDUAL / GROUP)
- ✓ Individual seminar USING POWER POINT
- ✓ Seminar based on lecture notes available online
- ✓ Group Discussions / Debate / Interactive Sessions
- ✓ Digital computation exercises with spreadsheet or Excel wherever possible
- ✓ Oral presentation on Topics of interest
- ✓ Field Study
- ✓ Visit to Laboratories

QUANTIFICATION OF INTERNAL EVALUATION - PG THEORY

- Minimum 6 tests – 2 out of 6
- Minimum 3 assignments – best of three
- Model Examination for 75 marks reduced to 10 marks

TEST	ASSIGNMENT	SEMINAR	MODEL EXAM	TOTAL	CONTINUOUS INTERNAL ASSESSMENT
10	**10**	**5**	**75**	**100**	**-**
Reduced To					
5	**5**	**5**	**10**		**25**

PRACTICALS

Maximum Marks : 100

Internal Assessment : 25 **External Valuation : 75**

Model test for 75 marks reduced to 5 marks

TEST	OBSERVATION	RECORD	MODEL	TOTAL
5	5	5	10	25

PRACTIAL EXAM – END SEMESTER
75

Passing minimum

University Examination 50%

Aggregate (CIA+UE) 50%

Grade Points and Cumulative Grade Point Average are awarded in the mark sheet

TEACHING METHODOLOGIES ADOPTED FOR THE PG PROGRAM

1. CHALK AND TALK
2. TEXT BOOK LEARNING
3. DIGITAL LEARNING- ONLINE PPT - LECTURE NOTES
4. VIDEO LECTURE – ONLINE – YOU TUBE – GOOGLE MEET – CLASSROOM
5. WEB RESOURCES/MOOC
6. INTERACTIVE SESSIONS
7. STUDENT SEMINAR
8. STUDENT ASSIGNMENTS
9. E-QUIZ
10. LECTURE BY EXPERTS IN FIELD – INVITED TALKS
11. PARTICIPATORY LEARNING – LECTURES IN OTHER INSTITUTIONS
12. FIELD STUDY
13. VISIT TO LABORATORIES

EDUCATIONAL OBJECTIVE (PEO):

On par with the institutional vision and mission, M.Sc Zoology Programme aims at imparting knowledge and skills to the students enabling them to

- Succeed in obtaining job opportunities appropriate to their interests, as well aspire for higher education, cultivate research abilities on updated topics in the core theory or practical and apply the knowledge of various branches of Zoology meant for a post graduate course and for pursuing career. **(PEO1)**
- Imparting fundamental skills and training to be life – long learners and demonstrate analytical skills and global competency. Development of technical writing skills by exposure to recent developments through project work which is aimed to inculcate ability to develop a research question. Organize relevant available literature to back up the hypothesis, conduct of seminar, workshops, symposium, Encouraging students to participate in inter-collegiate conferences. **(PEO2)**
- Improve leadership qualities in creating successful citizens with rational thinking and scientific temper. Develop positive attitude towards sustainable development and understand the unity of life with the rich diversity of organisms and their ecological and evolutionary significance. Acquire basic skills in the

observation and study of nature, biological techniques, experimental skills and scientific investigation. Use tools of information technology for all activities related to zoology**(PEO3)**

PROGRAM SPECIFIC OUTCOME (PSO):

After completing M.Sc. Zoology Program, the student would be able to

1. Develop a deep understanding, identify basic principles and concepts in theoretical and practical knowledge in all disciplines of Zoology , correlate and apply the concepts in the field of core and applied Zoology and sustain maintenance of high standards of learning in animal sciences.**PSO1**

2. Demonstrate the acquired knowledge of Zoology on animal - animal, animal - microbe and animal - environment interactions and apply the knowledge to solve the various issues in Zoology with relation to human, animal and environment.**PSO2**

3. Create an awareness of the impact of Zoology on the environment, society, and development outside the scientific community. To understand the classification of invertebrates and chordates with the help of charts/models/pictures. Perform procedures as per laboratory standards in the areas of Zoology. **PSO3**

4. To inculcate the scientific temperament in the students, to use modern techniques, advanced equipments and softwares. Understand good manufacturing practices, good laboratory practices and safety. Develop research oriented skills. Educate how to handle the sophisticated instruments/equipments. Apply analytical abilities acquired from the class room and laboratory in the field of academics, research, industry and everyday life and to equip students to get employed in R and D in life sciences. **PSO4**

5. Development of understanding on various fields of zoological science and its applications. Appreciate their experimental learning beyond the classroom; solve the problem, think methodically and independently. Gains knowledge about research methodologies, effective communication skills. Contributes the knowledge for Nation building. **PSO5**

PROGRAM OUTCOME (PO):

The outcome of the PG program in Zoology would be to create an individual with very high knowledge in the subject concepts, develop good communication skills through frequent seminars and digitally conversant through presentations, get inclined to analyze and solve problems, have a quest for enquiry and learning. The program also gives abundant opportunity for students to pursue disciplinary cum systematic learning (**PO**1), enhance and explore her communication skill set (**PO**2), undergo thorough training in analyzing problems (**PO**3), motivated to learn through questions and updated topics (**PO**4), work in teams (**PO**5) to take initiatives (**PO**6), become digitally efficient (**PO**7), embrace moral values (**PO**8), be aware of the resources available to equip knowledge (**PO**9), earnest to be self-learner (**PO**10) and project their findings globally. The program motivates the student to take initiatives, move forward to reach her goal. The skill levels are checked on a scale of 3 and correlated as low (1), moderate (2) and strong (3) for each unit of the course to arrive at the total correlation of skills for the program. Any level of skill below 30 % is not correlated and left as blank.

Graduate Attributes for M.Sc Zoology Programme:

PO1. Disciplinary knowledge and skills: Students will be able to identify the major groups of organisms with an emphasis on animals and be able to classify them within a phylogenetic framework. Compare and contrast the characteristics of animals that differentiate them from other forms of life, use the evidence of comparative biology to explain the theory of evolution. They will be able to use specific examples to explicate how descent with modification has shaped animal morphology, physiology, life history and behavior. Students will be able to explain how organisms function at the level of the gene, genome, cell, tissue, organ and organ-system. Drawing upon this knowledge, they will be able to give specific examples of the physiological adaptations, development, reproduction and behavior of different forms of life. Explicate the ecological interconnectedness of life on earth by tracing energy and nutrient flows through the environment. They will be able to relate the physical features of the environment to the structure of populations, communities, and ecosystems. Students will be able to apply fundamental mathematical tools (statistics) and physical principles (physics, chemistry) to the analysis of relevant biological situations. Demonstrate proficiency in the experimental techniques and methods of analysis. Access the primary literature, identify relevant works for a particular topic, and evaluate the scientific content of these works. **(PSO1)**

PO2. **Skilled communicator:** To demonstrate their communication skills effectively and scientifically in both verbal and written form as independent researcher involving the ability to listen and observe carefully, to read texts and research papers analytically and to present complex information in a concise manner. To improve analytical skills to construct logical arguments related to Zoology, to develop practical skills with the ability to design and construct experiments as well to interpret results in

animal sciences and to develop personal skills such as the ability to work both independently and in a group **(PSO3).**

PO3. **Critical thinker and problem solver:** To have scientific temperament that encompasses certain qualities like analytical thinking, problem solving, reasoning, creative thinking, critical analysis, research attitude and approach. This will go with the frame work of understanding the concepts of zoology such as Fishery biology, Poultry science, entomology (rearing of economically important insects), aquaculture, Animal husbandry, Goat and sheep farming and also methods of preparation and application of Milk and milk products. Students also understand how to solve problems in the field of biodiversity, population genetics, biostatistics and bioinformatics by using softwares. (**PSO4**).

PO4. **Sense of inquiry:** Students will be able to apply the scientific method to questions in zoology by formulating testable hypotheses, gathering data that address these hypotheses, and analyzing those data to assess the degree to which their scientific work supports their hypotheses. Students will be able to present scientific hypotheses and data both orally and in writing in the formats that are used by practicing scientists. Learn, understand and interpret statistical methods and bioinformatics – verbal, mathematical and graphical.

PO5. **Team player/worker:** Providing a broad educational and analytical knowledge necessary to make the students for appearing in competitive examinations and to develop a distinctive quality that can be self-sufficient in making her own career. Collaborate effectively and gain the ability to work both independently and in group.

PO6. **Skilled project manager:** Impart skills required to gather information from living and nonliving resources and use them. Skillful to identify or gather appropriate resources required for a project/ Case Study and manage the task through to completion, while observing responsible as well as principled, scientific hygiene and conduct, laboratory safety norms and practices. Develop scientific ideas, make field visits and study in their natural habitat and also in high throughput and state of art laboratories. Students undergo summer internships to develop scientific temperament, field and laboratory skills.

PO7. **Digitally Efficient:** Understand the flow of Project/plan, effective interaction with team members, method and means for its implementation. Ability to work on biotechnological concepts and allied fields (medical, microbial, agricultural, environmental, plant and animal) with modern tools and techniques towards product and process development for academic, industrial and research applications. (**PSO2**).

PO8. **Ethical awareness / reasoning:** Ability to think and analyze rationally with modern and scientific outlook and identify ethical issues related to one's work; avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism. Adhering to intellectual property rights and adopting objectives, unbiased and truthful actions in all aspects of work. Use

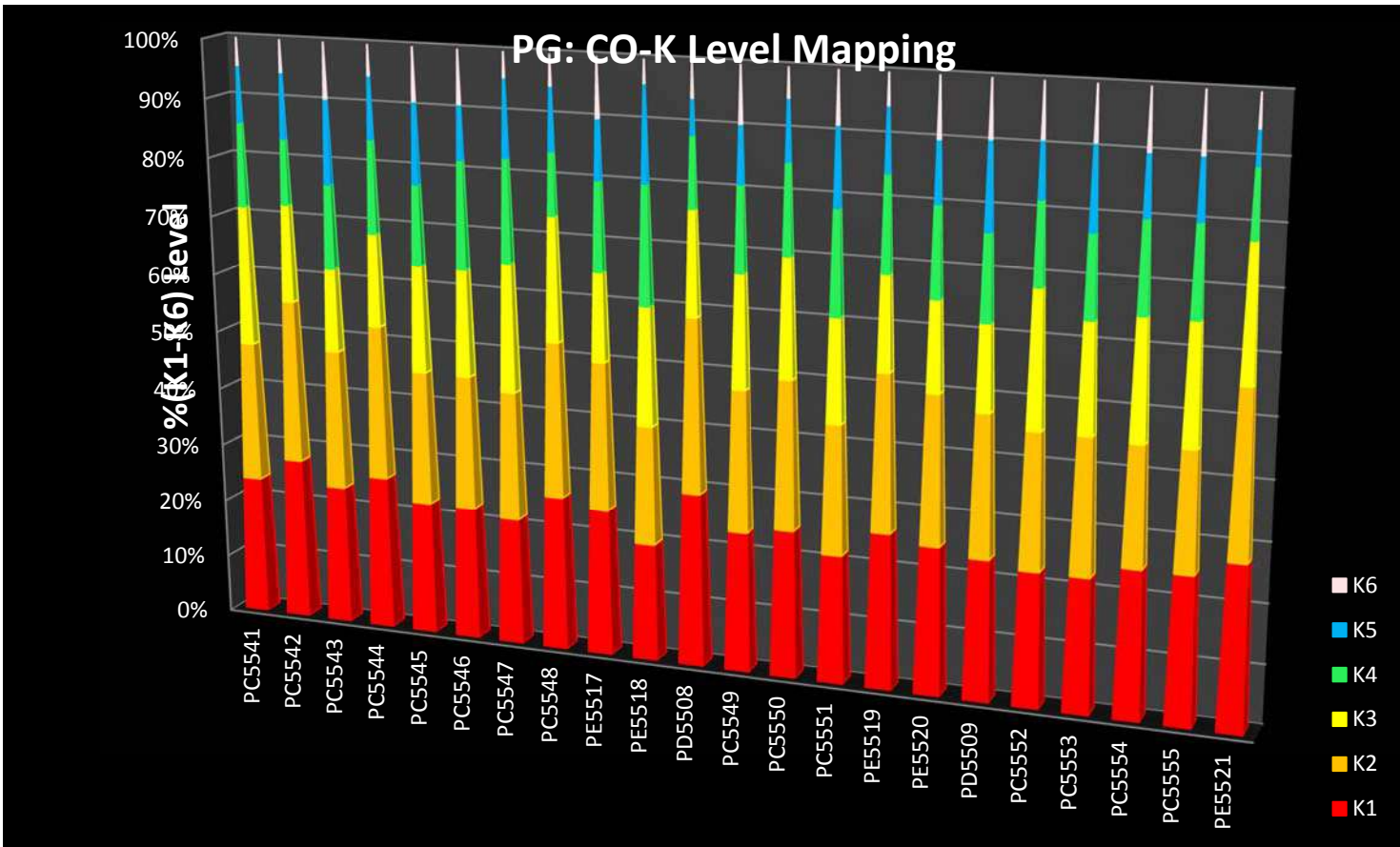
Information Communication Technology to gather knowledge and update scientific information and skills through ICT tools. (**PSO5).**

PO9. **National and international perspective:** The graduates should be able to develop a national as well as international perspective for their career in the chosen field of the academic activities. They should prepare themselves during their most formative years for their appropriate role in contributing towards the national development and projecting our national priorities at the international level pertaining to their field of interest and future expertise. Compulsory participation in several in-house and external conferences pave away for this attribute.

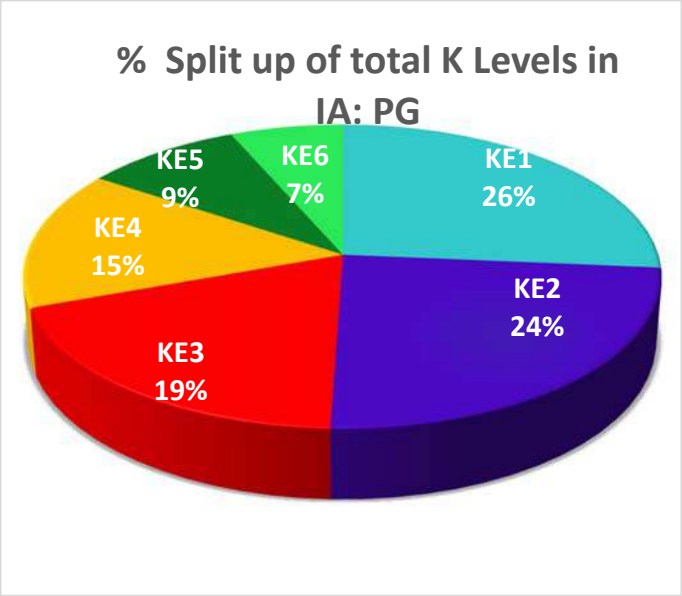
PO10. **Lifelong learners:** Graduates will be able to recognize need for self learning and lifelong learning. Learn, Unlearn, Relearn as well seeks solution to real life problems. Proficiency to demonstrate entrepreneurial and leadership skills with life-long learning. Apply the knowledge and understanding of Zoology to one's own life work and contribute to the society.

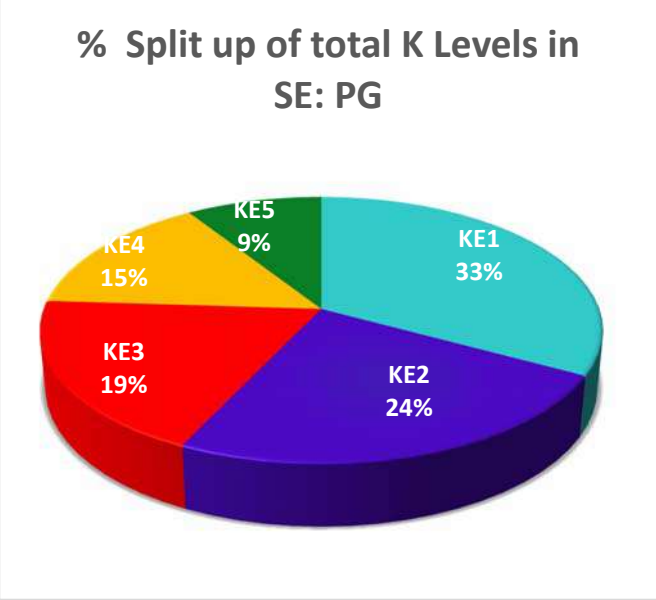
COURSE OUTCOME (CO):

The Zoology curriculum has been designed to fit thoroughly into the ideologies of Bloom's taxonomy with strong knowledge level foundation, catering to remembering and understanding of the advanced concepts in Zoology. Applying and analyzing the studied concepts scientifically based on the thorough theoretical and experimental knowledge acquired in all related fields, focused well in the evaluation pattern of both the continuous internal assessment and end-semester examination. Due weightage to creativity is given in internal assessment and project. The rational correlation of the course outcomes is evident in the evaluation pattern which is the strength of the course. Students would have acquired competence in areas of recent development and can fit themselves in places of scientific temper as they have the skill, computer knowledge and mastered the subject. Knowledge levels imparted in the curriculum are categorized based on Bloom's taxonomy under 6-levels as K1, K2, K3, K4, K5 and K6 and mapped to check their presence or absence and are not scaled.

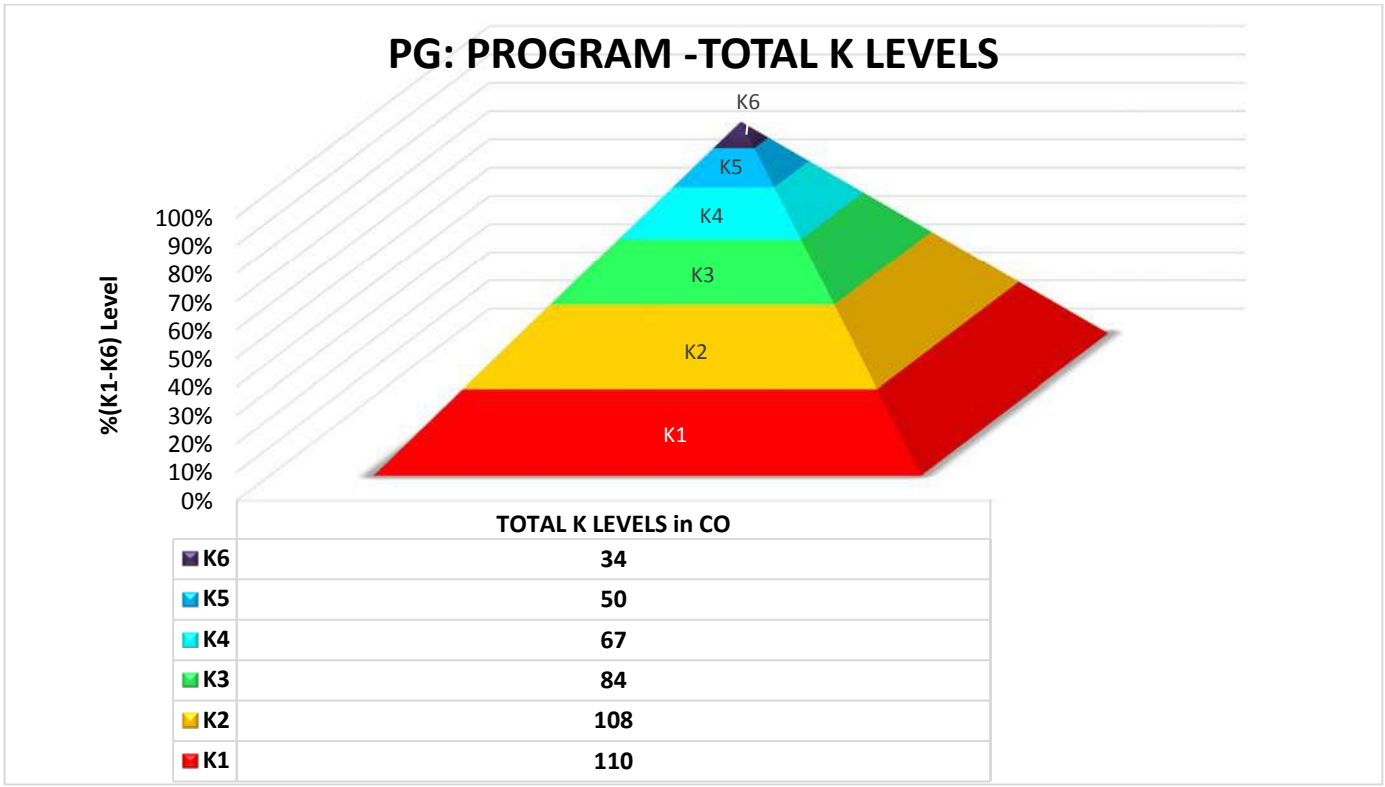


	PC5541	PC5542	PC5543	PC5544	PC5545	PC5546	PC5547	PC5548	PE5517	PE5518	PD5508	PC5549	PC5550	PC5551	PE5519	PE5520	PD5509	PC5552	PC5553	PC5554	PC5555	PE5521
K6	1	1	2	1	2	2	1	1	2	1	1	2	1	2	1	2	2	2	2	2	2	1
K5	2	2	3	2	3	2	3	2	2	4	1	2	2	3	2	2	3	2	3	2	2	1
K4	3	2	3	3	3	4	4	2	3	5	2	3	3	4	3	3	3	3	3	3	3	2
K3	5	3	3	3	4	4	5	4	3	5	3	4	4	4	3	3	3	5	4	4	4	4
K2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	5
K1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

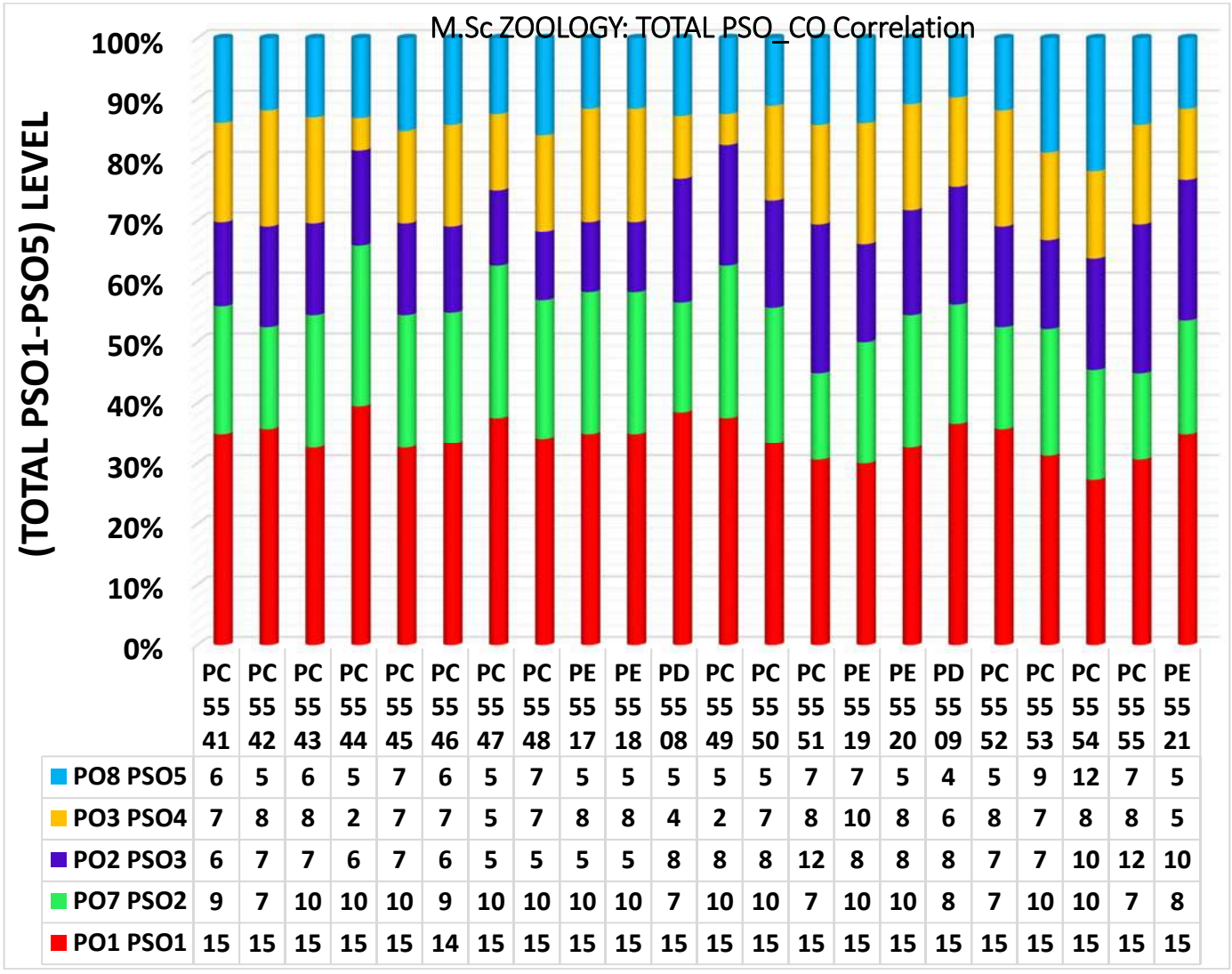




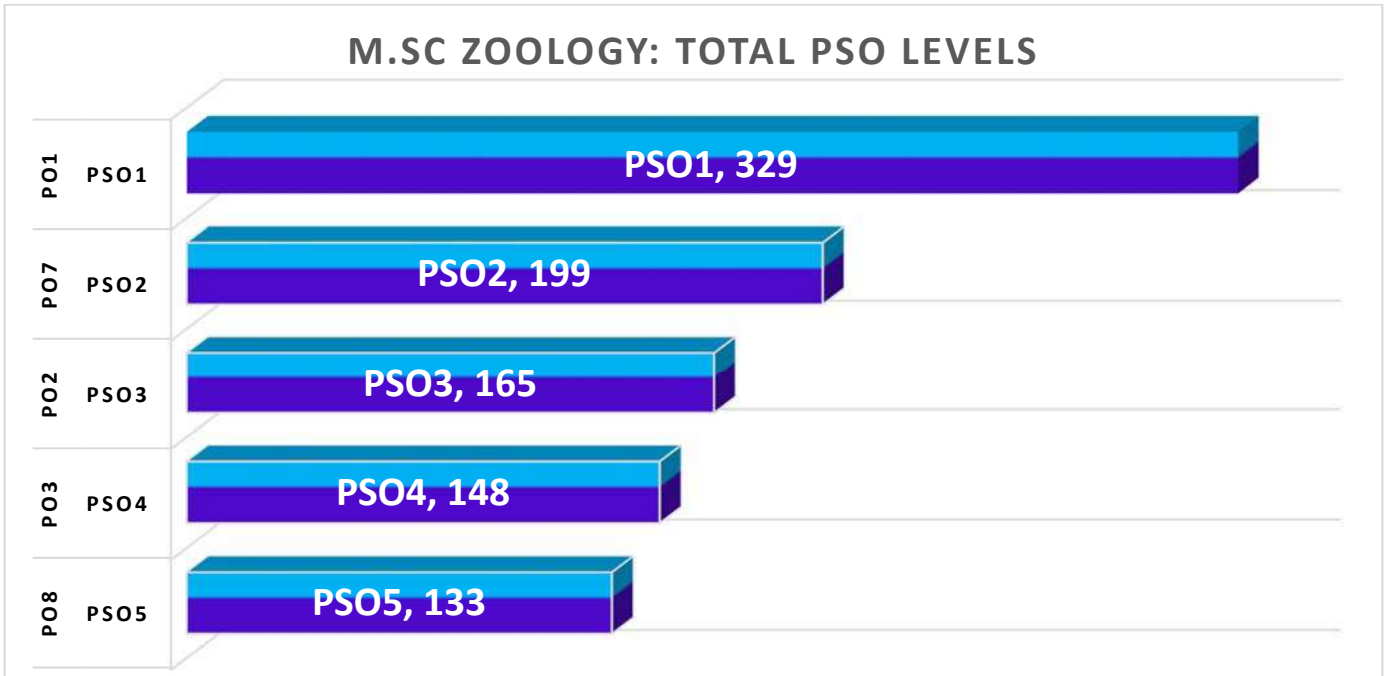
NOTE: Kindly refer Appendix for mapping and correlation details of all courses of the Program.

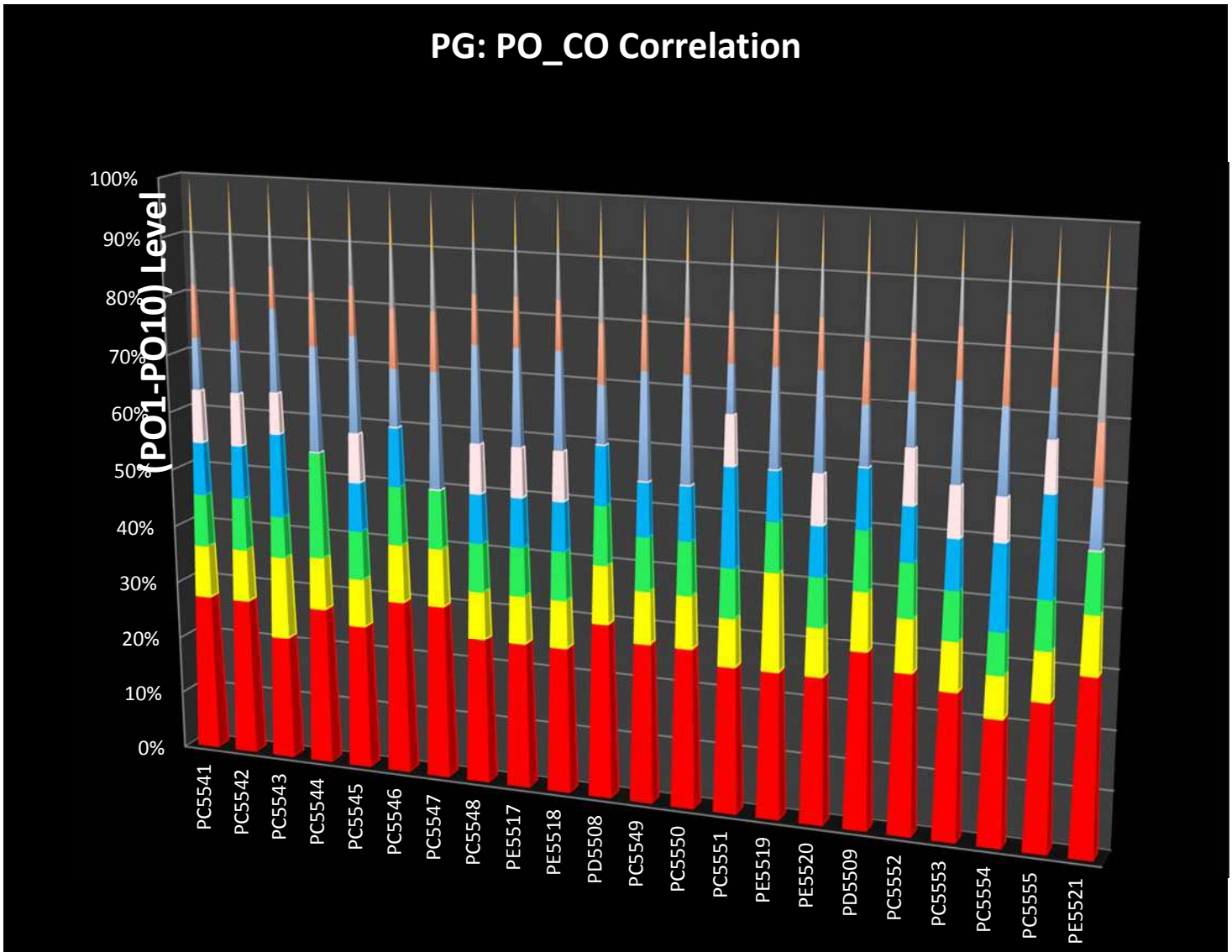


	TOTAL K LEVELS in CO
K6	34
K5	50
K4	67
K3	84
K2	108
K1	110

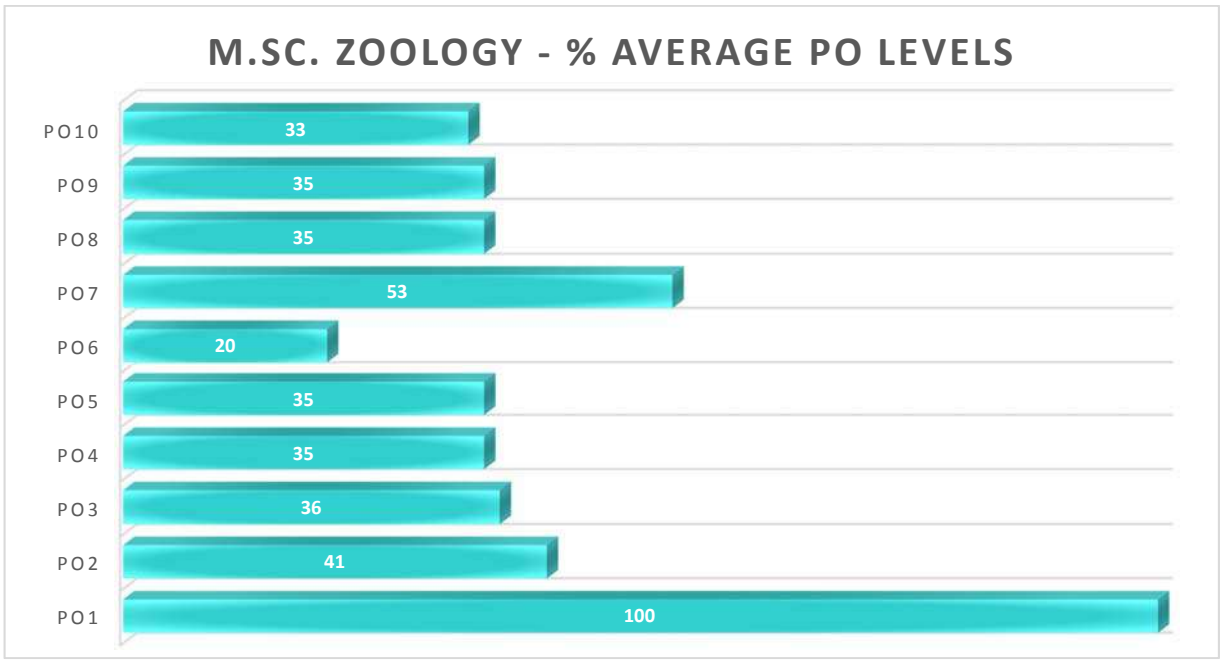


	PC 55 41	PC 55 42	PC 55 43	PC 55 44	PC 55 45	PC 55 46	PC 55 47	PC 55 48	PE 55 17	PE 55 18	PD 55 08	PC 55 49	PC 55 50	PC 55 51	PE 55 19	PE 55 20	PD 55 09	PC 55 52	PC 55 53	PC 55 54	PC 55 55	PE 55 21
PO8 PSO5	6	5	6	5	7	6	5	7	5	5	5	5	5	7	7	5	4	5	9	12	7	5
PO3 PSO4	7	8	8	2	7	7	5	7	8	8	4	2	7	8	10	8	6	8	7	8	8	5
PO2 PSO3	6	7	7	6	7	6	5	5	5	5	8	8	8	12	8	8	8	7	7	10	12	10
PO7 PSO2	9	7	10	10	10	9	10	10	10	10	7	10	10	7	10	10	8	7	10	10	7	8
PO1 PSO1	15	15	15	15	15	14	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15





	PC5541	PC5542	PC5543	PC5544	PC5545	PC5546	PC5547	PC5548	PE5517	PE5518	PD5508	PC5549	PC5550	PC5551	PE5519	PE5520	PD5509	PC5552	PC5553	PC5554	PC5555	PE5521
PO10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
PO9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
PO8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1
PO7	1	1	2	2	2	1	2	2	2	2	1	2	2	1	2	2	1	1	2	2	1	1
PO6	1	1	1	0	1	0	0	1	1	1	0	0	0	1	0	1	0	1	1	1	1	0
PO5	1	1	2	0	1	1	0	1	1	1	1	1	1	2	1	1	1	1	1	2	2	0
PO4	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
PO3	1	1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1
PO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3


M.SC. ZOOLOGY - % AVERAGE PO LEVELS
PO10
33
PO9
35
PO8
35
PO7
53
PO6
20
PO5
35
PO4
35
PO3
36
PO2
41
PO1
100

EVOLUTION AND DIVERSITY OF INVERTEBRATES

Semester:I **Course:I**
Code: PC5541 **Hours: 90**

Learning Objectives

To comprehend the animal diversity and phylogeny of invertebrates through evolutionary aspects. To study their structural peculiarities and affinities.

Course Outcomes: At the end of the Course, the student will be able to: Knowledge level - K1 (Remember), K2 (Understand), K3 (Apply), K4 (Analyze), K5 (Evaluate), K6 (Create). K1* K2* Throughout the course, retention of all the concepts is emphasized after thorough understanding

CO1	Able to **define** the different eras, periods and epochs of geological time scale. **applying** the taxonomic principles will be able to write the hierarchical classification of different groups of organisms. Know the **basic concepts** of binomial and trinomial nomenclature. **Understand** the role of taxonomic tools for **identifying** the species of organisms**.**	K1 K2 K3
CO2	**Applying** acquired knowledgeable towrite the salient features of protozoans and metazoans. C**ategorize** the differenttype of zooids and its functions. **Appraise** the role of coral reefs and its importance. **Understand** the phylogeny of lower invertebrates based on their ancestors by **creating chart on phylogenetic tree [PO5]**	K1 K2 K3 K4 K5
CO3	**Understand** the structural peculiarities of different minor phyla organisms. **Interpret** the affinities among minor phyla group of organisms with that of major phyla. **Recognize** the trilobites are a large group of extinct marine arthropods on the basis of fossil evidences. **by interactive tools , white board, GMEET.[PO7.PO9]**	K1 K2 K3
CO4	**Understand** the relationship of nephridia and coelomoducts in the process of excretion and reproduction in Annelida. **Identify** the adaptation in polychaetes with respect to mode of feeding. **Perceive** the evolutionary significance of trochophore larva, crustacean larvae and Peripatus. **Understand** the mechanism of respiration and excretion in Arthropods on the basis of mode of living. Comparative studies using **models, charts and ppt [PO5,PO7]**	K1 K2 K3 K4
CO5	**Understand** the different structure and composition of shells in Mollusca. Able to c**lassify t**he types of foot based on their mode of living in Mollusca. **Develop** the knowledge about the mode of respiration and excretion in Mollusca and **explain** its function. **Examine** the importance of adaptive radiation in gastropoda. **Justify** the economic importance of Echinoderms and **improve** the knowledge about the fossils of Echinoderms.**Lecture sessions using white board, interactive board and videos [PO7, PO9]**	K1 K2 K3, K4, K5, K6.

Strongly correlated – 3 Moderately correlated – 2 Weakly correlated – 1

CO/PO/ PSO	PO									
	1 Disciplinary Knowledge and skills	2 Skilled Communicator	3 Critical thinker and problem solver	4 Sense of inquiry	5 Team player/worker	6 Skilled project manager	7 Digitally Efficient	8 Ethical awareness/ reasoning	9 National and international perspective	10 Lifelong learners
CO1	**3**	1	1				**2**	1	1	1
CO2	**3**	1	2	**1**			**1**	1		
CO3	**3**	2	1				**2**	2		1
CO4	**3**	1	2	**1**	2		**2**	1		1
CO5	**3**	1	1	**1**	1		**2**	1	1	1
PC5541-AVG	**3**	1	2	**1**	2		**2**	1	1	1
PC5541–TOTAL	**15**	**6**	**7**	**3**	**3**		**9**	**6**	**2**	**4**

Unit I **(18 hours)**

Geological time scale, Principles of Taxonomy-Origin and Development of systematics, Utility of systematics, Systems of Classification. Nomenclature – Binomial, Trinomial, Hierarchy, Taxon and Category, Species, species concept, sub species, race. Tools for study of Taxonomy.

Unit II **(18 hours)**

Phylogeny of protozoa, Shelled protozoa. Origin and Evolution of Metazoa – Polymorphism, Nematocysts ; Ctenophora - affinities – Economic importance of Coelentrates. Origin of Bilateria – Coelom –types and evolution. Acoelomata, Pseudocoelomata, Eucoelomata. Phylogeny of helminthes.

Unit III **(18 hours)**

Rotifera, Gastrotricha, Nemertenia, Acanthocephala, Endoprocta, Phoronida, Siphunculida, Chaetognatha, and Pogonophora–Morphology, Structural Peculiarities, Classification and Affinities - Fossil trilobites.

Unit IV **(18 hours)**

Relationship of Nephridia and Coelomoducts, Trochophore larva and its significance – Types of feeding and mode of life in polychaetes – Reproduction in polychaetes – Evolutionary significance of Peripatus – Crustacean larvae and their significance. Respiration and Excretion in Arthropoda – Origin and Evolution of Arachnida.

Unit V **(18 hours)**

Structural peculiarities of Monoplacophora, Aplacophora, polyplacophora, Shell in Mollusca, Foot in Mollusca – Respiration and Excretion in Mollusca – Adaptive radiation in Gastropoda – Origin of Echinoderms – Fossil Echinoderms – Economic importance of Echinoderms.

REFERENCES:

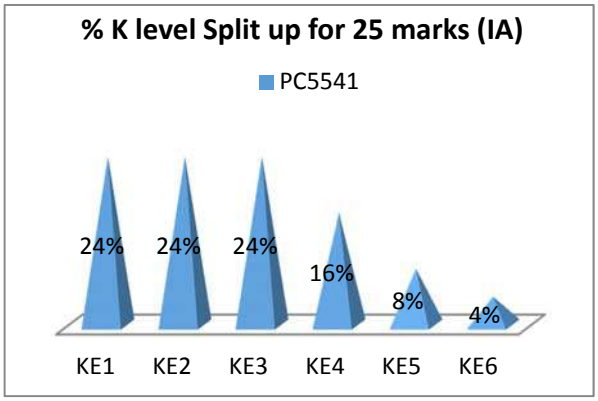
1. Borradaile, L. A. Eastham, L.E.S and J.T Sounders 1977, The Invertebrate Cambridge University press.
2. Barrington, F.J.W. 1969. Invertebrata Structure and Functions, English language Book Society.
3. Corter, G. 1940. General Zoology of Invertebrates, Sidewick and Jackson Ltd., London.
4. *Dhami*, J.K and P. S. *Dhami1979.* Invertebrate Zoology Edition 5, R. Chand & Company.
5. Hyman L.H. 1951. The Invertebrate Volume I-VI, Mc Graw Hill Book Co. Newyork.
6. Kapoor, V. C. 1983**.** Theory and Practice of Animal Taxonomy.. 6th edition. Oxford & IBH Publishing Company.
7. Kotpal, R. L. 1990. Textbook of *Minor Phyla.11th* Edition, Rastogi Publications.
8. Kotpal, R. L. 2014 Modern Text Book of Zoology: *Invertebrates* : Animal Diversity-I 11thEdition Rastogi Publications

WEB RESOURCES:

1. https://en.wikipedia.org/wiki/Systematics
2. https://www.infoplease.com/math-science/biology/genetics-evolution/systematics-taxonomy- and-classification-linnaeus
3. https://www.britannica.com/science/taxonomy
4. www.aboutbioscience.org/topics/biodiversity/
5. https://archive.org/details/ost-biology-textbookofevolut00lind
6. Animal Diversity Web - Database with information and photos on the animal kingdom.
7. https://libguides.viu.ca/c.php?g=188912&p=1247781
8. https://en.wikipedia.org/wiki/Taxonomy_(biology)3.

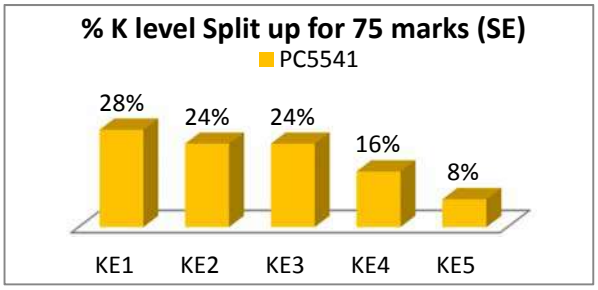
CIE- Continuous Internal Evaluation(25 Marks)

Bloom's Taxonomy	Test	Assignment	Seminar	Model Exam
Total (25)	**5**	**5**	**5**	**10**
Remember (6)	1	1	2	2
Understand (6)	1	0	1	4
Apply (6)	2	2	0	2
Analyse (4)	0	1	1	2
Evaluate (2)	1	0	1	0
Create (1)	0	1	0	0



ESE- End Semester Examination (75 Marks: Weightage 75%)

Bloom's Category	Weightage %
Remember	28
Understand	24
Apply	24
Analyse	16
Evaluate	8



CELL MOLECULAR BIOLOGY AND GENETICS

Semester:I **Course : II**

Code: PC5542 **Hours :90**

Learning Objectives

To understand the molecules within cell and the interaction between cells that allows construction of multicellular organism. Focus on the techniques and procedures commonly utilized in cell and molecular biology research.

Course Outcomes with K- Level Mapping: K1-Remember, K2-Understand, K3-Apply,K4-Analyze, K5-Evaluate, K6-Create.
At the end of the Course, the student would be able to:

CO1	To **list** out the subcellular organelles and explain their function through **charts and models as group activity [PO5].** To **construct** the knowledge about cell organization. **Distinguish** cell organelles and **draw** their structure and **label** their parts. **Illustrate** the structure of microscope and **applying acquired knowledge** to handle the microscope.	**K1 k2 k3 k4 K6**
CO2	To **understand** bio membranes and **illustrate** the structure. To **relate** different type of cell junction. To **understand** different stages of cell cycle and **distinguish** the stages through **interactive session – practice – PPT [PO7]**	**k1 K2 k3**
CO3	To **recall** the basic knowledge of Eukaryotic and prokaryotic DNA. To **explain** transcription. To **distinguish** different steps in transcriptional modification. To **discuss [PO5]** transcriptional modification by **PPT [PO8,PO9]**	**K1 k2 k4**
CO4	To **list** out characteristic features of prokaryote and eukaryotes. To **interpret** the prokaryotic and eukaryotic translations. To **explain** protein sorting and secreting. **Illustrate** gene expression **by interactive tools , white board, GMEET. PPT[PO7.PO9]**	**K1 k2 k3 k5**
CO5	To **understand** the mutation and **construct** the knowledge about gene mutation. To **demonstrating** mutagenesis and mutational hotspot. To **compare** and **identify** different types of DNA Repairs.**Programming session through video discussion lectures [PO9]**	**K1 k2 K5**

Strongly correlated – 3 **Moderately correlated – 2** **Weakly correlated – 1**

CO/PO	PO									
	1 Disciplinary Knowledge and skills	2 Skilled Communicator	3 Critical thinker and problem solver	4 Sense of inquiry	5 Team player/worker	6 Skilled project manager	7 Digitally Efficient	8 Ethical awareness / reasoning	9 National and international perspective	10 Lifelong learners
CO1	3	1	2	1	1		1	1		1
CO2	3	1	2	1			2	1		1
CO3	3	2	1	1	1		1	1		1
CO4	3	1	2	1	1		2	1		1
CO5	3	2	1	1	1	1	1	1	1	2
PC5542 - Avg	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
PC5542 - Total	**15**	**7**	**8**	**5**	**4**	**1**	**7**	**5**	**1**	**6**

Unit I **(20 hours)**

Cell organization: Subcellular organelles and their functions. Molecular composition of cell - structure and function of ER, Golgi apparatus, Mitochondria, Nucleus, Lysosomes.

Microscopy- Bright field, Dark field, Phase contrast, fluorescence; Electron (TEM, SEM and Tunneling SEM). Hybridization-FISH; Flow cytometry;

Unit II **(18 hours)**

Biomembranes - structural organization, transport across membrane (Passive Active and Bulk transport); CellCell adhesion- Cell junctions (Tight junctions, gap junctions, desmosomes, adherens); Extra cellular matrix (ECM)- components and role of ECM in growth. Cell signalling and their receptors, intracellular signal transduction. Cell cycles and its regulations.

Unit III **(18 hours)**

Organization of Eukaryotic DNA in to chromosomes; DNA replication – mechanism; Transcription- prokaryotic RNA polymerases- role of sigma factor, TATA box, promoter, closed and open promoter complexes- initiation, elongation and termination of transcription, post transcriptional modifications in prokaryotes (tRNA and rRNA). Inhibitors of transcription.

Unit IV **(17 hours)**

Translation in prokaryotes and eukaryotes; Post translational modifications; Protein sorting and secretion; Protein folding and degradation. Genetic code. Gene Expression: Regulation of Gene Expression in prokaryotes (Lac and Tryptophan operon) and eukaryotic gene regulation.

Unit V **(17 hours)**

Mutations: Gene mutations, Mutagens, Oncogenes, site-specific mutagenesis and mutational hot spots. DNA Repaor-types of damages, repair by direct reversal of damage, excision repair, recombination repair, SOS repair.

REFERENCES

1. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. 2002. Molecular Biology of the Cell. Fourth edition. Garland Science.

2. Burns G. W. 1969. The Science of Genetics. The McMillan Company, New York.

3. Cooper G.M. and Hausman R.E. 2009. The Cell: A Molecular Approach. 5th edition.Sunderland. Mass. Sinauer Associates, Inc.

4. David Freifelder. 1992. Essentials of Molecular Biology. 2nd edition. Jones & Bartlett Publications.

5. De Robertis, E. D.F. and De Robertis. E. M. F. 1981. Cell and Molecular Biology. Saunder International Edition.

6. Gerald Karp G. 2010. Cell and Molecular Biology: Concepts and Experiments . 6th edition. John Wiley & Sons. Inc.

7. Levine R. P. 1968. The Science. Holt Reinhart and Winston.b New York.

8. Lodish,H., Berk, A., Zipursky, S.L., Matsudaira, P., Kaiser, A., Kreiger, Scott,and Darnell, J. 2004. Molecular Cell Biology. Fifth edition. W.H.Freeman and Company.

WEB RESOURCES

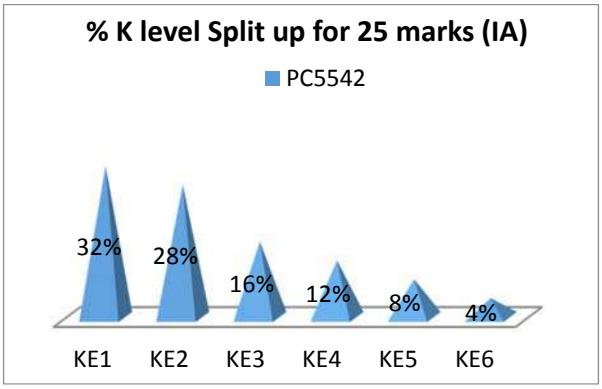
www.cellbio.com.edu

https://geneed.nlm.nih.gov

ASSESSMENT PATTERN

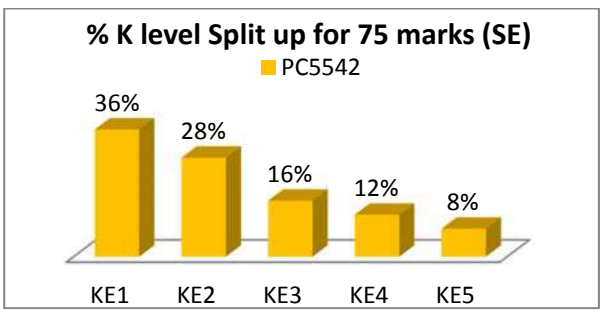
CIE- Continuous Internal Evaluation(25 Marks)

Bloom's Taxonomy	Test	Assignment	Seminar	Model Exam
Total (25)	**5**	**5**	**5**	**10**
Remember (8)	2	2	2	2
Understand (7)	1	0	1	5
Apply (4)	1	1	0	2
Analyse (3)	0	1	1	1
Evaluate (2)	1	0	1	0
Create (1)	0	1	0	0



ESE- End Semester Examination
(75 Marks; Weightage 75 %)

Bloom's Category	Weightage %
Remember	36
Understand	28
Apply	16
Analyse	12
Evaluate	8



DEVELOPMENTAL BIOLOGY

Semester- I **Course: III**

Subject Code: PC5543 **Hours: 90**

Learning Objectives: To understand the pattern of development among metazoans and gamete formation. To acquireknowledge on the various stages of fertilization, foetal development, organ formation and the recent trends in treatment of infertility. Students will be able to create awareness among the general public on the necessity of birth control and the methods to be adopted.

Course Outcomes: At the end of the Course, the Student will be able to:Knowledge level - K1 (Remember), K2 (Understand), K3 (Apply), K4 (Analyze), K5 (Evaluate), K6 (Create). K1* K2* Throughout the course, retention of all the concepts is emphasized after thorough understanding.

CO1	**Recalling** the history and basics of developmental biology. To **understand** and interpret the various patterns of development in living organisms and to **distinquish** spermatogenesis from Oogenesis recall the process of Gametogenesis by preparing charts **(PO1, PO2)**and **explain** the different layers of egg membranes by ppt and video lectures**.(PO7**)	**K1 K2 K4**
CO2	To **understand** the mechanism of fertilization and to **demonstrate** and **identify** the various patterns of cleavage and morphogenetic movements by watching animation videos **(PO7)** It enables students to **demonstrate** the process of gastrulation by preparing models **(PO10**)	**K1 K2 K5**
CO3	To **understand what** is chemodifferentiation by conducting seminar (**PO2) and** to **compare** and **analyze** the development of organ and to **interpre**t the **importance** of organizers (Web) **PO4**	**K1 K2 K3 K5**
CO4	To **define** the importance of reproductive cycle through assignments (PO1) and **interpret** the role of hormones during pregnancy by conducting quiz (PO3). To **minimize** and **evaluate** the problems of pregnancy. To **recommend** and **make use** of the immunization schedule. (Web) **PO9**	**K1 K2 K3 K4 K5 K6**
CO5	To **list** and suggest various safety methods of Birth control by white board interactive method. (PO7, PO9). To **explain** solutions for various causes of infertility by **applying** alternate methods of conception by group discussion (PO5). To **assess** and **create** awareness on Surrogacy and family system by teaching the ethical values (PO8). **by interactive tools , white board, GMEET.[PO7.PO9]**	**K1 K2 K3 K4 K6**

Strongly correlated – 3 **Moderately correlated – 2** **Weakly correlated – 1**

CO/PO/ PSO	PO									
CO1	**3**	2	1		1	1	**2**	1		1
CO2	**3**	1	2	**1**			**2**	1	1	
CO3	**3**	1	2				**2**	1	1	1
CO4	**3**	1	1	**2**	2		**2**	1	1	1
CO5	**3**	2	2	**1**	1		**2**	2	1	1
PC5543-AVG	**3**	1	1	**1**	1	1	**2**	1	1	1
PC5543– TOTAL	**15**	**7**	8	**4**	4	1	**10**	**6**	4	**4**

Unit I **16 Hours**

History, basic concepts of developmental biology-theories. Developmental patterns among the metazoans. The cellular basis of Morphogenesis, Differential cell affinity, thermodynamics model of cell interactions. Germ cells-origin, Gametogenesis, Spermatogenesis, Oogenesis, egg membranes.

Unit II **20 Hours**

Fertilization – Recognition of egg and sperm. Sperm activation – Acrosome reaction – fusion of gametes, activation of egg, metabolism – Fusion of genetic material. Preparation for cleavage, Patterns of embryonic cleavage. Mechanism of cleavage, Nucleus of cleavage cells, Distribution of cytoplasmic substances in the egg during cleavage, Role of egg cortex; Gastrulation-Reorganizing the embryonic cells- Morphogenetic movements.

Unit III **18 Hours**

Chemodifferentiation – Nucleocytoplasmic interactions early vertebrate development – Neurulation. Development of brain, eye, heart, and kidney in Frog. Organizer concept: Classical experiments. Embryonic induction and competence. Mechanism of induction.

Unit IV **18 Hours**

Human development – Reproductive organs, Reproductive cycle, Hormonal control, Implantation- Pregnancy, Role of Hormones in Pregnancy, Extra embryonic membranes, Placenta-structure and Function, Ectopic pregnancy, Parturition - Normal and Caesarean , Neonatal care, Immunization schedule.

Unit V **18 Hours**

Birth control- Safety methods for Birth control. Necessity for Birth control; contraceptive devices. Infertility causes-Male and Female. IUI, IVF, ICS ,IMSI, Embryo transfer, GIFT, Surrogacy, Twins, Importance of family system and Role of Parents.

REFERENCES

1.Verma P.S., V.K.Agarwal and Tyagi. 1995, Chordate Embrology. S. Chand and Co, New Delhi.

2.Balinsky. 2012. An Introduction to Embryology, 5th Edition. Cengage learning Publication

3.Berrill, N.J. 1986. Developmental Biology. Tata McGraw Hill Publication Co.Ltd.

4.Gilbert,S.F. 1997. Developmental Biology.5thed. Sinauer Associates, Inc., Sunderland, Massachusetts.

5.Robert S. McEwen. 3rded- Vertebrate Embryology. 3rded.. Henry Holt and company, NewYork.

6.Veer Bala Rastogi. 2011. Chordate Embryology, KedarNath and Ram Nath , Delhi

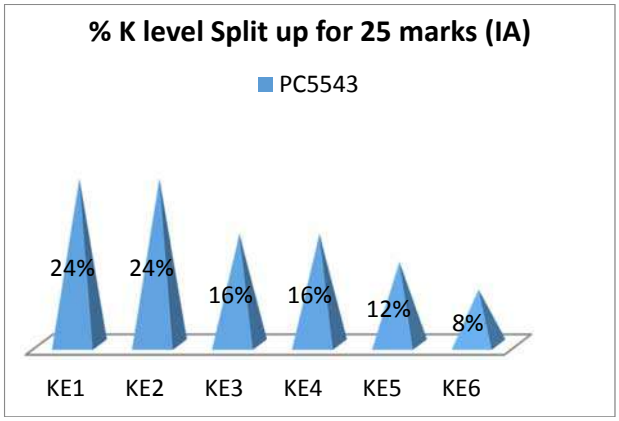
WEB RESOURCES:

https://www.sciencedaily.com/terms/developmental_biology.htm
https://cmb.i-learn.unito.it/mod/book/tool/print/index.
https://www.studocu.com/en-gb/document/university-of-leeds/animal-developmental-biology/lecture-notes/animal-developmental-biology-lecture-notes-

ASSESSMENT PATTERN

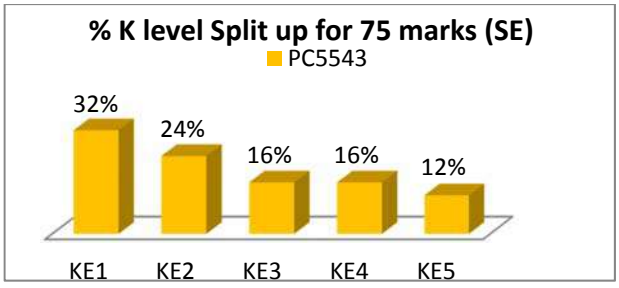
CIE- Continuous Internal Evaluation(25 Marks)

Bloom's Taxonomy	Test	Assignment	Seminar	Model Exam
Total (25)	**5**	**5**	**5**	**10**
Remember (6)	2	2	1	1
Understand (6)	1	0	1	4
Apply (4)	1	1	0	2
Analyse (4)	0	1	1	2
Evaluate (3)	1	0	1	1
Create (2)	0	1	1	0



ESE- End Semester Examination (75 Marks; Weightage 75 %)

Bloom's Category	Weightage %
Remember	32
Understand	24
Apply	16
Analyse	16
Evaluate	12



MICROBIOLOGY AND IMMUNOLOGY

Semester I **Course: IV**
Subject Code: PC5544 **Hours: 90**

Learning Objectives:

This course mainly describe the classification of microbes and provide knowledge on types of culture media and impart knowledge on the role of microbes in our daily life, also able the students to know the role of microbes in food and dairy industry and their role in the production of beneficial products for human welfare. Acquire the knowledge on the defense system in human and able to understand the system and cellular components. Acquire knowledge about the interactions exist between immune system and pathogens.

Course Outcomes: At the end of the Course, the Student will be able to:

Knowledge level - K1 (Remember), K2 (Understand), K3 (Apply), K4 (Analyze), K5 (Evaluate), K6 (Create). K1* K2* Throughout the course, retention of all the concepts is emphasized after thorough understanding.

CO1	To **recollect**and **understand** the basic knowledge on classification of microorganisms. To **explain** culture media and **apply** knowledge on growth of microbes and **able todistinguish** microbes by giving seminars **(PO2)** and to understand diseases caused by microorganisms. Interactive board and ppt and video lecture videos to explain the microbial classification **(PO7)**	**K1 K2 K3 K4**
CO2	To **explain** the importance of role of microbes in food, dairy and pharmaceutical industries by videos (PO7), identification of beneficial microbes and to knowthe knowledge on the production of metabolic products for human welfare.	**K1 K2 K6**
CO3	To **define and recall** entire immune system, classification of immune organs by showing images **(PO7)**, list of immune cells and to **explain and interpret** their role in defense mechanism. videos (PO7) to understand the immune response by immune cells. To know the role of immune organs and various cells by submitting assignments **(PO2)**	**K1 K2 K3 K5**
CO4	To **understand and acquire** knowledge on antigen, immunoglobulins, major histocompatibility complexes their structure, properties, types and functions and to demonstrate and **discuss** their role in immunity. Use charts to understand the components and , Web sources **(PO9)**	**K1 K2 K3 K4**
CO5	To **explain** the immune response elicited against various pathogens, to able to **gain the knowledge**and role of cytokines in immune system (videos). To **enlist** the hypersensitivity reactions. Use web **(PO9)** to **develop knowledge** about vaccines and schedule also to apply the knowledge of the relationship between immunity and self immune cells and development of autoimmunity and autoimmune disease.	**K1 K2 K4 K5**

Strongly correlated – 3 **Moderately correlated – 2** **Weakly correlated – 1**

CO/PO/ PSO	PO									
	1 Disciplinary Knowledge and skills	2 Skilled Communicator	3 Critical thinker and	4 Sense of inquiry	5 Team player/worker	6 Skilled project manager	7 Digitally Efficient	8 Ethical awareness/ reasoning	9 National and international perspective	10 Lifelong learners
CO1	**3**	1	1				**2**	1	1	1
CO2	**3**	1					**2**	1	1	1
CO3	**3**	1					**2**	1	1	1
CO4	**3**	1	1				**2**	1	1	1
CO5	**3**	2		**1**			**2**	1	1	1
PC5544-AVG	**3**	1	1	**1**			**2**	1	1	1
PC5544 – TOTAL	**15**	**6**	2	**1**			**10**	**5**	**5**	**5**

Unit I **19 hours**

Microbiology: microbial taxonomy - classification and nomenclature of microorganism. Nutritional requirements of microorganisms, types of culture media, sterilization of culture media, culture techniques, growth kinetics, enumeration of bacteria. Staining techniques – simple staining, differential staining - Gram staining, acid fast staining, capsular staining, flagellar staining. Microbial diseases: causative agent, symptoms, treatment and preventive measures; bacterial diseases – tuberculosis, typhoid, viral diseases - hepatitis, Covid - 19 and fungal disease - candidiasis**.**

Unit II **19 hours**

Food Microbiology: microorganisms in fresh food materials – meat, poultry, fruits and vegetables and milk, Food preservation- principle and methods. Industrial microbiology: Primary metabolites and secondary metabolites and their applications - production of penicillin, alcohol, VitaminB-12. Microbes as biofertilizer - Rhizobium, phosphate solubilizing bacteria. Use of *E.coli* as pollution indicator.

Unit III **18 hours**

Immunology: Types of immunity - innate and acquired. Components of the immune system - Lymphoid organs – primary and secondary lymphoid organs and immune cells – types of immune cells. Development, maturation, activation and differentiation of T-cells and B-cells; T Cell Receptor. Primary and secondary immune response. Humoral and cellular immunity.

Unit IV **17 hours**

Antigen – properties of antigen, types of antigens, antigen presenting cells, types of antigen presenting cells, antigen processing and presentation . Antibody – typical structure, types and subtypes of antibodies / immunoglobulins, characters and functions. Antigen-antibody interactions – precipitation, agglutination, neutralization, opsonization and complement fixation; Major Histocompatibility Complex – types and functions.

Unit V **17 hours**

Immune responses to infections - immunity to viruses, bacteria, fungi. Cytokines - interferons, chemokines, interleukins and tumor necrosis factor and their functions. Complements – types and types of activation pathways, hypersensitivity reactions - types; Immunodeficiency diseases - HIV; Vaccines – types, vaccination schedule. Autoimmune disorders – Type I diabetes, rheumatoid arthritis (RA), multiple sclerosis and myasthenia gravis

REFERENCES

1. A textbook of Microbiology, D.K.Maheswari, 2013, S. Chand Publishing
2. Textbook of Microbiology and Immunology, Subash Chandra Parija, 2016, Elsevier India.
3.Ananthanarayanan and Panickar CKJ, 2008, Text book of microbiology, Orient LongmanPvt.Ltd.
4.Eli Benjamini, Geoffrey Sunshine, Sidney Leskowitz, 1996, Edition 3, Wiley.
5. Janis Kuby, Barbara A. Osborne, 1992, Immunology textbook, WH Freeman and Co. Ltd.
6. Male D., Roth D. and Roit I.M., 2002. Immunology, 8th edition, Elsevier science publishers.
7. Parihar P., 2008. Dairy Microbiology, Student Edition.
8. Michael J. Pelczar, Chan ECS and Noel R.Krieg 2007, Microbiology, McGraw Hill Education.

9. Prescott LM, Harley JP and Klein DA, 2003, Microbiology, McGraw Hill education.
10. William C., Frazier, Dennis C. Westoff and Vanitta K.N. 2013, Food Microbiology. 5th Edition, McGraw Hill Education.

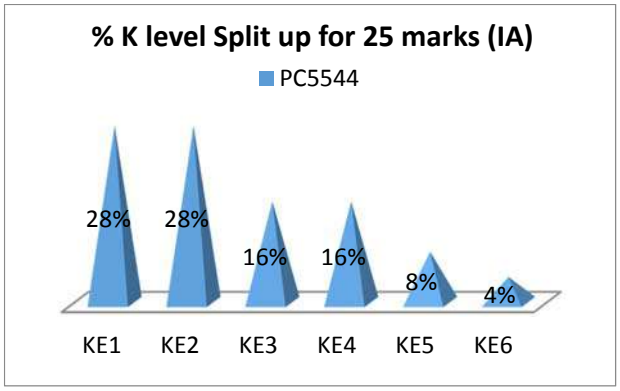
WEB REFERNCES / E RESOURCES :

www.aboutbioscience.org>topics>microbiology/
www.edufive.com
www. biologydiscussion.com
www.ncbi.nlm.nih.gov.

ASSESMENT PATTERN

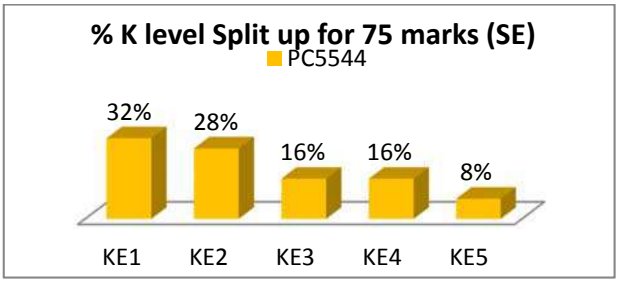
Continuous Internal Evaluation (25 Marks)

Bloom's Taxonomy	Test	Assignment	Seminar	Model Exam
Total (25)	**5**	**5**	**5**	**10**
Remember (7)	2	2	2	1
Understand (7)	1	0	1	5
Apply (4)	1	1	0	2
Analyse (4)	0	1	1	2
Evaluate (2)	1	0	1	0
Create (1)	0	1	0	0



ESE- End Semester Examination (75 Marks; Weightage 75 %)

Bloom's Category	Weightage %
Remember	32
Understand	28
Apply	16
Analyse	16
Evaluate	8



PRACTICAL – I EVOLUTION AND DIVERSITY OF INVERTEBRATES AND CHORDATES

Semester I **Course: V**

Subject Code: PC5545

Learning Objectives:

Animal Diversity enables the students to learn different species of animals as per their classification using taxonomic keys. It makes them to understand the different larval forms during development and their medical significance of parasites. Dissections enables students to have hands on experience to understand the anatomical structures of the animal and their functions**.**

CO1	**Identification** of various species makes the students to **name** them as per the biological nomenclature. This develops the skill of **identifying** the animal world using identification manuals and web resources **(PO3, PO7**. It also helps them to **illustrate** the outline structure and **label** them accordingly	**K1 K2 K4**
CO2	To **identify** the different larval forms and their significance by spotter test (PO1).To **interpre**t the medical importance of parasites.and to **improve** healthier society by providing proper **solutions.(PO3, PO9).** To **compare** and **discuss** the mouth parts of different insects by drawing charts (PO1). To **dissect** and display the various anatomical features which will enable the students to explain the various systems using you tube video and interaction of virtual dissections**(PO9**)	**K1 K2 K4 K5 K6**
CO3	It enables students to **identify** the different chordate forms and **classify** them using lab manuals **(PO1)** and **illustrate** with neat labelled diagrams by drawing chart as a team **(PO5)**.	**K1 K2 K3 K4**
CO4	To compare the anatomical features of the dissected specimen using interactive virtual dissections (PO7) . To know the importance of each organ system and their functions using web (PO9).	**K1 K2 K4 K5**
CO5	To **list** the various bones of significance and to **compare** and **analyze** the structural features by group discussion (PO2). Field trips helps students to **understand** and **apply** the theoretical knowledge. To **plan** the area of research (PO6). Campus fauna enables them to **understand** and **classify** the various fauna surrounding them **Interpret** and classifying them , It also enables them to **compil**e all the data and to **discuss** the **importance** of conservation of campus fauna (PO4, PO9 and PO10)	**K1 K2 K3 K4 K5 K6**

Strongly correlated – 3 Moderately correlated – 2 Weakly correlated –1

CO/PO/ PSO	PO									
	1 Disciplinar	2 Skilled Communic	3 Critical thinker and	4 Sense of inquiry	5 Team player/wo	6 Skilled project	7 Digitally Efficient	8 Ethical awareness	9 National and	10 Lifelong learners
CO1	**3**	1	1	**2**	2	3	**2**	1	3	1
CO2	**3**	1	1	**1**			**2**	1	1	
CO3	**3**	2	2				**2**	2		1
CO4	**3**	1	1	**2**	2		**2**	1	1	1
CO5	**3**	2	2	**1**			**2**	2	3	1
PC 5545AVG	**3**	1	1	**1**	1	1	**2**	1	1	1
PC5545– TOTAL	**15**	**7**	7	**6**	4	3	**10**	**7**	8	**4**

INVERTEBRATA

UNIT I

1. Identification and study of Protozoans, Sponges, Coelenterates, Platyhelminthes, Aschelminthes, Annelida, Arthropoda, Mollusca and Echinoderms – slides and museum specimens.
2. Minor Phyla: Rotifera, Gastrotricha, Chaetognatha, Sipunculoidea

UNIT II

1. Identification and study of larval forms from all major phyla of Invertebrates.
2. T.S of Sea Anemone, Planaria, Fasciola, Ascaris, Tapeworm, Earthworm, Nereis and Leech
3. Identification of Protozoan parasites
4. Identification of Helminth parasites
5. Mounting: Prawn Appendages, Housefly and Mosquito mouth parts,
6. Dissection: Prawn –Nervous and Digestive system

   Sepia- Nervous system

UNIT III

CHORDATA

1.Identification of Important South Indian Fishes, Amphibians, Reptiles, Birds, Mammals.

UNIT IV

Mounting: Fish Pituitary gland and Otolith.

3. Dissections: Fish Digestive system and Aortic arches

4. Virtual dissection: -Frog

UNIT V

OSTEOLOGY

1. Pectoral and Pelvic limbs of fish, frog, calotes, pigeon and rabbit.

2. Dentition –Rabbit and Human.

VISIT

1. Adyar-Estuary /Pallikaranai / any other field visit
2. Study of campus Fauna.

REFERENCES:

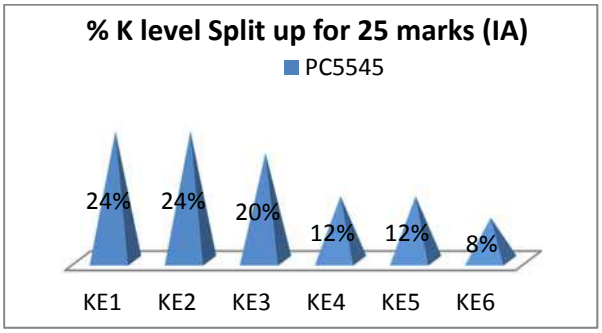
1. V.B Rastogi., A Manual of Practical Invertebrate Zoology, Published By KedarNath Ram Nath
2. P. S. Verma. A Manual of Practical Zoology: **Chordates**, S. Chand & Company
3. EkambaranathaAyyar, M.: A Manual of Zoology Part I. Invertebrata, S. Viswanathan (printers and Publishers) Pvt.Ltd,Chennai
4. EkambaranathaAyyar, M. and T.N.Ananthakrishnan. A Manual of Zoology Vol.II(chordate).S.Viswanathan (Printers and Publishers)Pvt.Ltd.,Chennai.
5. S. S. LaL Practical Zoology Invertebrate Rastogi Publications

Web Resources:

https://en.wikipedia.org/wiki/Dissection
https://www.britannica.com/science/dissection-biology
https://www.navs.org/additional-information/bioleap-dissection-alternatives/free-online-dissection

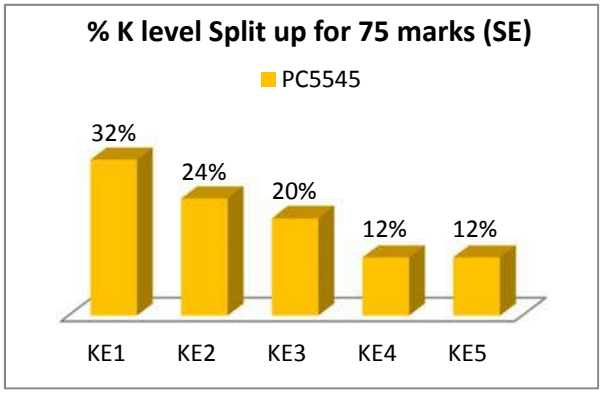
ASSESSMENT PATTERN **Continuous Internal Evaluation (25 Marks)**

Bloom's Taxonomy	Test	Assignment	Seminar	Model Exam
Total (25)	**5**	**5**	**5**	**10**
Remember (6)	1	1	1	3
Understand (6)	1	0	1	4
Apply (5)	2	2	0	1
Analyse (3)	0	1	1	1
Evaluate (3)	1	0	1	1
Create (2)	0	1	1	0



ESE - End Semester Examination (75 Marks; Weightage 75 %)

Bloom's Category	Weightage %
Remember	32
Understand	24
Apply	20
Analyse	12
Evaluate	12



EVOLUTION AND DIVERSITY OF CHORDATES

Semester: II **Course: VI**
Subject Code: PC5546 **Hours : 90**

Learning Objectives : The aim of this course is to examine the fundamental principles of evolution in animals at all levels from Genetics through the developmental behaviorand ecology. To consider the evolution of vertebrates and studying the major transitions in their evolutions, diverse morphological and physiological adaptations. A survey of the animal kingdom showed an evolutionary perspective. Major lines of evolution will be traced as characteristics of each animal group are compared and contrasted. The taxonomy, diversity, anatomy, physiology, behavior, and ecology of all major animals phyla will be studied along with several minor phyla with an emphasis on the fundamental anatomy of each group.

Course Outcomes: At the end of the Course, the Student will be able to: Knowledge level - K1 (Remember), K2 (Understand), K3 (Apply), K4 (Analyze), K5 (Evaluate), K6 (Create). K1* K2* Throughout the course, retention of all the concepts is emphasized after thorough understanding.

CO1	**Understand** the origin of chordates and criticize the theories. To understand and relate the broad classifications of chordates. Make them to understand the classification by giving the assignment [PO1] **Evaluate** the systematic review of Cephalochordates. **Develop** the knowledge of structural peculiarities and affinities of Cyclostomata and Placoderms explain with ppt [PO7]	**K1 K2 K3 K5**
CO2	**Compare** the origin and evolutionary process of Chondrichthyes and Osteichthyes by group discussion. [PO5] **Understand** the structural peculiarities and affinities of Dipnoi. explain them by using videos [PO7, PO8]	**K1 K2 K3 K4**
CO3	**Understand** the origin and evolution of amphibians. **Develop** the knowledge of origin and evolution of Reptiles. Explain the origin and evolution of Dinosaurs by using video lectures. [PO7] **Compare** the systemic review of flying reptiles and mammal like reptiles and Squamata by ppt [PO5]	**K1 K2 K3 K4**
CO4	**Outline** the evolutionary process of birds and Archaeopteryx. **Understand** the mechanism of flight and perching in birds. **Create** knowledge to identify the feets in birds by preparing charts. [PO1, PO2] **Acquire** knowledge about the origin and evolution of mammals by seminar [PO2] **Understand** the origin and evolution of man white board with interactive method. [PO7,PO9]	**K1 K2 K3 K4 K6**
CO5	**Acquire** knowledge and relate the anatomy of brain, heart and aortic arches. **Compare** the anatomy of vertbrates eye and kidneys by ppt [PO7]. **Create** knowledge to develop the preparation of models from different organs. [PO9]	**K1 K2 K4 K5 K6**

Strongly correlated – 3 Moderately correlated – 2 Weakly correlated – 1

CO/PO / PSO	PO									
	1 Disciplinary Knowledge and skills	2 Skilled Communicator	3 Critical thinker and problem solver	4 Sense of inquiry	5 Team player/worker	6 Skilled project manager	7 Digitally Efficient	8 Ethical awareness/ reasoning	9 National and international perspective	10 Lifelong learners
CO1	**3**	1	1				**2**	1		1
CO2	**3**	1	2	**1**			**1**	1	1	
CO3	**3**	2	1				**2**	2		1
CO4	**3**	1	2	**1**	2		**2**	1		1
CO5	**3**	1	1	**1**	1		**2**	1	1	1
PC5546-AVG	**3**	1	1	**1**	1		**1**	1	1	1
PC5546 –TOTAL	**15**	**6**	**7**	**3**	**3**		**9**	**6**	**2**	**4**

Unit I **18 hours**

Origin of chordates - review of theories - Broad Classification of Chordates. Systematic review of Cephalochordates, Hemichordates and Urochordates-Affinities and adaptations. Ostracoderms. Evolutionary and structural peculiarities of Cyclostomata, Systematic review of Placoderms.Differences between Ostracoderms and Placoderms.

Unit II **18 hours**

Chondrichthyes – Origin and evolution, Characteristics, Economic importance. Fossil history. Osteiochthyes – Origin and evolution. Structural peculiarities and distribution of Dipnoi. Crossopterigii.
Adaptive radiation

Unit III **18 hours**

Amphibia: Origin and Evolution, Terrestrialization of the Amphibians - Structural peculiarities of Urodela, Apoda and Anura. Reptiles: Origin and Evolution Rise and Decline of Reptiles. Dinosaurs, Systematic review of flying reptiles, mammal like reptiles, Systematic review of Chelonia, Crocodilia, Rhyncocephalia and Squamata.

Unit IV **18 hours**

Aves: Origin and evolution of Birds, Ratitae, Fossil Birds, Origin of Flight in Birds, Migration. Mechanism of Flight and Perching, Flight adaptations , Beaks and Feet in Birds. Mammals: Origin and evolution - Prototheria, Metatheria and Eutheria. Evolution of man.

Unit V **18 hours**

Comparative Anatomy: Epidermal derivatives - Brain and eye - Heart and aortic arches, vertebrate

kidneys.

REFERENCES

1. Dhami J.K and P. S.Dhami 1981. Chordate Zoology R. Chand. **(Book for study)**
2. Hyman .L.H 1966 Comparative vertebrate Anatomy -Chicago Press. Chicago.
3. Jollce M. 1968 Chordate Morphology East West Press Pvt Ltd
4. Mayor . E 1969. Principles and Systematic Zoology. McGraw –hill.Co.
5. Romer.A.J and Parson T.S 1978. Vertebrate Body W.B Sounders Co., Philadelphia
6. Waterman A.J 1972. Chordate Structure and Functions. Macmillan co

WEB RESOURCES:

www.notesoon zoology.com

E- RESOURCES

https://www.lib.ncsu.edu/guides/zoology/internet

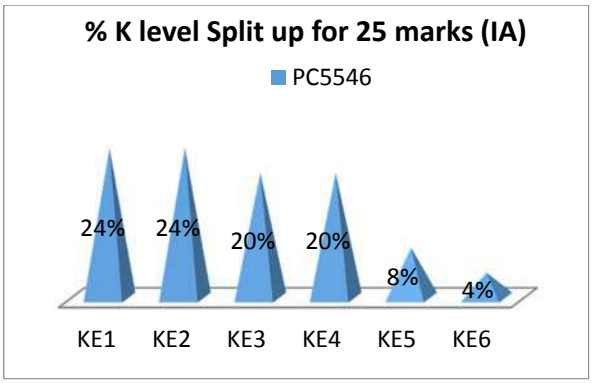
VIRTUAL LAB

https://lsa.umich.edu/ummz/mammals/animal-diversity-web.html

ASSESSMENT PATTERN

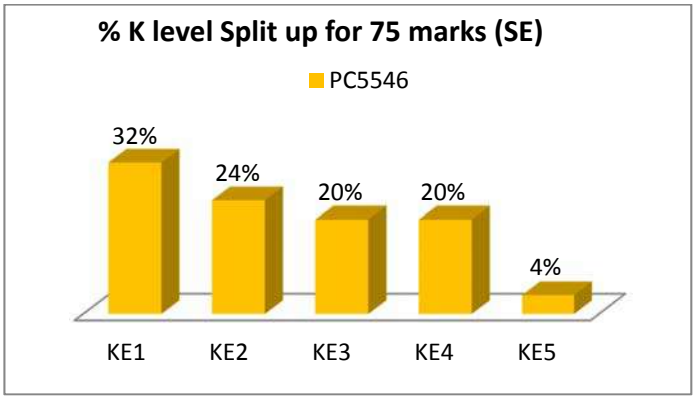
Bloom's Taxonomy	Test	Assignment	Seminar	Model Exam
Total (25)	**5**	**5**	**5**	**10**
Remember (6)	1	0	1	4
Understand (6)	1	0	1	4
Apply (5)	2	2	0	1
Analyse (5)	0	2	2	1
Evaluate (2)	1	0	1	0
Create (1)	0	1	0	0

CIE- Continuous Internal Evaluation (25 Marks)



Bloom's Category	Weightage %
Remember	32
Understand	24
Apply	20
Analyse	20
Evaluate	4

ESE- End Semester Examination (75 Marks; Weightage 75 %)



BIOCHEMISTRY AND BIOPHYSICS

Semester: II **Course: VII**

Code: PC 5547 **Hours: 90**

Learning Objectives:

The course is to understand and learn the basic unit of matter and the physical principles that underlie the dynamics of life, also helps to know the fundamental chemical principles and reactions that govern complex biological systems, Support to gain knowledge on energy production from biochemical reactions and energy transfer, utilization and storage to apply knowledge about the instruments and techniques to realize the effect of radiation and its biological effect

Course Outcomes: At the end of the Course, the Student will be able to:

Knowledge level - K1 (Remember), K2 (Understand), K3 (Apply), K4 (Analyze), K5 (Evaluate), K6 (Create). K1* K2*

Throughout the course, retention of all the concepts is emphasized after thorough understanding.

CO1	**Understand** the concepts of the basic unit of matter and compounds of life and explain various chemicals bonds, understand and **Explain** pH, acids, bases and buffers in living system. Explain the types of bonds, pH and buffers by preparing charts and models **(PO1)**. Make them tocompareandunderstand the fundamental unit of life by video lectures **(PO7)**	**K1 K2 K3 K4**
CO2	To **learn** and **demonstrate** the energy production by biochemical mechanism and **explain** to construct the flow chart of biochemical reactions in energy synthesis. Able to classify and make use of the biochemical reaction videos **(PO7)**, Energy production at the end of biochemical reaction by group discussion **(PO2)**	**K1 K2 K3 K4**
CO3	**Learn** the basis of enzyme classification **apply** the knowledge of working mechanism and to learn the **importance** of protein metabolism. It enables the students to **show** working mechanism of enzyme substrate by showing videos **(PO7)** and preparing models **(PO10)**	**K1 K2 K3 K5**
CO4	To **explain** various instruments, and **apply** the knowledge to **examine** various biochemical compounds. To show working methods of the instruments using videos **(PO7)**	**K1 K2 K3,K4 K5, K6**
CO5	To **acquire** knowledge on the impact of radiation on living organisms and the surrounding environment. Able to **understand** and **apply** the knowledge to **examine** the radiation effects using different equipments. Seminars and assignments (**PO2)** to make them understand the impact of radiation.	**K1 K2 K3 K4 K5**

Strongly correlated – 3 **Moderately correlated – 2** **Weakly correlated – 1**

CO/PO/ PSO	1 Disciplinary	2 Skilled Communicator	3 Critical thinker and	4 Sense of inquiry	5 Team player/wo	6 Skilled project manager	7 Digitally Efficient	8 Ethical awareness /	9 National and internatio nal	10 Lifelong learners
CO1	**3**	1	1	**1**			**2**	1	1	1
CO2	**3**	1	1	**1**			**2**	1	1	1
CO3	**3**	1	1	**1**			**2**	1	1	1
CO4	**3**	1	1	**1**			**2**	1	1	1
CO5	**3**	1	1	**1**			**2**	1	1	1
PC5547-AVG	**3**	1	1	**1**			**2**	1	1	1
PC5547 – TOTAL	**15**	**5**	**5**	**5**			**10**	5	**5**	**5**

Unit I **18 hours**

Structure of atoms, ions, molecules and elements, chemical bonds – Kossel's theory of chemical bonding, types of bonds - ionic, covalent, hydrogen and polar bonds. Principles of biophysical chemistry – pH, pH scale, buffers, Bronstead - Lowry concept of acids and bases. Strong and Weak acids, Ionization of weak acids, Handerson-Hasselbach equation. Colligative properties. Maintenance of pH in blood. High energy rich compounds.

Unit II **16 hours**

Bioenergetics – coupling, concept of energy, Laws of Thermodynamics, glycolysis, Kreb's cycle, Electron transport chain and oxidative phosphorylation, biological energy transducers, HMP shunt.

Unit III **18 hours**

Enzymes – Nomenclature and classification, characteristics of enzymes, Mechanisms of enzyme action - Fischer's Lock and Key model, Koshland's Induced fit model, Michaelis – Menten hypothesis. Metabolism of proteins - transamination, oxidative deamination, demethylation, structure and functions of lipids, β oxidation of lipids, structure and synthesis of cholesterol.

Unit IV **18 hrs**

Instrumentation: Principle and applications of electrophoresis, chromatography, spectrophotometer, mass spectrometry, computerised tomography, magnetic resonance imaging, positron emission tomography. X ray diffraction – principle and interpretation of results and applications.

Unit V **20 hrs**

Radiation Biophysics: Ionizing radiation, Units of radioactivity, exposure, dose and half life period. Interaction of radiation with matter – photoelectric effect, ion pair production, absorption and scattering of electrons. Biological effects of radiation: effect on nucleic acids, proteins, enzymes and carbohydrates. Cellular effects of radiation: somatic and genetic. Measurement of radioactivity – Geiger Muller counter, Scintillation counter and autoradiography.

REFERENCES

1. Ambika Shanmugam 2002. Fundamentals of Biochemistry - Publishers: S. Chand
2. Casey, E. J. 1962 Biophysics concepts and Mechanism. Affiliated East –West Press
3. David L.Nelson and Michael L.Cox , 2017 Leninger Principles of Biochemistry, 7th
4. Debajyotidas, 2007 Biophysics and biophysical chemistry, 6thedn., Academic Publishers, Kolkatta, West Bengal.
5. Jain J.L2005, Fundamentals of Biochemistry –Publishers: S. Chand and Co.

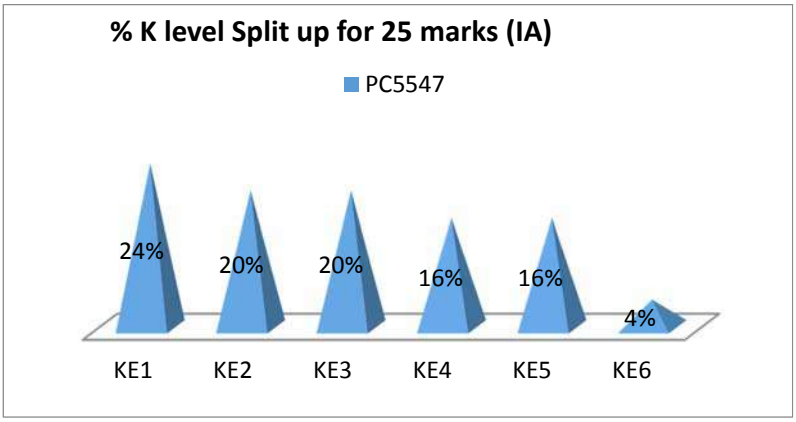
6.Sathyanarayana and Chakrabani 2004, Biochemistry - Publishers: S. Chand and Co.

7. Subramanian, M.A. 2005, Biophysics - MJP Publishers, Chennai.

WEB RESOURCES
http://biochemistry.org
http://mcgill.ca
http:// Britannica.com
global.oup.com
libretext.com

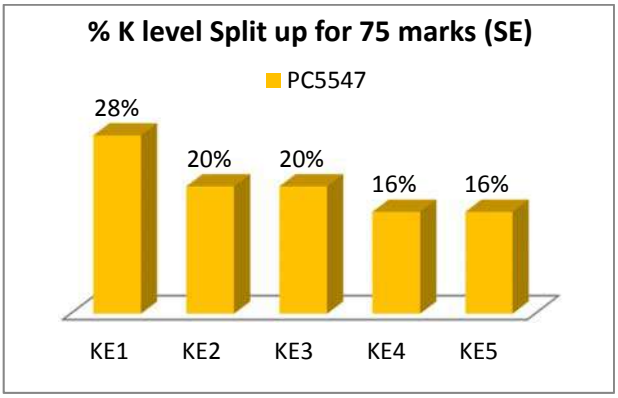
CIE- Continuous Internal Evaluation (25 Marks)

Bloom's Taxonomy	Test	Assignment	Seminar	Model Exam
Total (25)	**5**	**5**	**5**	**10**
Remember (6)	1	1	2	2
Understand (5)	1	0	1	3
Apply (5)	2	2	0	1
Analyse (4)	0	1	1	2
Evaluate (4)	1	0	1	2
Create (1)	0	1	0	0



ESE- End Semester Examination (75 Marks; Weightage75%)

Bloom's Category	Weightage %
Remember	28
Understand	20
Apply	20
Analyse	16
Evaluate	16



PRACTICAL II: CYTOGENETICS, DEVELOPMENTAL BIOLOGY, BIOCHEMISTRY, MICROBIOLOGY AND IMMUNOLOGY

Semester: II **Course: VIII**

Code: PC5548 **HOURS : 90**

CO1	To **remember** the basic terms in histology and **understand** the procedure of preparing permanent histological slides. **Apply** the working of micrometer in measuring a cell. **Develop** an Understanding about the role of genetics in mutation by observing microscopically and virtually. (PO7) . To know the importance of each organ system and their functions using web (PO9).	**K1 K2 K3 K5**
CO2	**Acquire** knowledge on the basic terms in biochemistry and the structure, functions of the various biomolecules. **Estimate** molarity and normality. **Classify** biomolecules qualitatively and quantitatively by referring to lab manuals and web resources **(PO3, PO7)**.	**K1 K2 K3 K4 K5 K6**
CO3	**Understand** the concepts of fertilization, cleavage, **different** patterns of zygote formation and metamorphosis and documenting them with neat labelled diagrams by drawing chart in groups **(PO5)**.	**K1 K K4**
CO4	**Develop** an understanding on sterilization and preparation of culture medium using practical manuals and web resources **(PO3, PO7)**. and study the principle and **applications** of the equipment used in microbiology.	**K K2 K3**
CO5	**Understand** the histology of lymphoid organs and its function in elucidating immune response**. Experiment** with the separation techniques and its principle and **applications**.	**K1 K2 K3**

Strongly correlated – 3 Moderately correlated – 2 **Weakly correlated –1**

CO/PO/ PSO	PO									
	1 Disciplinar	2 Skilled Communic	3 Critical thinker and	4 Sense of inquiry	5 Team player/wo	6 Skilled project	7 Digitally Efficient	8 Ethical awareness	9 National and	10 Lifelong learners
CO1	**3**	1	1	**1**		1	**2**	2	1	1
CO2	**3**	1	1	**1**			**2**	2	1	1
CO3	**3**	1	1		2		**2**	1	1	1
CO4	**3**	1	2	**1**			**2**	1	1	1
CO5	**3**	1	2	**1**	2		**2**	1	1	1
PC 5548AVG	**3**	1	1	**1**	1	1	**2**	1	1	1
PC5548– TOTAL	**15**	**5**	7	**4**	4	1	**10**	**7**	5	**5**

CELL BIOLOGY

1. Calibration of micrometer.
2. Measurement of a cell using micrometer.
3. Differential and total blood cell count of human blood.
4. Histological fixing, embedding and sectioning using microtome and staining
5. Histochemical identification of carbohydrates, proteins, lipids and DNA

GENETICS

1. Preparation of culture medium and culture of Drosophila.
2. Identification of Drosophila mutants.
3. Squash preparation of grasshopper testes to study meiotic stages
4. Onion root tip squash preparation to study mitotic stages
5. Study of giant chromosomes in the salivary gland of Chironomous larva
6. Human Karyotyping
7. Identification of Syndromes using karyotyping
8. Pedigree Analysis of human traits.
9. PTC tasting

BIOCHEMISTRY

1. Preparation of different molar solution.
2. Preparation of different normal solution (serial solution)
3. Qualitative analysis of tissues – liver and egg albumin
4. Quantitative estimation of glucose by Anthrone method.
5. Quantitative estimation of protein by Lowry *et al* method.

DEVELOPMENTAL BIOLOGY

1. Developmental stages of frog
2. Metamorphosis of Frog
3. Observation of chick embryo development -16, 24, 48 and 96 hrs.
4. Placenta of sheep, Shark and Pig
5. Human ovum and sperm

MICROBIOLOGY

1. Preparation and sterilization of culture media.
2. Streaking method - types, spread and pour plate techniques.
3. Staining techniques - Gram staining.
4. Spotters - Incubator, inoculation hood, autoclave, culture media, inoculation loops.

IMMUNOLOGY

1. Identification of human blood groups.
2. Isolation and histological slide preparation of lymphoid organs of Fish
3. Raising of antibodies in fish against goat RBC as antigen
3. Single and double Immuno diffusion
3. Visit to microbiology and Immunology laboratories.

REFERRENCE BOOKS

1. Biochemistry, 4th edition, (2013) by Voet D and Voet JG John Wiley and Sons, USA

2. Enzymes-Biochemistry, Biotechnology and Clinical Chemistry, 2 nd edition, (2007) by Palmer T., Affiliated East-West Press Pvt Ltd, India.

3. Biochemistry and molecular biology Elliott & Elliot (4th ed.)

4. Prescott's Microbiology, 10th Edition, (2016), Joanne Willey, Linda Sherwood, McGraw-Hill Education.

5. Medical Microbiology (1997) by D. Greenwood, R. Slack and J. Peutherer, ELST with Churchill Livingstone, Hong Kong.

6.Bergey's Manual of Systematic Bacterial Vol.1, (2001) David R.Barne, Springer Verlag.

7. Molecular Cell Biology (2016), Harvey Lodish et al., 8th Edition, W. H. Freeman and Company, New York. ISBN-10: 146418339

8. The Cell: A Molecular Approach (2019) 8th Edition, Geoffrey M.Cooper and Robert E.Hausman, New York :Sinauer Associates : Oxford University Press

9. Cell and Molecular Biology – Concepts and Experiments (2015), Gerald Karp, Harris, D, 8th Edition, John Wiley & Sons Inc, New York.

10. Genes XII (2018), 12th Edition, Benjamin Lewin, Jones and Barlett Publishers. ISBN: 0763740632.

WEB RESOURCES

http://biochemistry.org
www.cellbio.com.edu

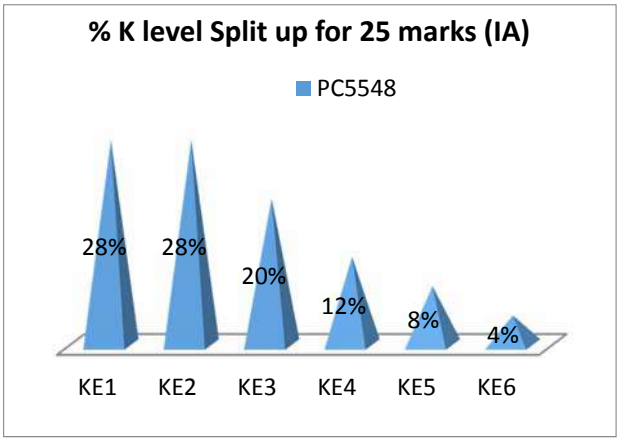
https://geneed.nlm.nih.gov

www.aboutbioscience.org>topics>microbiology/

ASSESSMENT PATTERN

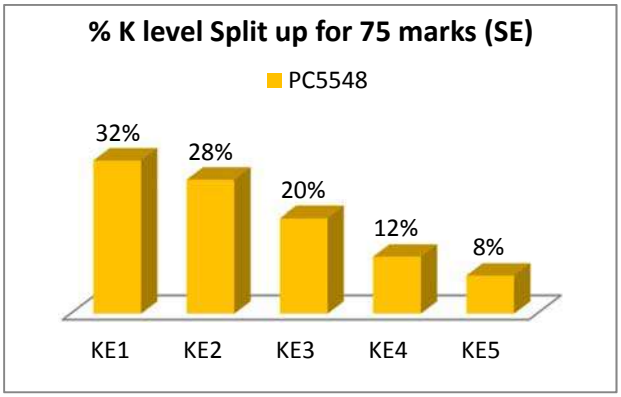
CIE- Continuous Internal Evaluation(25 Marks)

Bloom's Taxonomy	Test	Assignment	Seminar	Model Exam
Total (25)	**5**	**5**	**5**	**10**
Remember (7)	1	1	2	3
Understand (7)	1	0	1	5
Apply (5)	2	2	0	1
Analyse (3)	0	1	1	1
Evaluate (2)	1	0	1	0
Create (1)	0	1	0	0



ESE- End Semester Examination (75 Marks; Weightage 75 %)

Bloom's Category	Weightage %
Remember	32
Understand	28
Apply	20
Analyse	12
Evaluate	8



ELECTIVE-I –PARASITOLOGY

Semester: II **Course: XVI**
Subject Code: PE5517 **Hours : 60**

Learning Objectives: The course enable the students to provide knowledge about the classification of parasites and to study the host and parasite relationship. To learn the parasitic diseases and their causative agents, sources, modes and course of infections and to focus on the description, life cycle, pathology, diagnosis, prevention and control of each concerned parasitic type.

Course Outcomes: At the end of the Course, the Student will be able to:
Knowledge level - K1 (Remember), K2 (Understand), K3 (Apply), K4 (Analyze), K5 (Evaluate), K6 (Create). K1* K2* Throughout the course, retention of all the concepts is emphasized after thorough understanding.

CO1	**To list out** and **classify** the parasites by PPT and video lectures **(PO7).To study** the types of parasites and **to acquire** knowledge about their role in host parasite relationship by white board interactive method (**PO7,PO9).To outline** the parasitic diseases and name their causative agents by group activity **(PO5).**	K1 K2 K3 K4
CO2	**To discuss** the modes and sources of parasitic infections by group discussion **(PO5**). **To study** the course of parasitic infections by seminar **(PO3). To describe** the life cycle of pathogenic free living amoebae by web resources **(PO9).**	K1 K2 K3 K6
CO3	**To identify and describe** the protozoan parasitic diseases by charts and models **(PO1, PO2). To acquire** knowledge about the structure, lifecycle, pathogenesis, and **to examine**clinical symptoms, control and treatment of protozoan diseases by case studies **(PO6).**	K1 K2 K3 K4
CO4	**To understand** the importance of helminthic diseases by various teaching tools **(PO7).To explain** the morphology, lifecycle, pathogenesis, clinical symptoms and control and treatment of helminthic diseases by web resources **(PO9).**	K1 K2 K5
CO5	**To build** adequate knowledge on vector borne diseases by creating awareness **(PO8) To examine** the vector and parasite relationship by web resources **(PO9)** and **toexplain** the methods to prevent and control vector borne diseases by conducting survey and quizzes **(PO3).**	K1 K2,K4 K5,K6

Strongly correlated – 3 Moderately correlated – 2 Weakly correlated – 1

CO/PO/ PSO	PO									
	1 Disciplinary Knowl	**2 Skilled Comm**	**3 Critica**	**4 Sense of**	**5 Team player/ worker**	**6 Skilled project**	**7 Digitally Efficie**	**8 Ethical awareness/**	**9 National and interna**	**10 Lifelon**
CO1	**3**	1	1		1		**2**	1	1	1
CO2	**3**	1	2	**1**			**2**	1	1	
CO3	**3**	1	2			1	**2**	1	1	1
CO4	**3**	1	2	**2**	1		**2**	1	1	1
CO5	**3**	1	1	**1**	1		**2**	1	1	1
PE5517-AVG	**3**	1	1	**1**	1	1	**2**	1	1	1
PE5517 – TOTAL	**15**	**5**	**8**	**4**	**3**	1	**10**	**5**	**5**	**4**

UNIT I **12 hours**

Introduction to parasitology - parasite classification: protozoa and helminthes. Types of host and parasites. Host parasite relationship. Parasitism. Outline of Parasitic diseases and causative agents.

UNIT II **12 hours**

Sources of Infection, Modes of infection, Causes of infection, Immunity in parasitic infections. Parasitic adaptations. Pathogenic free living amoebae: *Naegleria and Acanthamoeba.*

UNIT III **12 hours**

Protozoan diseases – Amoebiasis (*Entamoebahistolytica*), Giardiasis (*Giardia lambia*), Trichomoniasis (*Trichomonasvaginalis*), - morphology, life cycle, pathogenesis, symptoms, diagnosis, treatment, prevention and control.

UNIT IV **12 hours**

Helminthic diseases – Taeniasis (*Taeniasolium*); Ascariasis (*Ascarislumbricoides*), Ancylostomiasis (*Ancylostomaduodenale*), - morphology, life cycle, pathogenesis, symptoms, diagnosis, treatment, prevention and control.

UNIT V **12 hours**

Vector borne diseases – Malaria (*Anopheles*spp), Leishmaniasis (Sand fly), Filariasis(*Culex*sps) - morphology, life cycle, pathogenesis, symptoms, diagnosis, treatment, prevention and control.

REFERENCES

1. Burt, 1970. Platyhelminthes and parasitism. The English Universities press ltd.
2. Chakraborty P, 2005, Text book of Medical Parasitology, New Central Book agePvt., Ltd.,
3. Chatterjee, 2009. Parasitology. CSB Publishers and distributors.
4. JayaramPanicker C.K.2013. Paniker's Textbook of Medical Parasitology. Jaypee Brothers Medical Publishers.
5. Roberts C.S and J.Janovy 2009. Foundations of parasitology, Eighth edition, McGraw Hill.
6. Sharma PN and Ratnu LS, 1984. An Introduction to Parasitology, S Chand Company Ltd.,
7. Subash Chandra Parija 2013. Text book of medical parasitology, protozoology and helminthology. 4thEdn. All India Publishers and distributers, Delhi.
8. Sood Ramanik,2020. Textbook of Humjan parasitology Protozoology and Helmintholigy, CBS Publishers and Distributors.

Web reference

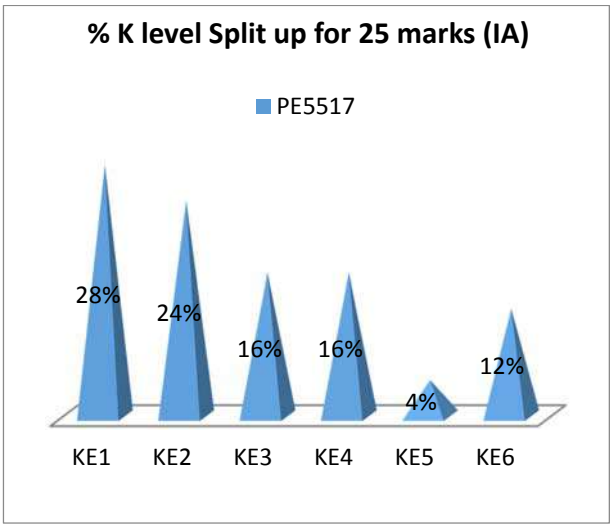
www.cdc.gov/parasites/about.html
https://thelifetree.com/pages/parasite-picture-gallery2

https://www.healthline.com/health/parasitic-infections
http://www.parasite-diagnosis.ch/diseases

ASSESSMENT PATTERN

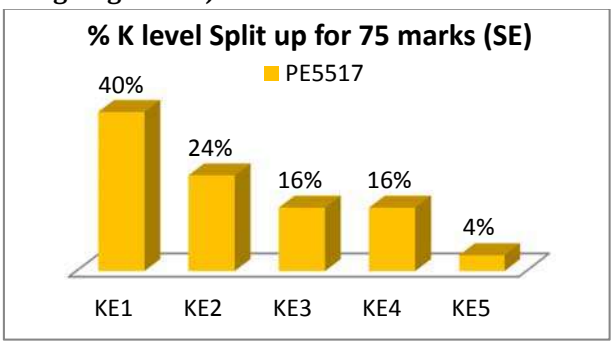
CIE- Continuous Internal Evaluation (25 Marks)

Bloom's Taxonomy	Test	Assignment	Seminar	Model Exam
Total (25)	**5**	**5**	**5**	**10**
Remember(7)	3	1	2	1
Understand (6)	1	0	1	4
Apply (5)	2	2	0	1
Analyse (4)	0	1	1	2
Evaluate (1)	0	0	0	1
Create (3)	0	2	1	0



ESE- End Semester Examination (75 Marks; Weightage 75 %)

Bloom's Category	Weightage %
Remember	40
Understand	24
Apply	16
Analyse	16
Evaluate	4



ENTOMOLOGY (ELECTIVE II)

Semester- II **Course: X**

Code:PE5518 **Hours: 60**

Learning Objectives

To impart knowledge on insect pest and their management to protect the plant species and equip the students to identify beneficial and harmful insects. Toacquire in depth knowledge on public health entomology and control of vectors.To understand the pest management strategies and gain knowledge on insects and their economic importance.

CO1	To recall the general characteristics of class insecta. To apply the acquired knowledge to explain and recognize the different structures of the insects. To develop the ability to identify the insects of different orders. To interpret the types of metamorphosis and able to understand the role of hormones on insect metamorphosis.	**K1, K2, K3, K4,K5**
CO2	To define the terms apiculture, sericulture and lac culture. To demonstrate the life cycle and culturing methods of bees, silk worms and lac insects. To develop the knowledge to identify the diseases and disease causing organisms of bees, silk worms and lac insects. To apply the acquired knowledge able to identify the caste and species of honey bees, type of silk worms and silk materials. To assess the value of honey, silk and lac in the human society.	**K1, K2, K3, K4, K5.**
CO3	To develop the ability to identify the vectors of different diseases of human society. To choose the right preventive method to control the mosquitoes, house fly, bedbug, louse and rat flies. To Improve the skill to analyze the various symptoms and recommend the importance of the proper treatment based on its diseases.	K1, K2, **K3, K4, K5,K6**
CO4	To define the term pest and perceive the ability to identify the pest of rice, sugarcane, ground nut, cotton, vegetables, fruits and stored products. To improve the skill to identify the pest based on its symptoms and damage to plants. To understand how to manage the insect pests and recommend eco-friendly methods for maintaining quality of crop and environment.	**K1, K2, K3, K4, K5,K6**
CO5	To understand the principles and components of IPM and encourages it is the most suitable of all existing pest destruction techniques. To perceive the importance of pheromones in pest control. To learn the classification of insecticides, its chemical nature, mode of entry, and action.	**K1,K2 ,K3, K4, K5.**

Strongly correlated – 3 **Moderately correlated – 2** **Weakly correlated – 1**

CO/PO/ PSO	PO									
	1 Disciplinary Knowl	**2 Skilled Comm**	**3 Critica**	**4 Sense of**	**5 Team player/ worker**	**6 Skilled project**	**7 Digitally Efficie**	**8 Ethical awareness/**	**9 National and internati**	**10 Lifelon**
CO1	**3**	1	1		1		**2**	1	1	1
CO2	**3**	1	2	**1**			**2**	1	1	
CO3	**3**	1	2			1	**2**	1	1	1
CO4	**3**	1	2	**2**	1		**2**	1	1	1
CO5	**3**	1	1	**1**	1		**2**	1	1	1
PE5518-AVG	**3**	1	1	**1**	1	1	**2**	1	1	1
PE5518 – TOTAL	**15**	5	**8**	**4**	**3**	1	**10**	**5**	**5**	**4**

UNIT - I **(12 hours)**

General characters of class insect, Classification of insects up to order. Morphology of an insect, Types of mouthpart in insects – biting and chewing, piercing and sucking, sponging and siphoning types. Metamorphosis in insect - Ametabola, Hemimetabola, Holometabola and Hormonal control of metamorphosis.

Unit II **(12 hours)**

Honey bee – Morphology, Life history, Bee colony - Social life in honey bees, Bee pasturage, Bee pollination, Bee language and communication, Uses of honey, Diseases and natural enemies of honey bee. Silk worm –Types, Life cycle, Silk gland, Cultivation and rearing of silk worms, Uses of Silk, Diseases and natural enemies of silkworm. Lac insect – Biology and behavior of Lac Insect, Lac cultivation, Uses of Shellac, Diseases and natural enemies of Lac Insect.

Unit III **(12 hours)**

Insects associated with diseases in Human and their control measures – vectors – Mosquitoes (Aedes, Anopheles, Culex); Housefly (*Muscadomestica*) ; Sandfly (*Phlebotomousargentipes*) ; Bed bug (*Cimexhemipterus*) ; Human body louse (*Pediculushumanushumanus*) ; Rat fleas (*Xenopsyllacheopis).*

Unit IV **(12 hours)**

Pest – Definition, Types of damage to plants by pest and their control measures – Pest of Rice – Rice stem borer, Rice gall midge, Rice brown plant hopper and Rice ear head bug; Pest of sugar cane – Shoot borer, Stem borer, Top borer, Root grub;Pest of Ground nut – Red hairy caterpillar, Ground nut leaf miner, Grab pod borer, Aphids, ; Pest of cotton – Thrips, Pink bollworm, Spotted boll worm, Jassids; Pest of vegetables – Brinjal fruit bore, Coconut Rhinoceros beetle; Pest of fruit – Mango nut weevil, Lemon leaf caterpillar; Pest of stored products – Rice weevil, Rice meal moth, Pulse beetle and Red flour beetle,.

Unit V **(12 hours)**

Pest control strategies – Physical, Mechanical and Chemical control; Biological control - Botanicals, Microorganisms, Predators, Parasites and Pheromones in pest control. Insecticide - Classification, Mode of entry, Mode of action and Chemical nature; Integrated Pest Management.

REFERENCE BOOKS

1. Chapman, R. F. 1998. The Insect: Structure and Function.10th Edition. Cambridge University Press, UK.
2. Patnaik, B. D. 2013. A Text Book of Entomology. Dominant Publishers and Distributers Pvt. Ltd., India.

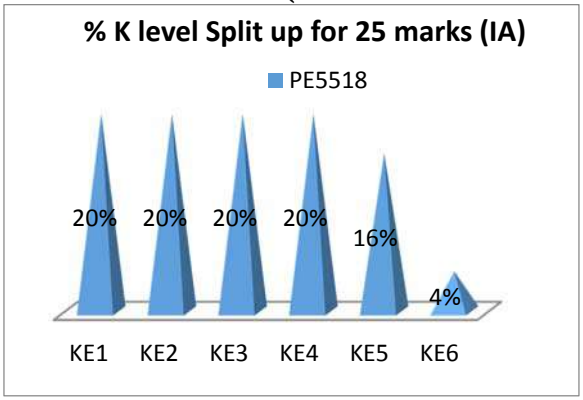
3. Ravindranathan K. R. I. 2003. Economic Zoology. Dominant Publishers and Distributers Pvt. Ltd., India.
4. Shukla, G. S. and Upadhyay, V. B. 2001. Economic Zoology. Rastogi Publications, Meerut.
5. Vasantharaj David, B. and Kumaraswami, T. 1975. Elements of Economic Zoology. Popular Book Depot, Madras.
6. Vasantharaj David, B., Muralirangan, M.C. and Meera M. 1992. Harmful and Beneficial Insects. Popular Book Depot, Madras.
7. Vasanthraj David, B and T. N. Ananthakrishnan, 2004. General and Applied Entomology, Second edition, Tata McGraw hill pubplishing company Ltd., New Delhi, Page 1-1184.
8. Vasanthraj David, B. 2001. Elements of Economic Entomology, Popular book Depot, Chennai.5.
9. Yadav, M. 2010. Applied Entomology. Discovery Publishing House Pvt. Ltd., New Delhi

WEB RESOURCES

1. http://guides.library.cornell.edu/entomology
2. https://entomology.unl.e du › IANR › Entomology
3. https://en.wikipedia.org/wiki/Pest (organism)
4. https://unl.libguides.com/entomology
5. https://askentomologists.com/entomology-resources/
6. https://guides.lib.udel.edu/entomologywildlifeecology/webresources
7. https://academic.oup.com/ae/pages/introtoentomology

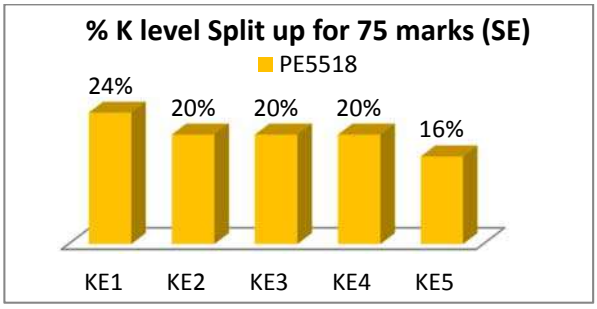
ASSESSMENT PATTERN **CIE- Continuous Internal Evaluation (25 Marks**

Bloom's Taxonomy	Test	Assignmen	Semi nar	Mode l
Total (25)	**5**	**5**	**5**	**10**
Remember (5)	1	0	1	3
Understand (5)	1	0	1	3
Apply (5)	2	2	0	1
Analyse (5)	0	2	2	1
Evaluate (4)	1	0	1	2
Create (1)	0	1	0	0



ESE- End Semester Examination (75 Marks; Weightage 75%)

Bloom's Category	Weightage %
Remember	24
Understand	20
Apply	20
Analyse	20
Evaluate	16



EXTRA DISCPLINARY PAPER I - ORNAMENTAL FISHERIES (FOR STUDENTS OF OTHER DEPARTMENTS)

Semester: II **Course: XI**
Code: PD5508 **Hours: 60**

Learning Objectives

Students will acquire knowledge about Ornamental fishes and setting up of an aquarium, understand the maintenance and management of an aquarium and develop an understanding on Indian fisheries and entrepreneurship in fishery industries.

Course Outcomes: At the end of the Course, the Student will be able to:
Knowledge level - K1 (Remember), K2 (Understand), K3 (Apply), K4 (Analyze), K5 (Evaluate), K6 (Create). K1* K2*
Throughout the course, retention of all the concepts is emphasized after thorough understanding.

CO1	**Acquire** knowledge on how to construct an aquarium and **understand** its classification based on different factors. [PO7]	**K1 K2**
CO2	**Identify**/and **distinguish** between different kinds of ornamental fishes and **develop** an understanding on the various diseases that affects the ornamental fishes and the control measures. Web resource on different types of fish diseases. [PO7]	**K1 K2 K3 K4**
CO3	**Analyse** different kinds of water suitable for maintenance of an aquarium and **learn** about the water quality management. Environment sustenance [PO8]	**K1 K2 K4**
CO4	**Build** knowledge on the nutrition and reproduction of fishes and **develop** an understanding on the breeding of fishes – PPT and interactive board used for explanation.	**K1 K2 K3**
CO5	To **create** awareness and knowledge of freshwater and marine Fisheries in India and how it contributes to Indian economy. Students will be able to **find** the reasons behind the depletion of fisheries resources. Aspirants can **apply** the knowledge for setting up a home and public aquarium, entrepreneurship or self-employment in fisheries-related business. [PO4]	**K1 K2 K3 K5 K6**

Strongly correlated – 3 Moderately correlated – 2 Weakly correlated – 1

CO/PO/ PSO	**PO**									
	1 Disciplinary Knowl	**2 Skilled Comm**	**3 Critica**	**4 Sense of**	**5 Team player/ worker**	**6 Skilled project**	**7 Digitally Efficie**	**8 Ethical awareness/**	**9 National and internati**	**10 Lifelon**
CO1	3	2	1				2	1	1	1
CO2	3	1		1	1		1	1	1	1
CO3	3	1	1				1	1		1
CO4	3	2	1	1	1		1	1	1	1
CO5	3	2	1	1	1		2	1	1	1
PD5508-AVG	3	1	1	1	1		1	1	1	1
PD5508 – TOTAL	**15**	**8**	**4**	**3**	**3**		**7**	**5**	**4**	**5**

Unit I **(12hours)**

Introduction, definition, origin and history of aquarium fishes. Classification of aquarium based on salinity, temperature and species selection. Types of aquarium tank : construction of aquarium tank. Setting of freshwater aquarium tank : size, location, selection of stones, gravels. selection of plants: branched, rooted and floating. Aerator.

Unit II **(12 hours)**

Selection of ornamental fishes. Description of common species of ornamental fishes. Fresh water fishes: gold fish, guppies, black molly, zebra fish. Marine water fishes: butterfly fish, parrot fish, anemone fish, marine angel fish. Diseases of aquarium fish: parasitic, bacterial, viral, protozoan, fungal and nutritional deficiency diseases.

Unit III **(12 hours)**

Management of aquarium: Water quality management - Chemical characteristics ; Oxygen, carbon dioxide, chlorine, ammonia, nitrites and hydrogen sulphide. Physical characteristics; turbidity, pH, temperature. Filtration: physical, chemical and biological filtration.

Unit IV **(12 hours)**

Introducing of Aquarium fishes. Fish nutrition – Classification of feed : Artificial feed, feed formulation, ingredients and feed preparation. Live feed, Dry feed, Vacation feeder. Breeding in aquarium fishes: Egg layers- scatters, hangers, buriers, stowers, anchors, splashers, scoopers, hiders, carriers and nest builders. Live bearers - ovoviviparous and viviparous.

Unit V **(12 hours)**

Prospects of Ornamental fishes in India.Economic *importance of ornamental fishes.* Self – employment. Loan availability. Small scale industries. Role of women in ornamental fish culture. List of fresh water and marine ornamental fishes available in India for export. Strategies for improvement of ornamental fish industry in India.

REFERENCES

1. Dey V.K. 1997. Ornamental Fishes –Marine ProdectsExport Development Authority (MPEDA) Kochi. Handbook of Aqua Farming.
2. Jhingran V. G. 1985. Fish and Fisheries of India. Hindustan Publishing Corp. India
3. Noga, E.J. 2010. Fish Disease: Diagnosis and Treatment. John Wiley and Sons.
4. Sarvesh, M. 2006. Hand book of Ornamental fishes. Eastern Book Corporation.
5. T. V. R. Pillay&M.N.Kutty. Aquaculture – Principles and Practices. Wiley India Pvt Ltd; Second edition. November 2011.
6. Tekriwal, K.L. and Rao, A. A. 1999. Ornamental Aquarium Fishes of India. TFH Publishers, Kingdom Books.

7. Tekriwal, K.L. and Rao, A. A. 2001. Review of "Ornamental Aquarium fishes of India", Kingdom Books.

Web Resources

http://vikaspedia.in/agriculture/fisheries/fish-production/culture-fisheries/ornamental-aquaculture/livebearers-of-ornamental-fishes?content=small

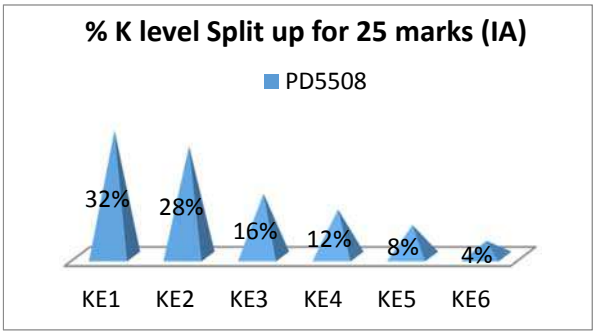
http://vikaspedia.in/agriculture/fisheries/fish-production/culture-fisheries/ornamental-aquaculture/overview-of-ornamental-industry
https://en.wikipedia.org/wiki/Disease_in_ornamental_fish
https://en.wikipedia.org/wiki/Fishkeeping

E - Books - Central Marine Fisheries Research Institute
www.cmfri.org.in › ebooks

ASSESSMENT PATTERN

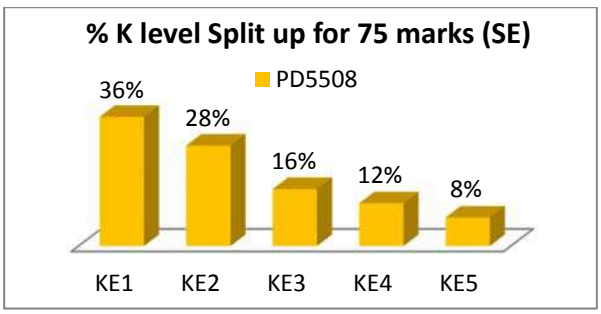
CIE- Continuous Internal Evaluation (25 Marks)

Bloom's Taxonomy	Test	Assignment	Seminar	Model Exam
Total (25)	**5**	**5**	**5**	**10**
Remember (8)	2	2	2	2
Understand (7)	1	0	1	5
Apply (4)	1	1	0	2
Analyse (3)	0	1	1	1
Evaluate (2)	1	0	1	0
Create (1)	0	1	0	0



ESE- End Semester Examination (75 Marks; Weightage 75 %)

Bloom's Category	Weightage %
Remember	36
Understand	28
Apply	16
Analyse	12
Evaluate	8



ANIMAL BIOTECHNOLOGY AND BIOETHICS

Semester:III **Course: XII**

Subject Code: PC5549 **Hours: 90**

Learning Objectives : The course enable the students to understand the new and emerging fields of animal biotechnology, make them gain a strong understanding on the animal based cell culture system and the techniques involved in recombinant DNA technology. Also aims to enable the students to apply the various techniques of genetic engineering in biological research and industries and to acquire knowledge on the ethical guidelines in Biotechnology, create patents, copyrights, trademarks and the importance of IPR and also equip students with knowledge in pursuing a career in biotechnology.

Course Outcomes: At the end of the Course, the Student will be able to:

Knowledge level - K1 (Remember), K2 (Understand), K3 (Apply), K4 (Analyze), K5 (Evaluate), K6 (Create). K1* K2* Throughout the course, retention of all the concepts is emphasized after thorough understanding.

CO1	**Acquire** knowledge on the basic techniques of biotechnology like DNA isolation, restriction digestion etc. **Remember** the concepts and mechanism of recombinant DNA technology. **Develop** their strength in **identifying** various tools **[PO7, PO8]** involved in gene cloning by ICT and PPT **[PO7]**	**K1 K2 K3 K6**
CO2	**Learn, understand** and **remember** the various techniques like construction of gene library, Blotting, DNA sequencing, DNA fingerprinting and DNA amplification. https://nptel.ac.in/courses/102107028/40 Analytical Technologies in Biotechnology (Video) Electrophoresis , PCR, DNA sequencing methods **[PO9]**	**K1 K2 K3**
CO3	**Learn** the basics of animal tissue Culture and **make useof** this to **understand** its **application** in the mass production of health care pharmaceuticals. Lecture video with discussion https://nptel.ac.in/courses/102103013/49 Genetic Engineering & Applications(Web) **[PO9]**	**K1 K2 K3 K4**
CO4	**Build** an **understanding** about GMOs and the **importance** of trangenesis. Students will be enabled to **recall** the strategy to manipulate genetic structure of an organism and **apply** the acquired knowledge in pursuing careers in biotechnology by initiating group discussions **[PO5]** on various avenues in biotechnology industries and facing mock question and answer sessions . **[PO4]**	**K1 K2 K3 K4 K5**
CO5	To **list out** the ethical and social [PO8]issues raised regarding GMOs and also to **learn** how to **create** patents, copyright and trademarks and to **evaluate [PO3]** the **importance** of IPR. Interactive programming session through white board and interactive board. **[PO7, PO9]**	**K1 K2 K4 K5 K6**

Strongly correlated – 3 **Moderately correlated – 2** **Weakly correlated –1**

CO/PO/ PSO	PO									
	1 Disciplinary Knowledge and skills	2 Skilled Communicator	3 Critical thinker	4 Sense of inquiry	5 Team player/worker	6 Skilled project manager	7 Digitally Efficient	8 Ethical awareness / reasoning	9 National and international perspectiv	10 Lifelong learners
CO1	**3**	2					**2**	1	1	1
CO2	**3**	2					**2**	1	1	1
CO3	**3**	1	1				**2**	1	1	1
CO4	**3**	1	1	**1**	2		**2**	1	1	1
CO5	**3**	2					**2**	1	1	1
PC5549-AVG	**3**	1	1	**1**	1		**2**	1	1	1
PC5549– TOTAL	**15**	**8**	**2**	**1**	**2**		**10**	**5**	**5**	**5**

Unit I **(19 hours)**

Biotechnology scope and importance. Molecular tools of genetic engineering- Exonucleases and Endonucleases, Restriction Endonucleases, Ligases, DNA and RNA polymerases, Reverse transcriptases, Alkaline Phosphatases.Cloning vectors – Plasmid : pBR322. Bacteriophage derived vectors: Lambda DNA and M13. Artificial Chromosomes - BAC and YAC, SV40, Shuttle vector. Gene Cloning/ rDNA technology – Isolation of desired DNA, Isolation of vector DNA, Ligation, Invitro construction of DNA, Linkers and adapters.

Unit II **(18 hours)**

Transfer of rDNA into host. Selection and screening of recombinants – direct selection, insertional inactivation method, blue - white selection method, colony hybridization test. Genomic and cDNA library. Blotting techniques – Southern, Northern and Western blotting. DNA Sequencing – MaxamGilbert's method, Sanger's method, Shotgun sequencing and RFLP. DNA finger printing - RAPD. DNA amplification - PCR.

Unit III **(18 hours)**

Animal cell, tissue and organ culture – requirements, substrates for cell culture, culture media, equipments required for cell culture , disintegration of tissue, establishment of cell cultures, types of cell lines – finite and continuous cell lines. Mass production of animal cell in bioreactor, suspension culture, organ culture, whole embryo culture. Applications of cell culture –Production of tissue plasminogen activator and blood factor, production of monoclonal antibodies and their use in diagnosis.

Unit IV **(17 hours)**

Applications of Genetic engineering in animals – Production of transgenic animals and their importance in biotechnology. Therapeutic products produced by Genetic engineering - Production of insulin, growth hormones, interferon, recombinant vaccines and its types. Gene therapy. Stem cells and their applications. Human Genome project.

Unit V **(18 hours)**

Bioethics in animal biotechnology – Good Manufacturing Practices (GMP), Good Lab Practices (GLP). Legal and ethical importance of genetic engineering - Ethical issues associated with Genetically Modified (GM) food and animals. Biosafety regulation – National and International levels. Intellectual property Rights (IPR) – Types of IP,Patents. Copyrights, Trademarks, Geographical indications, GATT, WTO, WIPO, TRIPS

REFERENCES

1. Benjamin Lewin. 2007. Gene X. 10th edition. Jones and Bartlett publishers Inc. Ltd.
2. Brown, T.A. 2007. Genomes 3. 3rd edition. Garland Science Publishers, London,
3. Dubey. R.C. 2014. A Textbook of Biotechnology. S. Chand Publishers.
4. Masters J.R.W. 2000. Animal Cell Culture: Practical Approach. Oxford University Press.
5. Old R.W & Primrose. 2006. Principles of Gene manipulations. 6th edition. S.B.Blackwell Scientific publications.
6. Ranga M.M. 2002. Animal Biotechnology. 3rd edition. Agrobios India Limited.
7. Ramadass P. Meera Rani S., 1997. Text Book of Animal Biotechnology. 2nd edition.
8. Sathyanarayana.U.2013.A Text book of Biotechnology, Publisher*Books* And Allied (p) Limited,
9. Srivastava.A.K. 2008. Animal Biotechnology, Oxford and IBH publishing

10. Yadov P.R 2009. Textbook of Animal Biotechnology. Discovery publishing Pvt Ltd.
11. Ganguli, P. (2001). Intellectual Property Rights: Unleashing the Knowledge Economy. New Delhi: Tata McGraw-Hill Pub.
12. National IPR Policy, Department of Industrial Policy & Promotion, Ministry of Commerce, GoI

WEB REFERRENCES

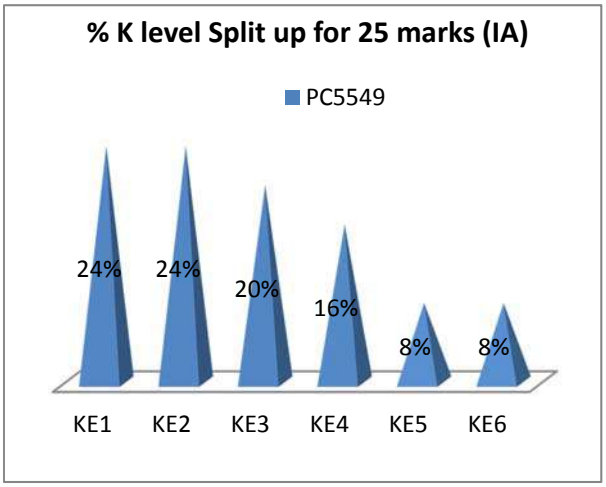
1. https://www.ncbi.nlm.nih.gov.class
2. https://www.genome.gov.
3. https://www.edx.org/course?search_query=biotechnology
4. https://www.coursera.org/courses?query=biotechnology&

E-RESOURCES

1. https://swayam.gov.in/courses/5178-molecular-biology-genetic-engineering-and-plant-tissue-culture Module no. :14,to 21,23&24
2. https://nptel.ac.in/courses/102103041/2 Gene Therapy
3. https://nptel.ac.in/courses/102103013/49 Genetic Engineering & Applications(Web)
4. https://nptel.ac.in/courses/102107028/40 Analytical Technologies in Biotechnology (Video) Electrophoresis , PCR, DNA sequencing methods

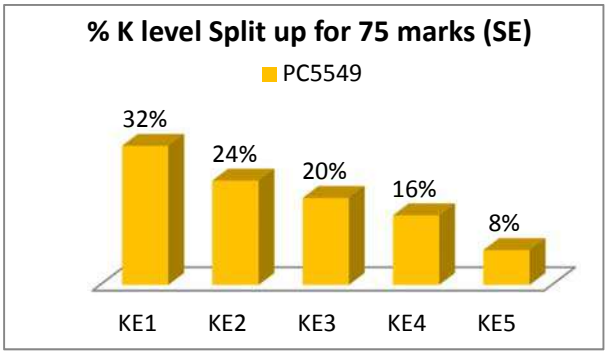
ASSESSMENTPATTERN CIE- Continuous Internal Evaluation (25 Marks)

Bloom's Taxonomy	Test	Assignment	Seminar	Model Exam
Total (25)	**5**	**5**	**5**	**10**
Remember (6)	1	1	1	3
Understand (6)	1	0	1	4
Apply (5)	2	2	0	1
Analyse (4)	0	1	1	2
Evaluate (2)	1	0	1	0
Create (2)	0	1	1	0



ESE- End Semester Examination (75 Marks; Weightage 75%)

Bloom's Category	Weightage %
Remember	32
Understand	24
Apply	20
Analyse	16
Evaluate	8



RESEARCH METHODOLOGY

Semester: III **Course: XIII**
Subject Code: PC5550 **Hours: 90**

Learning Objectives: To understand fundamentals of research methods.To develop an understanding of various research designs and techniques.

Course Outcomes: At the end of the Course, the Student will be able to:
Knowledge level - K1 (Remember), K2 (Understand), K3 (Apply), K4 (Analyze), K5 (Evaluate), K6 (Create). K1* K2*
Throughout the course, retention of all the concepts is emphasized after thorough understanding.

CO1	To solve various planning and operational problems. It aids in decision making, It involves the study of cause and effect relationships between various variables and helps to **identify** behaviour/patterns/trends in certain variables. **[PO3, PO7]**	**K1 K2 K3 K4**
CO2	To **interpretthe**action, to prove a theory, and contribute to developing knowledge in the field of study. **[PO3, PO7]**	**K1 K2 K3 K5**
CO3	To **understand** the proposed research is in relation to prior research in statistics. Research on existing theories and concepts help us to identify the range and applications of them. It also helpsusto **evaluat**e our life problems that occur every day. **[PO4, PO7]**	**K1 K2 K3 K5**
CO4	To **understand** and **analyze** the logical techniques. To **observe** the patterns in life. To discover useful information for business decision-making.Research experiment analyzed to define the relationship between two variables. { E resources www2.le.ac.uk (e resources and study guides for research students)} **[PO3, PO8, PO9]**	**K1 K2 K4 K6**
CO5	To **analyze** the different sections of report, to learn the style of writing. It helps to **evaluate** the information from various sources like journals, magazines,newspapers,websiteetc.www.modares.ac.ir>Agr.Oth.Lib.17.pdf **[PO3, PO8, PO9]**	**K1 K2 K3 K4**

Strongly correlated – 3 **Moderately correlated – 2** **Weakly correlated – 1**

CO/PO/ PSO	PO									
	1 Disciplinary Knowledge and skills	2 Skilled Communicator	3 Critical thinker and	4 Sense of inquiry	5 Team player/worker	6 Skilled project manager	7 Digitally Efficient	8 Ethical awareness/ reasoning	9 National and international perspective	10 Lifelong learners
CO1	**3**	2	2				**2**	1	1	1
CO2	**3**	2	1	**1**			**2**	1	1	
CO3	**3**	1	2				**2**	1	1	1
CO4	**3**	1	2	**2**	2		**2**	1	1	1
CO5	**3**	2		**1**	1		**2**	1	1	1
PC5550-AVG	**3**	1	1	**1**	1		**2**	1	1	1
PC5550 – TOTAL	**15**	**8**	**7**	**4**	**3**		**10**	**5**	**5**	**4**

UNIT-I **(18 hours)**

Concepts of Research – Definition, origin, meaning, characteristics, objectives and Importance of Research Methodology in Scientific Research. Types of Research – Descriptive Vs Analytical, Applied Vs Fundamental, Quantitative Vs Qualitative, Conceptual Vs Empirical and Research Methods Vs Methodology.

UNIT-II **(18 hours)**

Research Problem- selecting the Problem, Necessity of Defining the Problem, Technique Involved in defining a problem-Statement of the problem in a general way, understanding the nature of the problem, surveying the available literature, developing the ideas through discussions; and rephrasing the research problem into a working proposition.

UNIT-III **(18 hours)**

Review of Literature – Needs, literature search procedure and sources of literature. Research formulation - Defining, formulating and selecting the research problem.

UNIT-IV **(18 hours)**

Research Design - Basic Principles, need and features of a good design - Types of research design.–Data collection- Interpretation –Technique of Interpretation-Precaution in Interpretation.

UNIT-V **(18 hours)**

Research Report- Types of Report- structure and content of report – Cover and Title Page, Introductory Page, Text, References and Bibliography. Significance of Report writing.

References

1. Gurumani N. 1992. Research Methodology for Biological Sciences, MJP Publishers
2. Kothari C.R. 1996. Research Methodology methods and techniques, wishwaPrakasam Publications, Second Edition. New Delhi.
3. Ross 1974. “Research An Introduction” Barnes & Noble publisher
4. Saravanavel P. 1998. Research Methodology, KithabMahal, Sizth Edition.
5. Sharma K.R. 2002. Research Methodology, National Publishing House, Jaipur, New Delhi, 2002.

   Web resource: www.modares.ac.ir>Agr.Oth.Lib.17.pdf

WEB REFERENCES:

Cliffsnotes.com

www.modares.ac.ir>Agr.Oth.Lib.17.pdf

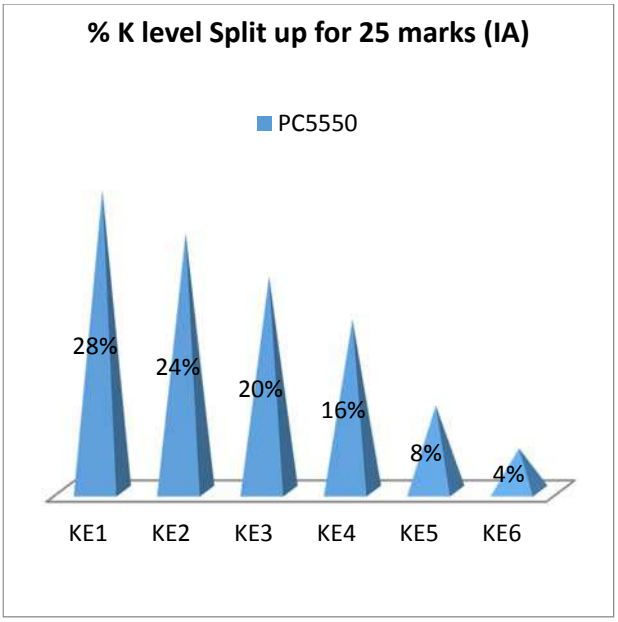
E-RESOURCES

www2.le.ac.uk (e resources and study guides for research students)

ASSESSMENT PATTERN

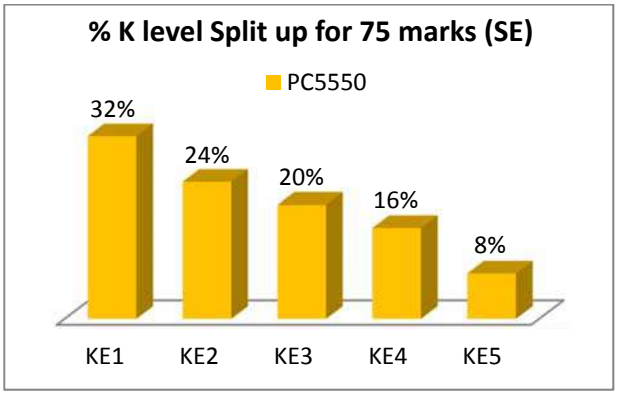
CIE- Continuous Internal Evaluation(25 Marks)

Bloom's Taxonomy	Test	Assignment	Seminar	Model Exam
Total (25)	**5**	**5**	**5**	**10**
Remember (7)	1	1	2	3
Understand (6)	1	0	1	4
Apply (5)	2	2	0	1
Analyse (4)	0	1	1	2
Evaluate (2)	1	0	1	0
Create (1)	0	1	0	0



ESE- End Semester Examination (75 Marks; Weightage 75 %)

Bloom's Category	Weightage %
Remember	32
Understand	24
Apply	20
Analyse	16
Evaluate	8



PRACTICAL – III PHYSIOLOGY, BIOTECHNOLOGY, BIOINFORMATICS and BIOSTATISTICS

Semester: III **Course: XIV**
Code: PC5551

Learning Objectives:

To introduce students to the principles of normal physiological function of organisms. To develop skill and expose the students to hands on training on various modern instruments used in biotechnology laboratory. To describe the different types of data bases found at the NCBI. To explain how do locate and extract data from bioinformatics resources. To describe the techniques used to data collection and develop analysis and interpretation of data.

Course Outcomes: At the end of the Course, the Student will be able to:

Knowledge level - K1 (Remember), K2 (Understand), K3 (Apply), K4 (Analyze), K5 (Evaluate), K6 (Create). K1* K2* Throughout the course, retention of all the concepts is emphasized after thorough understanding.

CO1	**Applying** acquired knowledge, **understand** the process of respiration like oxygen consumption and Co_2 released during respiration of fish. **Identify** the relationship between body weight and ability to consume oxygen and release of carbon dioxide. **Analyze** the haemolymph of cockroach and **identify** and **distinguish** the types of haematocyte by referring to lab manuals and web resources **(PO3, PO7)**.	**K1, K2, K3, K4**
CO2	**Understand** the enzyme and substrate dynamics. **Estimate and analyze** the enzyme activity with respect to pH and temperature. **Evaluate** physiological variations in blood pressure and a**ssess** the effect of exercise on heartbeat. Gain hands-on experience on measurement of blood pressure using Sphygmomanometer. Acquire the knowledge of principles and applications of Kymograph, CT- Scan, MRI, EEG. Develop the ability to **distinguish** normal and abnormal ECG report by visualizing original reports **(PO2)**.	**K1, K2, K3, K4, K5**
CO3	**Understand** the working mechanism of various instruments in a biotechnology lab. **Compare** and **Interpret** the applications of different type of electrophoresis and blotting techniques by web resources.**(PO3, PO7)**. **Appraise** the utilization of Column chromatography to isolate a particular chemical compound from a mixture. E**xplain** the application of ELISA test for detecting antibody against microbes and other foreign substances.	**K1 K2, K4, K5.**
CO4	Know **how** to locate and use the main databases at the NCBI**.** Able to **distinguish** the databases, tools, repositories. **Develop** ability to locate and use the advanced search query page on PubMed. Familiarize with bioinformatics software and **appraise** the applications and advantages of bioinformatics in the biological process. **Interpret** pairwise sequence alignment for a protein sequence and the various BLAST output results by using various softwares **(PO7)**.	**K1, K2, K3, K5, K6.**
CO5	**Understand** the statistical methods and develop ability to collect, **classify** and **analysis** biological research data. Develop skill to c**reate** graphs using research data in groups and **interpret** these graphs .**(PO5)**. Compute and **interpret** measures of association of mean, median and mode for discrete and continuous data. **Understand** the need of correlation coefficient and standard deviation in scientific research and develop skill to calculate and infer the result.	**K1 K2, K3, K4, K6.**

CO/PO	PO									
	1 Disciplinary Knowledge and skills	2 Skilled Communicator	3 Critical thinker and problem solver	4 Sense of inquiry	5 Team player/worker	6 Skilled project manager	7 Digitally Efficient	8 Ethical awareness / reasoning	9 National and international perspective	10 Lifelong learners
CO1	3	2	2	1	3		1	1	1	1
CO2	3	3	1	1	2		1	1	1	1
CO3	3	2	1	1	3		1	1	1	1
CO4	3	3	2	1	2		2	2	2	1
CO5	3	2	2		2	2	2	2	1	1
PC5551 - CO-PO-Avg	**3**	**2**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**
PC5551 - CO-PO-	**15**	**12**	**8**	**4**	**12**	**2**	**7**	**7**	**6**	**5**

UNIT -I

ANIMAL PHYSIOLOGY

1. Oxygen consumption in Fish with relation to light.
2. Oxygen consumption in Fish with relation to body weight.
3. CO_2 released by fish with relation to light.
4. CO_2 released by fish with relation to body weight.
5. Observation of haemolymph in cockroach.

UNIT -II HUMAN PHYSIOLOGY

1. Effect of enzyme concentration on amylase activity with reference to pH and temperature.
2. Effect of substrate concentration on amylase activity with reference to pH and temperature.
3. Measurement of heart beat during rest and exercises in human.
4. Monitoring the Blood pressure in humans using Sphygmomanometer
5. Principles and application of the following instruments: Kymograph, CT- Scan, MRI, EEG and ECG.

UNIT – III BIOTECHNOLOGY

1. Electrophoresis – AgaroseGel , Polyacrylamide Gel, and Tube gel Electrophoresis.
2. Blotting techniques
3. Column Chromatography
4. ELISA
5. Visit to Biotechnology Laboratory

UNIT – IV BIOINFORMATICS

1. Basics of Bioinformatics, Types of database, Online Sequence retrieval – NCBI
2. Literature database – Pub Med, Medline
3. Sequence database – Protein – Swissprot, prosite, Pfam, Nucleotide – Gen Bank.
4. Homology Study – Basic Alignment – BLAST and FASTA

UNIT – V BIOSTATISTICS

1. Collection and Classification of data
2. Representation of data: Diagram and Graph

3. Measures of Central tendency: Mean, Median, Mode
4. Calculation of Correlation Coefficient- Karl Pearson Coefficient of Correlation 5. Calculation of Standard Deviation

REFERENCES:

1. Agarwal, R. A., Srivastava, A. K. and Kaushal Kumar. 2014. Animal Physiology and Biochemistry (3rd Edition). S. Chand & Company Limited, 7361 Ram Nagar, New Delhi-110 055.
2. Antonisamy, B., Christopher S. and Samuel, P. P. 2010. Biostatistics: Principles and Practice. Tata McGraw Hill Education Private Limited, India.
3. Arora and Mathan. Bio Statistics. 2010. Himalaya Publishing House, Ramdoot, Dr.Bhalerao Marg,Girgaon,Mumbai – 400004.
4. Arora, M. P. Animal Physiology (6th Edition). 2011. Himalaya Publishing House, Ramdoot, Dr. Bhalerao Marg, Girgaon, Mumbai 400 004.
5. Arthur M. Lesk, 2003. Introduction to bioinformatics, Oxford University Press, New Delhi.
6. Berry, A.K. 1998. A Text book of Animal Physiology with related Biochemistry, Emkay Publications, NewDelh.
7. Dubey, R.C. 1995, A Text Book of Biotechnology, S.Chand& Co. Ltd., Ram Nagar, New Delhi – 110 055.
8. Ghosh Z and Mallick B. 2008. Bioinformatics: Principles and Applications, Oxford University Press.
9. Goel, K.A., and K.V. Sastry, 1984. A Text book of Animal Physiology, Rostogi publication, Meerut.
10. Gupta P.K. 2001. Elements of Biotechnology, Rastogi Publications, Meerut.
11. Gurumani, N. 2005. An Introduction to Biostatistics (computer Application included) 2nd Edition M.J.P. Publishers, Tamilnadu Book House, 47 Nallathambistreet,Triplicane- 600 005.
12. Guyton, A. C. and Hall, J.E. (2011). Textbook of Medical Physiology, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company.
13. William S.Hoar, 1976. General and Comparative Physiology, Prentice Hall of India Pvt. Ltd., New Delhi – 110 001, 848 pp.

E-RESOURCES / WEB REFERENCES:

1. https://www.adinstruments.com/lt/animal-physiology

2. https://www.biopac.com/discipline/animal-physiology-and-intro-human-physiology/

3 https://www.getbodysmart.com/

4. http://www.phys.szote.u-szeged.hu/edu/angla/labprac1+2.pdf

5.https://www.biopac.com/product/biopac-student-lab-animal-systems/ 7.

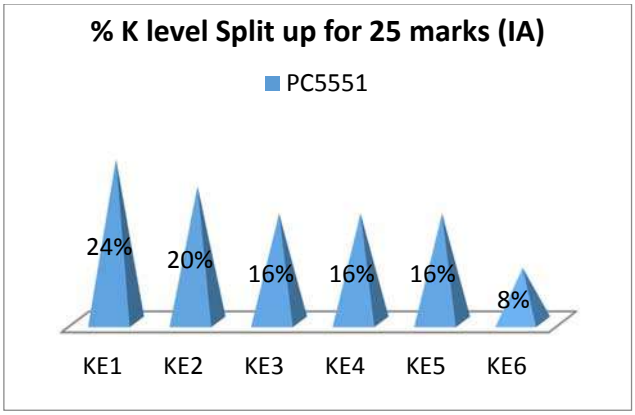
6. https://www.practicalstats.com/

7. https://study.com/academy/lesson/application-of-statistics-in-daily-life.

ASSESSMENT PATTERN

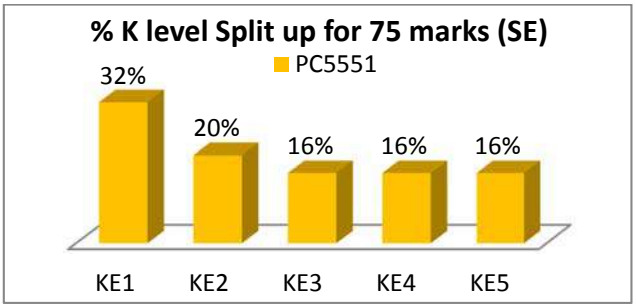
CIE-Continuos Internal Evaluation – 25 Marks

Bloom's Taxonomy	Test	Assignment	Seminar	Model Exam
Total (25)	**5**	**5**	**5**	**10**
Remember (6)	2	2	1	1
Understand (5)	1	0	1	3
Apply (4)	1	1	0	2
Analyse (4)	0	1	1	2
Evaluate (4)	1	0	1	2
Create (2)	0	1	1	0



ESE- End Semester Examination(75 Marks; Weightage 75 %)

Bloom's Category	Weightage %
Remember	32
Understand	20
Apply	16
Analyse	16
Evaluate	16



ELECTIVE III- BIOINFORMATICS AND BIOSTATISTICS

Semester: III **Course: XV**
Subject Code: PE5519 **Hours : 60**

Learning Objectives:
To provide an introduction to bioinformatics and to understand its importance in the field of zoology. Provide an overview on the various applications of bioinformatics**.**To understand the methods of collection of data, tabulation, presentation, analysis and interpretation of data.

Course Outcomes: At the end of the Course, the Student will be able to:
Knowledge level - K1 (Remember), K2 (Understand), K3 (Apply), K4 (Analyze), K5 (Evaluate), K6 (Create). K1* K2* Throughout the course, retention of all the concepts is emphasized after thorough understanding.

CO1	To **remember** nucleic acid structures, DNA, RNA and protein sequences. To **understand and apply** features of windows operating system**. [PO3, PO7]**	K1, K2 K3
CO2	To provide facilities for **comparing** DNA and proteins sequences with the existing DNA and protein databases. To understand the **functional** and evolutionary relationships between sequences as well as to help and **identify** members of gene families. **[PO4, PO7]**	K1 K2 K3 K4 K5
CO3	To **enrich** our **understanding** of how genes, genomes, species evolve. Construction and analysis of phylogenetic tree **[PO3, PO7] PPT**	K1 K2 K4 K5
CO4	To **remember** and **understand** the basic statistical concepts. Analyze and evaluate the methods for collecting data and presentation of data. **[PO3, PO8, PO9]**	K1 K2 K4 K5
CO5	To understand and perform statistical analysis. Apply and analyze the data collected [PO5, PO7] g-meet online class	K1 K2 K3 K6

Strongly correlated – 3 Moderately correlated – 2 Weakly correlated – 1

CO/PO/ PSO	PO									
	1 Disciplinary Knowledge and skills	2 Skilled Communicator	3 Critical thinker	4 Sense of inquiry	5 Team player/worker	6 Skilled project manager	7 Digitally Efficient	8 Ethical awareness / reasoning	9 National and international perspectiv	10 Lifelong learners
CO1	**3**	2	2				**2**	1	1	1
CO2	**3**	1	2	**1**			**2**	1	1	
CO3	**3**	2	2				**2**	2	1	1
CO4	**3**	1	2	**2**	2		**2**	1	1	1
CO5	**3**	2	2	**1**	2		**2**	2	1	1
PE5519-AVG	**3**	1	2	**1**	1		**2**	1	1	1
PE5519 – TOTAL	**15**	**8**	**10**	**4**	**4**		**10**	**7**	**5**	**4**

Unit I

Definition: Scope of bio-informatics. Operating systems-windows. MS office- MS word, power point, MS Excel. Internet –browsing and e- mailing.

Unit II

Sequence alignment - Introduction - Strings – Hemming's/Edit and Levenshtein distance pairwise sequence alignment- gap penalty - parametric sequence alignment - sub optimal alignment - multiple alignments - common multiple alignment methods. Sequence data base and their use - introduction to data base search FASTA - BLAST Amino acid substitution matrices PAM and BLOSUM.

Unit III

Phylogenetic Analysis –Phylogenetic tree structure and its construction. Phenetic methods. Genomics : structural and computational. Proteomics: structure prediction- *Ab Initio* modelling and comparative modelling

Unit IV

Biostatistics: Population, Sample, Statistical sampling methods in Biological study - Tabulation - Graphical and diagrammatic presentation - Histogram, Frequency Polygon - Frequency curve . Variation - Discrete and Continuous - Mean, Median and Mode.

Unit V

Measure of Dispersion - Standard deviation - standard error ; Elements of Probability addition and multiplication probability; Patterns of Distribution - Binomial, Normal and Poisson; Correlation - Coefficient of Correlation - Students 't' test and Chi – Square test -ANOVA.

REFERENCES

1. David W.Mount, 2001. Bio-informatics Cold Spring Harbor Laboratory press
2. Ignacimuthu. C,2005. Basic Bioinformatics. Narosa Publishing house.
3. Sundaralingam, R and V.Kumaresan.,2009. Bioinformatics. Saras Publications.
4. ImtiyazAlam Khan, 2005. Elementary Bioinformatics. Pharma Book Syndicate.
5. DovStekel, 2003. Microarry Bioinformatics. Cambridge University Press.
6. Dan Gusfield, 1997. Algorithms on strings trees and Sequences.
7. Kapoor, V.K 1990. Problems & Solutions In Statistics. Sultan Chand & Sons Publishers.
8. Gurumani, N. 2005. An Introduction to Biostatistics (computer Application included) 2nd Edition M.J.P. Publishers
9. Veer Bala Rastogi. 2017. Biostatistics 3rd Edition MEDTECH

WEB REFERENCES:

www.biologydiscussion.com › biodiversity › notes-on-bioinformatics-...

E-RESOURCES

http://www.evolbiol.ru/docs/docs/large_files/biostatistics.pdf

VIRTUAL LAB

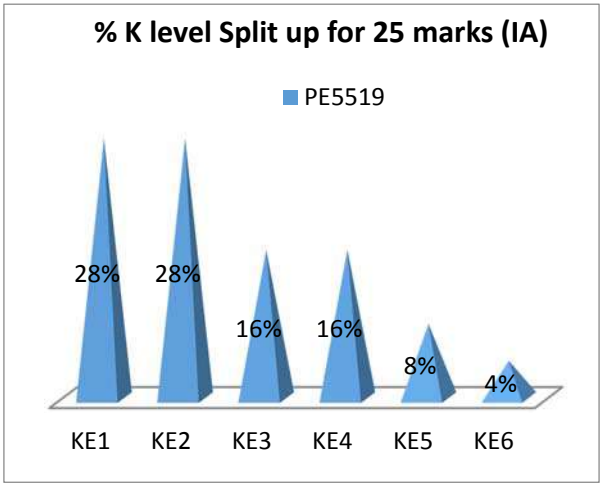
Genomics Virtual Laboratory: A Practical Bioinformatics Workbench for the Cloud, Plos one

https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0140829

ASSESSMENT PATTERN

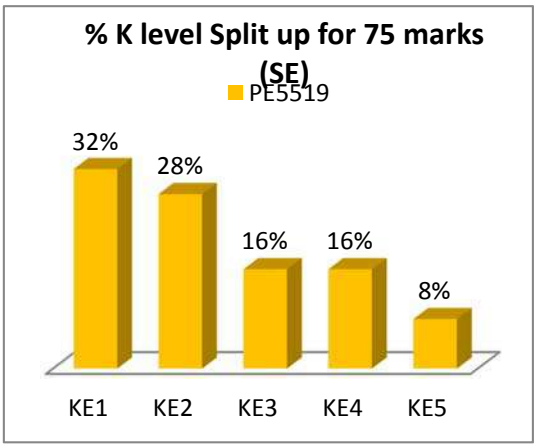
Bloom's Taxonomy	Test	Assignment	Seminar	Model Exam
Total (25)	**5**	**5**	**5**	**10**
Remember (7)	2	2	2	1
Understand (7)	1	0	1	5
Apply (4)	1	1	0	2
Analyse (4)	0	1	1	2
Evaluate (2)	1	0	1	0
Create (1)	0	1	0	0

CIE- Continuous Internal Evaluation (25 Marks)



ESE- End Semester Examination (75 Marks; Weightage 75%)

Bloom's Category	Weightage %
Remember	32
Understand	28
Apply	16
Analyse	16
Evaluate	8



ELECTIVE - IV AQUACULTURE

Semester: IV **Course: XVI**
Subject Code: PE5520 **Hours : 60**

Learning Objectives: The course enable the students to focus on the biology of marine and freshwater fishes. To learn the types of fish feeds and fish breeding techniques, to understand various aquaculture practices and culture methods and also to gain knowledge on aquarium and ornamental fishes.To know about the fish by products and to identify fish parasites.

Course Outcomes: At the end of the Course, the Student will be able to:
Knowledge level - K1 (Remember), K2 (Understand), K3 (Apply), K4 (Analyze), K5 (Evaluate), K6 (Create). K1* K2* Throughout the course, retention of all the concepts is emphasized after thorough understanding.

CO1	**To distinguish and identify** different marine and brackish water fishes and to study the biology of major and minor carps by manuals and web resources **(PO4)**	**K1 K2 K3 K4**
CO2	**To categorise and formulate**the fish feeds by group discussion **(PO5). To understand** the growth of fishes. **To determine** the age of fishes by different methods by survey and question session. (**PO3,PO4)**	**K1 K2 K4 K5 K6**
CO3	**To understand** the reproduction of fishes. **To study** the various methods on the production of transgenic fishes by web resources and various tools **(PO7, PO9)**	**K1 K2 K3**
CO4	**To acquire** knowledge on aquaculture farm. **To understand** the importance of water quality parameters in aquaculture by analysis and case studies **(PO6**). **To know** the different types of aquaculture methods. **To develop** skill on setting of an aquarium and its maintenance by group activity and question session (**PO4,PO5)**.	**K1 K2, K4 K6**
CO5	**To explain** the different shell fish culture techniques by interactive methods **(PO7).To list** gears and crafts used in fish harvesting by preparing models (**PO10).To enumerate** the significance of by products of fish industry by group discussion **(PO5**). **To identify** fish parasites and the fish diseases.	**K1 K2, K3, K5**

Strongly correlated – 3 Moderately correlated – 2 Weakly correlated – 1

CO/PO/ PSO	PO									
	1 Disciplinary Knowl	**2 Skilled Comm**	**3 Critica**	**4 Sense of**	**5 Team player/ worker**	**6 Skilled project**	**7 Digitally Efficie**	**8 Ethical awareness/**	**9 National and interna**	**10 Lifelon**
CO1	3	3	1	1			2	1	1	1
CO2	3	1	2	1	1		2	1	1	
CO3	3	1	2				2	1		1
CO4	3	1	2	1	1	1	2	1		1
CO5	3	2	1	1	1	1	2	1	1	1
PE5520-AVG	3	1	1	1	1	1	2	1	1	1
PE5520 – TOTAL	**15**	**8**	**8**	**4**	**3**	2	**10**	**5**	**3**	**4**

Unit I **Hours: 12**

Introduction: Habitat, morphology, feeding, breeding of - Marine fishes: Oil sardine, *Mackerel* and Seabass, Brackish water fishes: Chanos, Mullet and Pearl spot. Biology of economically important Indian major carps – *Catla, Rohu, Mrigal* and minor carps- *Labeobata, Labeocalbasu, Labeofimbriatus.*

Unit II **Hours: 12**

Fish feed: Live feed organisms – *Artemia* and Rotifer- Culture methods. Artificial feed – formulations and feeding methods. Growth of fish : Measurement of growth - length and weight relationship - factors influencing growth. Age determination of fishes - scale, otolith and bone method.

Unit III **Hours: 10**

Reproduction in fishes: Breeding techniques – Hypophysation, Induced breeding, Cryopreservation. Synthetic hormones. Crustaceans – Eye stalk abalation. Transgenic fishes – development and applications. Tagging of fishes.

Unit IV **Hours: 13**

Aquaculture farm – site selection, layout and construction of fish pond. Water source and water quality parameters and water quality management. Types of ponds in aquaculture. Different types of culture methods – composite, integrated, paddy cum fish culture. Ornamental fishes- Goldfish, Angel fish and guppies. Setting of aquarium and maintenance of aquarium fishes.

Unit V **Hours: 13**

Shell Fishes: Prawn culture, edible oyster culture and mussel culture. Processing, preservation storage and spoilage of fishes, By products of fish industry. Fish harvesting - Gears and crafts in fish harvesting. Common fish pathogens, diseases, symptoms and control measures.

REFERENCES

1. Bardach JE., Ryther JH and Miller WD, 1987. Aquaculture, B. John Wiley & Sons, New York.
2. Chakrabarti, N. M. 1998. Biology, Culture and Production of Indian Major Carps. Narendra Publishing House, New Delhi
3. Coche, A. G. and J. F. Muir. 1996. Pond Construction and Fresh Water Fish Culture – Pond Farm Structures and Layouts – Simple Methods for Aquaculture. FAO. Daya Publishing House, New Delhi.
4. Dey V.K. 1997. Ornamental Fishes - Marine Products Export Development Authority (MPEDA), Kochi. Handbook of Aqua Farming.
5. Jhingran V.G. , 1982. Fish and fisheries of India. Hindustan publishing Company India.
6 .Pillay, T. V. R. Aquaculture: Principles and Practices. Fishing News Books.
7. Santhanam R., 1990. Fisheries Science. Daya publishing house, New Delhi.

8. Srivastava C.B.L., 2002. A text book of fishery science and Indian fisheries, KitabMahal, Allahabad.
9. Yadav B. N., 1997. Fish and fisheries. Daya publishing house, New Delhi.

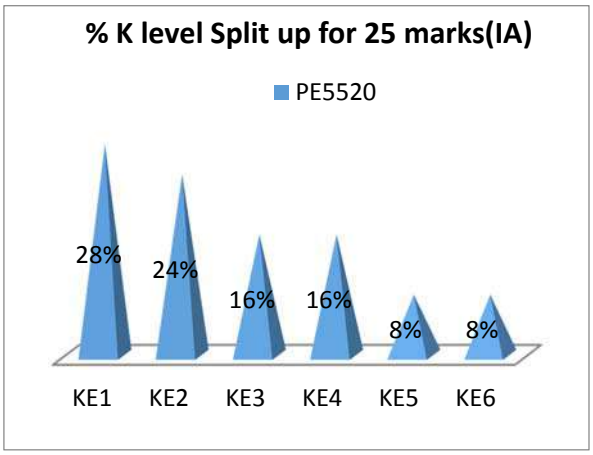
Web references

www.fishes.org
www.fao.org
www.labster.com
E - Books - Central Marine Fisheries Research Institute
www.cmfri.org.in › ebooks

ASSESSMENT PATTERN

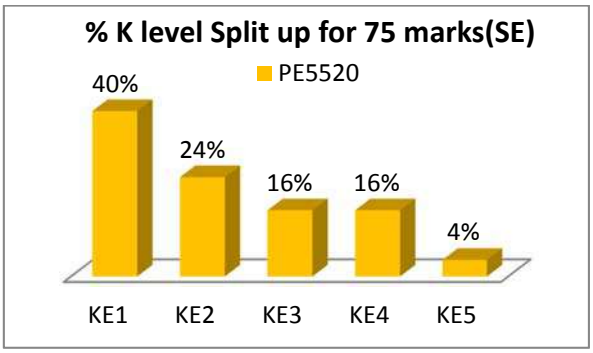
CIE- Continuous Internal Evaluation (25 Marks)

Bloom's Taxonomy	Test	Assignment	Seminar	Model Exam
Total (25)	**5**	**5**	**5**	**10**
Remember (7)	2	2	1	2
Understand (6)	1	0	1	4
Apply (4)	1	1	0	2
Analyse (4)	0	1	1	2
Evaluate (2)	1	0	1	0
Create (2)	0	1	1	0



ESE- Semester End Examination (75 Marks; Weightage75 %)

Bloom's Category	Weightage %
Remember	40
Understand	24
Apply	16
Analyse	16
Evaluate	4



EXTRA DISCIPLINARY PAPER II – MATERNITY AND CHILD CARE

Semester: III **Course: XVII**
Subject Code: PD5509 **Hours : 60**

Learning Objectives : The objectives of maternal, infant and child health systems indicators that affect the health, wellness and quality of life of women children and families. To reduce maternal morbidity and mortality due to pregnancy and childbirth. To promote reproductive health awareness for young children. The risk of maternal and infant mortality and pregnancy-related complications can be reduced by increasing access to quality preconception, prenatal and interconception care. The aim of maternal course enable the students to understand the knowledge of male and female reproductive organs. To provide education and support for the women and her families during the pregnancy period. To improve the health and well-being of women, infants, children and families.

Course Outcomes: At the end of the Course, the Student will be able to: Knowledge level - K1 (Remember), K2 (Understand), K3 (Apply), K4 (Analyze), K5 (Evaluate), K6 (Create). K1* K2* Throughout the course, retention of all the concepts is emphasized after thorough understanding.

CO1	**Illustrate** the structure and functions of reproductive organs in human by using models [PO10]. **Analyze** and **explain** the function of puberty, menstrual cycle and their related changes in various organs of the female body by using video lectures [PO7]	**K1 K2 K4 K5**
CO2	Understand the mechanism of fertilization. **Find** the solution for ectopic pregnancy by group discussion [PO5] **Explain** the various physiological changes which occur during pregnancy by seminar [PO2]	**K1 K2 K3 K6**
CO3	**Understand** the role of pregnancy hormones. **Acquire** knowledge to solve the problems related to pregnancy by videos [PO7]	**K1K2 K3K4**
CO4	**Acquire** knowledge, relate to parturition - normal and caesarian. **Recommend** and **influence** the importance of mother's milk by conducting quiz. [PO3] **Show** the value of the necessity of birth control and suggests various methods of birth control by whiteboard interactive method.[PO7,PO9]	**K1 K2 K5**
CO5	**Create** awareness about the infertility in male and female and the development of test tube babies by ppt [PO7] **Create** knowledge and awareness to adopt the immunization schedule. [web] [PO9]. **Recommend** the importance of family systems and **show** the value of role of parents in the family by teaching the ethical values [PO8]	**K1 K2 K3 K4 K5, K6**

Strongly correlated – 3 **Moderately correlated – 2** **Weakly correlated – 1**

CO/PO/ PSO	PO									
	1 Disciplinary Knowledge and skills	2 Skilled Communicator	3 Critical thinker and problem solver	4 Sense of inquiry	5 Team player/worker	6 Skilled project manager	7 Digitally Efficient	8 Ethical awareness/ reasoning	9 National and international perspective	10 Lifelong learners
CO1	**3**	1	1				**2**	1	1	1
CO2	**3**	2	1	**1**			**2**	1		
CO3	**3**	2	1				**1**		1	1
CO4	**3**	1	2		1		**2**	1		2
CO5	**3**	2	1	**1**	1		**1**	1		1

PC5509-AVG	**3**	1	1	**1**	1		**1**	1	1	1
PC5509 - TOTAL	**15**	**8**	**6**	**2**	**2**		**8**	**4**	**2**	**5**

Unit I

13 hours

Reproductive organs – Structure of Female and Male. Function. Spermatogenesis, Oogenesis. Puberty- Hormonal changes during puberty, Menstrual cycle- Changes of ovary, uterus, vagina, mammary glands during menstrual cycles.

Unit II **12hours**

Fertilization-Mechanism, Pregnancy test strip method; Stages of pregnancy -I,II,III trimester; Physiological changes during pregnancy, Ectopic pregnancy, Twins.

Unit III: **11 hours**

Role of Hormones in pregnancy -LH, FSH, Progesterone, Relaxin, oxytocin, prolactinPregnancy-related problems-CVS and Amniocentosis., Anaemia, Rh factor.

Unit IV **12 hours**

Epiduresis, Labour pain; False pain. Parturition- Normal, Caesarian , Lactation. Mother's milk and its advantages. Birth control- methods for Birth control. Necessity for Birth control; Contraceptive devices.

Unit V **12 hours**

Infertility in Male and Female. ART-Artificial insemination, Test tube Baby, Multiple pregnancy IVF, Embryo transfer, GIFT; Childcare-Inborn errors in man, Immunization schedule. Importance of family system-changing systems. Role of Parents.

REFERENCES

1. Verma P.S., V.K. Agarwal and Tyagi 1995. Chordate embryology, S.Chand and Co New Delho 110 055, 420pp
2. Gerard, J. Tortora and Sandra Reynolods Grabowski.. 2003. Principles of anatomy and Physiology. 10th edition. Mac Millain.John Wiley and Sons, IMC
3. Sastry, K.V and Dr. VineetaShukal. 2004. Developmental Biology, 1st Ed. Rastogi publications.
4. Balinsky. 2012. An Introduction to Embryology, 5th Edition. Cengage learning Publication
5. Berrill, N.J. 1986. Developmental Biology. Tata McGraw Hill Publication Co.Ltd.
6. Gilbert,S.F. 1997. Developmental Biology.5thed. Sinauer Associates, Inc., Sunderland, Massachusetts.
7 .Robert S. McEwen. 3rded- Vertebrate Embryology. 3rded.. Henry Holt and company, NewYork.
8.Veer Bala Rastogi. 2011. Chordate Embryology, KedarNath and Ram Nath , Delhi

WEB RESOURCES:

https://www.sciencedaily.com/terms/developmental_biology.htm
https://cmb.i-learn.unito.it/mod/book/tool/print/index.
https://www.studocu.com/en-gb/document/university-of-leeds/animal-developmental-biology/lecture-notes/animal-developmental-biology-lecture-notes-
https://biology.duke.edu>research>dev.

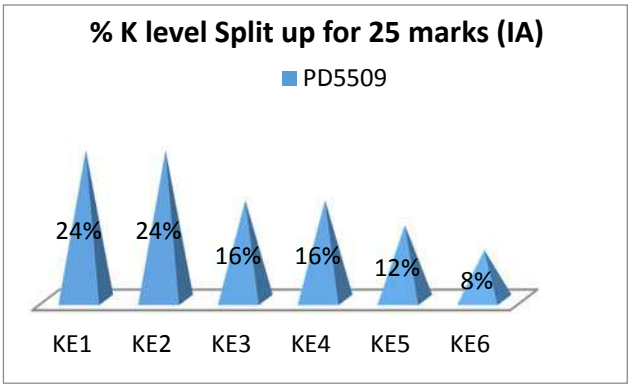
E- RESOURCES

https://www.who.int/maternal_child_adolescent/en/

ASSESSMENT PATTERN

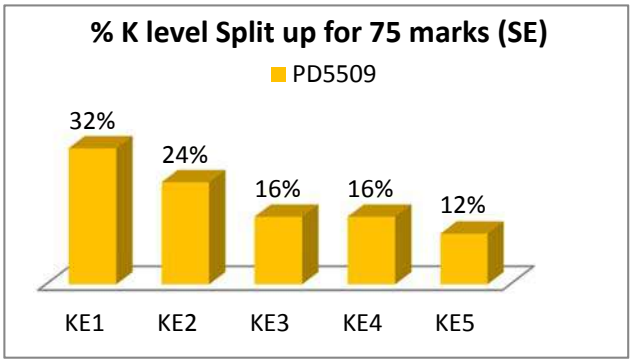
CIE- Continuous Internal Evaluation (25 Marks)

Bloom's Taxonomy	Test	Assignment	Seminar	Model Exam
Total (25)	**5**	**5**	**5**	**10**
Remember (6)	2	2	1	1
Understand (6)	1	0	1	4
Apply (4)	1	1	0	2
Analyse (4)	0	1	1	2
Evaluate (3)	1	0	1	1
Create (2)	0	1	1	0



ESE- End Semester Examination (75 Marks; Weightage 75 %)

Bloom's Category	Weightage %
Remember	32
Understand	24
Apply	16
Analyse	16
Evaluate	12



ANIMAL PHYSIOLOGY

Semester: IV **Course: XV**

Code : PC5552 **Hours: 90**

Learning Objectives:

The aim of this course is to impart deep understanding of the structure and function of organ and organ system. To acquire sufficient knowledge about the body systems with emphasis on clinical relevance.

Course Outcomes with K- Level Mapping: K1-Remember, K2-Understand, K3-Apply, K4-Analyze, K5-Evaluate, K6 Create. At the end of the Course, the student would be able to:

CO1	To **recall** the previous knowledge, ask the students to **relate** regulatory mechanism of the body. To **compare and distinguish** the different regulatory mechanisms of the body and environment. To **relate** different physiological adaptation. by video lectures, PPT **[PO7]**	**K1 K2 K3**
CO2	To **explain** the structure of digestive and excretory system. To **analyse** the energy balance. To **build** deep knowledge about BMR **[PO2].** To **make use of their** knowledge in their day to day life. To **elaborate** the formation of urine	**K1 K2 K3 K4 K5 K6**
CO3	To **recall** the respiratory system of animals and **tell** them different mode of respiration. Ask the students to **list** out different respiratory organs. To **build** strong concept of gaseous exchange. To **explain and compare** the structure of respiratory and circulatory system. To **distinguish** between respiratory system and circulatory system by PPT, GMEET, GOOGLE CLASSROOM AND WEB RESOURCES **[PO7, PO8]**	**K1 K2 K3 K4**
CO4	To **relate** nervous and muscular system. To **organize** a group activity **[PO3]**, they can able to **distinguish** muscular and nervous system **explain and compare** the structure of muscular and nervous system. To **elaborate** the muscle contraction and nerve impulse conduction. To **evaluate** the **importance** of impulse conduction.	**K1 K2 K3 K4 ,K5 K6**
CO5	To **list** out the receptors. To **explain and compare** the structure of sensing and endocrine system. To **develop** and construct the knowledge about endocrine related disorders in man by PPT, GMEET, GOOGLE CLASSROOM AND WEB RESOURCES **[PO7, PO8]**	**K1 K2 K3**

Strongly correlated – 3 Moderately correlated – 2 Weakly correlated – 1

CO/PO	PO									
	1 Disciplinary Knowledge and skills	2 Skilled Communicator	3 Critical thinker and problem solver	4 Sense of inquiry	5 Team player/worker	6 Skilled project manager	7 Digitally Efficient	8 Ethical awareness / reasoning	9 National and international perspective	10 Lifelong learners
CO1	3	1	2	1			1	1	1	1
CO2	3	1	1	1	2		1	1	1	1
CO3	3	2	1	1			2	1	1	1
CO4	3	1	2	1			1	1	1	1
CO5	3	2	2		2	1	2	1	2	1
PC5552 - Avg	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
PC5552 - Total	**15**	**7**	**8**	**4**	**4**	**1**	**7**	**5**	**6**	**5**

Unit I **18hrs**

Homeostasis and homeostatic mechanisms of the body – Thermoregulation, Exothermic and Endothermic organisms- Endothermy and physiological mechanism of body temperature regulation - Physiological adaptation to osmotic and ionic stress; mechanism of cell volume regulation - Osmoregulation in aquatic and terrestrial environments.

Unit II **17hrs**

Nutritive requirements – General, Structure and function of digestive system, Absorption of digested food-hormonal control of digestion. Energy balance, BMR. Excretion: Structure of kidney – Mechanism of urine formation – acid base regulatory mechanisms; endocrine regulation of water and mineral balance.

Unit III **21hrs**

Comparision of respiratory system in animals. Physiology of respiration, Respiratory pigments - transport of gases. Physiology of aerial and aquatic respiration in invertebrates and vertebrates. Respiratory adaptations in animals living in oxygen deficient environment- high altitude- deep sea. Circulation - types of heart - physiology of cardiac muscle - heart beat and its regulation - composition of blood and coagulation.

Unit IV **18hrs**

Types of muscles. Mechanism of muscle contraction. Neuronal control of muscle contraction. Nervous System- types, neuron, nerve impulse, resting potential, stimulation conduction of nerve impulse - synaptic transmission – neuro muscular junction – Reflex arc.

Unit V **16hrs**

Sensing the Environment- photoreception, chemoreception, mechanoreception, echolocation. Bioluminescence, pheromones, colouration, and function. Endocrinology: endocrine glands in vertebrates - endocrine related diseases and disorders in Man.

REFERENCES

1. Dantzler W.H. (ed.) Comparative Physiology (Handbook of Physiology): Vol. 1, 2,
2. Guyton A.G. 2002. Text Book of Medical Physiology, 12th Edn. Saunders Publication.
3. Hoar W.S. 1983. General and Comparative Animal Physiology, 3rd Edn. Prentice Hall Inc.
4. Nelson K. S. Animal Physiology- Adaptation and Environmental, Cambridge University Press, Cambridge, UK.
5. Prosser C.L. 1973. Comparative Animal Physiology, 3rd Edition. W.B. Saunders and Co., Philadelphia.
6. Rastogi S.C. 2001. Essentials of Animal Physiology, 3rd Edition. New Age International Publishers, New Delhi.

7. Randal, D., Burggren, W. and French K. 2002. Eckert Animal Physiology, Mechanisms and adaptations. 4th Edition. W. H. Freeman and Company, New York.

8. Schmid-Nielson K. 2002. Animal Physiology: Adaptations and Environment, 5th Edition, Cambridge University Press, UK.

Web Resources

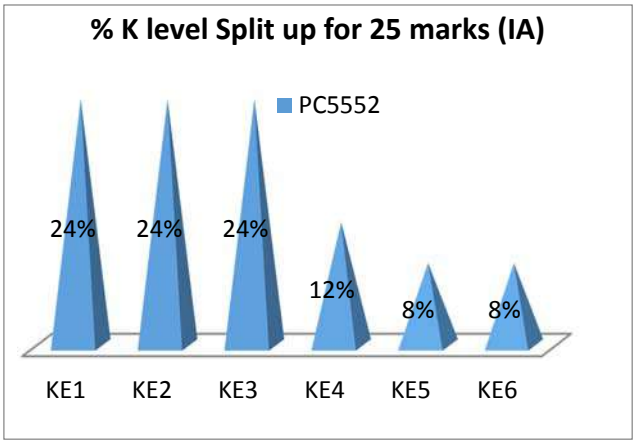
https.//learn org>Animal-biology>Ani..
https://animal phys4e.sinaver.com

E. resources
https://icssr.org/nassdoc
https://animalphys4e.sinauer.com/
https://www.chegg.com/homework-help/ animal- physiology- 3rd- edition- solutions

ASSESSMENT PATTERN

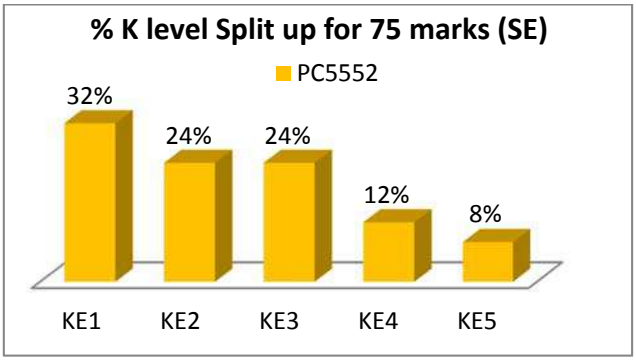
CIE- Continuous Internal Evaluation(25 Marks)

Bloom's Taxonomy	Test	Assignment	Seminar	Model Exam
Total (25)	**5**	**5**	**5**	**10**
Remember (6)	1	1	1	3
Understand (6)	1	0	1	4
Apply (6)	2	2	0	2
Analyse (3)	0	1	1	1
Evaluate (2)	1	0	1	0
Create (2)	0	1	1	0



ESE- End Semester Examination(75 Marks; Weightage 75 %)

Bloom's Category	Weightage %
Remember	32
Understand	24
Apply	24
Analyse	12
Evaluate	8



ENVIRONMENTAL BIOLOGY AND TOXICOLOGY

Semester: IV **Course: XIX**

SUBCODE: PC5553 **Hours: 90**

Learning objectives

It enables the students to know the role of Biotic and Abiotic factors in the environment and also to study the different types of habitat. To understand the concept of Community Ecology. To study the importance of wild life and its conservation. To learn about various global and regional environmental concerns that affect various forms of life. To understand the exposure of man and animal to potentially hazardous environment factors of chemical, biological and physical nature.

CO1	To **understand** the **concept** of biotic and Abiotic components using web resources (PO1) To **compare** and **relate** the characteristics and adaptations of various types of habitat by conducting quiz.(PO3)	**K1 K2 K3 K5 K6**
CO2	To **list** the characteristics of a population by white board interaction (PO1). To **understand** the nature of community and its structure by videos and ppt presentation (PO7). To **explain** the ecological succession and to **discuss** the concept of climax by group discussions and interactions. (PO2)	**K1 K2 K3 K4**
CO3	To **explain** the **importance** of Wildlife management and conservation by asking the students to do a survey around their surrounding places (PO8, PO9). To **discuss** the reasons for depletion.(PO2) To **create** and **improve** various conservation strategies by adopting projects. (PO6)	**K1 K2 K3 K6**
CO4	To **compare** the anatomical features of the dissected specimens. To **know** the **importance** of each organ system and their functions	**K1 K2 K4 K5**
CO5	To summarize the scope of toxicology by conducting seminar (PO2) and the students learn to **identify** and **assess** various toxicological tests by group activity (PO5). To **create** awareness on human health, environment and ethics by **survey** using social media and digital technology (PO10)	**K1 K2 K3 K4 K5**

Strongly correlated – 3 Moderately correlated – 2 Weakly correlated –1

CO/PO/ PSO	PO									
	1 Disciplinary	2 Skilled Communic	3 Critical thinker and	4 Sense of inquiry	5 Team player/wo	6 Skilled project	7 Digitally Efficient	8 Ethical awareness	9 National and	10 Lifelong learners
CO1	**3**	2	1	**2**	2	3	**2**	1	3	1
CO2	**3**	2	1	**1**	1		**2**	1	1	
CO3	**3**	1	2				**2**	3		1
CO4	**3**	1	1	**2**	1		**2**	1	1	1
CO5	**3**	1	2	**1**			**2**	3	3	1
PC 5553AVG	**3**	1	1	**1**	1	1	**2**	1	1	1
PC5553– TOTAL	**15**	**7**	7	**6**	4	3	**10**	**9**	8	**4**

Unit I **18hours**

The Environment – Abiotic – Role of light, temperature, water, air and soil, biotic factors, Law of limiting factors, animal interactions- intra specific, inter specific, positive and negative. Habitat ecology – fresh, marine, and estuarine water, terrestrial- characteristic and adaptation. Concept of Ecosystem, Ecological pyramids, Food chains, food web, Energy flow in an ecosystem, Biogeochemical cycles – Nitrogen, Carbon, Sulphur and phosphorous.

Unit II **17hours**

Population ecology - characteristics of a population, Population density, natality, mortality, age distribution of population, population growth curves; population dispersion. Community ecology - Nature of communities - community structure and attributes, edge effect and Ecotones, Ecological succession, concept of climax. Environment and Human health, Environmental ethics

Unit III **20hours**

Wild life conservation and management – Wild life of India; reasons for depletion of wild life, necessity for wild life conservation and management, modes of wild life conservation, protection by law, causes of extinction, threatened species, protected species of Indian wild life, red data book, WWF, CITES, IUCN, establishment of sanctuaries and national parks, Biodiversity management approaches, principles of biodiversity conservation. Biodiversity Hot spots in India.

Unit IV **17hours**

Environmental pollution- Air, Water, Soil ,Noise and Pesticide . Automobile emission of heavy metals - fertilizers - food additives - animal, plant and mushroom toxins. Role of biotechnology in pollution detection, bioremediation, biodegradation; organic farming and its merits, Green chemistry, Kyoto Protocol, Carbon Trading, Carbon Foot Print.

Unit V **18 hours**

Toxicology - definition and Scope. Bioassay test - single species test - multi species test - acute toxicity test - sub acute toxicity test - chronic toxicity test - determination of LC_{50} and LD_{50} values - Pathological techniques – autopsy.

REFERRENCE BOOKS:

1. Gupta P.K. and Salunka, D.K. 1985. Modern Toxicology, Volume I and II, Metropolitan, New Delhi
2. Sood, A. 1999. Toxicology, Sarup and Sons, New Delhi.
3. LU F.C., 1985. Basic Toxicology, Hemisphere Publication, Corporation, Washington, N.Y., London.
4. Odum E. P. 1983. Basic Ecology, Saunder's College Publishing, New York

5. Sharma P.D., 1996. Environmental Biology and Toxicology, Rastogi Publication, Meerut, India.
6. Verma and Agarwal, 2003. Environmental Biology – S.Chand&Co.Publications.

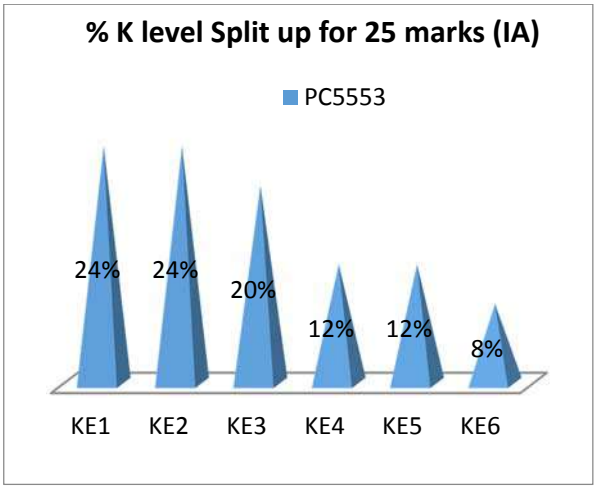
WEB RESOURCES:

https://www.sciencedirect.com/topics/earth-and-planetary-sciences/environmental-pollution
https://wildlifejustice.org/our-cause
https://www.atsdr.cdc.gov/training/toxmanual/modules/1/lecturenotes.html

ASSESSMENT PATTERN

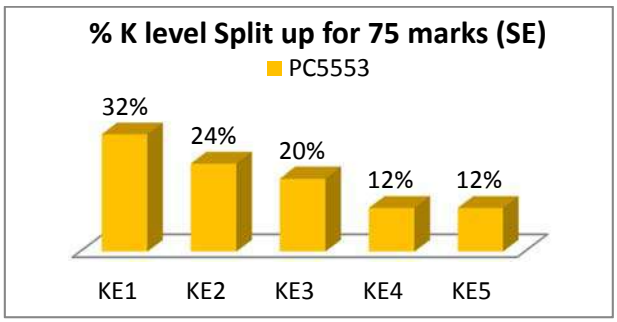
CIE- Continuous Internal Evaluation(25 Marks)

Bloom's Taxonomy	Test	Assignment	Seminar	Model Exam
Total (25)	**5**	**5**	**5**	**10**
Remember (6)	1	1	1	3
Understand (6)	1	0	1	4
Apply (5)	2	2	0	1
Analyse (3)	0	1	1	1
Evaluate (3)	1	0	1	1
Create (2)	0	1	1	0



ESE- End Semester Examination(75 Marks; Weightage 75 %)

Bloom's Category	Weightage %
Remember	32
Understand	24
Apply	20
Analyse	12
Evaluate	12



PROJECT

Semester: IV **Course: XX**
Code : PC5554 **Hours: 90**

Project helps for creating research attitude among the post graduate students

1. Project paper – 90 hours of practical work, analysis and interpretation.
2. Project work should be original and independent research by the student.
3. Two copies of the project report and also soft copy of report in CD should be submitted at the end of the term.
4. The maximum length of the report should not exceed 30 pages (typed matter: Times New Roman 12; space 1.5) excluding bibliography, tables, diagrams and annexure.
5. A certificate from the supervisor under whom the candidate worked that the report submitted is a record of research work done during the period of study under her and that the report has not formed the basis for the award to the candidate of any Degree, Diploma, Associateship, Fellowship or other similar title should be provided.
6. A viva (oral examination) will be conducted on the project work at the end of the term.

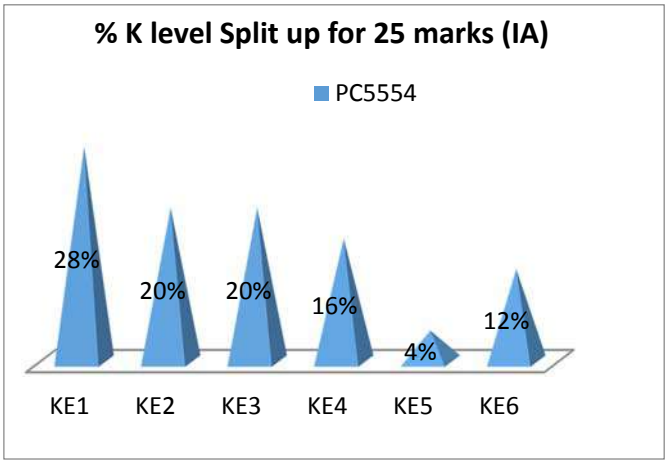
Strongly correlated – 3 Moderately correlated – 2 Weakly correlated – 1

CO/PO	PO									
	1 Disciplinary Knowledge and skills	2 Skilled Communicator	3 Critical thinker and problem solver	4 Sense of inquiry	5 Team player/worker	6 Skilled project manager	7 Digitally Efficient	8 Ethical awareness / reasoning	9 National and international perspective	10 Lifelong learners
CO1	3	2	2	1	2		2	3	2	1
CO2	3	2	1	1	2	1	2	2	1	1
CO3	3	2	1	1	2		2	2	2	1
CO4	3	2		1	2		2	3	1	1
CO5	3	2	2	2	2	2	2	2	2	1
PC5554 - Avg	**3**	**2**	**1**	**1**	**2**	**1**	**2**	**2**	**1**	**1**
PC5554 - Total	**15**	**10**	**8**	**6**	**10**	**3**	**10**	**12**	**8**	**5**

ASSESSMENT PATTERN

CIE- Continuous Internal Evaluation(25 Marks)

Bloom's Taxonomy	Test	Assignment	Seminar	Model Exam
Total (25)	**5**	**5**	**5**	**10**
Remember (7)	2	0	2	3
Understand (5)	1	0	1	3
Apply (5)	2	2	0	1
Analyse (4)	0	1	1	2
Evaluate (1)	0	0	0	1
Create (3)	0	2	1	0



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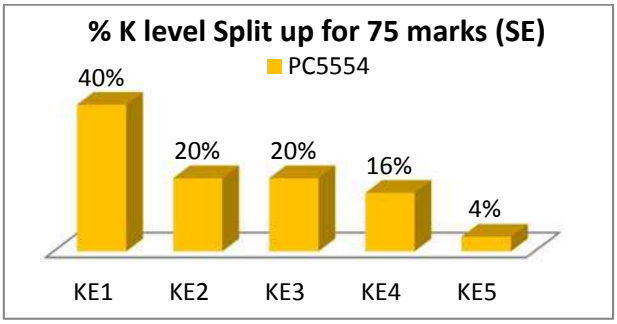
Evaluate	4



PRACTICAL – IV ENVIRONMENTAL BIOLOGY, AQUACULTURE AND MEDICAL LABORATORY TECHNIQUES

Semester: IV **Course: XXI**
Code : PC5555 **Hours: 90**

Learning Objectives

To acquire knowledge about the water quality parameters and study their influence on aquatic organisms. Students identify aquatic organisms and understand theirbiology. They can understand and apply the techniques used in medical laboratory.

Course Outcomes with K- Level Mapping:K1-Remember, K2-Understand, K3-Apply, K4-Analyze, K5-Evaluate, K6-Create. At the end of the Course, the student would be able to:

CO1	To **recall** water quality parameters of fresh water and marine water. To **develop** the skill of **analyzing** various water samples. The student will be able to **analysis** and **interpret** the values. To be able to **estimate** primary productivity by field visit **(PO6)**	K1 K2 K3 K4 K6
CO2	To **identify** and differentiate the plankton. To study different habitats and their fauna. Submission of field visit report **(PO6)**	K1 K2 K3
CO3	To **recall** meristic characters and **identification** of fish. To **analyse** the gut content of fish and **interpret** the feeding habit. Using manual **identify** and **classify** the fishes. To **identify** the commercially important invertebrates. by group discussions and interactions. (PO5)	K1 K2 K3 K4 K5
CO4	To **identify** the various fish farm implements and **explain** their importance. www.fishes.org**(PO7)** To **understand** different types of grafts and gears. **Examine** fishes and **find** out the fish parasite and **extent** their **knowledge** to the preparation of slide. **(PO2)** www.fao.org .**(PO7)**	K1 K2 K3 K4 K5
CO5	To **apply** different medical lab technique in diagnostics.	K1 K2

Strongly correlated – 3 Moderately correlated – 2 Weakly correlated – 1

CO/PO	PO									
	1 Disciplinary Knowledge and skills	2 Skilled Communicator	3 Critical thinker and problem solver	4 Sense of inquiry	5 Team player/worker	6 Skilled project manager	7 Digitally Efficient	8 Ethical awareness / reasoning	9 National and international perspective	10 Lifelong learners
CO1	3	2	2	1	3		1	1	1	1
CO2	3	3	1	1	3		1	2	1	1
CO3	3	2	1	1	2		1	1	1	1
CO4	3	3		1	2		2	2	1	1
CO5	3	2	2		2	2	2	1	2	1
PC5555-Avg	**3**	**2**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**
PC5555-Total	**15**	**12**	**8**	**4**	**12**	**2**	**7**	**7**	**6**	**5**

Unit I **Environmental Biology**

1. Estimation of salinity (demonstration only)
2. Estimation of alkalinity.
3. Estimation of calcium and
4. Magnesium in water samples
5. Estimation of Primary productivity in pond water
6. Calculation of biodiversity index.

Unit II **Environmental Biology**

1. Identification of any five Fresh water and Marine of Plankton.
2. Study of marine habitat- rocky shore fauna, sandy shore fauna, muddy shore fauna.
3. Study of fauna in their natural Habitats by visiting places of zoological interest.
4. Visit to water treatment plants and Tannery Effluent treatment plant

Unit III **Aquaculture**

1. Morphology and Morphometric measurement of fish
2. Fish anatomy (digestive system)
3. Gut content analysis of fishes.
4. Identification of locally available and economically important marine fish Species belonging to different families-Use of manuals
5. Identification of commonly available freshwater fish Species
6. Identification of cultivable prawns, commercially important invertebrates and their economic importance (Crab, Lobster, Clam, Mytilus, Loligo and Sepia)
7. Fish feed preparation – Pearson Square Method

Unit IV **Aquaculture**

1. Fish farm implements – Secchidisk,pH meter, hand centrifuge, aerator, Plankton net,
2. Identification of Crafts and gears
3. Observation of fish parasites – Prepared specimen and Slide preparation
4. Identification of public health fishes (larvivorous fishes) and Aquarium fishes
5. Fish by - products
6. Visit to Aquafarms

Unit V **Medical Laboratory Technology**

1. Pregnancy Test
2. Widal test
3. Urine analysis – glucose test
4. Stool analysis - identification of ova and cyst
5. Visit to medical Lab and Diagnostic center

REFERENCES

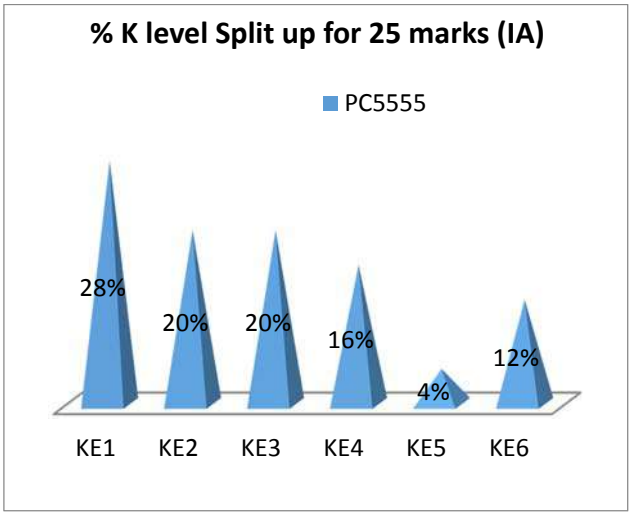
1. Day, Francis (1889). The Fauna of British India, Including Ceylon and Burma. Fishes. Volume 1.
2. Dey V.K. 1997. Ornamental Fishes - MPEDA Handbook of Aqua Farming.
3. Jayaraman K C 1981. The freshwater fishes in India, Pakistan, Bangladesh, Burma and Srilanka – A Hand Book. Edited by the Director, Zoological survey of India.
4. Jhingran V.G. , 1982. Fish and fisheries of India. Hindustan publishing Company, India.
5. Odum E. P. 1983. Basic Ecology, Saunder's College Publishing, New York.
6. RamnikSood 2006. Text book of Medical Laboratory Technology.
7. Santhanam R., 1990. Fisheries Science. Daya publishing house, New Delhi.

Web reference

www.fishes.org
www.fao.org
https://www.nhbs.com/fresh-water-fishes-of-central-india-bookhttps://en.wikipedia.org/wiki/Fishkeeping

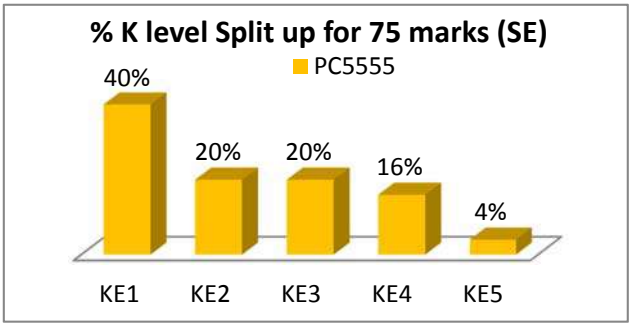
ASSESSMENT PATTERN **CIE- Continuous Internal Evaluation(25 Marks)**

Bloom's Taxonomy	Test	Assignment	Seminar	Model Exam
Total (25)	**5**	**5**	**5**	**10**
Remember (7)	2	0	2	3
Understand (5)	1	0	1	3
Apply (5)	2	2	0	1
Analyse (4)	0	1	1	2
Evaluate (1)	0	0	0	1
Create (3)	0	2	1	0



Bloom's Category	Weightage %
Remember	40
Understand	20
Apply	20
Analyse	16
Evaluate	4

ESE- End Semester Examination(75 Marks; Weightage 75 %)



ELECTIVE-V - MEDICAL LABORATORY TECHNIQUES

Semester:IV **Course: XXII**

Code: PE 5521 **Hours: 60**

Learning Objectives

This course provide knowledge to set up a clinical lab and to learn various haematological techniques, also aid to learn the role of different kinds of blood factors and analyses of these factors, able to enrich their knowledge on various diagnostic methods to diagnose diseases using different methods, finally will be able to develop professional skills so as make the students self employable.

Course Outcomes: At the end of the Course, the Student will be able to: Knowledge level - K1 (Remember), K2 (Understand), K3 (Apply), K4 (Analyze), K5 (Evaluate), K6 (Create). K1* K2* Throughout the course, retention of all the concepts is emphasized after thorough understanding.

CO1	To **explain** the scope and **apply** knowledge to set a medical laboratory with full safety measures and to **recall** the types of blood components and develop skills in assaying haematoloical parameters. Interactive board and video lectures use to show the haematology **(PO7)**	**K1 K2 K3 K6**
CO2	To **learn and explain** the analyses of body fluids and to **correlate** the results with body condition. Videos to explain the concepts (PO7). Give quiz to assess the learning and importance **(PO2)**	**K1 K2 K3**
CO3	To **analyse**, **correlate and infer** the results of diagnosis to provide knowledge on the state and the stages of diseases condition. Separate seminar topics is used to help the students to search in web and create ppt by them **(PO7)**	**K1 K2 K3 K4**
CO4	To **know how** to assess and to evaluate the clinical tests and to **understand** health condition. Use web sources **(PO9)**	**K1 K2 K3,K5**
CO5	To get an **idea** to examine life threatening diseases and to **know how** to examine pathogens, to arrange group discussion to create awareness on cancer and other diseases **(PO2)**	**K1 K2 K4**

Strongly correlated – 3 Moderately correlated – 2 Weakly correlated – 1

CO/PO	PO									
	1 Disciplinary Knowledge and skills	2 Skilled Communicator	3 Critical thinker and problem solver	4 Sense of inquiry	5 Team player/worker	6 Skilled project manager	7 Digitally Efficient	8 Ethical awareness / reasoning	9 National and international perspective	10 Lifelong learners
CO1	3	2	1	1				1	2	1
CO2	3	2	1				2	1	2	1
CO3	3	2	1				2	1	2	1
CO4	3	2	1				2	1	2	1
CO5	3	2	1	1			2	1	2	1
PC5521 - Avg	**3**	**2**	**1**	**1**			**1**	**1**	**2**	**1**
PC5521 - Total	**15**	**10**	**5**	**2**			**8**	**5**	**10**	**5**

Unit I **12 hours**

Setting up of a clinical laboratory, laboratory safety. Hematology – methods of collection of blood samples; anticoagulants; complete blood count – Total Red Blood Cells (RBC), White Blood Cells (WBC), platelets, Hemoglobin estimation by Sahli's method; preparation and staining of blood smear – Differential Leucocyte Count (DLC). Bleeding time and clotting time. Erythrocyte Sedimentation Rate (ESR).

Unit II **12 hours**

Clinical Chemistry, blood glucose – glucose tolerance test , Liver function test Alanine Amino Tranferase (ALT) and Aspartate Aminotransferase (AST), endocrine function – Estimation of thyroxin (T_4) and Thyroid Stimulating Hormone (TSH), Blood Urea Nitrogen (BUN).

Unit III **12 hours**

Diagnostic measures: Blood pressure, ECG, EEG, angiogram and angioplasty. Diagnosis of dengue, malaria, typhoid and Hepatitis A and B. Analysis of sputum, cerebrospinal Fluid (CSF), urine analysis – cast and crystals, stool analysis.

Unit IV **12 hours**

Pregnancy test - human Chorionic Gonadotropin (hCG), semen analysis, Vaginal smear examination , Diagnostic skin test - Mantoux test. Mycoses – superficial, intermediate and deep.

Unit V **12 hours**

Fine Needle Aspiration Cytology (FNAC) test breast cancer diagnosis. Staining techniques – bacteria – Gram staining; fungal culture technique and staining – Lacto phenol Cotton Blue (LCB).

REFERENCES

1. John Bernerd Henry M.D. 1991. Clinical diagnosis and Management by Laboratory methods. WB Saunders Company, Harcourt Brace Jovanovich, Inc.

2. John D. Bauer 1982. Clinical Laboratory methods, Edition 9, Mosby.

3. Leslie Cromwell, Fred J. 1994. Biomedical Instrumentation and Measurements. Weivell, Publishing Ltd.,

4. Monir Ahmed. 2011. BSc in laboratory medicine Part I,II and III. IHT, Dhaka.

5. Rajalakshmi, 2008. Biomedical instrumentations. Sam publications.

6. Ramnik Sood. 2006. Medical Laboratory technology: Methods and Interpretations. Jaypee Brothers Medical *Publishers* (P) Ltd

7. Satish, Gupta, 2010. Short text book of Medical Microbiology. Edition 10, Jaypee Brothers Medical *Publishers* (P) Ltd.

8. Sheryl A. Whitelock. 2010. Immuno haematology for laboratory technicians. Delamae cengage learning, USA.

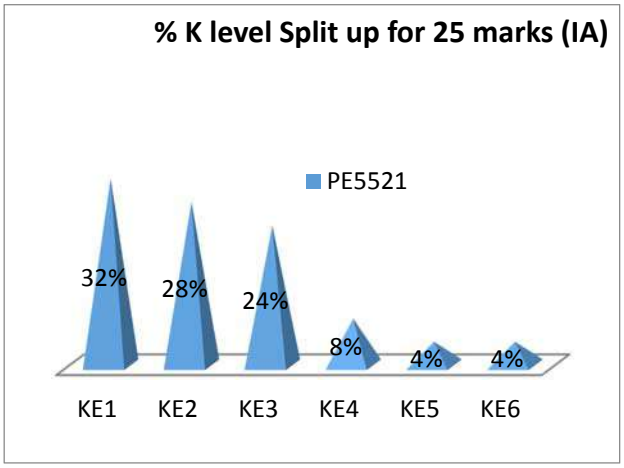
WEB RESOURCES

https://www.medicinenet.com

ASSESSMENT PATTERN

Bloom's Taxonomy	Test	Assignment	Seminar	Model
Total (25)	**5**	**5**	**5**	**10**
Remember (8)	2	1	3	2
Understand (7)	1	0	1	5
Apply (6)	2	2	0	2
Analyse (2)	0	1	1	0
Evaluate (1)	0	0	0	1
Create (1)	0	1	0	0

CIE- Continuous Internal Evaluation (25 Marks)



ESE- End Semester Examination (75 Marks; Weightage 75 %)

Bloom's Category	Weightage %
Remember	36
Understand	28
Apply	24
Analyse	8
Evaluate	4