A.V.V.M. Sri Pushpam College (Autonomous), Poondi – 613 503

PG & Research Department of ZOOLOGY

M.Sc., Programme in ZOOLOGY

OUTCOME BASED EDUCATION - CHOICE BASED CREDIT SYSTEM

SCHEME OF PROGRAMME AND SYLLABUS

(For the candidates admitted from 2023-2024 onwards)

Vision and Mission of the college

Vision

To provide quality academic programmes and value oriented higher education to the rural community, equip them to encounter current regional, national and global demands upholding moral standards and intellectual competency.

Mission

- To provide conducive environment for quality teaching-learning process and innovative research.
- To bestow substantial educational experience that is intellectually, socially, and personally transformative.
- To strive to bring out the latent potentiality and core competency of the learners
- To foster the culture of research-based learning, independent academic inquiry by encouraging the students to involve in research activities ranging from hands on training, student projects, publications etc.,
- To nurture essential skills, competent minds and compassionate hearts.
- To impart a practical, demanding and overall development of the personality generated by love, consideration and care for the society.
- To serve the society by extending needful outreach programmes to the rural populace.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

- Make the learners realise the transformative power of education.
- Acquire profound disciplinary, applied, integrative knowledge and intellectual competency and domain specific and generic skills.
- Pursue lifelong learning and generate innovative solutions for the problems at individual and social level.
- Create a collaborative and inclusive environment, and serve the betterment of the society with moral integrity.
- Motivate to become a committed professional with necessary ethics as a leader as well as a team player.

PROGRAMME OUTCOMES for M.Sc., Programme

On the completion of the M.Sc. Zoology programme, the learners will be able to,

- **PO1:** Profound expertise in discipline, interpret advanced and contemporary concepts, principle and theories in the appropriate field to solve real problems.
- **PO2:** The challenging, student-centered curriculum is research - based and technology - oriented and provides a foundation for life - long learning.
- **PO3:** The program caters to students' interest in different domains of biology – from classical to modern, including varied specializations (Behavioural Neuroscience, Aquaculture Technology, Nanotechnology, Cancer Biology, Reproductive Technology)
- **PO4**: Training in specialized domain of biology is intended to prepare students to become qualified graduates to address biology-related issues at national and international levels.
- **PO5**: Biology being evidence-based, the program is grounded with an equal number of laboratory courses in the formal practices of observation, experimentation, testing hypotheses and interpretation.
- **PO6**: Biology relies on applications of quantitative analysis and mathematical reasoning; therefore, the curriculum is designed to train the students to apply descriptive and inferential statistical methods, design and analyse diverse data set and understand the underlying probability in the calculations.
- **PO7**: The program provides training to the students to develop their knowledge and skills to communicate appropriate scientific content, formatting and presentation of data through scientific seminars.
- **PO8**: The program trains the students to understand the relationship between science and society, which enhances their vision to apply their knowledge in health systems, economic growth and sustainable environment.
- **PO9**: The research-oriented course engages in rigorous and original research that advances knowledge in their chosen field of study within the discipline
- **PO10**: Upon successful completion of the program will provide ample chances for them to qualify for national eligibility tests and professional development gained will lead them to be successful in their careers in academia / industry.

PROGRAMME SPECIFIC OUTCOMES for M.Sc. ZOOLOGY Programme

On the completion of the **M.Sc., Zoology** programme, the learners will be able to

- **PSO1: Knowledge expansion:** Learn in-depth complex biological concepts at the cellular and molecular level, demonstrate their ability to explain and apply their knowledge.
- **PSO2: Developing specialization:** Consistent in learning by earning extra credits in specialized courses within the field of biological sciences.
- **PSO3: Skill development:** All core courses with laboratory components will provide exposure to a wide range of research techniques, therein enhancing their understanding of the application of techniques.
- **PSO4: Scientific information and technology:** Skill oriented courses will provide details on principles, conduct of proper calibration and use of scientific instrumentation and appropriate use of scientific techniques in experimental design.
- **PSO5: Application of knowledge:** Preparation of field reports helps them to present their results and discussion in a written format that is typically required for their future professions.
- **PSO6: Critical thinking:** Field and academic visits will help students to develop observation skills, grasping ability, collect and interpret data and propose models that will help them to understand hypotheses and conclusions.
- **PSO7: Communication**: Mandatory seminars will help them to develop oral communication skills from formal subject-based presentations and informal scientific discourse.
- **PSO8: Numeracy:** Students will develop the ability to reason, apply numerical concepts, and equations in their fields of study for interpreting scientific data and drawing relevant scientific conclusions.
- **PSO9: Development of competency:** Through the interactions, students will develop skills of critical reading of texts, identifying gaps in knowledge, formulating scientific questions, and on will recognizing the synthesis of new ideas.
- **PSO10: Professional and Career Development:** Students undertaking a research thesis will have the opportunity to design, develop and execute their own research ideas in their experiments, thus expanding their knowledge of research methods and laboratory skills.

Curriculum Structure for PG Programmes (OBE- CBCS) - 2023

	Nature of Course	Total No. of Courses	Total marks	Total credits	Total credits for the Programme
Part – A	Core Course	13	1300	51	80 (CGPA)
	Elective Course	05	500	15	
	Extra Disciplinary Course	01	100	3	
	Core Industry Module (CIM)	01	100	3	
Part – B (i)	Skill Enhancement Course(SEC)	04	400	8	
Part – B (ii)	Ability Enhancement Compulsory Course (AECC) – Soft Skill	04	400	8	10 (Non CGPA)
	Internship / Industrial Activity	--	--	2	
	Total	**28**	**2800**	**90**	**90**
Value Added Course (VAC)		01	100	--	
Extra Credit Course - **MOOC / Field visit / Hands on Training**		--	--	Max: 4	

Part A component and Part B (i) will be taken into account for CGPA calculation for the postgraduate programme and the other components Part B and Part C have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the PG degree

Course Structure: M.Sc., ZOOLOGY (2023)

S. No.	Semester	Category	Course Code	Title of the Course	Maximum Marks			Minimum Marks for Pass			Hours/ Week	Credits
					CIA	EE	Total	CIA	EE	Total		
1	I	Core	23P1ZOC1	STRUCTURE AND FUNCTIONS OF INVERTEBRATES	25	75	100	10	30	50	5	4
2		Core	23P1ZOC2	COMPARATIVE ANATOMY OF VERTEBRATES	25	75	100	10	30	50	5	4
3		Core	23P1ZOCP1	PRACTICAL- I- INVERTEBRATES AND VERTEBRATES	25	75	100	10	30	50	6	4
4		Elective	23P1ZOEL1A/ 23P1ZOEL1B	MOLECULES AND THEIR INTERACTION RELEVANT TO BIOLOGY/ BIOCHEMISTRY	25	75	100	10	30	50	5	3
5		Elective	23P1ZOEL2A/ 23P1ZOEL2B	BIOSTATISTICS NANOTECHNOLOLOGY	25	75	100	10	30	50	5	3
6		SEC1	23P1ZOSEC1	POULTRY FARMING	25	75	100	10	30	50	2	2
7		AECC1	23P1ZOAECC1	Communicative Skill and Personality Development	25	75	100	10	30	50	2	2
		Extra Credit		Field visit / Hands on Training	-	-	-	-	-	-	-	-
8	II	Core	23P2ZOC3	CELL AND MOLECULAR BIOLOGY	25	75	100	10	30	50	5	4
9		Core	23P2ZOC4	DEVELOPMENTAL BIOLOGY	25	75	100	10	30	50	5	4
10		Core	23P2ZOCP2	PRACTICAL- II- CELL AND MOLECULAR BIOLOGY AND DEVELOPMENTAL BIOLOGY	25	75	100	10	30	50	6	4
11		Elective	23P2ZOEL3A/ 23P2ZOEL3B	ECONOMIC ENTOMOLOGY / GENERAL AND APPLIED ENTOMOLOGY	25	75	100	10	30	50	5	3
12		Elective	23P2ZOEL4A/ 23P2ZOEL4B	STEM CELL BIOLOGY/ CELL AND TISSUE CULTURE	25	75	100	10	30	50	5	3
13		SEC2	23P2ZOSEC2	DAIRY FARMING	25	75	100	10	30	50	2	2
14		AECC2	23P2ZOAECC2	Language Lab	25	75	100	10	30	50	2	2

S. No.	Semester	Category	Course Code	Title of the Course	Maximum Marks			Minimum Marks for Pass			Hours/ Week	Credits
					CIA	EE	Total	CIA	EE	Total		
15	III	Core	23P3ZOC5	ANIMAL PHYSIOLOGY	25	75	100	10	30	50	6	4
16		Core	23P3ZOC6	IMMUNOLOGY	25	75	100	10	30	50	5	4
17		Core	23P3ZOCP3	PRACTICAL- III- ANIMAL PHYSIOLOGY AND IMMUNOLOGY	25	75	100	10	30	50	6	4
18		CIM	23P3ZOCIM	Industry Module - MEDICAL LABORATORY TECHNIQUES	25	75	100	10	30	50	4	3
19		EDC	23P3ZOEDC	CLINICAL AND LAB TECHOLOGY	25	75	100	10	30	50	5	3
20		SEC3	23P3ZOSEC3	ANIMAL BEHAVIOUR	25	75	100	10	30	50	2	2
21		AECC3	23P3ZOAECC3	Research Methodology	25	75	100	10	30	50	2	2
		Internship / Industrial Activity (Carried out in summer vacation at the end of I Year – 30 hours)									-	2
		Extra Credit	MOOC (Massive open online course)		-	-	-	-	-	-	-	-
22	IV	Core	23P4ZOC7	GENETICS	25	75	100	10	30	50	6	4
23		Core	23P4ZOC8	EVOLUTION	25	75	100	10	30	50	5	4
24		Core	23P4ZOC9	ECOLOGY	25	75	100	10	30	50	5	4
25		Elective	23P4ZOEL5A/ 23P4ZOEL5B	AQUACULTURE / MICROBIOLOGY	25	75	100	10	30	50	5	3
26		Core	23P4ZOC10PR	Project with Viva Voce	25	75	100	10	30	50	5	3
27		SEC4	23P4ZOSEC4	APICULTURE	25	75	100	10	30	50	2	2
28		AECC4	23P4ZOAECC4	Comprehensive Knowledge	-	100	100	-	-	50	2	2
				Total			**2800**					**90**
		VAC	23P4ZOVAC	VALUE ADDED COURSE -VERMICULTURE TECHNOLOGY	-	100	100	-	50	50	SS	-
		Extra Credit	MOOC(Massive open online course)		-	-	-	-	-	-	-	-

Internship/ Industrial Activity:

Students must complete in-plant training in any industry or organization where a programme-related procedure is being used, and this training must be done during the summer vacation at the end of I Year. A minimum of 30 hours should be spent on training. Students must submit a report on their training together with a certificate from the relevant industry or organization authority.

Ability Enhancement Compulsory Course (AECC): (Communicative Skill and Personality Development, Language Lab, Research Methodology and Comprehensive Knowledge)

Mode of Assessment for these courses is Viva-Voce examination.

Components of Evaluation:

Internal Marks : 25
External Marks : 75
Total : 100

Field visit / Hands on Training:

In order to achieve experiential learning, these programmes with a minimum of 15 hours of contact time are offered as Extra Credit Courses in the I Semester.

Evaluation of visit report will be held at the end of II Semester.

Components of Evaluation:

Internal Marks : 25
External Marks : 75
Total : 100

MOOC:

Massive Open Online Course is offered in the III and IV Semester as an Extra Credit Course. Students can avail any one or more of the courses available in MOOC to equip their skill and knowledge themselves. To receive the extra credit, students must provide their MOOC course completion certificate at the end of the second year.

Skill Enhancement courses (SEC) offered by the Department of Zoology:

1. POULTRY FARMING **2. DAIRY FARMING** **3. ANIMAL BEHAVIOUR** **4. APICULTURE**

Extra Disciplinary Course (EDC) offered by the Department of Zoology: CLINICAL AND LAB TECHOLOGY

Value Added Course offered by the Department of Zoology: VERMI CULTURE TECHNOLOGY

A.VEERIYA VANDAYAR MEMORIAL SRI PUSHPAM COLLEGE (AUTONOMOUS),POONDI, THANJAVUR DIST.
(NAAC Re-Accredited with A grade in 4th cycle)
Question Pattern for UG and PG Programmes
(For the students admitted from 2023 – 2024 onwards)

Bloom's Taxonomy based Assessment pattern

Bloom's category	Section	Choice	Marks	Total
K1 to K6	A	Compulsory	10 x 2 = 20	75
	B	Either / Or	5 x 5 = 25	
	C	3 out of 5	3 x 10 = 30	

OBE QUESTION PATTERN
Total Marks: 75

CO	K Level	Q. No.	Questions
SECTION – A (10 x 2 = 20) **Answer All the questions** (Two Questions from each units)			
		1.	
		2.	
		3.	
		4.	
		5.	
		6.	
		7.	
		8.	
		9.	
		10.	
SECTION – B (5 x 5 = 25) **Answer All the questions** (One Question from each unit)			
		11(a).	
(OR)			
		11(b).	
		12(a).	
(OR)			
		12(b).	
		13(a).	
(OR)			
		13(b).	
		14(a).	
(OR)			
		14(b).	
		15(a).	
(OR)			
		15(b).	
SECTION – C (3 x 10 = 30) **Answer ANY THREE questions** (One Question from each unit)			
		16.	
		17.	
		18.	
		19.	
		20.	

Bloom's Taxonomy Action Verbs

K1 Remember	K2 Understand	K3 Apply	K4 Analyze	K5 Evaluate	K6 Create
• Choose • Copy • Define • Describe • Discover • Duplicate • Enumerate • Examine • Find • How • Identify • Label • List • Locate • Match • Memorize • Name • Omit • Recall • Recognize • Relate • Select • Show • Spell • State • Tabulate • Tell • What • When • Where • Which • Who • Why	• Associate • Classify • Compare • Contrast • Convert • Demonstrate • Describe • Differentiate • Discuss • Distinguish • Estimate • Explain • Express • Extend • Identify • Illustrate • Indicate • Infer • Interpret • Outline • Paraphrase • Predict • Relate • Rephrase • Show • Summarize • Translate	• Apply • Build • Calculate • Change • Choose • Complete • Construct • Demonstrate • Develop • Discover • Dramatize • Experiment • Identify • Interview • Interpret • Illustrate • Make use of • Manipulate • Model • Modify • Organize • Paint • Plan • Prepare • Produce • Relate • Select • Show • Sketch • Solve • Use • Utilize	• Advertise • Appraise • Analyze • Assume • Break down • Categorize • Classify • Compare • Conclusion • Connect • Contrast • Differentiate • Discover • Dissect • Distinguish • Discriminate • Divide • Examine • Explain • Function • Inference • Inspect • List • Motive • Order • Point out • Prioritize • Relationships • Select • Separate • Simplify • Subdivide • Survey • Take part in • Test for • Theme	• Agree • Appraise • Assess • Award • Choose • Compare • Conclude • Convince • Criteria • Criticize • Decide • Deduct • Defend • Determine • Discriminate • Estimate • Evaluate • Explain • Find errors • Grade • Importance • Influence • Interpret • Judge • Justify • Mark • Measure • Order • Predict • Prioritize • Prove • Rank • Rate • Recommend • Reframe • Select • Summarize • Support • Value	• Adapt • Build • Change • Choose • Combine • Compile • Compose • Construct • Create • Design • Develop • Discuss • Elaborate • Estimate • Formulate • Generalize • Hypothesize • Imagine • Improve • Integrate • Invent • Make up • Maximize • Minimize • Modify • Originate • Organize • Plan • Predict • Prepare • Produce • Propose • Rearrange • Rewrite • Role-play • Solution • Solve • Substitute • Write

Semester	Course Code	Title of the Course	Hours of Teaching / Week	No. of Credits
I	**23P1ZOC1**	**STRUCTURE AND FUNCTION OF INVERTEBRATES**	**5**	**4**

Nature of the course

Relevant to Local need		Employability Oriented	√	Addresses Professional Ethics	
Relevant to national need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to regional need		Skill development Oriented		Addresses Environment and Sustainability	√
Relevant to Global need	√			Addresses Human Values	

Course Objectives:

The main objectives of this course are to:

1. To understand the concept of classification and their characteristic features of major group of invertebrates.
2. To realize the range of diversification of invertebrate animals.
3. To enable to understand the Structure of various system of invertebrates
4. To realize the evolutionary importance of Larval forms of invertebrates
5. To understand the Organization and phylogenetic relationship of Minor Phyla

Unit	Content	No. of Hours
I	**Taxonomy** Principles of animal taxonomy- Species concept; International code of zoological nomenclature - Taxonomic procedures. New trends in taxonomy - Organization of coelom – Acoelomates – Pseudocoelomates – Coelomates : Protostomia and Deuterostomia	**15 Hrs**
II	**Locomotion and Nutrition** **Locomotion** -Pseudopodia, flagella and ciliary movement in protozoa - Hydrostatic movement in Coelenterates, Annelids and Echinoderms - Nutrition and Digestion - Patterns of feeding and digestion in lower metazoan - Filter feeding in polychaetes, Molluscs and Echinoderms	**15 Hrs**
III	**Respiration and Circulation** **Respiration:** organs of respiration: gills, lungs and trachea - Respiratory pigments - Mechanism of respiration. Circulation: Haemolymph – tubular and neurogenic heart -blood vessels - Circulation pattern.	**15 Hrs**
IV	**Excretory and Nervous system** **Excretion:** organs of excretion- coelom, coelomoducts, nephridia and Malphigian tubules - Mechanisms of excretion - osmoregulation Nervous system: Primitive nervous system: Coelenterata and Echinodermata - Advanced nervous system: Annelida, Arthropoda (crustaceans and insects) and Mollusca (cephalopoda) - Trends in neural evolution	**15 Hrs**

V	**Invertebrate larval forms and Minor phyla** **Invertebrate larvae:** Larval forms of free-living invertebrates - Larval forms of parasites - Strategies and evolutionary significance of larval forms(Crustacean and Echinoderm larva) **Minor Phyla:** Acoelomate: Mesozoa, Nemertinea ; Pseudocoelomate: Endoprocta, Rotifera ; Coelomate: Chaetognatha, Ectoprocta- General characters, organization and affinities.	**15 Hrs**

Text Books:

1. P.S.Verma and E L Jordan Invertebrate Zoology. S,Chand and company Ltd(2022)
2. R.L.Kotpal. Modern Text Book of Zoology: INVERTEBRATES, 12TH EDITION,2020, Ratogi Publications, GangtriShivaji Road, Meerut- 250 002.
3. N. Arumugan , T. Murugan , B. Ramanathan M.G Ragunathan. A Text Book of Invertebrates, 2019 Saras Publications.
4. Parker, T,J., Haswell, W.A. Text Book of Zoology, Macmillan Co., London2015
5. Dechenik, J. A. 2015. Biology of Invertebrates (Seventh Edition). Published by McGraw Hill Education (India) Private Limited, pp-624.
6. EkambaranathaIyer, M. and Ananthakrishnan, T.N. 2003. A Manual of Zoology, Vol I & II Viswanathan Publications, Chennai.

Reference Books:

1. DeSalle, R. and Schierwater, B. (2021). Invertebrate Zoology: A Tree of Life Approach. United States: CRC Press.
2. Edgecombe, G. D. and Giribet, G. (2020). The Invertebrate Tree of Life. United Kingdom: Princeton University Press.
3. Jan A Pechenik (2014), Biology of invertebrates 7th edition McGraw Hill Co., New York
4. Calow, P. (2012). Invertebrate Biology: A Functional Approach. United States: Springer, US.
5. Serge N. Vinogradov, and Oscar H. Kapp. (2011). Structure and Function of Invertebrate Oxygen Carriers. United States: Springer New York.
6. Bhate, A. and Puranik, P. (2007). Animal Forms and Functions: Invertebrata. India: Sarup& Sons.
7. Ruppert , Fox and Barness (2006) Invertebrate Zoology: A Functional Evolumeutionary Approach, 7th Edition , Cengage Learning ISBN: **9788131501047**
8. Brusca, R. C., and G. J. Brusca. (2003). Invertebrates, 2nd ed. New York: Sinauer Associates,
9. Nielsen, C. (2001) Animal Evolution: Interrelationships of the Living Phyla, 2nd ed. New York: Oxford University Press,
10. Kotpal. (1990). Minor Phyla. Rastogi Publication, Meerut.
11. Barrington, E.J.W.1976 Invertebrate structure and function. Thomas Nelson and Sons Ltd., London
12. Barnes, R.D. (1968), Invertebrate Zoology, III edition. W.B. Saunders Co., Philadelphia.
13. Hyman, L.H. (1923)The invertebrates. Vol.l Protozoa through Ctenophora, McGraw Hill Co., New York.

Web resources:

1. https://www.uou.ac.in › files › slm › MSCZO-501
2. https://openlibrary.org/books/OL21715834M/Invertebrate_structure_and_function
3. https://catalogue.nla.gov.au/Record/2942768
4. https://www.akinik.com/products/1339/structure-and-function-of-invertebrates.

5. https://www.intechopen.com/chapters/68302
6. http://assets.vmou.ac.in › MZO01

Pedagogy: Lecture, Assignment, PPT

Course Outcomes (CO):

On the successful completion of this course, students will be able to:

CO Number	CO Statement	Cognitive Level
CO1	Remember the general concepts and major groups in animal classification, origin, structure, functions and distribution of life in all its forms.	**K1 & K2**
CO2	Understand the evolutionary process. All are linked in a sequence of life patterns.	**K2 & K4**
CO3	Apply this for pre-professional work in agriculture and conservation of life forms.	**K3 & K5**
CO4	Analyze what lies beyond our present knowledge of life process.	**K4 & K6**
CO5	Evaluate and to create the perfect phylogenetic relationship in classification.	**K5 & K6**

Cognitive Level :K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes:										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	2	3	3	3	2	3	3	3
CO2	3	3	2	3	3	3	2	2	3	3
CO3	3	2	3	3	3	3	2	2	3	3
CO4	3	2	3	3	3	3	2	2	3	2
CO5	3	2	3	3	3	3	2	2	3	2

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated;
0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No.of Credits
I	**23P1ZOC2**	**COMPARATIVE ANATOMY OF VERTEBRATES**	**5**	**4**

Nature of the course

Relevant to Local need		Employability Oriented	√	Addresses Professional Ethics	
Relevant to national need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to regional need		Skill development Oriented		Addresses Environment and Sustainability	√
Relevant to Global need	√			Addresses Human Values	

Course Objectives:	
The main objectives of this course are:	
1.	Exemplifying the vertebrate origin and the intermediary position of Prochordates between invertebrates and vertebrates.
2.	Acquires the knowledge on evolution and adaptive radiation of Agnatha and Pisces.
3.	Understanding knowledge about the first terrestrial vertebrates and the adaptive radiation of land animals
4.	Imparting conceptual knowledge about the animal life in the air and their behaviours.
5.	Understanding the origin and efficiency of mammals and evolutionary changes that occurred in the life of vertebrates.

Unit	Content	No. of Hours
I	**Chordates and Protochordates** Characters and Classification of protochor data - Origin of chordates and classification -The nature of vertebrate morphology - Definition, scope and relation to other disciplines - Importance of the study of vertebrate morphology.	15 Hrs
II	**Vertebrate Integument and Digestive system** Origin and Classification of vertebrates –vertebrates Integumentand its derivatives -Development, structure and function of skin and its derivatives , Glands, scales, horns, claws,nails,Hoofs, feathers and hairs - Comparative account of digestive system of vertebrates.	15 Hrs

III	**Circulation and Respiration** General plan of circulation in various groups ;Blood - Evolution of heart - Evolution of aortic arches and portal systems. Respiratory system : Characters of respiratory tissue - Internal and external respiration ; Comparative account of respiratory organs in vertebrates.	15 Hrs
IV	**Skeletal system and urinogenital system** Skeletal system - Form, function, body size and skeletal elements of the body - Comparative account of jaw suspension , vertebral column - Limbs and girdles - Evolution of urinogenital system in vertebrate groups.	15 Hrs
V	**Sense organs and Nervous system** Sense organs ; Organs of Vision , Hearing , olfaction and taste. Nervous system ;Comparative anatomy of the brain in relation to its functions in fish , frog, Calotes, Pigeon and Rabbit -Comparative anatomy of spinal cord ; Nerves-Cranial, Peripheral and Autonomous nervous system.	15 Hrs

Text Books:

1. EkambaranathaIyyar. E.M.,and Anantha Krishnan T.N. 2009. Manual of Zoology Vol.II, Part I & II. (Chordata), S. Viswanathan Pvt. Ltd., Chennai.
2. Yong, J. Z. 1981. The life of Vertebrates, English language Book society, London, pp-645.
3. Romer, A.S. 1971. The Vertebrate body, W.B.S. Saunders, Philadelphia, pp-600.
4. Kotpal, R.L.2019. Modern Text Book of Zoology - Vertebrata, Rastogi and Company, Meerut, India.

References:

1. Waterman, A.J. 1972. Chordate Structure and Function, MacMillan Co., New York, pp.587.
2. Parker T. J. and W. A. Haswell. 1962. A text book of Zoology, Vol. 2, Vertebrates, 7th Edition, Mac Millan Press, London, pp-750.
3. Verma PS. (2018). *Chordate Zoology,* S. Chand Publishers, New Delhi
4. Kingsley, J. S. (2015). Text Book of Vertebrate Zoology. United States: FB&C Limited.
5. Kardong, K. V. (2019). Vertebrates: Comparative Anatomy, Function, Evolution. United States: McGraw-Hill Education.11
6. Pough, F. H. and Janis, C. M. (2019). Vertebrate Life. United Kingdom: Oxford University Press

Web resources :

1. Swayam Prabhhttps://www.swayamprabha.gov.in/index.php/program/archive/9
2. https://fas.calendar.utoronto.ca/course/eeb266h1 (Toronto University, Canada).
3. https://www.syllabusfinder.com/static/syllabus/EEB263-Comparative-Vertebrate-Anatomy-Fall-2014.pdf(Toronto University, Canada)
4. https://www.eurekalert.org/news-releases/953666
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3594521/

Pedagogy: Lecture, Assignment, PPT presentation, Quiz, Demonstration.

Expected Course outcomes (CO) :
On the successful completion of this course, the students will be able to :

CO1.	Remember the general concepts and major groups in animal classification, origin, structure, functions and distribution of life in all its forms.	**K1 & K2**
CO2.	Understand the evolutionary process. All are linked in a sequence of life patterns.	**K2 & K4**
CO3.	Apply this for pre-professional work in agriculture and conservation of life forms.	**K3 & K5**
CO4.	Analyze what lies beyond our present knowledge of life process.	**K4 & K6**
CO5.	Evaluate and to create the perfect phylogenetic relationship in classification.	**K5 & K6**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Mapping of Course Outcomes with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	2	1	3	2	3	2	3	2	3
CO2	3	1	1	3	2	3	2	2	2	2
CO3	3	2	1	3	2	3	2	1	2	2
CO4	3	1	1	3	1	3	2	1	2	1
CO5	3	2	1	3	3	3	2	3	2	2

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated; 0 – No correlation

Semester	Course code	Title of the course	Hours of teaching /week	No. Of Credits
I	**23P1ZOCP1**	Core Practical -I **Invertebrates and Vertebrates**	**6**	**4**

Nature of the course

Relevant to Local need	√	Employability Oriented	√	Addresses Professional Ethics	
Relevant to national need	√	Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to regional need	√	Skill development Oriented	√	Addresses Environment and Sustainability	√
Relevant to Global need	√			Addresses Human Values	

Course Objectives:	
The main objectives of this course are:	
1.	Understanding the different systems in invertebrates & vertebrates.
2.	Learning about various animal species, their phylogenetic affinities and their adaptive features
3.	Imparting conceptual knowledge about the salient features and functional anatomy.
4.	Developing the skill in mounting techniques of the biological samples.
5.	Gaining fundamental knowledge on the skeletal system

1. INVERTEBRATES

Dissection

Earthworm : Nervous system
Pila : Digestive and nervous systems
Cockroach : Nervous system
Grasshopper : Digestive system and mouth parts
Prawn : Appendages, nervous and digestive systems

Mounting

Earthworm : Body setae
Pila : Radula
Cockroach : Mouth parts
Grasshopper: Mouth parts

Spotters

1. Scorpion
2. *Penaeus indicus*
3. *Emerita* (*Hippa*)

4. *Perna viridis*

Study of the following slides with special reference to their salient features and their modes of life

1. *Amoeba*
2. *Entamoeba histolytica*
3. *Paramecium*
4. *Hydra* with bud
5. Sporocyst – Liver fluke
6. *Cercaria* larva
7. *Tape worm (Scolex)*
8. *Ascaris* T. S.
9. Mysis of prawn

2. VERTEBRATES

Virtual Dissection:

Video clippings of comparative study of Digestive system ,Arterial system, Venous system and Reproductive system of fish ,Frog ,Pigeon and Rat .

Dissection

Digestive system and Reproductive system of Fish.

Study the nervous system of Indian dog shark - Dissection

1. Nervous system of *Scoliodon laticaudatus* – 5^{th} or Trigeminal nerve
2. Nervous system of *Scoliodon laticaudatus* – 7^{th} or Facial nerve
3. Nervous system of *Scoliodon laticaudatus* – 9^{th} and 10^{th} or Glossopharyngeal & Vagus nerve

Mountings :

1. Placoid scale of shark
2. Ctenoid and Cycloid scales of Teleost Fish.
3. Brain of fish
4. Weberian ossicles of fish

Spotters:

Study of the following specimens with special reference to their salient features and their modes of life

1. *Amphioxus* sp. (Lancelet)
2. *Ascidia* sp. (sea squirt)
3. *Scoliodon laticaudatus* (Indian dog shark)
4. *Trygon* sp. (Sting ray)
5. *Torpedo* sp. (Electric ray)
6. *Arius maculatus* (Cat fish)
7. *Belone cancila*(Flute fish)
8. *Exocoetus poecilopterus* (Flying fish)
9. *Mugil cephalus* (Mullet)
10. *Tilapia mossambicus* (Tilapia)
11. *Rachycentron canadum* (Cobia)
12. *Tetrodon punctatus* (Puffer fish)
13. *Dendrophis* sp. (Tree snake)

Study of the frog skeleton system (Representative samples)

1. Entire skeleton
2. Skull
3. Hyoid apparatus
4. Pectoral girdle and sternum
5. Pelvic girdle
6. Fore limb
7. Hind limb

Text Books:

1. Lal, S.S. 2009. Practical Zoology, Rastogi Publications, pp-484.
2. Iuliis G. D. and D. Pulerà, 2007. The Dissection of Vertebrates: A Laboratory Manual. Academic Press, Imprint of Elsevier Publication, pp-416.
3. Verma, P.S. 2000. Manual of Practical Zoology: Chordates, S. Chand Publishing Company, pp-528

Reference Books:

1. Preeti, G., and C. Mridula, 2000. Modern Experimental Zoology, Indus International Publication.
2. Sinha, J., A. K. Chatterjeee, P. Chattopadhya. 2011. Advanced Practical Zoology, Arunabha Sen Publishers, pp-1070.

Expected Course Outcome:		
On the successful completion of the course, student will be able to**:**		
1.	Understand the structure and functions of various systems in animals	**K2 & K4**
2.	Learn the adaptive features of different groups of animals	**K1 & K2**
3.	Learn the mounting techniques	**K2 & K3**
4.	Acquire strong knowledge on the animal skeletal system	**K2 & K4**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Mapping of Course Outcomes with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	3	2	3	3	2	3	2	3
CO2	3	2	1	3	2	3	2	2	2	2
CO3	2	2	1	3	1	3	2	1	2	2
CO4	3	3	1	3	1	3	2	1	2	1
CO5	3	3	2	1	2	3	2	3	2	2

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated; 0 – No correlation

Semester	Course code	Title of the course	Hours of teaching / week	No. of Credits
I	**23P1ZOEL1A**	**Major Elective - I MOLECULES AND THEIR INTERACTION RELEVANT TO BIOLOGY**	**5**	**3**

Nature of the course

Relevant to Local need		Employability Oriented	√	Addresses Professional Ethics	√
Relevant to national need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to regional need		Skill development Oriented		Addresses Environment and Sustainability	
Relevant to Global need	√			Addresses Human Values	

Course Objectives:

The main objectives of this course are to:

- Understanding fundamental properties of elements, atoms, molecules, chemical bonds, linkages and structure, composition, metabolism and functions of biomolecules.
- To make the students aware various classes and major types of enzymes, classification, their mechanism of action and regulation
- To develop an idea regarding the fundamentals of biophysical chemistry and biochemistry, importance and applications of methods in conforming the structure of biopolymers
- To Comprehend the structural organization of and proteins, carbohydrates, nucleic acids and lipids
- To develop familiarization of biopolymer structures

Unit	Content	No. of Hours
I	**Basics of biophysical chemistry and biochemistry:** Structure of atoms, molecules and chemical bonds - Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).	15 Hrs
II	**Biomolecular interactions and their properties:** Stabilizing interactions (Vander Waals, electrostatic, hydrogen bonding, hydrophobic interaction, Stability, of protein and nucleic acid structure - Composition, structure of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).	15 Hrs
III	**Bioenergetics and enzymology:** Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers - Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isoenzymes	15 Hrs

IV	**Structural conformation of proteins and nucleic acids:** Conformation of proteins (Ramachandran plot, secondary, tertiary and quaternary structure; domains; motifs and folds) - Conformation of nucleic acids (A-, B-, Z-DNA), t-RNA, micro-RNA).	15 Hrs
V	**Metabolism of Biomolecules:** Metabolism and function of biomotecules – carbohydrates, liquids, proteins and nucleic acids	15 Hrs

Text Books

1. Berg, J. M., J. L. Tymoczko and L. Stryer 2002. Biochemistry. 5th Ed., W.H. Freeman & Co., New York, pp-1050.
2. Kuchel P.W. and G. B. Ralston. 2008. Biochemistry. McGraw Hill (India) Private Limited, UP, pp-580.
3. McKee T. and J. R. McKee. 2012. Biochemistry: The Molecular Basis of Life. (7th Edition). Oxford University Press, US, pp-793.
4. Nelson D.L. and M.M. Cox. 2012. Lehninger's Principles of Biochemistry. (6th Edition). W. H. Freeman Publishers, New York, pp-1158.
5. Satyanarayana U. and U. Chakrapani, 2006. Biochemistry. (3rd Edition). Books and Allied (P) Ltd. Calcutta, pp-695.

References

1. Buchanan, B.B., W. Gruissem and R.L. Jones. 2015. Biochemistry and Molecular Biology of Plants. John Wiley and Sons Ltd., UK, pp-1280.
2. Murray, R.K., D.K. Granner, P.A. Mayes and V.W. Rodwell. 2003. Harper's Illustrated Biochemistry (26th Edition), The McGraw-Hill Companies, Inc., USA, pp-704.
3. Palmer, T. 2004. Enzymes. Affiliated East-West Press Pvt. Ltd., New Delhi, pp-416.
4. Voet D. and J.G. Voet. 2011. Biochemistry. (4th Edition). John Wiley & Sons (Asia) Pvt. Ltd., pp-1428.

Web resources

- https://youtu.be/7naKUJshKTo
- https://www.youtube.com/watch?v=QEcAn24AEXY
- https://www.youtube.com/watch?v=EFvp2At8jhQ
- https://www.toppersnotes.com/wp-content/uploads/2021/02/1.CSIR-Life-science-sample-MOLECULES-THEIR-INERACTION-RELEVANT-TO-BIOLOGY.pdf
- http://aulanni.lecture.ub.ac.id/files/2012/01/15616949-Lehninger-Principles-of-Biochemistry-1-copy.pdf

Pedagogy: Teaching / Learning methods

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Cognitive Level
CO1	Learn the structure, properties, metabolism and bioenergetics of biomolecules	**K1 & K3**
CO2	Acquire knowledge on various classes and major types of enzymes, classification, their mechanism of action and regulation	**K1 & K2**
CO3	Understand the fundamentals of biophysical chemistry and biochemistry, importance and applications of methods in conforming the structure of biopolymers	**K2 & K3**
CO4	Comprehend the structural organization of and proteins, carbohydrates, nucleic acids and lipids	**K2 & K4**
CO5	Familiarize the use of methods for the identification, characterization and conformation of biopolymer structures	**K5 & K6**

Cognitive Level :K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;**K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	3	3	2	3
CO2	3	3	2	3	3	3	3	2	3	2
CO3	3	3	3	3	3	2	3	3	3	3
CO4	3	2	3	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3

3 - Strongly Correlated; 2 - Moderately Correlated;1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	**23P1ZOEL1B**	**Major Elective – I BIOCHEMISTRY**	**5**	**3**

Nature of the course

Relevant to Local need		Employability Oriented	√	Addresses Professional Ethics	
Relevant to national need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to regional need		Skill development Oriented	√	Addresses Environment and Sustainability	
Relevant to Global need	√			Addresses Human Values	√

Course Objectives

The main objectives of this course are to:

1. Familiarize with topics such as synthesis, classification, structure and properties of carbohydrates, lipids, proteins and enzymes.
2. Introduce the learner with basics of the genes that are responsible in various biochemical pathways with the chemical nature and properties of biomolecules.

Unit	Content	No. of Hours
I	**CHEMICAL FOUNDATIONS OF BIOLOGY** Structure and properties of atoms, molecules and chemical bonds. Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties). Isomerism: Types – structural and stereo isomerism with examples.	15
II	**INTERACTIONS OF BIOMOLECULES** Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.). Composition, nature of bonds/linkages, structure of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).	15
III	**ENZYMES AND BIOENERGETICS** Principles of catalysis, classification of enzymes and enzyme kinetics, enzyme regulation, inhibitors of enzymes - mechanism of enzyme catalysis, isozymes. Bioenergetics: transformation of energy in cell, ATP, Cellular respiration and photosynthesis. Glycolysis, oxidative phosphorylation, coupled reaction and biological energy transducers.	15

IV	**CONFORMATION OF BIOMOLECULES** Arrangement in space of its constituent atoms, over all shape of the molecule, bonding arrangement with in its structure. Proteins: (Ramachandran plot, primary, secondary, tertiary and quaternary structures, domains, motif and folds). Nucleic acids: (helix (A, B, Z), t-RNA, micro-RNA).	15
V	**STABILITY OF BIOMOLECULES** Stability of proteins and nucleic acids (DNA and RNA): formulation, understand the mechanism of instability and causes of degradation. Metabolism of amino acids (Glycogenic and Ketogenic), carbohydrates (Kreb's cycle, oxidative phosphorylation), lipids (energy production), nucleotides (Salvage pathways-three amino acid donor reaction).	15

Textbook:

1. Principles of Biochemistry by A.L.Lehninger, D.L.Nelson and M. M. Cox (2002), Worth publishers, New York.
2. Textbook of Medical Biochemistry Chatterjea M. N. (20019) Jaypee Brothers Medical Publishers.

References:

1. Ambika, S., "Fundamentals of Biochemistry for Medical Students", Seventh revised Edition. Nagaraj and Company Private Ltd., Chennai, 2006.
2. Principles of Biochemistry (4th edition) by Albert L. Lehninger, 2004. CBS Publishers and Distributors, New Delhi.
3. Biochemistry (8th edition) by LubertStryer, 2015. Co-written by Jeremy Berg, John L. Tymoczko and Gregory J. GattoJr and published by Palgrave Macmillan.
4. Biochemistry (4th edition) by D. Voet and J.G. Voet, 2010. John Wiley and Sons, USA Biochemistry, by R.H. Garrett and C.M. Grisham, Saunders College Publishers
5. Biochemistry by L.Stryer (2000) Freeman & Co. New York.
6. Biochemistry by G. Zubay (2004), MaacmillanPulishing Co. New York.
7. Harper's Biochemistry by R.K.Murray, P.a. Mayes, D.K. Granne and Vv.W. Rodwell (2002) Lanlge Medical Book.

Web resources:

1. https://swayam.gov.in/nd2_cec20_bt12/preview
2. https://swayam.gov.in/nd2_cec20_bt02/preview
3. https://nptel.ac.in/courses/102/105/102105034/

Pedagogy: Lecture, Assignment, PPT presentation, Group Discussion

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Cognitive Level
CO1	Get clear understanding about basic structure and function of biological macromolecules	**K2**
CO2	Distinguish the various advanced molecular and physiological mechanisms in human being.	**K2**
CO3	Distinguish the different processing mechanism of macromolecules in our system and how energy generation and transformations occurs.	**K2**
CO4	Apply the knowledge of the acid-bases role, electrolyte balances, and osmolality regulation in our system and its associated diseases diagnosis.	**K3**
CO5	Distinguish different enzymes types its clinical significance and advancements.	**K2**

Cognitive Level :K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	3	3	2	3
CO2	3	2	3	1	3	3	3
CO3	3	3	2	3	2	3	2
CO4	3	2	3	2	2	2	2
CO5	2	3	3	3	2	2	3

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated;
0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	**23P1ZOEL2A**	**Major Elective II – BIOSTATISTICS**	**5**	**3**

Nature of the Course

Relevant to Local need		Employability Oriented		Addresses Professional Ethics	√
Relevant to national need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to regional need		Skill development Oriented	√	Addresses Environment and Sustainability	
Relevant to Global need	√			Addresses Human Values	

Course Objectives:

The main objectives of this course are to:	
1	Students should know basic concepts in Biostatistics.
2	Students should be aware of importance of analysis of quantitative and qualitative information from biological studies.
3	Students to enhance the ability of learners to apply the knowledge and skill acquired by them to solve specific theoretical and applied problems in statistics.
4	To understand Indian official statistical system and data collection
5	Knowledge on the merits and limitation of practical problems in biological statistical methods

Unit	Content	No. of Hours
I	**Definition, scope and application of statistics;** Primary and secondary data: Source and implications; Classification and tabulation of biological data: Types and applications. Variables: Definition and types. Frequency distribution: Construction of frequency, distribution table for grouped data; Diagrammatic representation: Histogram, bar diagram, pictogram and pie chart.	**15 Hrs**
II	**Measures of central tendency:** Mean, median and mode for continuous and discontinuous variables. Measures of dispersion: Standard deviation, Standard error and Coefficient of variation.	**15 Hrs**
III	**Probability:** Theories and rules; Probability - Addition and multiplication theorem; Probability distribution: Properties and application of Normal, Binomial and Poisson distributions.	**15 Hrs**

IV	**Hypothesis testing:** Student'*t*' test - paired sample and mean difference'*t*' tests. Correlation: Types - Karl Pearsons Co-efficient, Rank correlation, Significance test for correlation coefficients. Regression analysis: Computation of biological data, calculation of regression co-efficient, graphical representation and prediction.	**15 Hrs**
V	**Analysis of variance:** one way and two way classification. Data analysis with comprehensive statistical software using Statistical Package for the Social Sciences (SPSS).	**15 Hrs**

Text Books:

1. Arora, P. N. and P. K. Malhan. 1996. Biostatistics, Himalaya Publishing House, Mumbai, pp-447.
2. Gurumani, N. 2005. Introduction to Biostatistics, M.J.P. Publishers, Delhi, pp-407.
3. Das, D. and A. Das. 2004. Academic Statistics in Biology and Psychology, Academic Publisher, Kolkata, pp-363.
4. Palanichamy, S. and Manoharan, M. 1990. Statistical Methods for Biologists, Palani Paramount Publications, Tamil Nadu, pp-264.

References Books:

1. Bailey, N. T. J. 1959. Statistical in Biology, English Universities Press, London, pp-48.
2. Sokal, R. R. and F. J. Rohlf, 1973. Introduction to Biostatistics, W.H. Freeman, London, pp-467.
3. Sokal, R.R. and F.J. Rohlf. 1981. Biometry: The principles and practice of statistics in biological research, San Francisco: W.H. Freeman, London, pp-859.
4. Zar, J.H. 1998. Biostatistical Analysis, Pearson Education (Singapore) Pvt. Ltd., Delhi, India, pp-660.
5. Bailey, N. T. J. 1994. Statistical Methods in Biology (Third Edition), Cambridge University Press, Cambridge, pp-255.
6. Wayne W. Daniel. Biostatistics: A Foundation for Analysis in the Health Sciences, John Wiley & Sons Inc, USA, pp-443.
7. Snedecor, G. W. and W. G. Cochran. 1967. Statistical Methods (Sixth Edition), Oxford & IBH Publishing Co., New Delhi, pp-593.
8. Pagano, M. and K. Gauvreau. 2008. Principles of Biostatistics (Second Edition), Cengage Learning, New Delhi, pp-525.

Web-resources:

1. http://fisher.stats.uwo.ca/faculty/kulperger/SS3858/Handouts/np-lemma.pdf
2. https://www.sciencedirect.com/topics/mathematics/uniformly-most-powerful-test
3. https://www.probabilitycourse.com/chapter8/8_4_5_likelihood_ratio_tests.php
4. https://www.statisticshowto.com/probability-and-statistics/statistics-definitions/parametric-and-non-parametric-data/

Pedagogy: Lecture, PPT presentation, Group Discussion

Course Outcomes:

On the successful completion of this course, students will be able to:

CO No.	CO Statement	CO Cognitive level
CO1	Clear understanding of design and application of biostatistics relevant to experimental and population studies.	**K2 & K3**
CO2	Acquired skills to perform various statistical analyses using modern statistical techniques and software.	**K3 & K4**
CO3	Knowledge on the merits and limitation of practical problems in biological study as well as to propose and implement appropriate statistical design/ methods of analysis.	**K5 & K6**
CO4	understand sampling distributions and its applications in real life	**K3 & K4**
CO5	Clear understanding of design and application of biostatistics relevant to biological studies.	**K2 & K3**

Cognitive Level: K1 - Remember; K2 - Understanding; K3 - Apply; K4 - Analyze;K5 – Evaluate; K6 – Create

Mapping of Course Outcomes with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	1	2	3	3	2	3	2	2
CO2	3	3	3	3	3	3	3	3	3	3
CO3	2	3	3	3	3	3	3	3	3	1
CO4	2	2	3	1	2	2	2	3	1	2
CO5	2	2	3	1	2	3	2	L	3	2

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated;
0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	23P1ZOEL2B	**Major Elective- II NANOTECHNOLOGY**	5	3

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to national need	√	Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives:

The main objectives of this course are:

1. To impart knowledge on the principles and background to nanotechnology .
2. To make students understand the classification and synthesis methods of nanostructured materials.
3. To make them gain knowledge on the principles and Characterization Techniques.
4. To detail the applications of nanomaterials in biological systems.

Unit	Content	No. of Hours
I	**Introduction to Nanotechnology** Principles of Nanobiotechnology; History of nanotechnology; Scope of nanotechnology; Classification of Nanomaterials; Properties of Nanomaterials; Surface to volume ratio; An overview of applications of nanomaterials.	15
II	**Synthesis of Nanomaterials** Top-down techniques- Ball milling; Combustion synthesis; Nanolithography; Photolithography; Electron beam lithography; Bottom-up techniques - Soft chemical method ; Sol-gel method.	15
III	**Fullerenes** Carbon nanotubes - Types of Carbon nanotubes - Single walled carbon nanotubes and Multi walled carbon nanotubes; Synthesis of Carbon nanotubes- Plasma arc-discharge method; Properties of Carbon nanotubes and biological applications.	15
IV	**Analytical equipments** Surface morphology-Scanning Electron Microscope(SEM); Scanning TunnelingMicroscope(STM) ;Transmission Electron Microscope(TEM) - Atomic force microscope (AFM); Compositional analysis- Energy Dispersive X-ray Analysis(EDAX); Fourier Transform Infrared spectroscopy(FTIR); Optical characterization-UV-vis-NIR double beam spectrophotometer.	15
V	**Biomedical applications** Targeted drug delivery; Cancer therapy-Targeted chemotherapy; Radiation therapy; Thermotherapy; Immunotherapy; Gene therapy; Tissue engineering; Biosensing and Bioimaging.	15

Textbook:

1. K. Ravichandran, K. Swaminathan, P.K. Praseetha and P. Kavitha (2019) Introduction to Nanotechnology, JAZYM Publications.
2. N.Yao and Zhong Lin Wang (2005) Handbook of Microscopy for Nanotechnology Kluwer Academic Publishers.
3. Murthy Raj, Shankar, Rath, Murd (2012) Text book of Nanoscience and Nanotechnology, Orient Blackswan Pvt. Ltd., New Delhi.

References:

1. ClaupdioNicolini (2009) Nanobiotechnology&Nanobiosciences Pan Stanford Publishing Pte. Ltd.
2. O.Skoseyov, Ilan levy (2008) Nanobiotechnology – BioInspired Devices and Materials of the Future, Humana Press Inc.
3. ChattopadhyayK. K., Banerjee (2009) Indroduction to Nanoscinece and Nanotechnology, Prentice Hall India Pvt. Ltd.

Web resources:

1. https://ec.europa.eu/health/scientific_committees/opinions_layman/en/nanotechnologies/l-3/1-introduction.htm#:~:text=Nanotechnology%20is%20the%20term%20given,%2C%20structures%2C%20devices%20and%20systems.
2. https://www.nanowerk.com/nanotechnology/introduction/introduction_to_nanotechnology_1.php
3. https://ccsuniversity.ac.in/bridge-library/pdf/L-3%20Synthesis%20of%20Nanostructured%20Materials%20Prof%20BPS.pdf
4. https://byjus.com/chemistry/carbon-nanotubes/
5. https://web.stanford.edu/group/mota/education/Physics%2087N%20Final%20Projects/Beta_Nanoparticles.ppt

Pedagogy::Teaching / Learning methods, Assignment, PPT presentation, Seminar, Group discussion

Course Outcomes:

On the successful completion of the course, students will be able to:

CO Number	CO Statement	Cognitive Level
CO1	understand the core concepts and principles of nanotechnology to meet global challenges.	**K2**
CO2	Familiar with the potential uses of nanomaterials in everyday life.	**K2 K4**
CO3	understand growing demand and the need to literate and motivate young generation towards the field of nanotechnology.	**K4 k5**
CO4	acquire knowledge to find lucrative career opportunity in health care industry	**K5**
CO5	pursue research on topics related to nanotechnology in collaboration with research institutes as well as industries.	**K4 K5**

Cognitive Level: K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;**K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes

	Mapping with Programme Outcomes*									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	3	2	3	3	2	3	3	1
CO2	3	2	3	3	2	3	3	3	2	3
CO3	2	3	3	3	3	2	3	3	2	3
CO4	3	3	2	3	3	3	1	3	3	3
CO5	3	2	3	3	3	2	3	3	2	3

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Title of the Course	Hours of Teaching / Week	No. of Credits
I	**23P1ZOSEC1**	**SKILL ENHANCEMENT COURSE - POULTRY FARMING**	**2**	**2**

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to national need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives:

The main objectives of this course are:

Students should know basic concepts in Poultry farming

SYLLABUS		
UNIT	**Content**	**No. of hours**
I	General introduction to poultry farming - Definition of Poultry - Principles of poultry housing - Poultry houses - Management of chicks - growers and layers - Management of Broilers. Poultry industry in India. Preparation of project report for banking and insurance.	15 Hrs
II	Poultry feed management-Principles of feeding, Nutrient requirements for different stages of layers and broilers - Feed formulation and Methods of feeding - Poultry diseases-viral, bacterial, fungal and protozoan; symptoms, control and management. Recycling of poultry waste.	15 Hrs

Text Books:-

1. Sreenivasaiah., P. V., 2015. Textbook of Poultry Science.1st Edition. Write & Print Publications, New Delhi 2.
2. Jull A. Morley, 2007. Successful Poultry Management.2nd Edition. Biotech Books, New Delhi"
3. Hurd M. Louis, 2003. Modern Poultry Farming.1st Edition. International Book Distributing Company, Lucknow."

Reference Books:

1. Jadhav, N.V. and Siddiqui, M.F. 2007. *Handbook of Poultry Production and Management,* 2nd Edn, New Delhi.

Web Resource:

2. http://www.asci-india.com/BooksPDF/Small%20Poultry%20Farmer.pdf
3. https://nsdcindia.org/sites/default/files/MC_AGR-Q4306_Small-poultry-farmer-.pdf
4. http://ecoursesonline.iasri.res.in/course/view.php?id=335
5. https://swayam.gov.in/nd2_nou19_ag09/preview

Expected Course Outcome:		
Upon completion of this course, Students would have		
I	To understand the various practices in Poultry farming. To know the needs for Poultry farming and the status of India in global market.	**K2 & K3**
II	To be able to apply the techniques and practices needed or Poultry farming.	**K1, K2 & K3**
III	To know the difficulties in Poultry farming and be able to propose plans against it.	**K5 & K6**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	1	1	1	1	1	3	3	1	1
CO2	3	1	2	2	3	2	2	2	3	3
CO3	3	2	2	2	3	3	3	3	2	2
CO4	3	3	3	1	3	3	3	3	3	3
CO5	3	3	2	3	3	3	2	1	3	2

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated;
0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	**23P1ZOAECC1**	**Ability Enhancement Compulsory Course - Communicative Skill And Personality Development**	**2**	**2**

Nature of the course

Employability Oriented	√	Relevant to Local need	√	Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to national need	√	Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to regional need	√	Addresses Human Values	√
		Relevant to Global development need	√	Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are to:

1. Cultivate positive personality traits for successful life.
2. Groom Winning Attitude among the learners.
3. Assist the learners to identify their own potential and realize their aspirations.
4. Enable a holistic development.
5. Facilitate optimum means of improving personal performance.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	Personality- Definition. Determinants of Personality. Personality Traits. Developing Effective Habits. Self Esteem (Freud and Erikson). Dos and Don'ts to develop positive self esteem. Interpersonal Relationship. Projecting Positive Body Language.	15
II	Presentation Skills – Opening, ending, Handling nerves, Handling audience, Power of Story telling, Visual aids, Question and answer session. Conflict Management. Change Management. Stress Management. Time Management. Decision Making Skills. Leadership Qualities of a Successful Leader. Attitudes – Positive Attitudes.	15

Textbook:

1. Andrews, Sudhir. *How to Succeed at Interviews*. 21st (rep) New Delhi:Tata McGrew Hill 1988.
2. Hurlock.E.B (2006) :*Personality Development*, 28th Reprint. New Delhi: Tata McCraw Hill.
3. Kumar, Pravesh.*All about Self Motivation*. New Delhi:Goodwill Publication House. 2005**.**
4. Preston,David Lawrence.*365 Steps to Self-Confidence*. Mumbai: Jaico Publishers, 2007
5. Stephen.P.Robbins and Timothy. A.Judge: *Organisation Behaviour.*16thEdition.Prentice Hall. 2014

References:

1. Grellet ,Françoise. *Developing Reading Skills*. Cambridge: Cambridge University Press, 2007.
2. Kristine, Brown and Susan Hood.*Academic Encounters Life in Society Reading, Study Skills, Writing*. , New Delhi:Cambridge University Press,2010.
3. Little ,Graham R .*Operations Team Leadership*. Mumbai :Jaico Publishers, 2006.
4. Nurnberg ,Maxwell and Morris Rosenblum *How to Build a Better Vocabulary*. New York :Warner Books, 1989.
5. O' Connell ,Sue with LousieHashemi.*Cambridge First Certificate: Listening and Speaking* –, Cambridge University Press, Cambridge, 2000.
6. Pfeifer , William Sanborn and T.V.S.Padmaja*Technical Communication : A Practical Approach,* (Sixth edition) New Delhi: Pearson, 2006.
7. Withrow, Jean, Gay Brookers and Martha Cumings .*Inspired to Write*. New York: Cambridge University Press, 2004.

Web resources:

https://www.managementstudyguide.com/personality-development.htm
https://www.artofliving.org/in-en/personality-development
https://study.com/academy/lesson/what-is-conflict-management-definition-styles-strategies.html
https://www.hays.com.au/career-advice/upskilling/soft-skills
https://www.skillsyouneed.com/presentation-skills.html

Pedagogy: Teaching / Learning methods

Lecture, Tutorial, Assignment, PPT presentation, Group Discussion, e-content, Seminar, Tasks, Role play, Debate, Group Activities etc.

Course Out comes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Cognitive Level
CO1	understand the significance of developing progressive and positive personality	**K1,K2**
CO2	Gain self-confidence and broaden perception of life.	**K3**
CO3	Maximize their potential and steer that into their career choice.	**K4**
CO4	Enhance one's self image and self-esteem.	**K3, K5**
CO5	Find a means to achieve excellence and derive fulfillment.	**K6**

Cognitive Level:K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3

3 - Strongly Correlated; 2 - Moderately Correlated;
1 - Weakly Correlated;0 – No correlation

Semester	Course Code	Title of the Course	Hours of Teaching/ Week	No. of Credits
II	**23P2ZOC3**	**CELL AND MOLECULAR BIOLOGY**	**5**	**4**

Nature of the course

Relevant to Local need		Employability Oriented	√	Addresses Professional Ethics	
Relevant to national need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to regional need		Skill development Oriented		Addresses Environment and Sustainability	√
Relevant to Global need	√			Addresses Human Values	

Course Objectives:	
The main objectives of this course are:	
1	To understand the ultra-structures and functions of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.
2	To realize involvement of various cellular components in accomplishing cell division.
3	To enable a successful performance in cell biology component of CSIR-UGC NET.
4	To understand the ultra structures and functions of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.

Units	Contents	Hrs
I	**General features of the cell:** Basic structure of prokaryotic and eukaryotic cells - Protoplasm and deutroplasm - cell organelles; cell theory; Diversity of cell size and shapes.	**15 Hrs**
II	**Cellular organization:** Membrane structure and functions - Structure of model membrane, lipid bilayer and membrane proteins diffusion, osmosis, ion channels, active transport, ion pumps, mechanism and regulation of intracellular transport, electrical properties of membranes. Structure and functions of Intracellular organelles: Nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids and vacuoles.	**15 Hrs**
III	**Cell division and Cell cycle:** Mitosis and meiosis, their regulation, steps in cell cycle and control of cell cycle. **Molecular biology of cell:** Structure of DNA and RNA; Process of DNA replication, transcription and translation in pro- and eukaryotic cells; Genetic maps.	**15 Hrs**

IV	**Cell communication and cell signaling:** Membrane- associated receptors for peptide and steroid hormones - signaling through G-protein coupled receptors, signal transduction pathways. General principles of cell communication: extracellular space and matrix, interaction of cells with other cells and non-cellular structures.	**15 Hrs**
V	**Cancer cells:** Characteristic features of normal and cancer cells; Carcinogens: types and cancer induction; Metastasis; Oncogenes and tumour suppressor genes, apoptosis; therapeutic interventions of uncontrolled cell growth.	**15 Hrs**

Text Books :

1. Manjot Kaur, (2022) A Text Book Of Cell And Molecular Biology, PV publication, New delhi,
2. Arumugam.N., Cell Biology and Molecular Biology, Saras publication,2021
3. Vyas ,(2019) .Cell And Molecular Biology CBS Publishers
4. Rastogi S.C, (2010)Cell and Molecular Biology , new age publishers III edition

Reference Books :

1. De Robertis, R.O.P and De. Robertis, E.M.F. (1980) Cell and Molecular Biology, Holt Saunders imitational Edition. Japan.
2. DePraw, E.L (1960) Cell and Molecular Biology, Academic Press, New York.
3. Gieses, A.C. (1957) Cell Physiology, W.E. Saunders Co., Threadgold, L.T. (1975). The ultra-structure of the animal cell, Pergmann Press, New York.
4. BrudeAlberts, Bennis – bray Lewis, Martin Raff Kiety – Roverts and James D.Wastern (1963). Molecular Biology of the cell, Garland Publishing Inc, New York and London.
5. Lohar P.S (2021) Cell and Molecular Biology, MJP Publishers.
6. Iwasa J, Marshall W and Karp G (2020), Cell and Molecular Biology, Wiley.
7. Latchman D.S (2008) ,Eukaryotic Transcription Factors , Elsevier Science
8. Raff M and Alberts B (2019) ,Essentials Cell Biology ,W W Norton.
9. Clark D P and Pazdernik N J (2013), Molecular Biology, Elsevier Science.
10. Priyadarshini A and Pandey P (2021) Molecular Biology, Taylor and Francis Limited.
11. Allison L.A (2021) Fundamentals of Molecular Biology, Taylor and Francis Limited.

Web Link:

http://www.lifesciences.nus.edu.sg/modules/lsm/LSM1106.pdf (NUS)

Pedagogy: Lecture, Assignment, PPT

Course Outcome:		
On the successful completion of this course, students will be able to:		
1.	Understand the general concepts of cell and molecular biology.	**K2**
2.	Visualize the basic molecular processes in prokaryotic and eukaryotic cells, especially relevance of molecular and cellular structures influencing functional features.	**K1 & K2**
3.	Perceive the importance of physical and chemical signals at the molecular level resulting in modulation of response of cellular responses.	**K3 & K4**
4.	Updated the knowledge on the rapid advances in cell and molecular biology for a better understanding of onset of various diseases including cancer.	**K5**
5.	Understand the general concepts of cell and molecular biology.	**K2**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Mapping of Course Outcomes with Programme Outcomes:										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO 6**	**PO 7**	**PO 8**	**PO9**	**PO1 0**
CO1	1	1	1	1	3	3	3	2	2	2
CO2	2	2	2	3	3	3	3	2	3	2
CO3	3	3	3	2	2	3	2	2	1	3
CO4	2	2	3	1	3	3	1	2	3	3
CO5	3	2	2	2	3	3	3	2	3	3

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated;
0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No.of Credits
II	**23P2ZOC4**	**DEVELOPMENTAL BIOLOGY**	**5**	**4**

Nature of the course

Relevant to Local need		Employability Oriented	√	Addresses Professional Ethics	
Relevant to national need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to regional need		Skill development Oriented	√	Addresses Environment and Sustainability	
Relevant to Global need	√			Addresses Human Values	√

Course Objectives:	
The main objectives of this course are:	
1.	Understand the process of gametogenesis, cleavage and gastrulation, embryonic development, extra embryonic membrane and placenta in various animals and human.
2.	Learn the principles, methods and applications of cryo-preservation of gametes and embryo.
3.	Understand the organogenesis related to mechanisms of development and differentiation.
4.	Understand the metamorphosis, regeneration and placenta in various animals
5.	Acquire students with knowledge about the role of hormones andreproductive technology.

Unit	Content	No. of Hours
I	**Pattern of animal development and Gametogenesis** Scope of Embryology -History of thoughts and Chief events in animal development . Gametogenesis: Origin of germ cells, spermatogenesis - Sperm morphology in relation to the type of fertilization, Oogenesis - Oogenesis in insects and amphibians; Composition and synthesis of yolk in invertebrates (insects and crustaceans) and vertebrates. polarity and symmetry of an egg. and organization of egg cytoplasm.	15
II	**Fertilization:** Sperm aggregation, Sperm activation, Chemotaxis, Sperm maturation and capacitaion in mammals, Acrosome reaction. Sperm – egg interaction. Sperm entry into the egg - Egg activation - Cortical reaction - Physiological polyspermy - Fusion of male and female pronuclei - Post fertilization metabolic activation - Parthenogenesis.	15
III	**Cleavage and Gastrulation** Cleavage; blastula formation-Pattern of embryonic cleavage, mechanisms of cleavage. Gastrulation; Determinate and regulatory embryos, Factors affecting gastrulation, mechanisms and types of gastrulation in respective	15

	animal embryos (Sea urchin, *Amphioxus*, Amphibians, Aves and Mammals); Activity of gene during gastrulation-Fate maps - (Amphibian and Chick),Formation of primary germ layers.	
IV	**Embryonic Development and Organogenesis :** Embryonic development of fish and birds ; formation of extra embryonic membranes in mammals – Organogenesis -development of Ectodermal (eye in frog), Mesodermal (kidney in frog)and Endodermal derivatives (Intestine in frog) Embryonic Induction and neurulation; - types of neural crest cells and their patterning - primary and secondary neurulation. Gene and development; Anterior- posterior axis in determination in drosophila, Maternal effect genes - *Bicoid* and *Nanos* proteins; Genetic control of segmentation – Gap genes; pair rule genes; Homeotic genes.	15
V	**Metamorphosis , Regeneration and Reproductive technology :** Metamorphosis: Endocrine control of metamorphosis in insect and amphibian - Neoteny and pedogenesis. Regeneration ; Types of regeneration in planaria -Regenerative ability in different animal groups, Factors stimulating regeneration – Aging and senescences: Biology of senescences- cause of aging- mechanism involved in apoptosis. Experimental Embryology : Mammalian reproductive cycle, Hormones regulation in sexual cycles in mammals, Endocrine changes associated with normal pregnancy - Induced ovulation in humans – Cryopreservation of gametes - Ethical issues in cryopreservation.	15

Text Books:

1. Verma, P.S. And Agarwal V.K. 2018. Chordate Embryology (Developmental Biology) S. Chand&Company Ltd., New Delhi.
2. Arumugam.N. 2021. Developmental Biology, Saras Publications Nagarcoil.

References :

1. Balinsky BI and Fabian BC. (2012). *An Introduction to Embryology*, 5th edition, CBS College Publishers, Cengage Learning India Pvt. Ltd. New Delhi.
2. Gilbert. S. F. 2010. Developmental Biology, 8th Edition, INC Publishers, USA, pp-785.
3. Berrill, N.J. 1974. Developmental Biology, Tata Mc-Graw Hill Publications, New Delhi, pp-535.
4. Tyler, M.S. 2000. Developmental Biology - A Guide for Experimental Study, Sunderland, MA, pp-208.
5. Subramoniam, T. 2011. Molecular Developmental Biology (2nd Edition), Narosa Publishers, India, pp-364.
6. .Rastogi, V.B and Jayaraj, M.S. 2015. Developmental Biology Kedar Nath Ram Nath, Meerut.
7. 6.Twymann, R.M. 2003. Developmental Biology. Viva Books Private Ltd., New Delhi.

Web resources :

1. www.easybiologyclass.com › developmental-biology-e
2. www.studocu.com › document › lecture-notes › view
3. *ocw.mit.edu* › courses › 7-22-developmental-biology-f.
4. https://www.ncbi.nlm.nih.gov/books/NBK225682/
5. https://www.pnas.org/doi/10.1073/pnas.0806007105

Pedagogy: Lecture, Assignment, PPT presentation ,Group discussion.

Expected Course Outcomes:		
On the successful completion of the course, student will be able to		
1.	Define the concepts of embryonic development	**K1**
2.	Observe various stages of cell divisions under microscope	**K2 & K3**
3.	Understand the formation of zygote	**K4**
4.	Differentiate the blastula and gastrula stages	**K4 & K5**
5.	Learn the distinguishing features of three different germ layers and formation of various tissues and organs	**K4**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

mapping of course outcomes with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	2	3	3	1	3	2	1	2
CO2	3	3	3	3	3	1	3	3	3	3
CO3	3	2	3	3	3	3	3	1	1	2
CO4	3	3	3	3	3	2	3	3	3	1
CO5	3	3	3	2	3	3	3	1	1	2

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Title of the Course	Hours of Teaching / Week	No. of Credits
II	**23P2ZOCP2**	**PRACTICAL-II- CELL AND MOLECULAR BIOLOGY AND DEVELOPMENTAL BIOLOGY**	**6**	**4**

Nature of the course

Relevant to Local need		Employability Oriented	√	Addresses Professional Ethics	
Relevant to national need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to regional need		Skill development Oriented		Addresses Environment and Sustainability	√
Relevant to Global need	√			Addresses Human Values	

COURSE OBJECTIVES:

The main objectives of this course are:	
1.	Practical course aims at demonstrating significant cellular and molecular biological principles, quantitative and analytical approaches that enable the students to translate the theoretical foundation in cell biology and developmental biology into practical understanding

CELL AND MOLECULAR BIOLOGY

1. Determination of cell size using micrometer
2. Mitosis in root meristematic cells of plants
3. Identification of various stages of meiosis in the testes of grasshopper
4. Detection of polytene chromosome in salivary gland cells of the larvae of the Chironomus
5. Detection of sex chromatin
6. Identification of blood cells in the haemolymph of the of the cockroach
7. Isolation of genomic DNA from eukaryotic tissue
8. Isolation of total RNA from bacterial cells/tissues
9. Agarose gel electrophoresis of DNA
10. SDS-Polyacrylamide gel electrophoresis

DEVELOPMENTAL BIOLOGY

Gametogenesis - Observation of gametes from gonadal tissue sections

i. Oogenesis:
   - ✓ Section through ovary of shrimp and fish

ii Spermatogenesis:
   - ✓ Section through testis of shrimp and fish

Fertilization

iii Induced spawning in polycheate worm *Hydroids elegans*

iv *In vitro* fertilization and development in a polycheate worm *Hydroids elegans*

v Observation of egg developmental stages in *Emerita emeritus*

Embryogenesis

vi Observation and whole mount preparation of the chick blastoderm - 18 hours of development

vii Chick embryonic stage - 24 hours of development

viii Chick embryonic stage - 48 hours of development
ix Chick embryonic stage - 72 hours of development
x Chick embryonic stage - 96 hours of development

Histological preparation: Mounting of invertebrate carvae, developmental stages of chick, tissues sections of fish.

Experimental Embryology:
Regeneration in Frog Tadpoles
xi Blastema formation
xii Demonstration of regenerative process in tadpole

Metamorphosis:
xiii Demonstration of metamorphosis in Frog Tadpole using exogenous Iodine
Cryopreservation
xiv Demonstration of cryopreservation of gametes of fin fish/shell fish

Course Outcome:		
Upon completion of this lab course, students		
1.	Acquire knowledge to differentiate the cells of various living organisms and become awares of physiological processes of cells e.g. cell divisions, various stages of fertilization and embryo development.	**K2**
2.	Understand and observe as well as correctly identify different cell types, cellular structures using different microscopic techniques.	**K3**
3.	Develop handling - skills through the wet-lab course.	**K6**
4.	Learn the method of culturing of *Drosophila* and identification of their wild and mutant strains	**K1 & K2**
5.	Acquire skills to perform human karyotyping and chromosome mapping to identify abnormalities	**K1 & K2**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	3	3	3	3	3	1	1	2
CO2	3	3	3	3	3	2	2	2	2	2
CO3	3	3	2	3	3	1	3	2	1	2
CO4	2	2	1	2	1	2	2	3	2	1
CO5	3	3	2	1	3	2	1	3	3	3

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	**23P2ZOEL3A**	**Major Elective- III Economic Entomology**	**5**	**3**

Nature of the course

Relevant to Local need	√	Employability Oriented	√	Addresses Professional Ethics	
Relevant to national need	√	Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to regional need	√	Skill development Oriented		Addresses Environment and Sustainability	
Relevant to Global need	√			Addresses Human Values	√

Course Objectives

The main objectives of this course are to:

The students with a basic background in biological sciences with a special emphasis on the study of insects including systematic, beneficial insects, destructive insects, integrated pest management and insects of medical and veterinary importance.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**Overview of insects and insect taxonomy:** Insects and their biological success - Man and insects; Basic concepts in Insect Taxonomy and classification.	15
II	**Beneficial insects:** Silkworms - types, life history, disease management and rearing methods - Types of honey bees, life history, social organization (colonies and caste system), honey bee care and management of bee hive - Lac insects-life history, lac cultivation; Pollinators, predators, parasitoids, scavengers, weed killers, soil-builders.	15
III	**Destructive insects:** Insect pests - definition - Categories of pests - Types of damage to plants by insects - Causes of pest outbreak - Economic threshold level - Biology of the insect pests - Pests of paddy, cotton, sugarcane, vegetables, coconut and stored grains cereals.	15
IV	**Pest management/Control strategies:** Methods and principles of pest control - Natural control, Artificial control, Merits and demerits or limitations of these methods in pest control - Development and uses of pest resistant plant varieties - Integrated pest management - Concepts and practice.	15
V	**Vector biology:** Vectors of veterinary and public health importance - Mosquitoes as potential vectors of human diseases-control measures	15

Textbook:

1. Ayyar, L.V. R. 1936. Hand book of Economic Entomology for South India. Narendra Publishing House. New Delhi, pp- 528.
2. Vasantharaj David, B. and V.V. Ramamurthy. 2016. Elements of Economic Entomology, Eighth Edition, Brillion Publishing, New York, pp-400.
3. Ross. H.H. 1965. A Text Book of Entomology, John Wiley & Sons Inc., New York, pp-746.

References:

1. Chapman, R.F., S.J. Simpsonand A.E.Douglas. 2012. The Insects: Structure and Function, Fifth Edition, Cambridge University Press, pp-959.
2. Imms, A.D., O.W.Richards andR.G. Davies (Eds.)IMMS' General Textbook of Entomology, Volume I: Structure, Physiology and Development, pp-418; Volume 2: Classification and Biology, pp-934, Springer Netherlands.
3. Daly, H.V., J.T. Doyen and P.R. Ehrlich. 1978. Introduction to Insect Biology and Diversity. Mc Graw-Hill Kogakusha Ltd., Tokyo, pp-564.
4. Hill, D.S. 1974. Agricultural Insect Pests of the Tropics and Their Control. Cambridge University Press, New York, pp-746.
5. Krishnaswami, S. 1973. Sericulture Manual, Vol. I & II, Silkworm rearing, FAO Agricultural Science Bulletin, Rome.
6. Mani, M.S. 1982. General Entomology. Oxoford & IBH Publishing Co., pp-912.
7. Wigglesworth, V.B. 1972. The Principles of Insect Physiology, ELBS & Chapman and Hall, London, pp-827.

Web resources:

Pedagogy: Teaching / Learning methods

Lecture, PPT presentation, Group Discussion

(Please mention teaching / Learning methods like Lecture, Tutorial, Assignment,PPT presentation, Quiz, Group Discussion, e-content Seminar etc.)

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Cognitive Level
CO1	Understand taxonomy, classification and life of insects in the animal kingdom.	
CO2	Know the life cycle, rearing and management of diseases of beneficial insects.	
CO3	Know the type of harmful insects, life cycle, damage potential and management of pests including natural pest control	
CO4	Recognize insects which act as vectors causing diseases in animals and human.	
CO5	Overall understanding on the importance of insects in human life.	

Cognitive Level :K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of course outcome with Programme Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3							
CO 2	2	3						
CO 3				3		3		
CO 4				3	3	2		
CO 5			3					3

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	**23P2ZOEL3B**	**Major Elective – III** **GENERAL AND APPLIED ENTOMOLOGY**	**5**	**3**

Nature of the course

Relevant to Local need		Employability Oriented	√	Addresses Professional Ethics	√
Relevant to national need	√	Entrepreneurship Oriented	√	Addresses Gender Sensitization	
Relevant to regional need		Skill development Oriented	√	Addresses Environment and Sustainability	√
Relevant to Global need	√			Addresses Human Values	√

Course Objectives

3. Define applied entomology and classify insects
4. To study of insect morphology and physiology
5. Understand the agriculture and medical pest of various crops such paddy, cotton and food grains. Medical vectors disease causes and control measures.
6. Provide knowledge on sericulture, apiculture and lac culture for the economic important insect's culture and uses.

SYLLABUS

Unit	Content	No. of Hours
I	**INSECT TAXONOMY** General characters of class insect, Classification of insects up to orders with common South Indian examples – Bionomics of Aptergotes - Orthoptera, Diptera, Hemiptera, Coleoptera and Hymenoptera.	**18 Hrs**
II	**INSECT MORPHOLOGY** General structure of insect head, thorax and abdomen. Head-segmentation, sutures and types of antennae. Mouthparts, Wings, legs - types and external genitalia of insects.	**18 Hrs**
III	**INSECT PHYSIOLOGY** Structure and physiology of circulatory, respiratory, digestive, nervous, excretory and reproductive systems of insects. Insect hormones and metamorphosis - pheromones.	**18 Hrs**

IV	**AGRICULTURE AND MEDICAL ENTOMOLOGY** Biology and control method of any five insect pest of paddy, cotton. Stored products pests and their control. common fruit and vegetables Integrated Pest management (IPM) mechanical, chemical, biological control. Important vectors pest of - mosquitoes, flea and houseflies.	**18 Hrs**
V	**ECONOMIC IMPORTANCE OF INSECT** Sericulture: Biology and culture methods – types of silkworm – silkworm diseases – economics and marketing. Apiculture: Biology and types of honey bees – culture and rearing- medical uses of Honey. Lac culture: Biology and rearing methods of Lac insect - Uses of Lac.	**18 Hrs**

Textbook:

3. Chapman, R.F. The Insects: Structure and Function, Hodder and Bhoughton Ltd., Kent, U.S.A., 2015.
4. Jawetz Melnick & Adelbergs Medical Microbiology – 27 Edition (2015).
5. Nalina Sundari, M.S., and R. Santhi, Entomology, MJP Publishers, Chennai. 2006.
6. Fundamentals of Entomology by Richard J. Elzinga, 2003, Pearson.

References:

1. David B. V & Ananthkrishnan T. N. (2004). General and Applied Entomology. Tata McGraw Hill, New Delhi.
2. Dent, D. (2000) Insect pest management (2nd edition) CAB International.
3. Dhaliwal & Arora (2001). Integrated Pest Management: Concepts and Approaches. Kalyani Publ., New Delhi.
4. Duntson P. A. (2004). The Insects: Structure, Function and Biodiversity. Kalyani Publ., New Delhi.
5. Evans J. W. (2004). Outlines of Agricultural Entomology. Asiatic Publ., New Delhi.
6. Mani, M.S., General Entomology, Oxford and IBH publishing Co., New Delhi. 1982.
7. Snodgrass, R.E., Principles of Insect Morphology, McGraw Hill and Co., New York. 1985.
8. Nayar, K.K.., Ananthakrishnan,T.N., and David., M., General and Applied Entomology, Tata McGraw Hill Pub. Co., Ltd., New York. 1995.

Web resources:

4. https://www.britannica.com/science/ecological-succession
5. https://www.icmr.gov.in//
6. https://vcrc.icmr.org.in//
7. https://www.who.int//

Pedagogy: Lecture, Assignment, PPT presentation

(Please mention teaching / Learning methods like Lecture, Tutorial, Assignment, PPT presentation, Quiz, Group Discussion, e-content Seminar etc.)

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Cognitive Level
CO1	Insect structure and physiology of systems, including their functional mechanisms.	**K1**
CO2	Learn The Insect Pests and Their Control Measures	**K2**
CO3	Acquire Skills In Rearing of Silkworm, Honeybee and beneficial economical insects.	**K3**
CO4	Gain knowledge on The Integrated Pest Management.	**K4**
CO5	Distinguish different economic importance to Insects.	**K6**

Cognitive Level : **K1 -** Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes

	Mapping with Programme Outcomes*									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	2	2	3	3	3	2	2	3
CO2	3	3	3	2	3	3	3	2	3	3
CO3	3	3	3	3	3	3	3	3	3	2
CO4	3	3	2	3	3	3	3	2	2	3
CO5	3	3	2	3	2	3	2	1	3	3

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated;
0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching /Cycle	No. of Credits
II	**23P2ZOEL4A**	**Major Elective-IV STEM CELL BIOLOGY**	**5**	**3**

Nature of the course

Employability Oriented	√	Relevant to Local need	
Entrepreneurship Oriented	√	Relevant to regional need	√
Skill development Oriented		Relevant to national need	√
Addresses Gender Sensitization		Relevant to Global development need	
Addresses Environment and Sustain ability		Addresses Professional Ethics	√
Addresses Human Values			

Course Objectives:

The main objectives of this course aret

1. To familiarize the students with stem cell technology and its applications for betterment of the society.
2. To give abroad view of mammalian stem cells, reviewing where they are found in the body, the different types and how they are cultured.
3. Gainknowledgeonthebasicbiologyofthesestemcellsaswellasbioengineeringandapplicationofthese stem cells topotential treatments of human diseases.

Unit	Content	No. of Hours
I	**STEM CELL BIOLOGY** Introduction to stem cell biology: Stem cell definition, origin and hierarchy, stem cell properties, Identification and Characterization, potency and differentiation, niche of stem cell, over view of different stem cell types (embryonic stem cells, adult stem cells and induced pluripotent stem cells).	**15**
II	**EMBRYONICSTEM (ES) CELL** Embryonic stem (ES) cell: Characterization and properties of ES cells, pluripotency and self-renewal of ES cells; molecular mechanisms regulating pluripotency and maintenance of the stem state, progressive differentiation of ES cells into ectodermline age organs (skin, brain and nerve), mesoderm Lineage organs (heart, kidney, muscle, bone and blood), and endodermlineage organs (lung, liver, stomach, pancreas and intestine).	**15**
III	**ADULT STEM CELLS** Adult stem cells: Mesenchymal stem cells (MSCs) - sources, properties(plasticity,homingandengraftment),potencyandcharacterization; Haematopoieticstemcells(HSCs)-sources, properties, potency and characterization; steps involved in production finducedpluri potent stem Cells (iPSCs); role of Yamanakafactorini PSCs.	**15**

IV	**STEM CELL AND AGING** Stem cell and aging: aging theory; cell cycle; telomere and telomerase; Senescence of stem cell; role of stem cellinaging; tissuere pair and regeneration of adult stem cell.	15
V	**STEM CELL THERAPIES** Current stem cell therapies: Advantages and disadvantages of ES cells and adult stem cells (MSCs and HSCs) therapy; Ethical concern on stem cell therapy; current stem cell therapy for various diseases; clinical outcome of stem cell therapy; state of clinical trials in adult stem cells for various diseases.	

Text Book

1. Quesenberry,P.J.,G.S.Stein,B.ForgetandS.Weissman.2001.StemCellBiologyandGeneTherapy,Wiley Publishers, pp-584.
2. Sell,S. and Totowa,N.J.2004. Stem Cells Handbook, Humana Press, pp-534.
3. Sullivan, S.,C.A.Cowan and K. Eggan.2007. Human Embryonic Stem Cells: The Practical Handbook, Wiley Publishers, pp-424.
4. Battler,A.,andLeo,J.2007.StemCellandGene-BasedTherapy:FrontiersinRegenerative Medicine, SpringerPublication,pp-422.

References:

1. Kiessling,A.A.2006.HumanEmbryonicStemCells(SecondEd.),Jones&BarlettPublishers
2. Lanza,R.andA.Atala.2005.Essentialsof StemCellBiology.AcademicPress,pp-712.
3. Turksen,K.2004.AdultStemCells.HumanaPress,Inc,pp-429.
4. Lanza,R.*etal*.2004.HandbookofStemCells:Embryonic/AdultandFetalStemCells(Vol.1&2).AcademicPress, pp-1626.
5. InstituteofMedicine,2002.Stemcellsandthefutureofregenerativemedicine.NationalAcademy Press, pp-112.
6. Marshak, D., R.L. Gardener and D. Gottlieb. 2001. Stem Cell Biology, Cold Spring Harbour Monograph Series, 40, pp-55.
7. Booth, C. 2003. Stem Cell Biology and Gene Therapy, Cell Biology International, Academic Press.

Web resources:

1. https://www.yourgenome.org/facts/what-is-a-stem-cell/
2. https://byjus.com/biology/stem-cells/
3. https://rnlkwc.ac.in/pdf/study-material/zoology/Sem%20VI%20ESC.pdf

Pedagogy: Teaching / Learning methods

(Please mention teaching / Learning methods like **Lecture**, Tutorial, Assignment, PPT presentation, Quiz, Group Discussion, e-content Seminar etc.)

Course Outcomes:

On the successful completion of the course, students will be able to:

CO Number	CO Statement	Cognitive Level
CO1	Understand the basic knowledge of stem cells and their origin	**K1&K2**
CO2	Differentiating the embryonic and adult stem cells	**K2**
CO3	Understand and apply the current stem cell therapies for their research	**K3**
CO4	Understand about ageing theory and senescence character of stem cell	**K4&K5**
CO5	Remember the importance of stem cell theraphy	**K3&K6**

CognitiveLevel:K1- Remember;**K2-** Understanding;**K3-**Apply;**K4-** Analyze; **K5–** Evaluate;**K6–**Create

Mapping of Course Outcomes with Programme Outcomes

Mapping of Course Outcomes with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	1	3	2	3	3	3	2	1	2
CO2	2	1	3	1	3	3	3	2	1	3
CO3	3	2	3	1	3	3	3	2	1	2
CO4	1	2	3	2	3	3	3	2	1	2
CO5	3	1	2	3	3	3	3	2	1	3

3-StronglyCorrelated;2-ModeratelyCorrelated;1-WeaklyCorrelated; 0– No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	**23P2ZOEL4B**	**Major Elective – IV CELL AND TISSUE CULTURE**	**5**	**3**

Nature of the course

Relevant to Local need		Employability Oriented	√	Addresses Professional Ethics	
Relevant to national need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to regional need		Skill development Oriented	√	Addresses Environment and Sustainability	
Relevant to Global need	√			Addresses Human Values	√

Course Objectives:

The main objectives of this course are to:

1. To know the plant cell, aseptic Techniques, callus induction.
2. To know about Micro propagation.
3. To know cell culture Manipulation.
4. To know the principles of cell and Tissue Culture.
5. To know Tissue Culture Techniques.

Unit	Content	No. of Hours
I	**BASICS OF CELL AND TISSUE CULTURE** History of plant and animal cell – laboratory organization – aseptic techniques – nutritional requirements and culture media – Types of cultures – solid – liquid – stationary – agitated – batch cultures – Organogenesis – Callus induction – Caulogenesis – Rhizogenesis techniques of hairy root production.	**15**
II	**MICRO PROPAGATION** Micro propagation – mass production of plantlets – Hardening and mist chambers – transplantation to field – techniques for Maintaining plantlets in the field – somatic embryo genesis – induction of haploids and triploids – techniques of overcoming incompatibility barriers – embryo rescue protoplast and pansexual hybridization – exploitation of Somaclonal and Gametoclonal variations.	**15**
III	**MASS CULTURE OF CELLS** Manipulation of cell line selection – immobilization of cells and its application – synchronization of cell cultures and cell division –	**15**

	production of secondary metabolites – biotransformation – Induction of cell line mutants and mutations – cryo preservation - germplasm conservation and establishment of gene banks – synseed technology.	
IV	**PRINCIPLES OF CELL AND TISSUE CULTURE** Advantages and disadvantages of tissue culture methods – cell markers: role of molecular markers in crop and farm animal improvement – types of cells – Primary and established cell lines – Kinetics of cell growth – genetics of cultured cells. Application of animal cell culture for *in vitro* testing of drugs; Use in gene therapy, cloning for production of transgenic animals, cloning for conservation.	**15**
V	**TECHNIQUES OF CELL AND TISSUE CULTURE** Sources of cells – techniques of cell culture, Mechanical, biochemical and types of animal cells – culture procedures – preparation of animal materials – primary culture, cell lines and cloning – Slide and coverslip cultures, washing and feeding, double coverlid cultures, text tube culture – Organ culture – whole embryo culture – specialized culture techniques – cell synchronization – measurement of cell death – stem cell culture and transplantation.	**15**

Textbook:

1. Gupta P K, 2003, Elements of Biotechnology, Rastogi Publications, Meerut, India.

References:

1. Kalyan Kumar De, 1992, Plant Tissue Culture, New Central Book Agency, Calcutta.
2. D.C.Daring and S.J.Morgan, 1994, Animal Cells, Culture and Media, BIOS Scientific Publishers Limited.
3. Robert N. Trigiano, Dennis J.Gray, 1996, Plant Tissue Culture Concept and Laboratory Excurses. CRC Press London.
4. Ann Harris, 1996, Epithelial Cell Culture, Cambridge University Press.
5. P.S.Srivasta, 1998, Plant Tissue Culture an Molecular Biology, Narosa Publishing House, New Delhi.
6. David W. Galbraith, Hans J. Bohnertan Don p. Bourque, 1995, Methods of Plant Cell Biology, Academic Press, New York.
7. Jennie P. Mathur and David Barnes, 1998, Methods in Cell Biology, Volume 57: Animal Cell Culture Methods Academic Press.
8. John H.Dods and Lorrin W. Roberts, 1995, Experiments in Plant Tissue Culture, Cambridge University Press, USA.
9. M-M-Ranga, 2000, animal Biotechnology, Agro bios (India).
10. Plants, Genes and Crop Biotechnology 2nd Edition by Chrispeels, M.J. &Sadava D.E. American Society of Plant Biologists, Jones and Bartlett Publishers, USA (2003).
11. Butler, M "Mammalian Cell Biotechnology- A Practical Approach," IRL Oxford University Press (1991)

Web resources:

1. https://link.springer.com/chapter/10.1007/978-94-009-4396-4_6 (DNA Plant Technology

Corporation, Cinnaminson, USA)

Pedagogy: Teaching / Learning methods

Lecture, **Assignment, PPT presentation, Group Discussion**

(Please mention teaching / Learning methods like Lecture, Tutorial, Assignment, PPT presentation, Quiz, Group Discussion, e-content Seminar etc.)

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Cognitive Level
CO1	To know the plant cell, aseptic Techniques, callus induction.	**K1 & K2**
CO2	Imparts the knowledge to culture animal cells in artificial media.	**K2**
CO3	Knowledge of animal cells in culture, growth of cell lines.	**K3**
CO4	Use in recombinant DNA technology, genetic manipulations and in a variety of industrial processes.	**K4 & K5**
CO5	To know Tissue Culture Techniques.	**K3 & K6**

Cognitive Level :K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes

PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	3	2	3	2	3	3
CO2	3	2	3	1	3	3	3
CO3	3	3	2	3	3	3	2
CO4	1	2	3	2	2	1	3
CO5	2	3	3	3	2	2	3

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated;
0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	**23P2ZOSEC2**	**SKILL ENHANCEMENT COURSE - DAIRY FARMING**	**2**	**2**

Nature of the course

Employability Oriented	√	Relevant to Local need	√	Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to regional need		Addresses Environment and Sustainability	√
Skill development Oriented	√	Relevant to national need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives:

The main objectives of this course are:

Students should know basic concepts in Dairy farming

UNIT	Content	No. of hours
I	Introduction to Dairy Farming-Advantages of dairying- Classification of breeds of cattle-Indigenous and exotic breeds- Selection of dairy cattle. Breeding-artificial insemination. Construction of Model Dairy House - Types of Housing - Different Managemental Parameters. Feedstuffs available for livestock-Mineral Supplements - Vitamin Supplements -Feed additives - Feeding management - Calves Feeding - Feeding of adults - Feeding of pregnant dairy animals - Feeding pregnant heifer.	15 **hours**
II	Milk-Composition of milk-milk spoilage-pasteurization - Role of milk and milk products in human nutrition – Dairying as a source of additional income and employment. Contagious disease - Common Bacterial - Protozoal - Helminth and Viral Diseases - Parasitic Infestation - Vaccination - Biosecurity.	15 **hours**

Text boks:

1.The Veterinary Books for Dairy Farmers by Roger W. Blowey.
2. Hand Book of Dairy Farming by Board Eiri.
3. Handbook of animal husbandry TATA, S.N ed., ICAR 1990
4. Prabakaran, R. 1998. Commercial Chicken production. Published by P. Saranya, Chennai.
6. Hafez, E. S. E., 1962. Reproduction in Farm Animals, Lea &Fabiger Publisher. J

7. ames. N. Marner, 1975. Principles of dairy processing, wiley eastern limited, New Delhi.
8. Baradach, JE. Ryther. JH. and, MC larney WO., 1972. Aquaculture. The farming and Husbandry of Freshwater and Marine Organisms. Wiley InterScience, NewYork.

Web Link:

1. https://agritech.tnau.ac.in/farm_enterprises/Farm%20enterprises_%20Dairy%20unit.html
2. https://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Tata,+S.N.,+ed%22

Course Outcome:		
On the successful completion of this course, students will be able to:		
I	To understand the various practices in Dairy farming. To know the needs for Dairy farming and the status of India in global market.	**K2 & K3**
II	To be able to apply the techniques and practices needed for Dairy farming.	**K1, K2 & K3**
III	To know the difficulties in Dairy farming and be able to propose plans against it.	**K5 & K6**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Mapping of Course Outcomes with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	2	3	1	1	3	3	2	3	1	2
CO2	2	3	3	3	2	3	2	1	3	3
CO3	2	3	3	3	3	3	3	3	3	2
CO4	2	3	3	3	2	2	1	1	2	2
CO5	3	3	3	2	3	2	3	1	2	3

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	**23P2PZOAECC2**	**Ability Enhancement Compulsory Course - Language Lab**	**2**	**2**

Nature of the course

Employability Oriented	√	Relevant to Local need	√	Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to national need	√	Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to regional need	√	Addresses Human Values	√
		Relevant to Global development need	√	Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are to:

To facilitate computer-assisted multi-media instruction enabling individualized and independent language learning

To sensitize students to the nuances of English speech sounds, word accent, intonation and rhythm

To bring about a consistent accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking

To improve the fluency of students in spoken English and neutralize their mother tongue influence

To train students to use language appropriately for public speaking and Interviews.

Unit – I LSRW

Listening Skills: Introduction to Phonetics – Speech Sounds – Vowels and Consonants, Listen to News, poem, songs, Motivational speech, stories, movies, interesting facts, sign of zodiac, dialogues, idioms, dictation – Common errors

Speaking Skills: Stress, Intonation, Homophone, Silent Letters, Greetings, Small Talk, Telephone English, Role Play, Tongue Twisters, Welcome Speech & Vote of Thanks, Compering, Declamation, Sing Along, Brain Storming, JAM (Just A Minute)

Reading Skills: Reading test, Skit, Proof Reading, Oral Reading Fluency, Reading Stories,

Writing Skills: learn English Grammar through Tamil Translation, Reading Comprehension-short stories, informational passages, Advanced Critical reading – Intelligence Augmentation, Dialogues, Sentence Completion, Word Definition, Classic Analogy Bridges, Sentence Analogies, Same Sound, Divided Syllables, Finish the Story, Answering the questions, Practical Writing, Making a formal Argument, Free Writing, Using Precise Language

Unit – II Career and Soft Skills

Career Skills: Body Language (BL) : BL Interview, BL Model, BL Tips, Business English, Communication skills, GD, Interview Skills

Soft Skills: Assertiveness, Creativity, Critical Thinking and Problem Solving, Empathy, Enthusiasm and attitude, Goal Setting, Great interviews, Negotiation Skills, Personality Development, Professionalism, Self Esteem, Stress Management, Team Building, Time Management, Motivation and Attitude, Interpersonal relationship and skills, Networking,

Reference:

1. Materials prepared by the Department of English for Writing skills
2. Soft Skills – Know Yourself and know the world, Dr.K.Alex, Chand Publications, 3rd revised edition 2014
3. Software : Express Pro Lite.

The Language Lab focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations both in formal and informal contexts.

Course Objectives:

Learning Outcomes: Students will be able to attain

- Better understanding of nuances of English language through audio- visual experience and group activities
- Neutralization of accent for intelligibility
- Speaking skills with clarity and confidence which in turn enhances their employability skills

Minimum Requirement of infrastructural facilities for Language Lab:

1. Computer Assisted Language Learning (CALL) Lab:

The Computer Assisted Language Learning Lab has to accommodate 40 students with 40 systems, with one Master Console, LAN facility and English language learning software for self- study by students.

System Requirement (Hardware component):

Computer network with LAN facility (minimum 40 systems with multimedia) with the following specifications:

i) Computers with Suitable Configuration
ii)High Fidelity Headphones

2. Interactive Communication Skills (ICS) Lab:

The Interactive Communication Skills Lab: A Spacious room with movable chairs and audio-visual aids with a Public-Address System, a LCD and a projector etc.

Semester	Course Code	Title of the Course	Hours of Teaching/ Week	No. of Credits
III	**23P3ZOC5**	**ANIMAL PHYSIOLOGY**	**6**	**4**

Nature of the course

Relevant to Local need		Employability Oriented		Addresses Professional Ethics	
Relevant to national need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to regional need		Skill development Oriented		Addresses Environment and Sustainability	
Relevant to Global need				Addresses Human Values	

Course Objectives:	
The main objectives of this course are:	
1.	Students acquire the basic knowledge on physiology of different organs in animals and human.
2.	Understand the functions of different systems such as digestion, excretion, blood circulatory system, respiration and nervous system of animal relating them to structure and functions of various organs.
3.	To know the structure and functions of endocrine glands in man.

Units	Contents	Hrs
I	**Blood and circulation:** Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis. Cardiovascular system : Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, blood pressure, neural and chemical regulation.	**18 Hrs**
II	**Respiratory system:** Comparison of respiration in Frog, Pigeon and Man anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration	**18 Hrs**
III	**Nervous system:** Neurons, action potential, gross neuro-anatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture. Sense organs: Vision, hearing and tactile response	**18 Hrs**
IV	**Digestive system:** Digestion, absorption, energy balance, BMR. Excretory system: Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, electrolyte balance, acid-base balance	**18 Hrs**

V	**Endocrinology and reproduction:** Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, ovulation, neuroendocrine regulation. **Thermoregulation:** body temperature- physical, chemical, neural regulation, acclimatization: Stress and adaptation	**18 Hrs**

Text Books:

1. Guyton A.C and Hall J.E, (2015) Text Book of Medical Physiology, Elsevier.
2. Verma P.S, Tyagi and Agarwal (2016) Animal Physiology, Chand & Company.
3. Mariakuttikan A and Arumugam N (2019) A Text Book of Animal Physiology, Saras publication.
4. Jain A.K., (2018) Text book of Physiology, Avichal Publishing Company.

Reference Books:

1. Christopher D. Moyes and Patricia M. Schulte (2015) Principles of Animal Physiology, Pearson Publishers.
2. Linda S. Coastanzo. (2017) Physiology, Elsevier.
3. Tortora, G.J., and Derrickson, B.H. (2019) Principles of Anatomy and Physiology, John Wiley and Sons, Inc.
4. Widmaier, E.P., Raff, H. and Strang, K.T. (2018) Vander's Human Physiology, McGill University.
5. Marieb, E. (1998) Human Anatomy and Physiology, Addision – Wesley.
6. Hoar, S.W., 1978. General and comparative Physiology, Prentice Hall, London, New York.
7. Prosser, O.D. and Brown, A.F. (Jr), 1961. Comparative Animal Physiology, W.B. Saunders Co., New York, London.'
8. Kesar,S and Vashisht, N (2007) Experimental Physiology, Heritage Publishers.
9. David T. Plummer, AnIntroduction to Practical Biochemistry, Tata McGraw Hill Publishing Co-Ltd., New Delhi.
10. Richard W. Hill Michigan State University Gordon A. Wyse University of Massachusetts, Amherst Margaret Anderson Smith College "Animal Physiology Third Edition".
11. Haris G.W. and Donovan B.T. (1968) The Pituitary gland, S. Chand & company.
12. Ingleton, P.M. and. Bangara J.T (1986) Fundamentals of comparative vertebrate endocrinology, Kluwer Academic Publishers.

Web Resource:

1. https://www.uwosh.edu/facstaff/kurtzc/document files/S18%20319%20syllabus.pdf (University of Wisconsin-Oshkosh, America).
2. https://courses.kaust.edu.sa/StudentCourses/GetPdf?fileName=2018-Spring-B_101-00074120.pdf&isExternal=False(King Abdullah University of Science Technology, Saudi Arabia).
3. https://canvas.harvard.edu/course/63071/assignments/syllabus. (Hradvard University).

Pedagogy: Lecture, Assignment, PPT

Expected Course Outcome:		
On the successful completion of the course, student will be able to		
1	Understand the functions of different systems of animals	**K1**
2	Learn the comparative anatomy of heart structure and functions	**K2**
3	Know the transport and exchange of gases, neural and chemical regulation of respiration	**K2 & K4**
4	Acquire knowledge on the organization and structure of central and peripheral nervous systems	**K3 & K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Mapping of Course Outcomes with Programme Outcomes:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	2	3	2	3	2	1	3	2	3	3
CO2	3	3	2	3	3	3	3	2	3	3
CO3	3	2	3	3	3	2	1	3	2	3
CO4	3	3	3	3	3	1	2	3	3	2
CO5	3	3	3	2	2	2	2	1	1	2

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
III	**23P3ZOC6**	**IMMUNOLOGY**	**5**	**4**

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to national need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives:

The main objectives of this course are:

1. To impart conceptual understanding of functional organization of immune system and its responsiveness in health and disease.
2. To enable a successful performance in Immunology component of CSIR-UGC NET.

Unit	Content	No. of Hours
I	**Introduction to Immunology:** Scope of immunology, Recognition of self and non-self as a basic functional feature of immune system; Concepts of external and internal defense systems; External (first line / innate) defense system: components, distribution, salient functions; Internal (second line / acquired) immune system: cellular and humoral immune components-distribution, salient functions-primary and secondary immune responses; Immune tissues / organs: types, anatomical location, structure and development; lymphocyte traffic during development; Types of immunity: innate and acquired - types, functional features; concept of adaptive immunity	15
II	**Antigens:** Definition, characteristic features and classification; Antigenicity versus immunogenicity; Adjuvants: definition, types and applications	15
III	**Major effector components of cellular immune system**: Lymphocytes - types, morphology, clones; sub-populations, distribution, B and T cell receptors, B and T cell epitopes, Toll-like receptors; Antigen presenting cells: antigen processing and presentation, MHC molecules and their immunologic significance.	15
IV	**Major effector components of humoral immune system:** Antibodies **-** Primary structure, classification, variants and antigen-antibody interactions; Structural and functional characteristics of various antibody classes; Generation of diversity; Monoclonal antibodies: definition, production and applications; Antibody engineering and its applications. Complement	15

	system - Components, three major activation pathways, and immune functions including anaphylaxis and inflammation. Cytokines -Definition and salient functional features; Interleukins: definition, types (lymphokines and monokines), and functions. Interferons - Origin, types and functions	
V	**Diseases and immune responses:** Hypersensitivity: definition, Types I to IV and immune manifestations; Auto-immune diseases: onset, spectrum of diseases, and major immune responses; Immunodeficiency diseases: types including SCID and consequences; Viral (HIV), bacterial (tuberculosis) and parasitic (malaria) diseases: etiology, host immune responses and evasion by pathogens; Vaccines: types, preparations, efficacies and recent developments	15

Textbook:

1. Kuby, J. 1997. Immunology. W. H. Freeman & Co., New York, pp-670.
2. Male, D. J. Brostoff, D. B. Roth and I. Roitt. 2006. Immunology (7th edition), Mosby / Elsevier, Philadelphia, pp-472
3. Abbas, A. K and A. H. Lichtman. 2007. Cellular and Molecular Immunology (6th edition), W. B. Saunders, Philadelphia, pp-564
4. Coica, R. Sunshine, G. 2015. Immunology (Seventh Edition), Wiley Blackwell, UK, pp-406.

General References:

1. Weir, D. M and J. Stewart. 1997. Immunology, Churchill Livingstone, London, pp-362
2. Janeway, C. A and P. Travers. 1997. Immunology, Garland Publ. Inc., London, pp-904
3. Peakman, M and D. Vergani. 1997. Basic and Clinical Immunology, Churchill Livingstone, London, pp-366
4. Parham, P. 2009. The Immune System (Third Edition), Garland Science, USA, pp-506
5. Weissman, I. Hood, L. Wood, W. 1978. Essential Concepts in Immunology, the Benjamin/Cummings, California, pp-165.
6. Hood, L. Weissman, I. Wood, W. Wilson, J. 1984. Immunology (Second Edition), the Benjamin/Cummings, California, pp-558.
7. Coica, R and Sunshine, G. 2009. Immunology A Short Course (Sixth Edition), John Wiley & Sons, USA, pp-391.
8. Doan, T. Melvold, R. Viselli, S. *et al*., 2013. Immunology (Second Edition), Lippincott Williams & Wilkins, Maryland, pp-376.
9. Owen, J. A. Punt, J. Stanford, S. A. 2013. Kuby Immunology (7th Edition), Macmillan, England, pp-692.

Web resources:

1. https://microbenotes.com/introduction-to-antigen-antibody-reactions/aaSaby
2. http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000035ZO/P001308/M020591/ET/1498566307ModelsofImmunoglobulinQuad1.pdf
3. https://www.rnlkwc.ac.in/pdf/study-material/zoology/Antigen-Antibody%20interaction.pdf
4. https://www.immunology.org/public-information/bitesized-immunology/systems-processes/complement-system

Pedagogy::Teaching / Learning methods, Assignment, PPT presentation, Seminar, Group discussion

Course Outcomes:
On the successful completion of this course, students will be able to:

CO Number	CO Statement	Cognitive Level
CO1	. Various basic concepts in immunology and organization of immune systems.	K2
CO2	Mechanisms of immune response in health and their defects in various diseases.	K2 & K4
CO3	The application of immunological principles in biomedical sciences including blood transfusion, tissue grafting and organ transplantation.	K3 & K5
CO4	Vaccinology and its importance in disease management	K3
CO5	Autoimmune and Immunodeficiency diseases	

Cognitive Level: K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;**K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes

	Mapping with Programme Outcomes*									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	2	3	3	3	3	2	3	3	3
CO2	3	3	2	3	3	3	2	2	3	3
CO3	3	2	2	3	3	3	3	3	3	2
CO4	2	3	2	2	3	3	3	3	3	2
CO5	2	3	3	3	2	3	2	3	3	2

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
III	**23P3ZOCP3**	**Practical - III ANIMAL PHYSIOLOGY AND IMMUNOLOGY**	**6**	**4**

Course Objectives:
The main objectives of this course are:
1. To develop skills in estimation of chlorides, ammonia and urea and effect of salinity on oxygen consumption 2. To provide hands-on training to perform specific lab courses in immunology and research methodology. 3. To enable clear understanding of the methodology through wet – lab courses.

A-ANIMAL PHYSIOLOGY

1. Estimation of chlorides in biological samples.
2. Salt-loss and Salt-gain in Crab.
3. Quantitation estimation of ammonia and urea.
4. Estimation of oxygen consumption in fish.
5. Study of cardiac cycle of frog and its response to temperature
6. Effect of salinity on oxygen consumption of crab

B- IMMUNOLOGY

1. Identification of various immune tissues and organs in rat
2. Identification of various types of immune cells in peripheral blood smear
3. Separation of RBC as intact cellular antigen for immunization
4. Preparation and storage of antiserum
5. Agglutination reaction: Qualitative analysis of antigen-antibody reaction using human blood group system
6. Agglutination reactions: Determination of hemagglutination titer of IgM antibodies using human RBC
7. Detection of IgG by precipitation ring test
8. Detection of IgG by Ouchterlony double immuno-diffusion test
9. Detection of reactivity of IgG with fractionated antigens by immune - electrophoresis
10. Separation of lymphocytes from peripheral blood and identification of T and B cells

Reference:

1. Mali RP and SK Asfar,2015 A Practical Manual on Innovative Animal Physiology ,Oxford Book Company
2. GROVUM 2012 ANIMAL PHYSIOLOGY LAB MANUAL M&t Printing Services ISBN: 9780901000286
3. J.M.Z Kamau Ed.1991 A practical manual on Animal Physiology. Ed, Nairobi University Press. Talwar G P and S K Gupta 2016 Hand Book of Practical and Clinical Immunology, Vol. II 2nd Edition

Course Outcome:

On the successful completion of this course, students will be able to:		
1.	Acquire ability to perform/ demonstrate various basic concepts in immunology as well as applications of research methods for quantitative/ qualitative analysis of biochemical components.	**K3 & K4**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Mapping of Course Outcomes with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	3	2	3	3	2	3	2	3
CO2	3	2	1	3	2	3	2	2	2	2
CO3	2	2	1	3	1	3	2	1	2	2
CO4	3	3	1	3	1	3	2	1	2	1
CO5	3	3	2	1	2	3	2	3	2	2

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
III	**23P3ZOCIM**	**Industry Module- Medical Laboratory Techniques**	**5**	**3**

Nature of the course

Relevant to Local need	√	Employability Oriented	√	Addresses Professional Ethics	
Relevant to national need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to regional need	√	Skill development Oriented	√	Addresses Environment and Sustainability	√
Relevant to Global need	√			Addresses Human Values	√

Course Objectives:	
The main objectives of this course are:	
	Students should understand the different protocols and procedures to collect clinical samples.

Units	
I	Laboratory safety - toxic chemicals and biohazards waste- biosafety level- good laboratory practice - hygiene and health issue - physiology effect of alcohol, tobacco, smoking & junk food & its treatment - biomedical waste management.
II	Composition of blood and their function- collection of blood & lab procedure- haemopoiesis- types of anaemia- mechanism of blood coagulation- bleeding time- clotting time- determination of hemoglobin-erythrocyte sedimentations rate- packed cell volume- Total count of RBC & WBC- Differential count WBC- blood grouping and typing- haemostasis- bleeding disorder of man - Haemolytic disease of newborn, Platelet count, reticulocytes count, Absolute Eosinophil count.
III	Definition and scope of microbiology- structure and function of cells - parasites - Entamoeba- Plasmodium- Leishmania and Trypanosome-Computer tomography(CT scan) - Magnetic Resonance imaging - flowcytometry - treadmill test - PET.
IV	Cardiovascular system- Blood pressure - Pulse - regulation of heart rate, cardiac shock. Heart sounds, Electrocardiogram (ECG) - significance - ultra sonography- Electroencephalography (EEG).
V	Handling and labelling of histology specimens - Tissue processing - processing of histological tissues for paraffin embedding, block preparation. Microtomes – types of microtome- sectioning, staining - staining methods - vital staining - mounting- problems encountered during section cutting and remedies - Frozen section techniques- freezing microtome.

Reading list

1. Godker, P. B. and Darshan, P, Godker, 2011. Text book of medical Laboratory Technology, Mumbai.

2. Guyton and Hall, 2000. Text Book of medical Physiology, 10th edition, Elseiner, New Delhi.
3. Mukerjee, K.L, 1999. Medical Laboratory Technology- Vol,I,II,III. Tata MC GrawHill, New Delhi.
4. Sood, R, 2009. Medical Laboratory technology, Methods and interpretation.

Recommended texts

1. Manoharan,A, and Sethuraman, 2003. Essential of Clinical Heamatology, Jeypee brothers, New Delhi.
2. Richard, A, McPherson, Mathew, R, Pincus, 2007. Clinical and management by laboratory methods, Elsevier, Philadelphia.Published by Tata McGraw-Hill Education Pvt. Ltd.,
3. Ochei. J., A. Kolhatkar (2000). Medical Laboratory science: Theory and practice, Published by Tata McGraw-Hill Education Pvt. Ltd, First edition.

Expected Course Outcome:

Upon completion of this course, Students would have

I	Understand protocols and procedures to collect clinical samples for blood analysis and to study human physiology.	**K2 & K3**
II	Explain the characteristics of clinical samples and demonstrate skill in handling clinical equipment.	**K3, K4 & K5**
III	Evaluate the hematological and histological parameters of biological samples.	**K3, K4, K5 & K6**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Mapping with Programme Outcomes*

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	2	1	1	2	2	1	2
CO2	3	3	2	3	3	3	1	2	3	3
CO3	2	3	3	3	3	3	3	3	3	1
CO4	3	3	2	2	1	2	1	2	2	3
CO5	2	2	3	3	2	3	1	1	3	3

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
III	20P3ZOEDC	Extra Disciplinary Course - CLINICAL LAB TECHNOLOGY	4	3

Nature of the course

Employability Oriented	√	Relevant to Local need	√
Entrepreneurship Oriented	√	Relevant to regional need	√
Skill development Oriented	√	Relevant to national need	√
Addresses Gender Sensitization		Relevant to Global development need	√
Addresses Environment and Sustainability	√	Addresses Professional Ethics	√
Addresses Human Values			

Course Objectives:

The main objectives of this course are to:

1. To study the precautionary techniques for laboratory personnel and various sterilization techniques.
2. To know the disposal of hospital waste and infectious material
3. To identify the blood group and urine sugar.
4. To identify the bacteria and fungus by using culture techniques.
5. To know the handling techniques of laboratory instruments and equipment.

Unit	Content	No. of Hours
I	**Laboratory and Safety:** Laboratory safety - toxic chemicals and biohazards waste- biosafety level- good laboratory practice - hygiene and health issue - physiology effect of alcohol, tobacco, smoking & junk food & its treatment - biomedical waste management. First aid; definition - Types and applications – Universal work precautions for laboratory Personnel - Disinfection laboratory glassware and equipments.	Hrs.12
II	**Haematology and Urine analysis:** Composition of blood and their function- collection of blood & lab procedure- haemopoiesis- mechanism of blood coagulation- bleeding time- clotting time- bleeding disorder of man, Platelet count, determination of hemoglobin-erythrocyte sedimentations rate- packed cell volume- Total count of RBC & WBC- Differential count WBC- blood grouping and typing- Sugar level in Blood – Hypoglycemia – Hyperglycemia conditions – Composition of urine – Physical and chemical characteristics of urine – Method of urine analysis for sugars – Urea - Creatinine.	Hrs.12
III	**Microbial Parameters and analysis of semen, sputum and stool:** Definition and scope of clinical microbiology- structure and function of cells - parasites - Entamoeba- Plasmodium- Leishmania and Trypanosome – Parasitic identification in Blood and Stool – Bacterial culture by NA medium – Fungal culture by PDA medium – Histological study of cells: Histological procedure for the preparation of slides. Analysis of Semen, Sputum and stool	Hrs.12

IV	**Laboratory instruments and its uses:** Cardiovascular system- Blood pressure - Pulse - regulation of heart rate, cardiac shock. Heart sounds, Principles and Application of Diagnostic equipments: Electrocardiogram (ECG) - significance - ultra sonography- Electroencephalography (EEG) - Colorimeter – pH meter – PCR – Laminar airflow – Binocular microscope – Incubator – Autoclave – Hot air Oven.	**Hrs.12**
V	**Histological techniques:** Handling and labelling of histology specimens - Tissue processing - processing of histological tissues for paraffin embedding, block preparation. Microtomes – types of microtome- sectioning, staining - staining methods - vital staining - mounting- problems encountered during section cutting and remedies - Frozen section techniques- freezing microtome.	**Hrs.12**

Text Book

1. Mrinalini Sant M.D., (Path), 2022. Textbook of Medical Laboratory Technology, 2/e Paperback (ISBN: 9354665187) 2nd Ed., CBS Publishers & Distributors Pvt Ltd, New Delhi, 760 pages.
2. P.B. Godkar, 2014, Textbook of Medical Laboratory Technology, 3rd ed., Bhalani Publishing House, Mumbai, India. (ISBN: 9789381496190).
3. Mohan H. (2005). Text book of Pathology, 5th ed., Jaypee Brothers (ISBN: 9788180613685)
4. Godker, P. B. and Darshan, P, Godker, 2011. Text book of medical Laboratory Technology, Mumbai.
5. Guyton and Hall, 2000. Text Book of medical Physiology, 10th edition, Elseiner, New Delhi.

References:

1. Kanai L. Mukherjee, Medical Laboratory Technology Vol. I.Tata McGrawHill 1996, New Delhi.
2. Jha, S.M., Hospital Management, 2003, Himalaya publishing house, New Delhi. 3. Mohd.Faisal Khan, Hospital Waste Management, 2004, Kanishka publishers, New Delhi. 4. Shakti Gupta & Sunil Gupta, Hospital Stores Management – An Integrated Approach, 2000, Jaypee Brothers Medical Publishers, New Delhi
3. Medical Laboratory Technology (1994) (4th edition), By RamikSood, Jaypee Brother Medical Publishers (P) Ltd.,New Delhi 110 002.
4. Medical Laboratory Technology, K.M. Samuel.
5. Clinical Pharmacology (1987), by Dr. Lawrance and P.N. Bennett (Sixth Edition), ELBS, English Language Book Society, Churchil Livingstone, England.
6. Fischbach, F.T., Dunning, M.B, 2002. A Manuel of Laboratory and Diagnostic Tests. Lippinocott Williams and Wilkins, Baltimore.
7. Differential Diagnosis in Lab Medicine,VincentMarks,Thomas Cantor,Dusan Mesko, Rudolf Pullman, Gabriela Nosalova. Springer 2003.
8. Medical Laboratory Science,Theory andPractice,J.Ochei.A.Kolhatka.Tata McGraw Hill 2000.
9. Medical Laboratory Techniques Methods and Interpretation,Ramnik Sood,Jaypee 2002.
10. Text book of Radiology and Imaging, Vol-1, David Sultan, 7th Edition. 2003.

Web Links:

1. https://microbenotes.com/biosafety-levels/
2. https://nios.ac.in/media/documents/dmlt/Microbiology/Lesson-06.pdf
3. https://www.uobabylon.edu.iq/eprints/publication_12_9377_754.pdf

4. https://www.studocu.com/ph/document/centro-escolar-university/medtech/urinalysis-lecture-notes-1-7/16893630
5. https://scert.kerala.gov.in/wp-content/uploads/2020/06/16-mlt.pdf
6. https://old.amu.ac.in/emp/studym/99992736.pdf

Course Outcomes

On the successful completion of the course, students will be able to:

CO Number	CO Statement	Cognitive Level
CO1	Understand protocols and procedures to collect clinical samples for blood, Unine, sputum and stool analysis and to study human physiology.	**K1 & K2**
CO2	Explain the characteristics of clinical samples and demonstrate skill in handling clinical equipment.	**K2**
CO3	Evaluate the hematological and histological parameters of biological samples.	**K3**
CO4	Gaining knowledge on the parasitic analysis in blood, sputum and stool and expertise on histological slide preparation.	**K4 & K5**
CO5	Develop the skill in handling techniques of diagnostic equipments.	**K3 & K6**

Cognitive Level :K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	2	3	3	2	3
CO2	3	3	3	3	3	2	3	3	2	3
CO3	3	3	3	3	3	3	2	3	3	2
CO4	3	3	3	3	2	3	3	2	3	3
CO5	3	3	3	3	2	3	2	2	3	2

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
III	**23P3ZOSEC3**	**SKILL ENHANCEMENT COURSE - ANIMAL BEHAVIOUR**	**2**	**2**

Nature of the course

Employability Oriented	√	Relevant to Local need	√	Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to regional need		Addresses Environment and Sustainability	√
Skill development Oriented	√	Relevant to national need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives:

The main objectives of this course are:

Students should know basic concepts in

UNIT	Content	No. of hours
I	Natural selection and behaviour, Darwinian fitness, Evolution of adaptive strategies. Sexual selection, Altruism, Sexual strategy and social organisation, Animal perception, Neural control of behaviour, Sensory processes and perception, Visual adaptations to unfavourable environments. Coordination and Orientation, Homeostasis and Behaviour, Physiology and Behaviour in changing environments,	15 **hours**
II	Animal Learning, Conditioning and Learning, Biological aspects of learning, Cognitive aspects of learning. Instinct and learning, Displacement activities, Ritualization and Communication, Decision making behaviour in Animals, Complex behaviour of hobey bees, Evolutionary optimality, Mechanism of Decision making. The mentality of Animals: Languages and mental representation, non-verbal communication in human, mental images, Intelligence, tool use and culture, Animal awareness and Emotion. Human health and diseases - Chronopharmacology, chronomedicine, chronotherapy.	6 **hours**

Text Books:

1. David McFarland, 1985.Animal Behaviour, Longman Scientific & Technical, UK.576pp.
2. HarjindraSingh, 1990. A TextBook of Animal Behaviour, AnomolPublication, 293pp.
3. Hoshang S.Gundevia and Hare Goving Singh, 1996. Animal Behaviour,S.Chand&Co, 280pp.
4. Shukla, J. P 2010, Fundamentals of Animal Behaviour, Atlantic, 587pp.

5. Vinod Kumar, 2002. Biological Rhythms. Narosa Publishing House, Delhi.

Reference Books:

1. Michael D. Breed and Janice Moore, 2012. Animal Behaviour, Academic Press, USA, 359pp.
2. Aubrey Manning and Martin Stamp Dawkins, 2012. An Introduction to Animal Behaviour, 6th Edition, Cambridge University Press, UK. 458pp.
3. Davis E.Davis, 1970. Integral Animal Behaviour, Mac Millan Company,London, 118pp.
4. Jay, C. Dunlap, Jennifer, J. Loros, Patricia J. De Coursey (ed). 2004. Chronobiology Biological time Keeping, Sinauer Associates Inc, Publishers, Sunderland, MA.

Expected Course Outcome:		
Upon completion of this course, Students would have		
I	Recall and record genetic basis and evolutionary history of behaviour.	**K1 & K2**
II	Analyse and identify innate, learned and cognitive behaviour and differentiate between various mating systems.	**K3 & K4**
III	Classify movement and migration behaviours and explain environmental influence upon behaviour.	**K1, K4 & K5**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	2	2	1	1	2	2	1	1
CO2	3	2	1	1	3	1	2	2	1	2
CO3	2	1	2	1	3	3	2	3	2	3
CO4	3	3	3	3	2	3	1	1	1	3
CO5	3	1	1	1	2	1	1	3	2	2

3 - Strongly Correlated; 2 - Moderately Correlated;
1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	**23P3PZOAECC3**	**Ability Enhancement Compulsory Course – Research Methodology**	**2**	**2**

Nature of the course

Relevant to Local need		Employability Oriented	√	Addresses Professional Ethics	√
Relevant to national need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to regional need		Skill development Oriented	√	Addresses Environment and Sustainability	√
Relevant to Global need	√			Addresses Human Values	√

Course Objectives:

The main objectives of this course are:

1. To write report / thesis / dissertation and or for publications in appropriate research journals.
2. The aim of the paper is a strong foundation for the student for thesis writing, editing, analysis and interpretation

UNIT	Content	No. of hours
I	Research: Selection of research problem – stages in the execution of research: choosing a topic to publication – preparation of manuscript – report writing – format of journals – proof reading – sources of information : journals, reviews, books, monographs etc –Thesis writing and their standard format – standard organization of bibliography. Planning of research: Research proposals, time scheduling of research, available sources and generation of funds and facilities	2 **hours**
II	Journals: Standard of research journals – paid and refereed journals – impact factor, citation index, H-index and plagiarism. Choice of journals for publication. Information retrieval: access to archives and databases, search engines: Google, Pubmed, NCBI, etc.,National Informatic Center - Online data base library	2 **hours**

Text Books

1. Garg,B.L.,Karadia,R.,Agarwal,F.andAgarwal,U.K.,2002.*AnintroductiontoResearchMethodology*,RBSAPublishers.
2. Kothari,C.R.,1990.*ResearchMethodology:MethodsandTechniques*.NewAgeInternational.418p.
3. Sinha,S.C.andDhiman,A.K.,2002.*ResearchMethodology*,EssEssPublications.2volumes.
4. Trochim,W.M.K.,2005.*ResearchMethods:theconciseknowledgebase*,AtomicDogPublishing.270p.

5. Dawson,Catherine,2002,Practical Research Methods,NewDelhi,UBS
6. Kothari,C.R.,1985,ResearchMethodology-MethodsandTechniques,NewDelhi

Reference Books

1. J.A.Bryan, Introduction to bioethics(2018),2ndedition
2. P. Narayanan, Intellectual Property Laws, Eastern Law House.
3. Meenu Paul, Intellectual Property Laws, Allahabad Law Agency.

Web resources

- https://bbamantra.com/research-methodology/
- https://www.researchgate.net/publication/329736173_Research_Methodology_Msc_notes_of_Dr_Judu_illavarasusvyasa_univ

Expected Course Outcome:		
Upon completion of this course, Students would have		
I	After studied unit1,the student will be able to understand research concepts,issues and types and basic knowledge of qualitative research, observation and Collection of data and Generalization and Interpretation	**K1 & K2**
II	Afterstudiedunit-2,the student will be able to Have adequate knowledge of ethics, plagiarism, citation and acknowledgment	**K3 & K4**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	2	2	1	1	2	2	1	1
CO2	3	2	1	1	3	1	2	2	1	2
CO3	2	1	2	1	3	3	2	3	2	3
CO4	3	3	3	3	2	3	1	1	1	3
CO5	3	1	1	1	2	1	1	3	2	2

3 - Strongly Correlated; 2 - Moderately Correlated;
1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Title of the Course	Hours of Teaching / Week	No. of Credits
IV	**23P4ZOC10**	**GENETICS**	**6**	**4**

Nature of the course

Relevant to Local need		Employability Oriented		Addresses Professional Ethics	
Relevant to national need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to regional need		Skill development Oriented	√	Addresses Environment and Sustainability	
Relevant to Global need	√			Addresses Human Values	√

Course Objectives:

- To understand the principles of Mendelian inheritance.
- To gain insight into sequential events occurs during protein synthesis.
- To learn the structure and function of chromosome and chromosomal basis of genetic disorders.
- To inculcate molecular approach in genetics.
- To acquire knowledge about microbial genetics.
- To provide information about rDNA technology and its application.

Unit	Content	Hours
I	**Mendelian principles:** Dominance, segregation, independent assortment. Concept of gene: Allele, multiple alleles, pseudo allele. Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy.	**18**
II	**Molecular Genetics:** Genetic code - Methods of deciphering the genetic code and general features of the code word dictionary. Chromosomal genetics: Molecular structure of chromosomes - Variation in chromosome number (Euplndy and Aneuplandy) and structure - Chromosome nomenclature - Chromosomal syndromes. Grors of metabolism.	**18**
III	**Microbial Genetics:** DNA as the genetic Materials -Genetics of Virus - Viral chromosome, Lytic cycle, Lysogenic cycle - Bacterial genetics -Bacterial genome - Gene transfer mechanisms in bacteria and virus - conjugation, transduction and transformation	**18**
IV	**Recombinant DNA technology:** Recombinant DNA technology - Overview - Physical and Chemical properties of nucleic acid, base properties, denaturation and renaturation, hybridization. Tools for Recombinant DNA Technology – Vectors - types - Techniques used in recombinant DNA technology - generation of DNA fragments - Restriction endonucleases, DNA modifying enzymes, Ligases.	**18**
V	**Gene transfer techniques and applications in rDNA technology:** Introduction of rDNA into host cell - calcium chloride mediated gene transfer - *Agrobacterium* mediated DNA transfer, electroporation, microinjection, liposome fusion, particle gun bombardment - Selection and screening of transformed cells - Expression of cloned gene; Application of rDNA technology in human welfare - Environment, Medicine and Agriculture.	**18**

Text Books:

1. SinghB. D. (2022) Fundamentals of Genetics, Medtech Science Press.
2. Veer Bala Rastogi (2019) Genetics 4th edition, Medtech.
3. Meyyan.R.P. (2017) Genetics,Saras Publication.
4. Phundan Singh (2012) Principles of Genetics Kalyani Publishers.
5. Verma.P.S. and V. K. Agarwal. (2009) Genetics, S Chand & Co Ltd.
6. Gardner, E. J., M. J. Simmons and D.P. Snustad. 2006. Principles of Genetics. 8th Edition, John Wiley & Sons. INC. New York, pp-740.
7. Brooker, R. J. 2014. Genetics: Analysis and Principles. 5th Edition, McGraw Hill Publsiher, pp-880.
8. Russell, P.J. 2005. Genetics: A Molecular Approach (2nd Edition). Pearson/Benjamin Cummings, San Francisco, pp-850.

Reference Books:

1. Hartl D. L. and Jones E. W, (1998) Genetics- Analysis of Genes and Genomes - Jones & Bartlett
2. Griffith A. F. et al (2004)An Introduction to Genetic Analysis , Freeman
3. Snustad D. P. and Simmons M. J, Principles of Genetics (1997) - John Wiley & Sons.
4. Strickberger M. W Genetics (2005) -., Prentice-Hall
5. Mange and Mange (1993) Basic Human Genetics, Sinauer Assoc ,Inc.US
6. Klug, Cummings, Spencer, Palladino, and Killian, (2019), "Concepts of Genetics", 12th editionPearson Benjamin Cummings, ISBN978-0-134- 60471-8
7. Strachan and Read (2012), Human Molecular Genetics 4th Ed., Wiley
8. Brown, T.A.(2006), Gene Cloning and DNA Analysis - An Introduction, Blackwell

Pedagogy: Lecture, Assignment,PPT, Group Discussion

(Please mention teaching / Learning methods like **Lecture**, Tutorial, **Assignment,PPT** presentation, Quiz, **Group Discussion**, e-content Seminar etc.)

Expected Course Outcomes (CO):

After the successful completion of the course, students will be able to

CO Number	CO Statement	Cognitive Level
CO1	Explain the organization and functions of genetic material in the living system.	**K1 & K2**
CO2	Understand various sequential processes in protein synthesis	**K1 & K2**
CO3	Explicate the structures and functions of chromosomes and identify the diseasescaused by the chromosomal abnormalities.	**K2 & K4**
CO4	Distinguish lytic and lysogenic cycle and explain the mechanisms of genetic recombination of the microbes.	**K2 & K5**
CO5	Understand the principle and application of rDNA technology for the welfare of human being.	**K2 & K3**

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
K5 – Evaluate; **K6 –** Create

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	2	1	1	3	3	3	1	2	3
CO2	3	2	2	2	3	2	2	2	1	3
CO3	2	3	1	1	2	3	2	1	3	1
CO4	3	2	3	2	2	3	3	3	3	3
CO5	3	3	3	2	2	3	2	3	2	2

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
IV	23P4ZOC11	EVOLUTION	5	4

Nature of the course

Relevant to Local need		Employability Oriented		Addresses Professional Ethics	√
Relevant to national need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to regional need		Skill development Oriented	√	Addresses Environment and Sustainability	√
Relevant to Global need	√			Addresses Human Values	√

Course Objectives:

The main objectives of this course are to:

- To make the students aware of the historical periods during the evolution of earth and status of fauna during the particular age.
- To develop an idea regarding the evolution of various vertebrate forms
- To develop an idea of the adaptations and its significance in relation to evolution.
- To make the students aware of how organic evolution occurred and how the various life forms come into existence.
- To develop an idea of the distribution of the various faunal components.

Unit	Content	No. of Hours
I	**Emergence of evolutionary thoughts:** Lamarck and Darwin–concepts of variation, adaptation, struggle, fitness and natural selection – Mendelism - Spontaneity of mutations - The evolutionary synthesis	15 Hrs
II	**Origin of cells and unicellular evolution:** Origin of basic biological molecules - Abiotic synthesis of organic monomers and polymers - Concept of Oparin and Haldane - Experiment of Miller (1953) - The first cell - Evolution of prokaryotes - Origin of eukaryotic cells - Evolution of unicellular eukaryotes - Anaerobic metabolism, photosynthesis and aerobic metabolism	15 Hrs
III	**Paleontology and evolutionary history:** The evolutionary time scale - Eras, periods and epoch - Major events in the evolutionary time scale - Origins of unicellular and multi cellular organisms - Stages in primitive evolution including *Homosapiens*	15 Hrs
IV	**Molecular evolution:** Molecular divergence - Molecular tools in phylogeny, classification and identification - Protein and nucleotide sequence analysis -Origin of new genes	15 Hrs

	and proteins - Gene duplication and divergence	
V	**Evolutionary mechanisms:** Population genetics - Populations, Gene pool, Gene frequency - Hardy-Weinberg Law - concepts and rate of change in gene frequency through natural selection, migration and random genetic drift- Adaptive radiation - Isolating mechanisms – Speciation - Allopatricity and Sympatricity - Convergent evolution - Sexual selection - Co-evolution - Altruism and evolution	15 Hrs

Text Books

1. Bergstrom, C. T. and L. A. Dugatkin. 2012. Evolution,Second MEDIA Edition. W.W. Norton & Company, International Student Edition, pp-756.
2. Jobling, M., E. Hollox, M. Hurles, T.Kivisild and C. T.Tyler Smith. 2014. Human Evolutionary Genetics. Second Edition. Garland Sciences, London, pp-650.
3. Veer Bala Rostogi, 2018. Organic Evolution (Evolutionary Biology), Thirteenth Edition Vinoth Kumar Jain, Scientific International (Pvt.) Ltd, New Delhi, pp-590.

References

1. Strickberger. M. W. 2000. Evolution. Third Edition, Jones Bartlett Publishers, pp-722.
2. Hall B. K. and B. Hallgrimsson. 2014. Strickberger's Evolution. Fifth Edition, Bartlett Learning, An Ascend Learning Company, pp-642.
3. Barton, N.H., D. Briggs, J.A. EisenDavid,D.B. Goldstein and N.H. Patel. 2007. Evolution. Cold Spring Harbor Laboratory Press, pp-833.

Web resources

- https://www.flipkart.com/books/evolution~contributor/pr?sid=bks
- http://www.evolution-textbook.org/
- https://onlinelibrary.wiley.com/journal/15585646
- http://darwin-online.org.uk/
- http://science.kennesaw.edu/~jdirnber/InvertZoo/Tree/InvertTreeSimple.html
- http://sysbio.oxfordjournals.org/content/6/4/187.extract

Pedagogy: Teaching / Learning methods

CourseOutcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Cognitive Level
CO1	To understand the concept of evolution. It provides a comprehensive account of evidences to support concept of evolution and different theories for exploring the mechanism of evolution.	**K1 & K3**
CO2	Study the origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.	**K1 & K2**
CO3	Understand the major events in the evolutionary time scale; Origins of unicellular and multi-cellular organisms.	**K2 & K3**
CO4	Comprehend the origin of new genes and proteins; Gene duplication and divergence.	**K2 & K4**
CO5	Appreciate the concepts and rate of change in gene frequency through natural selection, migration and random genetic drift	**K4 & K5**

Cognitive Level :K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Specific Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	2	3	2	1	3	2	1	2
CO2	3	3	1	3	3	1	3	3	3	3
CO3	3	2	3	3	3	3	3	1	1	2
CO4	3	3	3	3	3	2	3	3	3	1
CO5	3	3	3	2	2	3	3	1	1	2

3 - Strongly Correlated; 2 - Moderately Correlated;1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No.of Credits
VI	**23P4ZOC12**	**ECOLOGY**	**5**	**4**

Nature of the course

Relevant to Local need	√	Employability Oriented	√	Addresses Professional Ethics	
Relevant to national need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to regional need	√	Skill development Oriented	√	Addresses Environment and Sustainability	√
Relevant to Global need	√			Addresses Human Values	√

Course Objectives:	
The main objectives of this course are:	
1.	Knowing the ecology and climatic changes at world level and its impact on natural resources.
2.	Understanding the contributing factors for pollution in the environment and the ways in controlling and restoring to natural conditions
3.	Understand the species interaction and community ecology
4.	Understand the Eco system of terrestrial and water in a comparative manner.
5.	Acquire students with knowledge about the Pollution and and control measures. Conservation biology

Unit	Content	No. of Hours
I	The Environment: Physical environment; biotic environment; biotic and abiotic interactions.Habitat and niche:Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.	15
II	Population ecology:Characteristics of a population; population growth curves; population regulation; life history strategies (*r* and *K* selection); concept of metapopulation-demes and dispersal, interdemic extinctions, age structured populations -action taken to control population explosion.	15
III	Species interactions:Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.Community ecology:Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.Ecological succession:Types; mechanisms; changes involved in succession; concept of climax	15
IV	Ecosystem:Structure and function; energy flow and mineral cycling (CNP); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.	15

V	Applied ecology:Environmental pollution; global environmental change; biodiversity-status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches - Waste management.Conservation biology:Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).	15

Text Books:

1. Odum, E.P. 1893. Basic Ecology, Saunders & Co., Philadelphia, pp-383.
2. Barthwl, R.R. 2002. Environmental Impact Assessment, New Age International Publishers, New Delhi, India, pp-425.
3. United Nations Environment Programme (UNEP). 1995. Global Biodiversity Assessment, Cambridge University Press, pp-1140.
4. Krishnamurthy, K.V. 2003 Text book of Biodiversity, Science publishers Inc.

References :

1. Sharma, P.D. 2009. Ecology and Environment, Rastogi Publication, India, pp-616.
2. Calabrese, E.J. 1978. Pollutants and High-Risk Groups, John Wiley, pp-286.
3. Raven, P.H. and L.R. Berg, G.B. Johnson, 1993. Environment, Saunders College Publishing, pp-579.
4. Cunningham, W. P. and B. W. Saigo, 1999. Environmental Science, McGraw Hill Boston, 5th Edition.
5. Online courses.nptel.ac.in / noc 19 - g e 23/previewClass central.com/course/swayam - ecology - and environment – 14021.

Web resources :

1.https://bio.libretexts.org/Bookshelves/Botany/Botany_(Ha_Morrow_and_Algiers)/Unit_4%3A_Ecology_and_Conservation
2.https://en.wikipedia.org/wiki/Ecology
3.https://plato.stanford.edu/entries/ecology/
4.http://ecoursesonline.iasri.res.in/mod/page/view.php?id=128623

Pedagogy: Lecture, Assignment,PPT presentation ,Group discussion .

Course Outcomes:		
On the successful completion of the course, student will be able to		
1.	Learn about the ecosystem, biotic communities and utilizing the energy processing	**K1**
2.	Study the various community and population and population control	**K2 & K3**
3.	Understand the fundamentals of climatic conditions and its impact on environment	**K4**
4.	Realizing the nature of pollution and the ways for its control/reduction	**K4 & K5**
5.	Impact of environmental studies on solid waste management	**K4**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Mapping of course outcomes with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	2	3	3	1	3	2	1	2
CO2	3	3	3	3	3	1	3	3	3	3
CO3	3	2	3	3	3	3	3	1	1	3
CO4	3	3	3	3	3	2	3	3	3	1
CO5	3	3	3	2	3	3	3	1	1	2

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated;
0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No.of Credits
IV	23P4ZOEL5A	Major Elective - V AQUACULTURE	5	3

Nature of the Course

Relevant to Local need		Employability Oriented	√	Addresses Professional Ethics	
Relevant to national need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to regional need		Skill development Oriented	√	Addresses Environment and Sustainability	√
Relevant to G obal need	√			Addresses Human Values	√

Course Objectives:

The main objectives of this course are:

- Students should know basic concepts in Aquaculture.
- Students should know the fin fishes and shell fishes of commercially important candidate species.
- To Understand the Present Status of Aquaculture In India.
- To Study the Engineering and Culture Aspects of Aquaculture System.
- To Understand the Feeding Biology, Natural Food, Supplementary Feeds,
- To Know the Induced Breeding And Pathology of Cultivable Species

Unit	Content	No. of Hours
I	Importance of aquaculture- Present status, prospects and scope in India. Freshwater aquaculture- Brackishwater aquaculture- Mariculture - Metahaline culture in India. Types of fish culture -Types of fish ponds for culture practice. Topography, site selection - water quality - soil condition and quality – structure and construction design and layout - inlet and outlet. Water quality management for aquaculture. Control of parasites, predators and weeds in culture ponds. Fish farm implements - Secchi disc - aerator - pH meter - tools for hypophysation - feeding trays – Fishing gears used in aqua farming.	15Hrs
II	Hatchery technology for major carps and freshwater prawn. Artificial seed production –Breeding under control conditions, induced breeding technique, larval rearing, packing and transportationCommercial substitute for pituitary extracts. Classification of fish feed- Artificial feedsTypes, Feed - formulation - feeding methods. Live feed- Microalgae, Rotifer, Artemia and their culture.	15Hrs
III	Shrimp hatchery technology - Hatchery design, brood stock management, spawning, larval rearing, Shrimp developmental stages, algal culture, packing and transportation. - Biofloc technology - Culture operations (water quality, feed and health management) - harvesting, preservation and marketing.	15Hrs

	Brackish water fish culture. Edible and Pearl oyster culture - pearl production. Crab culture. Economic importance of Lobster, Sea urchin and Sea cucumber - their by-products. Types of Seaweeds - species and methods of culture - by-products.	
IV	Fish and Shrimp diseases and health management – infectious diseases - Bacterial, Fungal, Viral, Protozoan; Non-infectious - environmental and nutritional diseases. Diseases diagnosis, prevention and control measures.	**15Hrs**
V	Types of ornamental fishes (freshwater and marine), their breeding behavior and biology. Oviparous, Ovo-viviparous and Viviparous fishes. Setting and maintenance of freshwater Aquarium tanks. Central aquaculture research organizations- CMFRI, CIBA, CIFT, CIFA, CIFE, MPEDA and its activities.	**15Hrs**

Text Book:

1. Pillay, T. V. R. (1990). Aquaculture: Principles and Practices. Blackwell Scientific Publications Ltd.
2. Santhanam, R. (1990). Fisheries Science. Daya Publishing House.
3. Sinha, V.R. P. and Srinivastava, H. C. (1991). Aquaculture Productivity. Oxford and IBH Publications CO., Ltd., New Delhi.
4. Yadav, B. N. (1997). Fish and fisheries.Daya Publishing house, New Delhi.

Reference Books:

1. Das M. C. and Patnaik, P. N. (1994) Brackish water culture. Palani paramount Publications, Palani, T. N.
2. Day, F (1958). Fishes of India , VoL I and Vol. II. William Sawson and Sons Ltd., London.
3. Jhingran, V. G. (1991). Fish and Fisheries of India. Hindustan Publishing Co., India
4. Maheswari. K. (1983) Common fish disease and their control. Institute of Fisheries Education, Powarkads (M.P).

Pedagogy:
Lecture, Assignment,PPT presentation, Group Discussion

Course Outcome:		
Upon successful completion of this course, Students would have		
I	To develop knowledge on the fish farm and their maintenance.Understand the methods of fish seed and feed production anddevelops knowledge on hatchery techniques	**K1& K2**
II	To apply the knowledge about different culture methods in aquaculture and gain knowledge on fish and shrimp breeding techniques and larval culture	**K3 & K4**
III	Identifies the different fishes diseases, diagnosis and their management strategies. Understands Ornamental fishes and central aquaculture organizations	**K5 & K6**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	2	2	3	3	3	2	2	3
CO2	3	3	3	2	3	3	3	2	3	3
CO3	3	3	3	3	3	3	3	3	3	2
CO4	3	3	2	3	3	3	3	2	2	3
CO5	3	3	2	3	2	3	2	1	S	3

3 - Strongly Correlated; **2 -** Moderately Correlated;
1 - Weakly Correlated; **0 –** No correlation

Semester	Course code	Title of the course	Hours of teaching / week	No.of Credits
IV	**23P4ZOEL5B**	**Major Elective - V MICROBIOLOGY**	**5**	**3**

Nature of the course

Relevant to Local need		Employability Oriented	√	Addresses Professional Ethics	√
Relevant to national need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to regional need		Skill development Oriented		Addresses Environment and Sustainability	√
Relevant to Global need	√			Addresses Human Values	√

Course Objectives

- To know the scope of Microbiology,
- To learn the techniques on the isolation of Microbes.
- To study the role of microbes in Industry.
- To study the role of microbes in Environment.
- To analyse the Pathogens and their treatment in human diseases

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**Introduction to Microbiology** History of Microbiology - Discovery of microorganisms (Robert Hooke & Leeuwenhoek) Contributions of Francesco Redi, Needham, Splallanzani, Pasteur, Robert Koch, Edward Jenner, Ehrlich, Fleming, and Dubos. Classification based on – Carolus Linnaeus, Carl Woese and Robert –H. Whittaker (Five Kingdom system)	15 Hrs
II	**Structure of Microbes** Bacteria: Ultra structure and functions of bacterial cell wall, plasma membrane, flagella, pili, capsules, nuclear materials and spores. Virus: Structure of enveloped (Morphology and structure of Herpes) and non-enveloped virus (Morphology and structure of Tobacco Mosaic Virus) and bacteriophages (Morphology and structure of T4 Bacteriophage). Fungi –Filamentous, non-filamentous and dimorphic fungi; Morphology and structure of *Aspergillus niger* and *Saccharomyces cerevisiae*.	15 Hrs
III	**Metabolic activity of Microbes** Metabolic diversity among organisms – Photoautotrophs, Photoheterotrophs, Chemoautotrophs, Chemoheterotrophs. Energy production –oxidation –Reduction reactions, Oxidative and Phosphorylation. Metabolic pathways of energy production – Glycolysis,	15 Hrs

	Entner –Doudoroff pathway, Aerobic and Anaerobic respiration, Photosynthetic metabolisms – Light & Dark reactions.	
IV	**Food and Environmental Microbiology** Food Microbiology: Types of foods – Spoilage process (souring, putrefaction, rancidity and soft rot) Preservation of foods (Physical and Chemical agents) Food poisoning and Microbial toxins. Environmental Microbiology – Role of microorganisms in nutrient cycling - Nitrogen, Carbon, Sulphur and Phosphorous.	15 Hrs
V	**Applied Microbiology** Sewage Treatment, Biofertilizer (Rhizobium, Azolla) Production of Penicillin and SCP. Microorganisms and Human disease – Causative agent, symptoms, transmission, prevention and control of Bacterial disease: Pneumonia, Diphtheria, Tuberculosis, Meningitis, Typhoid, Cholera, Plague and leprosy; Viral diseases – Influenza, Chicken Pox, hepatitis, Poliomyelitis, Rabies, Japanese encephalitis and HIV infection (AIDS).	15 Hrs

Text Books

1. Pelczar, M.J., E.C.S. Chan and N.R. Kreig. 2009. Microbiology, 5th edition. McGrawHill. Book Co. Singapore
2. Tortora, G.J., Funke, B.R. and Case, C.L. 2009. Microbiology: An Introduction. 9th edition, Pearson Education, Singapore

Reference Books

1. Alcamo, I.E. 2001. Fundamentals of Microbiology, 6th edition, Addison Wesley Longman, Inc. California.
2. Alexopoulos, C.J., C.W. Mims and Blackwell, M. 2000. Introductory Mycology. 5th edition, John Wiley & Sons. Chichester.
3. Atlas, R.A. and Bartha, R. 2000. Microbial Ecology. Fundamentals and Application, 4th edition Benjamin Cummings, New York.
4. Black, J.G.2005. Microbiology-principles and explorations, 6th edition. John Wiley & Sons, Inc. New York.
5. Dubey, R.C. and Maheswari, D.K. 2010. A Text Book of Microbiology. 3rd edition S. Chand, New Delhi.
6. Frazier, W.C., and Westhoff, D.C. 2005. Food Microbiology, sixth edition, Tata McGraw Hill Publishing Ltd., New Delhi.
7. Johri, R.M., Snehlatha, Sandhya Shrama, 2010. A Textbook of Algae. 2nd edition, Wisdom Press, New Delhi.
8. Kanika Sharma, 2011. Textbook of Microbiology – Tools and Techniques. 1st edition, Ane Books Pvt. Ltd., New Delhi.
9. Madigan, M.T., Martinkl, J.M. and Parker, J. 2009. Brock Biology of Microorganisms, 12th edition, MacMillan Press, England.
10. Prescott, L.M., Harley, J.P. and Klein, D.A. 2008. Microbiology 7th edition, McGraw Hill, New York.
11. Schlegel, H.G. 2008. General Microbiiology, 7th edition, Cambridge University Press, U.K.

Web Source:

- https://microbenotes.com/category/basic-microbiology/
- https://microbiologyinfo.com/different-size-shape-and-arrangement-of-bacterial-cells/

- https://www.mednotes.in/2021/07/microbiology.html
- https://faculty.ksu.edu.sa/sites/default/files/140_mbio-final_notes.pdf

Pedagogy: Teaching / Learning methods
(Please mention teaching / Learning methods like **Lecture**, Tutorial, **Assignment,PPT presentation**, Quiz, Group Discussion, **e-content Seminar** etc.)

CourseOutcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Cognitive Level
CO1	Students knowing the scope of Microbiology, classification and structure of microorganisms and enhancing the technical process about microorganisms such as isolation, preservation and maintenance.	**K1 & K2**
CO2	Understand the food contamination by microorganism, different methods of detoxification and food sanitation in food manufacturing industries.	**K2 & K3**
CO3	Gain the knowledge of bio-geo cycle of microorganisms in the environment, role of biofertilizer and biopesticides for improving fertile soil quality and biodegradation using genetically engineered microorganism.	**K3 & K4**
CO4	Understand the microbiology of water and methodology of sewage treatment in industrial and municipal effluents.	**K2, K4 & K5**
CO5	Focusing the knowledge of Pathogen, Pathogenesis and diagnosis of various microorganisms.	**K3, K4, K5 & K6**

Cognitive Level :K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Specific Outcomes

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	2	2	2	3	2	2	3
CO2	3	3	3	2	2	2	3	3	2	3
CO3	3	3	3	3	2	2	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	2

3 - Strongly Correlated; **2 -** Moderately Correlated;
1 - Weakly Correlated; **0 –** No correlation

Semester	Course code	Title of the course	Hours of teaching / week	No.of Credits
III	**23P4ZOSEC4**	**SKILL ENHANCEMENT COURSE - APICULTURE**	**2**	**2**

Nature of the course

Employability Oriented	√	Relevant to Local need	√	Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to regional need		Addresses Environment and Sustainability	√
Skill development Oriented	√	Relevant to national need		Addresses Human Values	√
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives:

The main objectives of this course are:

1. Students should know basic concepts in apiculture.
2. To analyze the quality of honey.
3. To realize the Economics of bee culture

UNIT	Content	No. of hours
I	Honeybee – Systematic position – Biology – Life history of honey bee – Bee colony – Castes – natural colonies and their yield – Types of bee hives – Structure – location, care and management.	**15 hours**
II	Bee keeping equipment: – Artificial bee hives – types – construction of space frames – Selection of sites – Handling –Instruments employed in Apiary – Extraction instruments. Honey – Composition – uses – Quality of honey - Bee wax and its uses – medicinal importance- commercial value-yield in national and international market – Enemies - Diseases of honey bees and their control methods.	**15 hours** 6 **hours**

Text Books:

1. Singh, D., Singh, D. Pratap. 2006. A Handbook of Beekeeping. AGROBIOS (INDIA)
2. Sharma P.L. and Singh, S.H. Book of Bee keeping.
3. Cherian and Ramanathan, S. Bee keeping in south India.
4. Prospective in Indian Apiculture - R.C. Mishra.

Reference Books:

1. Caron, D.W. 2013 (revised from 1999). Honey Bee Biology and Beekeeping. Wicwas Press. Cheshire, CT, 368 pp.
2. Kaspar, R., C. Cook, and M. D. Breed. 2018. Animal Behaviour 142: 69-76.
3. Hendriksma, H. P., A. L. Toth, and S. Shafir. 2019. Individual and Colony Level Foraging decisions of Bumble Bees and Honey Bees in Relation to Balancing of Nutrient Needs. Frontiers in Ecology and Evolution 7: 177.
4. Steinhauer, N. et al. 2018. Drivers of Colony Loss. Current Opinion in Insect Science 26: 142-148.

5. Technology and value addition of Honey - Dr. D. M. Wakhle and K. D. Kamble.
6. ABC & XYZ of Bee culture - A. I. Root.

Course Outcome:		
On the successful completion of this course, students will be able to:		
I	Clear understanding of morphology, life cycle, characteristics of honey bees and bee keeping.	**K1, K2 & K3**
II	Acquired skills to perform bee keeping from managing colonies of bees in order to harvest honey and other Bee related by-products in different setups and as an Entrepreneurial venture.	**K3, K4 & K5**
III	Knowledge on the harvesting, preserving and processing of bee products and identification of the appropriate markets to sell the produce.	**K5 & K6**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create