KONGUNADU ARTS AND SCIENCE COLLEGE
(AUTONOMOUS)

COIMBATORE-641 029

DEPARTMENT OF ZOOLOGY

(PG)

CURRICULUM AND SCHEME OF EXAMINATIONS
(CBCS)
(2020 - 2021)

PG PROGRAMME OUTCOMES (PO)

PO1.	Understand the new avenues of the biological sciences and imbibe the knowledge from different perspectives.
PO2	Understand concept behind genetic disorder, gene-mutations – various disorders associated with inborn errors of metabolism
PO3	Understand the interactions and interdependence of physiological and biochemical process
PO4	Gain knowledge and understands concepts of beneficial and non-beneficial insects, interaction of insects with its environment, Role of insects in day to day life.
PO5	Imparts in depth knowledge of tissues, cells and molecules involved in host defense mechanisms.
PO6	Provides knowledge on recombinant DNA technology and its application
PO7	Enrich knowledge on ornamental fish breeding which is highly professional and attractive avenue for youngsters.
PO8.	The students will be well equipped to become competent in research and teaching profession after they get graduated.

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO1.	Understand the physiological, molecular, biotechnological and Environmental development in relation to animals.
PSO2.	Understand the various application of Biotechnology in society
PSO3.	Explore the nature and basics and interaction of molecules in cell.
PSO4.	Acquire knowledge and skill on Aquaculture related to various scientific phenomena and their relevance in the day-to-day life
PSO5.	Develop scientific outlook not only with respect to science subjects but also in all aspects related to life.

KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)
COIMBATORE – 641 029
Course Name: M.Sc., Zoology
Curriculum and scheme of Examination under CBCS
(Applicable to students Admitted from the Academic Year 2020-2021)

Semester	Part	Subject Code	Title of the Paper	Instruction	Exam. Marks			Duration of Exam (hours)	Credits
					CIA	ESE	TOTAL		
SEMESTER I									
I	I	20PZO101	Core Paper 1 Animal physiology	5	25	75	100	3	5
		20PZO102	Core Paper 2 Cell and Molecular biology	5	25	75	100	3	4
		20PZO103	Core Paper 3 Biotechnology	5	25	75	100	3	5
		20PZO104	Core Paper.4 Aquaculture	4	25	75	100	3	5
		20PZO2CL	Core Practical. 1	4	-	-	-	-	-
		20PZO2CM	Core Practical. 2	4	-	-	-	-	-
		20PZO2N1	Non Major Elective I	3	25	75	100	3	4
			Total	**30**	125	**375**	**500**		**23**
SEMESTER II									
II	I	20PZO205	Core Paper 5 Biostatistics and Bio informatics	6	25	75	100	3	5
		20PZO206	Core Paper 6 Molecular Genetics	6	25	75	100	3	5
		20PZO207	Core Paper 7 Immunology and Microbiology	6	25	75	100	3	4
		20PZO2CL	Core Practical 1	4	40	60	100	4	2
		20PZO2CM	Core Practical 2	4	40	60	100	4	2
		20PZO3N2	Non Major Elective. II	4	25	75	100	3	4
			Total	**30**	**180**	**420**	**600**		**22**

SEMESTER III									
III	I	20 PZO308	Core Paper 8 Entomology	5	25	75	100	3	5
		20PZO309	Core Paper 9 Bio physics and Bioinstrumentation	5	25	75	100	3	4
		20 PZO310	Core Paper 10 Developmental Biology	6	25	75	100	3	5
		20PZO4CN	Core Practical .3	4	-	-	-	-	-
		20PZO4CO	Core Practical .4	4	-	-	-	-	-
		20PZO3E1	Major Elective. I	4	25	75	100	3	5
			EDC-Extra Departmental Course	2	25	75	100	3	2
			Total	**30**	**125**	**375**	**500**		**21**
SEMESTER IV									
IV	I	20 PZO411	Core Paper 11 Biodiversity and Evolution	5	25	75	100	3	5
		20PZO412	Core Paper.12 Applied Entomology	6	25	75	100	3	5
		20PZO4CN	Core Practical 3	4	40	60	100	4	2
		20PZO4CO	Core Practical .4	4	40	60	100	4	2
		20PZO4E2	Major Elective II	6	25	75	100	3	5
		20PZO4Z1	Project and Viva voce	5	20	80	100	-	5
			Total	**30**	**175**	**425**	**600**		**24**
			Grand Total		**605**	**1595**	**2200**		**90**

Note:

CBCS – Choice Based Credit System
CIA – Continuous Internal Assessment
ESE – End of Semester Examinations

MAJOR ELECTIVE PAPERS

(2 papers are to be chosen from the following 4 papers**)**

1. Environmental Biology
2. Wild Life Ecology and Management
3. Environmental Biology and Toxicology
4. Poultry Science and Management

NON –MAJOR ELECTIVE PAPERS

(2 papers are to be chosen from the following 4 papers**)**

1. Nutrition and Dietetics
2. Ecotourism
3. Nanobiotechnology
4. Human genetics and Counseling

Extra Departmental Course

1. 20P203XI – EDC Paper I - Vermitechnology

Tally Table:

Part	Subject	No. of Subjects	Total Marks	Credits
I	Core – Theory / Practical / Project	18	1800	70
	Major Elective Paper	2	200	10
	Non Major Elective Paper	2	200	10
	Grand Total	**22**	**2200**	**90**

- 25 % CIA is applicable to all theory subjects except JOC, ALC, COP and Diploma Courses, which are considered as extra credit courses.
- The students should complete a **SWAYAM-MOOC** before the completion of the 3rd semester and the course completed certificate should be submitted to the HOD. Two extra credits will be given to the candidates who have successfully completed.
- A **field Trip** preferably relevant to the course should be undertaken every year.

PZO 4

Components of Continuous Internal Assessment

Components		Marks	Total
Theory CIA 1	75	**75+75=150/10 15**	**25**
Assignment / Seminar		**5**	
Attendance		**5**	
Practical			
CIA Practical		**25**	**40**
Observation Notebook		**10**	
Attendance		**5**	
Project			
Review		**15**	**20**
Regularity		**05**	

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PZO 5

Bloom's Taxonomy Based Assessment Pattern

K1- Remember ; K2-Understanding ; K3- Applying ; K4- Analyzing ; k5 – Evaluating

1.Theory Examination – Part I, II and III

(i) CIA I & II and ESE : 75 Marks

Knowledge level	**Section**	**Marks**	**Description**	**Total**
K1 –K2	A (Answer all)	10X1=10	MCQ	75
K2 – K4	B (Either or Pattern)	5X5 = 25	Short Answer	
K2 – K4	C (Either or Pattern)	5X8 = 40	Descriptive/ Detailed	

(ii) CIA I & II and ESE : 55 Marks

Knowledge level	**Section**	**Marks**	**Description**	**Total**
K1 –K2	A (Answer all)	10X1=10	MCQ	55
K2 – K4	B (Either or Pattern)	5X3 = 15	Short Answer	
K2 – K4	C (Either or Pattern)	5X6 = 30	Descriptive/ Detailed	

2.Practical Examination:

Knowledge level	**Section**	**Marks**	**Total**
K2 – K5	Experiments	50	60
	Record Work	10	

3. Project Viva-Voce :

Knowledge level	**Section**	**Marks**	**Total**
K3 – K5	Project Report	60	80
	Viva-Voce	20	

Programme code: 06.		**M.Sc., Zoology**		
Course Code: 20PZO101		Core Paper 1. Animal physiology		
Batch	Semester	Hours / Week	Total Hours	Credits
2020-2021	I	5	75	5

Course Objectives

1.To get knowledge about the structure and functions of various systems

2.To understand the physiology of digestion, respiration, circulation and muscle fibre.

3.To study the structure and functions of endocrine glands.

Course Outcomes

K1 - K4	CO1	Know the importance of nutrients and digestion
	CO2	Understand the physiology of respiration, circulation and muscle
	CO3	Impart knowledge on the role of renal organs in excretion
	CO4	Describe the endocrine glands and their secretions.

SYLLABUS

UNIT I: Digestion and Nutrition **15Hrs**

Nutritional Aspects: Role of Protein, carbohydrate, lipid, mineral and dietary fibers in nutrition, Caloric value of foods, BMR- factors influencing and physiological variations, Role of enzymes in digestion.

UNIT II

Respiration **15Hrs**

Comparison of respiration in different animals. Process of gaseous exchange, Transport of oxygen and CO2,Factors affecting O2 and CO2 transport , Respiratory quotient (RQ) and factors affecting respiratory quotient. Effects of Hypoxia, Oxygen therapy, Control of respiration, Regulation of respiration during exercise, Physiological adaptations at high altitude and deep sea*

UNIT III

Circulation 15Hrs

Blood and its component, its role and functions, types of blood pigments, structure and function, comparative anatomy of vertebrate heart, types of heart, cardiac cycle and its control. Plasma proteins, types, characteristics and its clinical imporatance.Haematological abnormalities (anaemia, leucopenia, leucocytosis, Thromboctopenia) Blood pressure, cardiac cycle and ECG.

UNIT IV

Muscle Physiology & Excretion 15Hrs

Ultra structure of muscle fiber, muscle proteins, Mechanism of muscle contractions, Comparison of vertebrate kidney, patterns of Nitrogen elimination, Mechanism of urine formation, Osmoregulation in fishes, Acid base balance, Regulation of excretion,

UNITV

Endocrine Glands and Reproduction 15Hrs

Pituitary, Thyroid, Parathyroid, Adrenal and Pancreatic glands, Gastro intestinal hormones, Reproductive hormones, Neuroendocrinal regulation and feedback mechanism.

***Self study (Questions may be asked from theses topic also)**

Teaching Methods:

Over Head Projector, Power Point Presentation, Seminar, Smart class, Assignment, Discussion, Quiz.

Text Books:-

1. Goel, K.A, and K.V. Sastry (2012), Animal Physiology, Rastogi publications, Meerut.
2. Guyton C.and John E. Hall. (2006)., Text books of medical physiology- W.B. Saunders Company,
3. Rastogi, S.C. (2003). Essentials of Animal physiology- New Age International (P) Ltd., Publishers.

Reference Books:-

1. Sunetra Roday, (2012), Food science and Nutrition, IInd Ed. Oxford University Press, New Delhi.
2. William S. Hoar, (1984) General and Comparative Physiology, Prentice Hall of India. New Delhi.
3. Singh H.R and Neeraj Kumar (2007), Animal physiology and Biochemistry –Vishal publications, Jalandhar.

4. Chandramouli R. (2010), Text book of Physiology, Jaypee Brothers Publications.

5. Saradhasubramaniam K and P.Madhavankutty, S. (2007). Text books of human physiology- Chand Company Ltd., New Delhi

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	M	H	H	S
CO2	H	S	M	M	H
CO3	H	H	S	M	H
CO4	M	H	H	S	M

S – Strong H – High M – Medium L – Low

Programme code 06	M.Sc Zoology			
Course code-20PZO102	Core paper 2. Cell and Molecular Biology			
Batch 2020-2021	Semester I	Hour/Week 5	Total hours 75	Credit 4

Course Objectives

1. To study the cell membrane, cytoskeleton structure, nucleus and their functions.
2. To impart knowledge on protein synthesis.
3. To include knowledge on the cell cycle, apoptosis, programmed cell death and cancer biology.

Course Outcomes

K1 - K4	CO1	Get knowledge about cell organelles and their functions
	CO2	Understand the various functions adapted inside the cells.
	CO3	Apply knowledge on molecular mechanisms of protein synthesis
	CO4	Acquire knowledge on the cell cycle, signaling pathways and molecular mechanism of cell death

SYLLABUS

UNIT I **15Hrs**

Cell Organelles

Ultra structure, chemical composition and functions of cell membrane Cell transport, types of cell junction – cell communication, and Endoplasmic reticulum, microfilaments and microtubules, Lysosomes, Ribosomes, and Mitochondria.

UNIT II **15Hrs**

Nucleus: Structure, types and composition of DNA. C value paradox, Satellite DNA and its role, nuclear matrix - composition and its role, nucleolus- its structure and function**.**

Chromosomes: Types of chromosomes, basic structural features, chromosomal banding, molecular organization of eukaryotic chromosome, Giant chromosomes, Chromosomal movement during cell division.

UNIT III **15Hrs**

Protein Synthesis : RNA types and their structure and functions, Transcription, Translation. Post translational modifications in Prokaryotes and Eukaryotes, Lac Operon concept.

UNIT IV **15 Hrs**

Cell cycle: Comparative account of cell cycle events in yeasts and animal cells; check points during cell cycle-G1 to S, progression of S phase, G2 to M phase.

Apoptosis: Characteristic features of cells undergoing apoptosis and necrosis, par apoptosis and cell death forms. Apoptosis during developmental process and irregular apoptosis and disease. Mechanism of programmed cell death (PCD), direct activation by death signals. Pathways of Apoptosis*.

UNIT V **15 Hrs**

Cancer: Types of cancer, development of cancer, cancer stem cells, causes of cancer, properties of cancer cells. Metastasis, breast cancer, colon cancer, leukemia. Retroviral oncogenes, protooncogenes, tumor suppressor genes (P53) and their functions. Early detection of cancer, molecular diagnosis, treatment (radiotherapy, chemotherapy, immunotherapy and stem cells).

* Self study (Questions may be asked from these topics also)

Teaching Methods:

Over Head Projector, Power Point Presentation, Seminar, Smart class, Assignment, Discussion, Quiz.

Text books

1. P. K Gupta (2018-19). Cell and Molecular Biology; Rastogi Publication, UP, India
2. Rastogi, S. C. (2010). Cell & Molecular Biology (3rd Edn.,) New Age International (P) Ltd, Publishers New Delhi.
3. Eduardo D.P.De Robertis and E.M.P.De Robertis, (Pb 2017). Cell and Molecular Biology, 8th Edn., Lea & Febiger.
4. Alberts B, A Johnson, J Lewis, D Morgan, M Raff, K Roberts & P Walter (2014) Molecular Biology of The Cell (6th Edn), Garland Science, Taylor & Francis Group, LLC, an informa business, 711 Third Avenue, New York, NY 10017, USA

References:

1. Alberts, B., Bray, D. and Hopkin, K. (2004). Essential Cell Biology. 3rd edition. Garland Science, U.S.A
2. Lodish,H., Berk, A., Zipuoskry, and C. A., Kaiser. (2007) Molecular Biology W.H Freeman G Co. 47
3. Gerald Karp (2013) Cell Biology (7^{th} Edn), Wiley publishers.
4. Geoffrey M Cooper, Robert E Heusman (2016) The Cell; A Molecular Approach, (7^{th} Edn), Sinculler Associates Inc.,

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	POS5
CO1	S	H	S	M	H
CO2	H	S	H	M	M
CO3	S	H	M	H	M
CO4	S	H	S	S	S

S – Strong H – High M – Medium L - Low

Programme code :06	M.Sc Zoology			
Course code 20PZO103	Core Paper 3. Biotechnology			
Batch 2020-2021	Semester I	Hour/Week 5	Total hours 75	Credit 5

Course objective

1. To know the students about the Animal Biotechnology, Industrial and Enzyme
2. To learn knowledge on Agricultural, Environmental and Medical Biotechnology
3. To make the students know about the application of medical biotechnology

Course outcomes

K1 - K4	CO1	Get knowledge about the cell and tissue culture methods of animals
	CO2	Understand the production of monoclonal and polyclonal antibodies and know about the r-DNA technology
	CO3	Apply knowledge in production of Biofertilizers, antibodies, hormones and vaccines.
	CO4	Understand the importance of microbes and Industrial application

SYLLABUS

Unit-i: Tools of genetic engineering 15 hours

Basic principles - mechanism of natural gene transfer by Agrobacterium, generation of foreign DNA molecules, restriction enzymes, their types and target sites, cutting and joining DNA molecules, linkers, adapters, homopolymers, enzymes used in genetic engineering, cloning vehicles and their properties, natural plasmids, in vitro vectors, cosmids and T-DNA based hybrid vectors.

Unit-ii: DNA Cloning and Sequencing 15 hour

Cloning strategies - cloning with single strand DNA vectors, cDNA cloning and gene libraries, recombinant selection and screening methods, expression of cloned genes-problems and solutions, shuttle vectors, DNA sequencing strategies - Sanger's and Maxam - Gilbert's methods, applications of PCR and DNA hybridization, Southern, Northern and Western blotting.

Unit – iii: Primary Culture. 15 hrs

Primary cell culture disaggregation (enzyme, mechanical), separation of viable cells. Maintenance of cell lines. Advantages and disadvantages of finite and continuous cell lines. Cloning of cell lines and cell synchronization. Large scale cell cultures.

Unit – iv Animal Cell Culture 15 hrs

Slide, flask, and test tube culture. Media components, Cell culture contamination-sources, consequences, prevention. Type of animal cell culture – primary, continuous and cancer cell lines. Sub culturing, and cell quantitation. Whole embryo culture . Stem cell technology- basic principle and applications (brief outline), Transgenic animals

Unit – v Applications of Tissue Culture 15 hrs

Applications of animal tissue culture for diagnosis, development of vaccines. Tissue engineering – basic concept. enzyme biotechnology - production and uses of industrially important enzymes such as protease, waste treatment, bioenergy and biogas production. Gene therapy (somatic)-the principle and approaches. Biosafety and Bioethics

Teaching Methods:

Over Head Projector, Power Point Presentation, Seminar, Smart class, Assignment, Discussion, Quiz.

Text books:

1.Kumaresan, V. (2009), Biotechnology. Saras Publications, Kanyakumari.

2.Dubey, R.C. (2012), A text books of Biotechnology - S. Chand and Company, New Delhi.

3. Glick, J. and Jack J. Pasternak, (2010), Molecular Biotechnology-Bernard American Society for Microbiology, 4th edition, Canada.

4. Singh, B. D. (2015). Biotechnology –Kalyani Publishers.

5. Satyanarayana, U. (2008). Biotechnology –Books and Allied Ltd.

Reference Books :

1. Genes - VIII (2003) by Lewin B Oxford University Press

2. Sadasivam, S. (2004). Biochemical methods - New Age International Publications.

3.Jogdand, S. N. (2005). Advances in Biotechnology - Fifth revised edition Published by Himalaya publishing house.

4.Brown, T. A. (2001). Gene cloning and DNA analysis - Fourth edition Blackwell Publishing.

5.Mohan. P. Arora. (2003). Biotechnology - First Edition, Published by Himalaya Publishing House. Edited by Chander Kanta.

MAPPING

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 4
CO1	S	M	H	M	H
CO2	S	M	M	H	M
CO3	H	H	H	H	M
CO4	H	S	H	S	H

S-Strong H- High M-Medium L-Low

Programme Code : 06	M.Sc, Zoology			
Course code: 20PZO104	Core Paper 4 – Aquaculture			
Batch	Semester	Hour/Week	Total hours	Credit
2020-2021	**1**	**4**	60	5

Course Objectives

1. To explore the aquatic resources of the edible and economically important organisms.
2. To make use of the inland waters and marine potential to substitute the protein requirements by the human population.
3. To provide self employment opportunities and knowledge for students.

Course Outcomes

K1 - K4	COI	Get knowledge about the production of cultivable candidate fish species
	CO2	Understand the global, national, traditional and modern techniques related to fishes for food security
	CO3	Apply practical knowledge into the aquaculture field to enhance production level
	CO4	Analyze students theoretical and technical knowledge useful for teaching, research, extension and entrepreneurship in the field of Aquaculture

SYLLABUS

UNIT I **(12Hrs)**

Principle of Aquaculture

Principle of Aquaculture- The need for aquaculture, Over view of national and international Aquaculture. Systems of aqua culture –Extensive, Semi-intensive, intensive, and super intensive aqua culture. traditional aqua culture.

UNIT II (12 Hrs)

Culture of Fishes

Qualities of cultivable species of fishes, Types of culture - Monoculture, Polyculture, pond culture, pen culture, cage culture, running water culture, zero water exchange system, culture sewage fish culture, Paddy fish culture , brackish water culture marine fish culture , integrated fish farming .

UNIT III (12Hrs)

Aquaculture Engineering

Preliminary survey, site selection, topography, location, design and construction of hatcheries, race ways and farm complex. Tide fed and pump fed farms, creeks, estuarine and marine water source utilization. Design and construction of ponds and dykes. Water distribution system- main feeder channel, drainage channel. Types of inlet and outlet and their construction

UNIT IV (12Hrs)

Feed Management

Criteria for selection of candidate species for aquaculture. Live feed culture and its nutritional value. Proximate composition of live feed and Green algae, Blue green algae, Diatoms, Spirulina, *Artemia*, Rotifers, Copepods, feed for formulation, Manufacturing , Feed additives

UNIT V (12Hrs)

Fish diseases and Management

Significance of fish disease in relation to aquaculture*. Host,pathogen and environment interaction. Pathogenecity and mechanism of bacterial, viral and fungal infections of candidate species. Conventional and rapid diagnostic technique. Health management in aquaculture- Drugs, chemicals, antibiotics and probiotics used in aquaculture and their mode of action. Quarantine and health certification in Aquaculture

***Self study (Questions may be asked from theses topic also)**

Teaching Methods:

Over Head Projector, Power Point Presentation, Seminar, Smart class, Assignment, Discussion and Quiz.

Text books

1. Kamaheshwar Pandey and J.P. Shukla (2005). Fish and fisheries. Rastogi Publications, Meerut, India.
2. Ahilan, B. and N.Felix. (2008). Text book of Aquaculture. Daya Publishing House New Delhi, India.
3. Jhingran, V.G. (1991). Fish and fisheries of India. Hindustan Publish Corporation, Delhi.

Reference books

1. Bardach JE, Rhyther JH&Mc. Larney WO.(1972). Aquaculture Farming and Husbandry of Freshwater and marine Organism. Jhon Wiley &Sons. London. UK.
2. Boyd, C.E. and C.S. Tucker, (1992). Water Quality and Pond Soil Analyses for Aquaculture. Alabama Agricultural Experiment Station, Auburn University, Alabama, 183 pp.
3. Pillay TVR and Kutty MN (2005). Aquaculture: Principles and Practices. 2nd ED ISBN: 978-1-405-10532-3, Wiley-Blackwell, 640 pages, Blackwel, Publication.
4. Ayyappan, S. J. K. Jena, A. Gopalakrishnan, A. K. Pandey. (2011). Handbook of fisheries and aquaculture. Indian Council of Agricultural Research. Directorate of Information and Publications on Agriculture, Directorate of Information and Publications of Agriculture, Indian Council of Agricultural Research, New Delhi, India.
5. De Silva SS & Anderson TA. (1995). Fish Nutrition in Aquaculture. Published by Chapman and Hall, United Kingdom.
6. Andrews, C, Excell A and Carrington, N. (1988). The manual of fish health. Salamander Book Ltd. Londaon. pp.209.
7. Shankar, K.M. and C.V. Mohan. (2002). Fish and shellfish health management, UNESCO, New Delhi.

MAPPING

CO \ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 4
CO1	S	H	H	H	S
CO2	M	S	M	H	H
CO3	H	M	H	H	H
CO4	H	H	S	M	H

S-Strong H- High M-Medium L-Lo

Programme Code: 06		M.Sc., Zoology		
Course Code: 19PZO205		Core Paper – 5. Biostatistics and Bioinformatics		
Batch 2018-2019	Semester II	Hours / Week 6	Total Hours 90	Credits 5

Course Objectives

1. Creates awareness on collection, analysis of data and interpretation of results.

2. Students can able to Know the level of significance after analysis of data and also applied in research work.

3.Acquire knowledge on sources for the Biological databases and its storage and Analysis.

Course Outcomes

K1	CO1	Students get the knowledge about sampling techniques
K2	CO2	Understand the test of significance
K3	CO3	Apply the knowledge in Biophysical methods
K4	CO4	It helps to analyze the Bioinformatics tools of Proteomics, Genomics and Drug designing

SYLLABUS

Unit I : Sampling and Tabulation (18 hrs)

Variables in biology, Collection, Classification and Tabulation of data, Frequency distribution, Diagrammatic and graphical representation of statistical data, Sampling techniques, Measures of Central Tendencies- Mean, Median, Mode, Standard Deviation and Standard error*.

Unit II: Test of Significance (18 hrs)

Hypothesis testing and estimation, Measures of relationship. Correlation- Introduction, Types (simple, partial and multiple) and Merits and Demerits – Regression analysis – Definition,

Method of studying regression and uses. Probability- Definition, Types, addition and multiplication theorems

Unit III: Test of samples (18 hrs)

Sampling and sampling errors- Test of significance for small and large sampes. Definitions and applications of Chi-square test, Student's -"t" test and Analysis of variance ("F" test) - one way and two way classified data, Application of SPSS in biology.

Unit IV – Introduction to Bioinformatics, Scope and Application of Bioinformatics, Information technology, systems biology, Introduction to genomics and proteomics databases, Nucleic acids, sequence database, Genbank, EMBL, UCSC, Protein sequence databases, Swiss – port, PDB, BLAST, PSI-BLAST, FASTA, Clustal W.

Unit V – World wide biological databases, Database search-data mining, data management and interpretation, protein prediction tools, multiple sequence alignment, genes and primer modeling, protein structure analysis, docking and phylogenetic analysis, molecular modeling, programme languages for biological studies.

Teaching Methods:

Over head projector, PowerPoint presentation, Seminar, Smart class, Assignment, Discussion, Quiz.

Text books

1. Palanichamy, S. Manoharan, (1992). Biostatistics for biologist - Paramount Publications, Palani
2. Ramakrishnan .P, (2009). Biostatistics for UG and PG students –Saras Publications, Nagercoil.
3. Palanichamy,S., Shanmugavelu (2002) Principles of Biophysics –Paramount Publications, Palani .
4. Vasantha Pattabhi, N.Gautham (2002).Biophysics –. Narosa publishing house, New Delhi, Chennai, Mumbai & Calcutta
5. Jeremy Ramsden, (2015) Bioinformatics –Springer Publication

Reference Books

1. Gupta, S.P. (2001) Satistical methods- Sultan Chand & Sons publications,New Delhi
2. Waynew Daniel (2002) Biostatistics (A Foundation for analysis in the health Sciences) Wiley India (Students Edition) New Delhi.
3. SundarRao, P.S.S. and J. Richard, (2003). An introduction to Biostatistics - Prentice, Hall of India Pvt. Ltd., New Delhi
4. Irfan Ali khan and Atiya Khanum (2004). Fundamentals of biostatistics, Ukaaz publications, Andrapradesh, India
5. Guyton, C and John E. Hall. (2006).Text book of Medical physiology- W.B.Saunders Publications. New Delhi, India.
6. Roy. R.N. (2001).Text book of Biophysics -New central book agencies , Calcutta.
7. Rastogi. S.C. (2001). Essentials of Animal Physiology- New age International (P) Ltd. Publications, New Delhi.
8. Rastogi, S.C . (2013) Bioinformatics : Methods and Applications, PHI,NewDelhi.
9. Harish (2007) -Bioinformatics-.IK International Publishers. Delhi.
10. Ignacimuthu, S.J. (2008). -Text book of Basic Bioinformatics –Narosa Publishing House, New Delhi, Chennai, Mumbai and Kolkata

MAPPING

PSO CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	M	S	H	S	M
CO2	S	M	H	H	S
CO3	M	H	S	M	S
CO4	H	M	M	S	H

11.

12. S – Strong H – High M – Medium L – Low

Programme code :06		M.Sc., Zoology		
Course Code: 20PZO206		Core Paper 6. Molecular Genetics		
Batch 2020 -2021	Semester II	Hours / Week 6	Total Hours 90	Credits 5

Course Objectives

1. To get knowledge about the components of genetic material.
2. To know about genome and their role in inheritance
3. To understand the relation between genes and diseases.

Course Outcomes

K1 - K4	CO1	Get knowledge about the structure, organization and functions of genetic materials.
	CO2	Understand the expression, regulation and mutation of gene.
	CO3	Apply the knowledge on the role of genes in heritability and its measurements
	CO4	Analyze the importance of viral oncogenes, regulation of gene expression and signal transduction by oncoproteins.

SYLLABUS

Unit-I:

Structure of genetic material **18Hrs**

Chromatin structure and nucleosome concept, organization & function of genetic material, Repetitive DNA, Overlapping genes, Split genes, Pseudogenes, Mitochondrial DNA, Types and structure of RNA, Transposons.

Unit-II:

Gene expression **18Hrs**

Genetic structure and analysis of eukaryotic genomes, Gene regulation in prokaryotes and eukaryotes, Gene clustering, Mechanism of positive and negative control of gene expression. Translational and transcriptional control of regulatory mechanism of expression, Environmental effects on gene regulation, Gene silencing and Epigenetics, (Environmental influences).

Unit-III:

Mutation **18Hrs**

Polygenic inheritance – Crossing over – Inborn errors of metabolism – mutation and mutagenesis; Mutation – Types (lethal, conditional and biochemical) causes and detection – loss

of function, gain of function, germinal verses somatic mutants, insertional mutagenesis- molecular basis of mutation – Transition and Transversion – spontaneous and induced mutations, Single Nucleotide polymorphism and genetic disorders*

Unit-IV:

Heredity and variation 18Hrs

Linkage maps, tetrad analysis, Mapping with molecular markers, Mapping by using somatic cell hybrids, Lod score for linkage testing, Karyotyping, Pedigree analysis. Heritability and its measurements, QTL mapping

Unit-V:

Oncology 18Hrs

Viral oncogenes, Activation of proto-oncogenes, Tumour suppressor genes, Regulation of gene expression by oncoproteins, Signal transduction by oncoproteins, cell cycle check points.

***Self study (Questions may be asked from theses topic also)**

Teaching Methods:

Over Head Projector, Power Point Presentation Seminar, Smart class, Assignment, Discussion, Quiz.

Text Books

1. Ajoypaul. (2012) Text book of genetics from genes to genome, Books and allied (p) Ltd, Kolkata.
2.Verma, P.S. and V.K. Agarwal. (2010) Genetics, 21st Ed. S Chand publishers, New Delhi.
3. Singh B.D (2009) Genetics, Kalyani publishers, New Delhi.
4.Gupta PK. (2005) Genetics. III Edn. Rastogi Publication, India.

Reference books

1. Robert H. Tamarin, (2008)Principle of genetics, 7th edition, McGraw-Hill Publishers, London.
2. Strickberger MW(2010) Genetics. II edn. Macmillon Publications. New York.
3. Weaver and Hedrick (1997) Genetics, III Edn.WMC Brown Publishers. McGraw Hill Companies Inc, U.S.

4.Robert H. Lewin (2002) Principles of Genetics,VII Edn. Tata McGraw Hill Publishing Company Ltd, New Delhi.

5.Benjamin Lewin (1997) Genes, Oxford University Press, New York.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	M	H	H	S
CO2	H	S	M	S	H
CO3	H	H	S	M	H
CO4	M	H	S	H	M

S – Strong H – High M – Medium L – Low

Programme Code 06	M.Sc Zoology			
Course code: 20PZO207	Core Paper 7. Microbiology and Immunology			
Batch	Semester	Hour/Week	Total hours	Credit
2020-2021	II	6	90	4

Course objective

1. To aware the knowledge of microorganisms in water, soil, sewage and human body and sterilization techniques
2. To observe the importance of microorganisms in agriculture, food processing and medicine.
3. To inculcate the basic knowledge of immunology and disorders in human beings

Course outcomes

K1 - K4	COI	Apply the knowledge on microorganisms classification, importance and application
	CO2	Observe the role of microorganisms on food processing, environment, microflora on human health and disinfectication methods
	CO3	Make awareness on immunity and immune response
	CO4	Analyse the techniques for the infectious disease diagnosis

SYLLABUS

Unit I- History and Scope of Microbiology 18 hours

Classification of microbes, Economic importance of bacteria, DNA and RNA viruses, Colony morphology and growth, Growth curve and Growth kinetics, Recombination in bacteria, Genetic applications of bacteria and viruses.

Unit II: Food and Environmental microbiology 18 hours

Microbes of milk, Pasteurization, food poisoning and food preservation methods. Micro-organisms in extreme environments- thermophilic, methanogenic and holophilic. Cyanobacteria. Role of microbes in environment protection and management. Normal microflora of human body. Basic concepts, Disinfection- physical and chemical agents.

Unit III: Pathology and microbial prevention 18 hours

Epidemiology, Pathogenecity, Infection, Virulence – Causative agents, Modes of transmission and preventive measures – Pneumonia, TB, Typhoid, Syphilis, AIDS, Viral Hepatitis A and B. Antimicrobial agents (Antibiotics).

Unit – IV Immunity 18 hours

Immunity – innate and acquired immunity- Immunoreactive cells - macrophages, granulocytes, NK cells, T and B lymphocytes. Lymphoid organs – Primary, Secondary and lymphoid tissues. Antigens and its types - immunogen, haptens, super antigen, tolerates, epitope, paratope. Antigenecity and immunogenicity. Immunoglobulin - structure, types and functions. Monoclonal and polyclonal antibodies. Complement cascade system - biological functions.

Unit – V Immune Response 18 hours

Humoral and cell mediated immune response, Antigen recognition and antigen antibody interaction. Antigen processing and presentation to T-lymphocytes. Major histocompatibility complex (MHC) – types and its functions. Role of cytokines, lymphokines and chemokines. Hypersensitivity – types and mechanisms, Autoimmunity, Tumor and Transplantation immunology.

Teaching Methods:

Chalk and Talk, Power Point Presentation, Seminar, Smart class, Assignment, Discussion, Quiz and E-content.

Text books

1. Pawar.C.B. Daginawala (2001) General Microbiology - Vol I & II -. H.F. Himalaya publishing House, Mumbai- 400 004.
2. Jenni Punt, Sharon Stranford, Patricia A. Jones, Judy Owen (2013) Kuby Immunology, W.H.Freeman & Co Ltd
3. Subhash Chandra Parija (2012) Textbook of Microbiology & Immunology, Elsevier, India

Reference

1. Pelizar L.Jr. M. J.Chan, E.C.S (2007) Microbiology. TataMcGraw Hill company
2. Ananthanarayanan R. and C. K.Jayaram Paniker (2000).Textbook of Microbiology-sixth Edition. Orient Longman Private Ltd.., Chennai.
3. Delves P.J, S.J. Martin, D.R. Bruton & I.M. RoiH, (2017) Roitt's Essential Immunology,13th edition , niley – Blackwell.
4. Punt J , Stranfords, Jones. P. ,Owen .J.A Kuby Immunology 8th edn 2018 . Macmillan Learning.

MAPPING

CO \ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 4
CO1	S	H	M	H	S
CO2	S	M	H	S	H
CO3	S	H	H	H	M
CO4	H	S	M	S	H

S-Strong H- High M-Medium L-Low

Programme Code: 06		M. Sc. Zoology		
Course Code: 20PZO2CL		Core Practical I . Animal Physiology and Molecular Genetics		
Batch	Semester	Hours / Week	Total Hours	Credits
2020-2021	I & II	4	120	2

Course Objectives

1. To determine the physiological action in relation to temperature, PH and osmotic pressure.
2. To acquire the practical knowledge about primary metabolites and its estimation in higher organisms.
3. To apply the clinical laboratory techniques and its applications.

Course Outcomes

K2 – K5	CO1	Understand the role of primary metabolites.
	CO2	Apply the knowledge on the physiological changes in relation to temperature, PH and Osmotic Pressure.
	CO3	Analyze the significant role of primary metabolites in higher organisms.
	CO4	Evaluate the physiological and biomedical parameters.

SYLLABUS

Animal Physiology

1. Determination of the rate of activity of salivary amylase (human saliva) by titration in relation to temperature and calculation of Q_{10}.
2. Amylase activity in relation to pH and calculation of Q_{10}.
3. Biological response of animals to various osmotic concentrations and their effects

a. Changes in weight of Earthworm in heterosmotic media

b. Active uptake of Na^+ and CI^- ions of a fish from the environmental water and change in salinity.

4. Determination of rate of ammonia excretion by a fish in different media.

5. Effect of temperature on the oxygen consumption of a fish and calculation of Q_1

Biochemistry

1. Quantitative estimation of carbohydrates in liver of an animal.
2. Quantitative estimation of proteins in muscles of an animal
3. Quantitative estimation of lipids in the given animal tissue.
4. Preparation of Haemin crystals from human blood.
5. Quantitative estimation of Hemoglobin in human blood.
6. Determination of urea in the given sample.

Molecular Genetics and Molecular Biology

1. Study of Polytene chromosome in the Drosophila larva.
2. Determination of RBC counting in Human blood.
3. Determination of differential count in Human blood.

Spotters

1. pH meter
2. Haemoglobinometer
3. Spectrophotometer
4. Centrifuge
5. Sphygmomanometer
6. ECG recorded strip

MODEL QUESTION PATTERN FOR CORE PRACTICAL I

CIA Practical Exam

Model Practical Exam = 25 - Marks

Observation Note = 10 - MFarks

Attendance = 5 - Marks

Total = 40 - Marks

END OF SEMESTER EXAMINATION

Time-4 Hours **Max Marks-60**

Q I: Major Experiment – 20 marks

Q II: Minor Experiment - 1 – 10 marks

Minor Experiment – 2 – 10 marks

Q III: Spotters 2x5 _ 10 marks

Q IV: Record _ 10 marks

Total _ 60 marks

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	H	H	H
CO2	H	H	H	H	H
CO3	H	H	S	H	S
CO4	S	M	H	M	H

S – Strong H – High M – Medium

Programme Code 06		M.Sc. Zoology		
Course Code: 20PZO2CM		Core Practical II. Biotechnology, Bioinformatics and Biostatistics		
Batch	Semester	Hours / Week	Total Hours	Credits
2020-2021	I& II	4	120	2

Course Objectives

1. To know isolation, separation and purification of Nucleic acids and enzymes

2. To understand about the culture methods of microbes

3. To analyze the data by using varied statistical methods

4. Demonstration of bio informatics tools for nucleotide sequencing

5. To acquire knowledge on the importance of biodiversity and endangered species

Course Outcomes (CO)

K2-K5	CO1	Understand about the isolation, separation and purification of Nucleic acids and enzymes
	CO2	Observe the growth of various microbes in culture media
	CO3	Analyze the data and interpretation with results
	CO4	Apply the information tools for nucleotide sequencing

SYLLABUS

Biotechnology

1. Culture Media-Types and Use; Preparation of Nutrient broth and agar
2. Gram staining, Microscopy methods in the study of microorganisms – Working and care of Microscope
3. Isolation of pure cultures from soil, air and water samples
4. Antibiotic Sensitivity tests-disc method
5. Isolation of DNA from liver goat
6. Quality of milk by MBR test
7. Protein presicpitation
8. Agarose gel electrophoresis
9. SDS PAGE

Spotters

1. Medicinal plants
2. Bio-diesel plants
3. Autoclave.
4. Carrel flask
5. Liquid N2 chamber
6. Electrophoretic instruments
7. Northern and Southern blot.
8. Vermicompost

Bioinformatics

1. PDB
2. BLAST
3. FASTA
4. Clustal W
5. EMBOS
6. PHYLIP

Biostatistics

1. Construction of frequency distribution for a given sample.
2. Construction of Histogram and frequency polygon for the frequency distribution Calculation of Mean, Median, Mode for the distribution.
3. Calculation of Standard deviation for the frequency distribution.
4. Calculation of correlation co-efficient for the given data.
5. Application of Student's t test in the given samples.
6. Calculation and F value for the given data.(One way method)

MODEL QUESTION PATTERN FOR CORE PRACTICAL II

CIA Practical Exam

Model Practical Exam = 25 Marks

Observation Note = 10 Marks

Attendance = 5 Marks

Total = 40- Marks

END OF SEMESTER EXAMINATION

Time-3Hours **Max Marks-60**

Q I: Major Experiment - 20 marks

Q II: Minor Experiment - 5 marks

Q III: Spotters 3x5 - 15 marks

Q IV: Record - 10 marks

Total - 60 marks

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	H	H	H
CO2	H	H	H	H	H
CO3	H	H	S	H	S
CO4	S	M	H	M	H

S – Strong H – High M – Medium L – Low

Programme code -06	M.Sc Zoology			
Course code 20PZO308	Core Paper.8.Entomology			
Batch 2020-2021	Semester III	Hour/Week 5	Total hours 75	Credit 5

Course objectives

1. To know taxonomical position and collection aspects of insects
2. To inculcate knowledge of morphology and physiology of insects
3. To impart knowledge about the growth and metamorphosis in insects

Course outcomes

K1 -K4	COI	Get knowledge about the collection, identification and preservation of insects
	CO2	Understand the morphology, structure and chemistry of integument
	CO3	Apply knowledge in studying the behavior and physiology of insects
	CO4	Analyze the role of endocrine glands and their hormones in insect metamorphosis

SYLLABUS

UNIT I Systematic study of insects 15Hrs

Insect Collection and preservation methods. Classification up to order with examples.Identification of Insects using keys.

UNIT II Morphology of Insects 15Hrs

Mouth parts, Head, Thorax, Abdomen, Genitalia and Appendages

Integument-Structure, Chemistry, Synthesis of chitin, Sclerotization and Tanning.

UNIT III Anatomy and Physiology 15Hrs

Digestive system, Respiratory system and Circulatory system.

UNIT IV Anatomy and Physiology 15Hrs

Excretory system, Nervous system, Reproductive system and Sense organs*.

UNIT V Growth and Development 15Hrs

Metamorphosis- Definition, types. Endocrine Glands - Hormones – Structure and functions. Neurohormones – Structure and functions..

***Self study (Questions may be asked from these topic also)**

Teaching Methods:

Chalk and Talk, Power Point Presentation, Seminar, Smart class, Assignment, Discussion, Quiz. E-content.

Text Books

1. Vasantharaj David .B and T.Kumarasami (2011). Elements of Economic Entomology, Popular Book depot, Madras -15
2. Tembhare D.B. (2009) Modern Entomology -Himalaya publishing house –Delhi
3. Chapman R.F(2002) The insects structure and function, fourth edition - Cambridge university press United Kingdom.

Reference Books

1. Fenemore P.G. & A. Prakash (2002) Applied Entomology. New age international (P) publishers - New Delhi-2.
2. Duntson PA. 2004. The Insects: Structure, Function and Biodiversity. Kalyani Publ., New Delhi.
3. Saxena RC & Srivastava RC. 2007. Entomology: At a Glance. Agrotech Publ. Academy, Jodhpur
4. Meir Pener Stephen Simpson (2009) Advances in Insect Physiology, Elsewier

MAPPING

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 4
CO1	S	H	H	S	H
CO2	S	S	H	S	H
CO3	H	M	M	H	H
CO4	S	H	H	M	H

S-Strong H- High M-Medium L-Low

Programme Code : 06		M.Sc. Zoology		
Course Code: 20PZO309		Core Paper 9 – Biophysics and Bioinstrumentation		
Batch	Semester	Hours / Week	Total Hours	Credits
2020-2021	III	5	75	4

Course Objectives

1. To study the principle and working mechanism of bioinstruments

2. To understand the role of instruments in diagnosing various diseases.

3. To inculcate the hands on training knowledge for the practical purposes

Course Outcomes

K1	CO1	Understand the principles and application of various instruments for biological Science.
K2	CO2	Apply knowledge to know the blotting and polymerase chain reaction analysis.
K3	CO3	Analyze the various biological samples for Histopathological, Haematological and Immunological studies
K4	CO4	Evaluate the application of various instruments

SYLLABUS

UNIT I **15Hrs**

DNA Microarray – Radioisotopic Techniques – Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Phase contrast Microscope and Fluorescent Microscope.

UNIT II **15Hrs**

*Spectrophotometer, Biosensors, Atomic Absorption Spectrophotometer and UV and Visible Spectrophotometer.

UNIT III **15Hrs**

Histological techniques: Preparation of sample, serial sections, Microtome, Staining techniques. Immunological techniques – Radio Immuno Assay & Enzyme Linked Immunosorbent Assay and Flow Cytometry.

UNIT IV **15Hrs**

Chromatography (Paper, Column, Gas and High performance Liquid). Electrophoresis - Paper, Agarose, Polyacrylamide Gel Electrophoresis (PAGE) and Southern blotting, Northern blotting, Western blotting.

UNIT V **15Hrs**

Fourier Transform Infrared Spectroscopy(FTIR) ,Gas Chromatography –mass Spectrometry (GCMS),Nuclear magnetic Resonance Spectroscopy (NMR), Inductively Coupled Plasma Spectroscopy. (ICP)

*** denotes Self study**

Teaching Methods:

Over Head Projector, Power Point Presentation, Seminar, Smart class, Assignment, Discussion, Quiz.

Text books

1. Bajpai, P.K., (2008.) Biological Instrumentation and methodology. S. Chand & Co. Ltd. New Delhi.

2. Asokan, P. (2002.) Analytical Biochemistry (Biochemical Techniques) Chinna Publications. Melvisharam, Vellore, TN.

3. Veerakumari, L, (2010). Bioinstrumentation, M J P – Publishers, Chennai.

4.Brian C.Smith (2011) .Fundamentals of FTIR , CRC Press , Second Edition .

5.Keithwilson and Johnwalther ,(2010). Priniciples and Techniques of Biochemistry and Molecularbiology,Cambridge University Press,(7 th Edition)

Reference books

1. Mahinder Singh (2005) A Text Book of Analytical Chemistry - Instrumental Techniques, Dominant Publishers & Distributors, New Delhi .

2. Douglas A. Skoog (1985) Principle of Instrumental Analysis. Saunders College Publishing, Tokyo .

3. Currell, Graham, (2008) Analytical Instrumentation- Performance Characteristics and qualities, John Wiley & Sons, New York.

4. Robyt, J.F. and White B.J. (1987) Biochemical Techniques, Brooks and Coles, Monterey, California.

5. Wilson K and Walker J. (2000) Practical Biochemistry Principles and Techniques. Cambridge Univ. Press.

6. Arumugam, N. and Kumaresan, V. (2012), Biophysics and Bioinstrumentation. Saras Publications, 1st edition.

7. Douglas A. Skoog, James Holler. and Timothy A. Nieman, (1998). Principles of Instrumental Analysis, Saunders College Publishing, 5th Edition.

MAPPING

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 4
CO1	S	H	H	M	M
CO2	S	M	H	M	H
CO3	H	M	M	H	M
CO4	S	H	H	M	M

S-Strong H- High M-Medium L-Low

Programme code :06	M.Sc., Zoology			
Course code: 20PZO310	Core Paper 10 -Developmental Biology			
Batch	Semester	Hour/Week	Total hours	Credit
2020-2021	III	5	75	5

Course objectives

1.To learn about the developmental stages of an embryo

2.To obtain the knowledge of fertilization and differentiation of mammals

3.To understand the organogenesis, nutrition , regeneration and teratogenesis of mammals

Course outcomes

K1	COI	Get knowledge about the spermatogenesis oogenesis and ovulation in human
K2	CO2	Understand the mechanism of fertilization , metabolic activities and molecular changes in cleavage process in human
K3	CO3	Study the development of various organs and physiology of Human
K4	CO4	Study the mechanism of induction, major events during regeneration and teratogenesis

SYLLABUS

UNIT- I Gametogenesis **15 Hrs**

Primodial germ cells and their origin – Spermatogenesis – Oogenesis and Vitellogenesis – Comparison of spermatogenesis and oogenesis – *Types of eggs and egg membrane – Role of hormones on oogenesis and ovulation in Insects and Human.

Fertilization

Activation of egg - Mechanism of fertilization – Metabolic activities during fertilization.

UNIT- II Differentiation **15 Hrs**

Cleavage : Salient features – Theories of cleavage – Cleavage planes & patterns – Types of blastula – Molecular changes during cleavage.

Gastrulation : Salient features – Major events of gastrulation – Mechanism of Gastrulation in Amphibia, Birds and Mammals.

UNIT- III Organogenesis In Mammals **15 Hrs**

Development of Brain, Ear, Heart and Kidney.

Embryonic Nutrition

Types of Placenta – Physiology of Placenta – Endocrine function of placenta – Hormonal control during pregnancy and lactation.

UNIT- IV Induction 15 Hrs

Primary organizer : Spemann's experiments and conclusions – Types of embryonic Induction (Primary, Secondary, chain of induction) –Experiments on Chemical nature of inducing substance – Mechanism of induction (surface interaction, regional specificity and theories) – Competence.

UNIT - V Regeneration 15 Hrs

Definition and Types of regeneration – Major events of regeneration – Regeneration in invertebrates (Hydra and Planaria) – Physiological changes during regeneration – Factors influencing regeneration.

Teratogenesis

Definition – Chemical agents causing congenital abnormalities – Genetic teratogenesis – Environmental teratogenesis.

***Self study**

Teaching methods :

Over Head Projector, Power Point Presentation, Seminar,Smart Class Room, Seminar, Quiz

Text Books :

1.Verma P.S and V.K. Agarwal (2014) Chordate Embryology S.Chand Publication company Ltd., New Delhi 2014.

2.Veer Bala Rastogi and M.S. Jayaraj (2008) Developmental Biology Keendarnath Ramnath Publication Edition

3.Balinsky B.L. (2008) An Introduction to Embryology W.B. Sounders Company Publication Philadelphia

4.Jain, P.C (1998)Elements of Developmental Biology Vishal Publication, New Delhi.

Reference Books :

1.Bruce .M (2007). Carlson Foundations of Embryology – McGraw Hill Publishing companies

2.Scott F. Gilbert Sinaver (2008) Developmental Biology Amociates Sunderland3.CHR. P. An (1959) Outline of Developmental physiology Raven Pergamon Press. New York. London

4.S.Banerjee (2005) Developmental Biology Dominant Publishers and Distributers, New Delhi

5.Munish Kainth (2013) A Textbook of Chordate Embryology, Wisdom Press, Dominant Book publications.

6.McEwen,R.S.(1969)Vertebrate Embryology Oxford and IBH publishing co., New Delhi.

MAPPING

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 4
CO1	S	S	S	H	H
CO2	H	H	S	H	S
CO3	S	S	H	S	S
CO4	H	M	H	M	H

S-Strong H- High M-Medium L-Low

Programme Code : 06		M.Sc Zoology		
Course Code: 20PZO411		Core Paper 11 – Biodiversity and Evolution		
Batch 2020-2021	Semester IV	Hours / Week 5	Total Hours 75	Credits 5

Course Objectives

1. To understand the present status of Fauna and their evolutionary significance.

2. To Create awareness on conservation of Endangered Fauna.

3. To Study the various strategies for minimizing the Global warming

Course Outcomes

K1	CO1	Understand the values of Biodiversity
K2	CO2	Knowledge on IUCN categories
K3	CO3	Apply the methods of calculating Zoological Time Scale
K4	CO4	Analyze the techniques of genetic materials and migration pressure

SYLLABUS

UNIT I **15Hrs**

Biodiversity concept and definition - Values of biodiversity - Methodologies for valuation of biodiversity. Bio geographic Zones of India.

Wild life of India (Study of Mammals, Birds, Reptiles, Amphibians and fishes - 5 examples in each family) Wild life management in India.Biodiversity Hot Spots.

UNIT II **15Hrs**

Conservation of biodiversity- Loss of biodiversity - Factors causing the loss of biodiversity. Threatened species - IUCN - Red Data book. Cyropreservation and genetic markers.

UNIT III **15Hrs**

Biodiversity and Wild life management - Project Tiger, Project Elephant, Gene Bank, Captive Breeding Programme. Wild life Sanctuaries and National Parks in India.

UNIT IV Evolution **15Hrs**

Isolation: Definition- types of isolation- isolating mechanisms: prezygotic and postzygotic; Barriers- role of isolating mechanisms in organic evolution.

Speciation: Definition: species- race- deme; Species concept: Biological species- Phylogenetic species. Modes of speciation: Instantaneous speciation- gradual speciation. Sympatric and Allopatric speciation.

UNIT V **15 hrs**

Genetics and evolution: Selection- genetic load- mutation- genetic drift/ (meiotic drive) - migration pressure- their evolutionary significance. Role of transposons in evolution, Hardy Weinberg Equilibrium.

*** denotes Self study**

Teaching Methods: Over Head Projector, Power Point Presentation, Seminar, Smart class,Assignment,Discussion, Quiz.

Text books

1.Evolution: Verma P.S. & V. K. Agarwal - S.(2008) Chand & Company Ltd.

New Delhi.Ed.1.

2. Supriyochakraborty. (2007). Biodiversity: Pointer Publishers. India. Ed.1.

3. Narasaiah. M. L. .(2005). Biodiversity and sustainable development: Discovery

Publishing . House. New Delhi- Ed.1

4. Yadav P.R. and S. R. Mishra. .(2004.) Environmental Biodiversity- Discovery

Publishing House New Delhi.Ed.1

5. K.Krishnamoorthy(2005).An advanced text book of biodiversity, principles and practice

Reference Books

1.Genes and evolution: Jha. A.P. (1993). – Macmillan India Ltd. New Delhi..Ed.1.

2.Biodiversity- RamamurthiRallapalli and Teetha Bali (2002). – APH Publishing corporation. New Delhi

3.Evolution and the Diversity of Life-Ernst Mayr. (1997). The Belknap Press Hardvard Univ.Press.London,Ed.4.

4.Evolution. Monroe W Strickberger.(. 1994.)CBS Publishers and Distributors.Delhi.Ed.1

5.Glimpses of Biodiversity- Hosetti B.B. (2002) Daya Publishing House.New Delhi

6.Biodiversity in India-T.Pullaiah (2006)Regency.

7.Organic evolution –Rastogi (1999) kedarnath Publishing House

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	S	S	H	H
CO2	H	S	H	H	H
CO3	S	H	H	H	H
CO4	H	H	H	S	H

S – Strong H – High M – Medium L – Low

Programme code -06	M.Sc Zoology			
Course code: 20PZ0412	Core Paper 12 Applied Entomology			
Batch	Semester	Hours/Week	Total hours	Credit
2020-2021	IV	6	90	5

Course objectives

1. To acquire information on sericulture, apiculture and insect pests
2. To learn knowledge on disease carrying insects
3. To inculcate knowledge on pest of agriculture, stored grain and their control measures

Course outcomes

K1 - K4	COI	Get knowledge and explain beneficial insects and pests of agriculture and man
	CO2	Describe life cycle and benefits of silkworm and honey bees and insect pests of agricultural crops.
	CO3	Apply knowledge in the control of insect pests and their management
	CO4	Analyze the eco-friendly methods of insect pest control

SYLLABUS

UNIT I Sericulture **18Hrs**

Scope and Economic importance of Sericulture, Types of silkworms - Silkworm culture- rearing techniques, Moriculure- varieties of food plants of silkworms - Silkworm diseases and control measures - Harvesting of cocoons – reeling. Socio Economic Impact of Sericulture in India

UNIT II Apiculture **18Hrs**

Scope and Economic importance of Apiculture, Kinds of honey bees - Morphology - life cycle - Bee keeping – social behaviour - Diseases and enemies of honey bees - extraction of honey. Apiary management, Socio Economic Impact of Apiculture in India

UNIT III Medical Entomology **18Hrs**

Morphology, life cycle, disease caused by and control measures of Mosquitoes, House flies, Bed bug, Head louse and Cockroach

UNIT IV Agricultural Entomology 18Hrs

A. Crop pests : Biology, life cycle, damages and control measures of

1. Paddy pests : Rice stem borer - *Scirpophaga incertulas*
   Brown Plant hopper - *Nilaparvata lugens*
2. Coconut pests: Rhinoceros beetle - *Oryctes rhinoceros*

3. Red palm weevil : Shoot borer - *Rhynchophorus ferrugineus*
4. Cotton pests : Tobacco cut worm - *Spodotera litura*
   American boll worm - *Helicoverpa armigera*

B. Stored Produce pests

1. Rice : *Sitophilus oryzae*
2. Flour: *Tribolium castaneum*
3. Green gram : *Bruchus chinensis*

UNIT V Pest management and Control 18Hrs

Pest control methods (General) - Cultural, mechanical, physical, legal, biological & Chemical. Recent pest control – Ionizing radiation, Chemosterilants, Genetic manipulation, hormones, insect attractants (pheromones)*, Repellants, antifeedants, Electromagnetic energy, manipulation of animal behaviour and Integrated Pest Management(IPM). Outline classification of pesticides, mode of action of organophosphorus and pyrethroid pesticides.

***Self study (Questions may be asked from these topic also)**

Teaching methods:

Chalk and Talk, Power Point Presentation/ Seminar/ Smart Class Room/ Quiz/Assignment, E- content

Text Books

1. Vasantharaj David. B and T.Kumarasami (2011).Elements of Economic Entomology, Popular Book depot, Madras -15
2. Tembhare D.B. (2009) Modern Entomology -Himalaya publishing house –Delhi
3. Tyagi B.K. (2003).Medical Entomology, Scientific Pubilshers, India.

Reference Books

1. Fenemore P.G.,& A. Prakash (2002) Applied Entomology- New age international (P) publishers -New Delhi.2.
2. Larry O. Pedigo and Marlin E.Rice (2009) Applied Entomology. PHI Learning Private Limited
3. Chapman R.F(2002) The insects structure and function, fourth edition - Cambridge university press United Kingdom.

Mapping

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 4
CO1	S	M	H	M	H
CO2	S	H	M	H	S
CO3	H	H	H	H	H
CO4	H	S	H	S	H

S-Strong H- High M-Medium L-Low

Programme Code: 06		M.Sc., Zoology		
Course Code: 20PZO4CN		Core Practical III. Environmental Biology and Toxicology		
Batch	Semester	Hours / Week	Total Hours	Credits
2020-2021	III& IV	4	120	2

Course Objectives

1. To observe the quality of the water and soil.
2. To understand the microbial activities and biological analysis of the water.
3. To know the toxicity testing methods and encourage the students to visit the field environment.

Course Outcomes

K3	CO1	Apply knowledge in determining the physical characteristics of the water and soil.
K4	CO2	Analyze the plankton population, microbial quality and the biological analysis of the water.
K5	CO3	Evaluate the toxicity of pollutants on animals and to expose the students in the field study.

SYLLABUS

I. Analysis of water – Pond / Pool water; /River water; Sewage / Effluent

1. pH
2. Total dissolved solids (TDS, TSS)
3. Dissolved carbondioxide
4. Dissolved oxygen
5. Hardness (Temporary – carbonates, bicarbonates, Permanent – calcium, magnesium, chlorides, sulphates, phosphates, nitrates and silicate.
6. BOD and COD (Demonstration only)

II. Analysis of soil – Clayey soil, Sandy soil, Garden soil and Red soil

1. Soil moisture
2. Soil texture
3. Chlorides

4. Sulphates
5. Nitrates
6. Phosphates
7. Silicates
8. Humus

III. Biological analysis

1. Qualitative analysis of organisms (Pollution indicators) such as diatoms / algae, flagellates, ciliates, annelids, insects, mollusks and fish.
2. Biological analysis of sewage water and industrial effluent.
3. Estimation of chlorophyll content in the leaves as an indicator of pollution.
4. Microbiological study in water and soil.

IV. Toxicological Testing methods

LC_{50}, LD_{50}

V. Lab and Field Study

1. Detailed study of Pond/Lake ecosystems

    a. Physico-chemical parameters

    b. Qualitative and quantitative analysis of plankton

2. Measurement of noise pollution
3. Estimation of Primary productivity in fresh water habitat

VI. Field Trip

1. Visit to – Drinking water treatment Plant; Sewage water treatment plant and District Environmental Laboratory.

VII. Submission of the following at the time Practical Examination without which the students will not be permitted to write the examination.

1. A minimum of 5 whole mounts of Plankton – 5 Marks
2. Bonafide Record – 10 Marks

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	M	M	H	S	S
CO2	M	S	M	H	H
CO3	S	M	M	H	M

S – Strong **H** – High **M** – Medium **L** – Low

MODEL QUESTION PATTERN FOR CORE PRACTICAL III

CIA Practical Examination

Model Practical Examination = 25 Marks

Observation Note = 10 Marks

Attendance = 5 Marks

Total = 40 Marks

END OF SEMESTER EXAMINATION

Time – 4 Hours **Max. Marks – 60**

Q I : Estimation of water sample (Major Experiment) - 15 marks

Q II : Estimation of soil sample (Minor Experiment) - 10 marks

Q III : Estimation of Chlorophyll - 10 marks

Q IV : Spotters (2) - 10 marks

Q V : Submission of slide - 5 marks

Q VI : Record - 10 marks

Total - 60 marks

Programme Code -06	M.Sc Zoology			
Course Code 2PZO4CO	Core Practical IV. Entomology			
Ba0tch 2020-2021	Semester III&IV	Hour/Week 4	Total Hours 120	Credit 2

Course Objectives

1.To observe the types of insects
2.To understand the behavior and physiology of insects
3.To know the impact of pests on crops
4.To know the importance of beneficial insects

Course outcomes

K1	COI	To apply knowledge in identifying insects of different orders
K2	CO2	To analyze the behavior, importance and physiology of various insects
K3	CO3	To demonstrate the importance of beneficial insects
K4	CO4	To evaluate the effect of pests on crops and man. Field visit to study the biodiversity of insect fauna

SYLLABUS

Identification of insects

Key to insect identification (10 insects of different orders)

Mounting

Mouth parts based on their types(5 types)
Genitalia-male and female(3 pairs)

Dissection

Digestive System, Nervous System, Reproductive System of Cockroach and Nepa and Cybister (Demo only).

Physiology (Cockroach)

Analysis of Digestive enzymes
Qualitative analysis of Haemocytes, protein, carbohydrate and lipid.

Sericulture (Silkworm-Bombyxmori)

Study of egg, larva, pupa and adult-Life cycle,Pests and Diseases.
Reeling- Assessment of Cocoon characters,Denier, Shell ratio and Renditta.

Apiculture

Bee hive, Honey comb, Types honey bees, Caste differentiation, Pests and diseases of honey bees.

Medical Entomology

Identification-Mosquitoes, Housefly, Bed bug and Head Louse.

Crop pests

Identification of pests (one in each) of coconut, cotton, sugarcane and paddy

Stored grain pests

Identification of rice pest-*Sitophilus*; wheat pest- *Tribolium*; Green gram pest- *Bruchus*

Submission :

i) Insects Only Photographic album

ii) Slides – Whole mounting of 10 small insects**.**

Field visit

Model question paper pattern for Core practical IV

CIA Practical Examination

Model Practical Examination	25 marks
Observation Note	10 marks
Attendance	5 marks
Total	**40 marks**

End of Semester Examination

Time 4 Hours Max.marks – 60

1	Major Question	20 Marks
2	Minor Question	10 Marks
3	Spotters 2X5	10 Marks
4	Submission i) Insect album	05 Marks
	ii)Slides	05 Marks
5	Record	10 Marks
	Total	**60 Marks**

MAPPING

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 4
CO1	S	H	S	H	H
CO2	H	H	M	H	M
CO3	S	S	H	H	H
CO4	S	H	M	H	S

S-Strong H- High M-Medium L-Low

Programme Code :06	M.Sc, Zoology			
Course code 20PZO4Z1	Project Work and Viva - Voce			
Batch	Semester	Hour/Week	Total hours	Credit
2020-2021	VI	3	45	5

Course Objectives

1. To acquire the basic knowledge about research and carryout research problems in the field of zoology.
2. To explore the ability to plan, carryout innovation in project
3. To improve the knowledge on various research methods in zoology

Course Outcomes

K2	COI	Use foundational practical knowledge to carry out research in the specified area.
K3	CO2	Analyze the results and to collect the basic information in the field of zoology.
K4	CO3	Evaluate the research findings and present them in written and oral.
K5	CO4	Implement the research findings for the pollution free environment upliftment of mankind.

Guidelines to the Distribution of Marks:

IA	Project Review	15	**20**
	Regularity	5	
ESE	Project Report Present	60	**80**
	Viva – Voce	20	
Grand Total		**100**	

Teaching Methods: Over Head Projector, Power Point Presentation, Seminar, Assignment, Quiz

MAPPING

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 4
CO1	M	S	M	H	S
CO2	H	S	S	M	H
CO3	H	H	H	H	H
CO4	S	M	H	S	H

S-Strong H- High M-Medium L-Low

MAJOR ELECTIVE PAPERS

1. Environmental Biology
2. Wild Life Ecology and Management
3. Environmental Biology and Toxicology
4. Poultry Science and Management

PZO 54

Programme Code: 06	M.Sc. Zoology		
	Major Elective Paper 1 – Environmental Biology		
Batch 2020-2021	Hours / Week 4	Total Hours 60	Credits 5

Course Objectives

1. To obtain knowledge about the biosphere and their characteristics.

2. To know the energy, natural resources and their conservations.

3. To get information about the space ecology.

Course Outcomes

K1 - K4	CO1	Expertise knowledge about the biosphere.
	CO2	Understand the physical, chemical and biological characteristics of the biosphere.
	CO3	Apply the knowledge in measuring the energy resources and the conservation of natural resources.
	CO4	Analyze the techniques of the remote sensing and space travel.

SYLLABUS

Unit I **(12 Hours)**

Atmosphere

Composition and Structure, Climatic factors – Air, Light, Temperature, Atmospheric Pressure, Wind, Humidity and Rainfall.

Unit II **(12 Hours)**

Hydrosphere

Water resources, hydrological cycle, physico-chemical and biological characteristics of ponds, lakes, rivers, estuaries, mangroves and sea.

Unit III **(12 Hours)**

Lithosphere

Soil formation, components of soil, physico-chemical properties of soil, structure, texture and classification of soil, Soil organisms, Soil erosion (degradation).

Unit IV **(12 Hours)**

Energy and Environment

Concept of energy, Sources of energy, Measurements of primary production, Energy flow in ecosystem. Conservation of Natural resources – Minerals, Forest, Agriculture, Afforestation, Wild life management*****, Freshwater fish culture.

Unit V **(12 Hours)**

Radiation Ecology – Radiation environment – Remote sensing, Radio Telemetry as a tool for ecological research, Space ecology – Exobiology – Hazards of space travel – Regenerating system.

*** denotes Self study**

Teaching Methods:

Over Head Projector, Power Point Presentation, Seminar, Smart class, Assignment, Discussion, Quiz**.**

Text Books

1. Sharma P.D.,(2012), Ecology and Environment – Rastogi Publications, India.

2. Biswarup Mukerjee,(1997), Environmental Biology – Tata McGraw Hill publishing company Ltd, New Delhi.

3. Odum E.P.(1971), Fundamentals of Ecology – 3rd edition, W.B.Saunders & Co, Philadelphia.

Reference Books

1. Joesph M. Moran, Michael, P.Morgan, James, H.Wiesma,(1991), Introduction to Environmental Science –Published by W.H. Freeman and Company, Sanfrancisco.
2. Agarwal K.C., (1989), Environmental Biology –Agro Botanical Publishers(India).
3. Charles R. Goldman, Alexander J. Horsno Mcgraw ,(1983), Limnology – Hill International book company, New Delhi.
4. Dilip Kumar,(2010), Introduction to Soil Science – DasKalyani Publishers, New Delhi.
5. Edward John Kormandy ,(1969), Concept of Ecology – Prentice Hall Publishers New Delhi.
6. Singh J.P., Singh S.P and S.R.Gupta, (2014), Ecology Environmental Science and Conservation – S.Chand Publishers, New Delhi

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	H	M	S
CO2	S	H	H	H	S
CO3	M	M	M	H	S
CO4	H	M	M	L	M

S – Strong H – High M – Medium L – Low

PZO57

Programme Code: 06		M.Sc. Zoology		
		Major Elective 2 - Wild Life Ecology and Management		
Batch 2020-2021	Semester	Hours / Week 3	Total Hours 45	Credits 5

Objectives

1. To understand and appreciate biodiversity and the Act to protect the wild species.
2. To learn different techniques to study wild life and develop knowledge of the benefits of ecosystem.
3. To get knowledge the about various methods to conserve biodiversity**.**

K1 - K4	COI	Explain the various components of an ecosystem
	C2	Describe the wildlife management in India and National Parks and Sanctuaries.
	CO3	Analyze the Biodiversity hot spots, Endangered species and their Protection
	CO4	Evaluate the Wild life management Techniques and animal plant interaction.

SYLLABUS

UNIT I **9Hrs**

Ecosystem aquatic ecosystem- Pond, terrestrial ecosystem- forest trophic relations in ecosystems, foodchain, foodweb, ecological pyramids - productivity of ecosystem-primary and secondary production. Energy flow in ecosystem. Biotic community and ecological niche.

UNIT II **9Hrs**

Wild life of India – Ecological sub regions of India. Endangered flora and fauna. Wild life management in India - Indian board for wild life. Protected areas network. National parks and sanctuaries. Special projects for endangered species.

UNIT III **9Hrs**

Biodiversity

Biodiversity-kinds of biodiversity; Biogeography-continental shift, zoogeography, biodiversity hot spots, endemicity; biodiversity assessment; Endagered species-Indian Wild life protection Actl972 and International Redlist Species Criteria, concept and assessment

UNIT IV **9Hrs**

Field Sampling Techniques

Population estimation-concept, line transect, quadrate sampling; Animal Trapping Techniques – Pitfall funnel, Sherman traps; marking and recapture techniques; use of indirect evidences in species inventory; Basic methods in behavioral and food habit studies; Wildlife management techniques.

UNIT V **9Hrs**

Ecosystem Services

Animal plant interactions-pollinators, seed dispersal, biological pest control, vector; Wildlife products - food, medicine, Germplasm, domestication; Ecological balance - prey predator relationships. herbivory and scavengers.

Text Book:

1. Ecology and Environment. P.D.Sharma. 2009/10th Ed. Rastrogi publications. Meerut.
2. Concepts in Wild Life Management Hoselli BB (2008) Daya publishing house New Delhi 110002.

Reference Books

1. Ecology and evolution of communities. Cody, M.L.and J.M Diamond 1975.Harvard University Press.Cambridge. Wildlife Management Techniques. Giles.H. 1984. Natraj Publishers, Dehra Dun.
2. Fundamentals of Wildlife Management. Gopal, R. 1992. Justice Home. Allahabad. Biodiversity - Gaston, K.J. 1996.
3. A biology of numbers and difference. Blackwell Science, Oxford. Ecology. V.K.Agarwal and Usha Gupta. 2004. 1st Ed. S.Chand and Company Ltd.New Delhi.
4. Environmental Studies. D.K.Asthana and Meerut Asthana. 2006 1st Ed. (Reprint 2007). S. Chand and company Ltd. New Delhi.

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MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	H	M	S
CO2	S	H	H	H	S
CO3	M	M	M	H	S
CO4	H	M	M	L	M

S – Strong H – High M – Medium L – Low

PZO60

Programme Code: 06	M.Sc. Zoology		
	Major Elective Paper 3 – Environmental Biology and Toxicology		
Batch 2020-2021	Hours / Week 6	Total Hours 90	Credits 5

Course Objectives

1. To assess the environmental degradation of the biosphere.

2. To create awareness about the environmental quality and monitoring.

3. To obtain the information about toxicants and their impacts in the environment.

Course Outcomes

K1 - K4	CO1	Obtain knowledge about the pollutants of the biosphere and their impacts on human beings.
	CO2	Understand the effects and control measures of the pollutants.
	CO3	Apply the knowledge in monitoring the quality of the environment and to promote bioremediation.
	CO4	Analyze and evaluate the toxicity of pollutants on living organisms.

SYLLABUS

Unit I **(18 Hours)**

Air Pollution

Air pollutants, sources of Air pollution, Effects on the environment – Acid rain, Green house effect and Ozone depletion, Effects on the living organisms including man, control methods of air pollution.

Unit II **(18 Hours)**

Water Pollution

Water pollutants, sources of water pollution, Types of Pollution (Organic, Pesticidal, Heavy metal and Oil pollution), Effects on the living organisms including man, Control methods of water pollution.

Unit III **(18 Hours)**

Soil, Noise, Thermal and Radioactive Pollution

Soil pollution – Sources and their effects on the environment and organisms including man, solid waste management.

Noise pollution – Sources of noise and their effects on the environment, organisms including man and Control of Noise pollution.

Thermal and radioactive pollution – Sources and their effects on the environment, organisms including man and Control of Thermal and Radioactive pollution.

Unit IV **(18 Hours)**

Environmental Quality, Awareness and Management

Ecoindicators and the environment, Environmental education and Awareness, Environmental monitoring and Environmental Impact Assessment (EIA), Environmental management and Bioremediation.

Unit V **(18 Hours)**

Toxicology

Scope and significance, Classification, Toxic substances, Absorption and Excretion of toxicants, Toxicity – Mode of action of toxicants, Toxicity – Acute and chronic toxicity. Impacts of toxicants*, Toxicological testing methods – Evaluation of toxicity in organisms – LC_{50} in sAquatic organisms, LD_{50} in Terrestrial organisms.

*** Denotes Self study**

Teaching Methods:

Over Head Projector, Power Point Presentation, Seminar, Smart class, Assignment, Discussion, Quiz.

Text Books

1. Sharma P.D., (2012), Environmental Biology and Toxicology –, Rastogi publications, India.
2. Biswarup Mukherjee, (1997), Environmental Biology –Tata McGraw Hill publishing company Ltd, New Delhi.
3. Subramanium M.A., (2004), Toxicology principles and methods –M.J.Publishers Chennai.

Reference Books

1. Chattwal G.R., M.C.Mehra, J.Katyal, M.Satake, Mohan Katyal, T.Nagahiro, (1989), Environmental Air pollution and its control –Anmol Publications, New Delhi.
3. Goel P.K., (1997), Water pollution – Causes, effects and control –New Age International Pvt. Ltd. Publishers, New Delhi.
4. Voudouris, (2012), Water quality Monitoring and Assessment –Intech Publishers.
5. Jimmy Katayal and M.Satake, (2001), Environmental pollution – Anmol Publications Pvt. Ltd., New Delhi.
6. Purohit Agarwal . P. (2006), Environmental pollution – causes, effects and control – Agrobios publishes, India.

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MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	S	H	H
CO2	M	H	S	S	H
CO3	H	M	S	S	S
CO4	M	M	S	S	S

S – Strong H – High M – Medium L – Low

PZO64

Programme code : 06	M.Sc. Zoology			
	Major Elective Paper 4–Poultry Science and Management			
Batch	Semester	Hour/Week	Total hours	Credit
2020-2021	VI	3	45	5

Course objectives

1. Make the students to develop knowledge on the history and the role of poultry in rural development and its structure.
2. Students can learn the methods of rearing, breeding and production of poultry.
3. Get the knowledge about the preparation of feed antibiotics, vaccines and marketing.

Course Outcomes

K1 - K4	COI	Get knowledge about the importance of poultry farming
	CO2	Understand the types of poultry breeding
	CO3	Apply the knowledge in types of incubators for poultry breeding
	CO4	Analyze the importance of poultry marketing

SYLLABUS

UNIT I **9Hrs**

History and importance of Poultry farming, Role of the Poultry in rural development*, employment potential, Economics and contribution to national productivity, Egg production, Table bird production, manure as by-product. Anatomy and physiology of poultry birds with reference to digestive and reproductive system.

UNIT II **9Hrs**

Breeds of poultry birds and scientific methods of breeding Hybrid and cross breed. Indian and exotic selecting chicks and parents for production factors in selection, Hatching, selecting eggs for hatching, Natural and artificial incubations, Types of incubators. Maintenance of temperature and humidity sterilization of room during hatching, separation and selling.

UNIT III **9Hrs**

Poultry house and equipment, space requirement, types of house, number birds, equipments for feeding, protection from enemies and adverse conditions.

UNIT IV **9Hrs**

Nutrition of Poultry birds, requirement according to age feed formulation, classification of feed stuffs. Milling by products, distilleries and brewery by products. Availability of raw materials and their cost, food grinders and mixtures, use of antibiotics.

UNIT V **9Hrs**

Brooding and rearing, sexing, vaccination, natural and artificial breeding, types of brooding, temperature . requirement culling. Debreaking, characters of good layers and broilers caponettes and and capons, rearing of chicks.

*** Denotes Self study**

Teaching Methods:

Over Head Projector, Power Point Presentation, Seminar, Smart class, Assignment, Discussion, Quiz.

Text Books

1. Keith Wilson (2007).A Hand book of poultry practice. 2nd Ed. Agrobios (India), Jodhpur.
2. Norris Elye. (2005). The poultry science L.C.R.. Biotech books.Delhi.35.

Reference Books

1. Manju Yadav.(2003). Economic Zoology: Discovery publishing house. New Delhi
2 Pande B. V.R.Reddy, V.R.Sadagopen and A.K.Shrinivasan. (1984). Feeding of Poultry. (reprinted 1997), Indian council of Agricultural research. Power Printers New Delhi.
3 R.Venkatakrishnan, (1995). Poultry farm guide. Balaji publications. Madras.
4 Sharma R.D.(1997).Hand book of Animal Husbandry Indian Council of Agricultural Research, Published by, Director Directorate of Publications and information on Agriculture. New Delhi.

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MAPPING

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 4
CO1	S	H	M	S	H
CO2	M	S	H	M	S
CO3	H	M	S	H	M
CO4	H	S	H	S	M

S-Strong H- High M-Medium L-Low

NON-MAJOR ELECTIVE

1. Nutrition and Dietetics
2. Nano-Biotechnology
3. Human Genetics and Counseling

PZO 68

Programme code : 06	M.Sc. Zoology Non Major Elective 1- Nutrition and Dietetics		
Batch	Hour/Week	Total hours	Credit
2020-2021	4	60	5

Course objectives

1. To study nutrition for the better health/life.
2. To study nutritional need for different age groups.
3. To create awareness about different Nutrition dietetic organization /industries.

Course outcomes

K1 - K4	COI	Get knowledge on nutrition, dietetics and health to the children, adolescents ,adults and their families.
	CO2	Understand the pathophysiology of children, adolescents ,and adults diseases and nutrition modification
	CO3	Apply knowledge for the effective strategies to engage population in promotion of nutritional well being
	CO4	Analyze the food science knowledge to describe the function in maintaining health. Explain the nutritional knowledge to the public through health organization.

Teaching methods :

Over Head Projector / Power point presentation/ Seminar/ Smart Class Room/ Seminar/ Quiz/ Internship/ Assignment

PZO 69

SYLLABUS

UNIT I Status of Nutrition 12Hrs

Status of nutrition –Global, India and Tamilnadu levels. Nutritional value of Rice, Wheat, Millet, Milk, Fish and Egg. Food exchange list, Basic dietary calculations.

UNIT II Nutritional Needs of Different Diseases 12Hrs

Nutritional deficiency and management - diabetes, obesity, underweight, cardiovascular diseases, gastrointestinal diseases and hyper tension, Nutritional requirement during pregnancy.

UNIT III Nutrition During Infancy 12Hrs

Growth and development - Advantages of breast feeding - Difference between human milk and Cow's milk - Factors to be considered in bottle feeding - Different milk formulae. Weaning foods ; meaning - need and uses of growth chart to monitor development - Nutritional requirement of infants* (upto 1 year) Weaning foods developed by different organizations.

UNIT IV Nutritional Needs Of Pre-School Children (1-5 Years) 12Hrs

Factors to be considered in planning meals - Eating problems of children and their management - Preparation of supplementary foods using available low foods.

Nutrition for school children: Nutrition requirement - Meal planning.

UNIT V 12Hrs

Nutrition during adolescence - Growth - nutritional requirements special need for girls - menarche.

Nutritional needs of adults (Men and women) - in relation to occupation - meal planning.

Nutrition during old age - Nutritional problems of aged and their management

*** Self Study**

Teaching Methods:

Over Head Projector, Power Point Presentation, Seminar, Smart class, Assignment, Discussion, Quiz.

Text books

1. Dietetics –Sri Lakshmi.B.2011. New age International publishers New Delhi.

2. Passmore, D.P., Break, J.P.1986. Human Nutrition and Dietetics, English Language Book society, Livingston.

3. Anita, F.P. 1997. Clinical Dietetics and Nutrition, 4th edition, Oxford University Press, New Delhi.

Reference Books

1. Anita. F.P. 1986. Clinical Dietetics and Nutrition, Anita. F., Oxford paper back edition, Calcutta.

2. Emma. S.Weighley, Donna.H, Muellar, 1997. Basic nutrition, Prantice hall INC, New Jersey.

3. M.Swaminathan, 1978. Hand book of food and Nutrition, published by the Printing and Publishing Co., Ltd., Bangalore.

4. Rosi, M.S. 1987 A Laboratory hand book for Dietetics, 4th Edition, McMillan Publishing Corporation, New York.

MAPPING

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 4
CO1	S	H	S	H	M
CO2	H	H	S	M	H
CO3	S	H	M	S	M
CO4	S	S	H	S	H

S-Strong H- High M-Medium L-Low

PZO71

Programme Code: 06	M.Sc Zoology		
	Non Major Elective 2 – Nano- Biotechnology		
Batch 2020-2021	Hours / Week 4	Total Hours 60	Credits 5

Course Objectives

1. To understand the basic knowledge of Nanobiotechnology
2. To enhance the synthesis and application of nano-materials in medicine and agriculture.
3. To apply nano-technological knowledge on the DNA, Proteins, Nucleic acids, drug delivery and biomedicine.

Course Outcomes

K1	CO1	To aware the fundamentals of bio-nano-materials, synthesis and characterizations.
K2	CO2	To understand the applications of bio-nano materials in different field applications like agriculture and medicine.
K3	CO3	To analyze the significance of bio-nano-materials to enhance the treatment of various diseases and enhancement of agriculture through nonmaterial's.
K4	CO4	To apply nano-technological knowledge on environmental and health issues.

SYLLABUS

Unit I: Nanotechnology and Nanoparticles (12 Hrs)

Nanotechnology- Introduction, Scope, History, Importance and Applications and Types of Nanoparticles.

Unit II: Properties and characterizations (12 Hrs)

Synthesis of nanoparticles- green and microbial synthesis. Characterization of nanoparticles- UV-Vis, X – ray diffraction, EDAX and FTIR.

Unit III: Applications of Nano – materials in Biosystems (12 Hrs)

Applications of nano-materials in agriculture, medicine. Impacts of nano-materials on environments.

Unit IV: Nanomaterials and Diagnostics/ Drug delivery and Therapeutics (12 Hrs)

DNA coupled Nanomaterials and drug delivery. Metal / metal oxide Nanoparticles (Antimicrobial) Antisotropic and magnetic particles (Hyperthermia) and Nanobiomolecules (Protein, Carbohydrates and lipids)*.

Unit V: Concept of Nano toxicity (12 Hrs)

Types of toxicity based on route of entry, nature of toxin. Cytotoxicity, Genotoxicity, Invivo testol assay.

*** Denotes Self study**

Teaching Methods:

Over Head Projector, Power Point Presentation, Seminar, Smart class, Assignment, Discussion, Quiz.

Text books

1. Thomas E., Twardowski (2007). Introduction to nanocomposite materials. Properties, Processing, characterization. DES tech Publications, USA.
2. Rathy RK,, (2009). “Nanotechnology”, S. Chand Publisher.
3. Sidharth Baliyan, (2011).“Basics of Nanotechnology” Anmol Publications PVT. Ltd.
4. Niemeyer CM, and C. A. Mirkin. (2004). “Nanobitechnology: Concepts, Applications and Perspectives”, Wiley- VCH.

Reference Books

1. Rajendran, V., Saminathan, K., Paramasivam, P., Geckeler, K.E., (2012). “Nanomaterials Synthesis and Charecterization”, Bloomsburry Publishing India PVT. LTD, New Delhi.
2. Vinod Labhasetwar and Diandra L. Leslie, (2007). “Biomedical Applications of nanotechnology”, A john Willy & Son inc, NJ, USA.

3. Challa, S.S.R. Kumar, Josef Hormes, Carola Leushaer, (2005). "Nanofabrication towards biomedical applications, techniques, tools, applications and impact, Wiley-VCH,.

4. Houdy. P, Lahmani M. Marano F. (2011). Nano-ethics and Nanotoxicology. Spriger, Verlag Berlin Heidelberg.

5. Simeonova P.P., N. Opopol and M.I. Luster, (2007). "Nanotechnology- Toxicological Issues and Environmental Safety", Springer.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	H	H	H
CO2	H	H	H	H	H
CO3	H	H	S	H	S
CO4	S	M	H	M	H

S – Strong **H** – High **M** – Medium **L** – Low

PZO74

Programme code : 06	Major Elective Paper 3 –- Human Genetics and Counselling			
Batch	Semester	Hour/Week	Total hours	Credit
2020-2021		3	45	5

Course objectives

1. To Understand knowledge on the blood types, transfusion and diseases.
2. To know about the applications of aminocentesis, dermatoglyphics and Population genetics.
3. To learn the applications of Genetic engineering and Genetic counseling

Course outcomes

K1	COI	Explain the Physiology and genetics of blood groups.
K2	CO2	Describe the various syndromes and Population genetics.
K3	CO3	Analyses the application of genetic engineering in man.
K4	CO4	Evaluate the genetic counselling and pedigree chart.

SYLLABUS

UNIT I 9Hrs

Blood groups (major types) Blood transfusion, Erythroblastosisfoetalis. Physiology and genetic of blood groups.

UNIT II 9Hrs

Aminocentesis, Dermatoglyphics: Terminology, methods of observation and printing, dermatoglyphic features of syndrome.

UNIT III 9Hrs

Population genetics, Hardy-Weinberg principle and its application in human population.

UNIT IV 9Hrs

Genetic engineering and its applications in human being, Cancer***** , AIDS.

UNIT V 9Hrs

Genetic counseling, definition, aims, procedure in genetic counseling and its limitation. Pedigree chart and its uses.

*** Denotes Self study**

Teaching Methods:

Over head projector, PowerPoint presentation, Seminar, Smart class, Assignment, Discussion, Quiz.

Mapping

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 4
CO1	S	H	M	S	H
CO2	M	S	H	M	S
CO3	H	M	S	H	M
CO4	H	S	H	S	M

S-Strong H- High M-Medium L-Lo

PZO 76 20PZO3X1

Programme Code: 06	M.Sc. Zoology		
	EDC- Vermitechnology		
Batch 2020-2021	Hours / Week 2	Total Hours 30	Credits 2

Course Objectives

1. To aware the significance of sustainable agriculture and organic farming.
2. To inoculate basic knowledge on recycling of biodegradable waste of different kinds.
3. To understand the value of Vermitechnology and its significance.

Course Outcomes

K1 – K4	CO1	Get knowledge on the significance of earthworms.
	CO2	Understand the importance of waste degradation by eco-friendly method.
	CO3	Apply the significance of vermicomposting methods.
	CO4	Apply knowledge on commercialization of Vermiproducts.

SYLLABUS

UNIT I **6Hrs**

Diversity and ecology of earthworms

Distribution and ecological categories of earthworm, food and feeding habits, digestive system and gut microflora of earthworms and their importance and life cycle of earthworms.

UNIT II **6Hrs**

Role of earthworms in sustainable agriculture

Role of earthworms in sustainable agriculture, organic farming, physical, chemical and biological changes caused by earthworm in soil drilosphere.

UNIT III

Vermiculture methods 6Hrs

Requirements for vermiculture, advantages of vermiculture and vermicompost – selection and description of suitable species, major vermicomposting species, Eudrilus eugeniae, Eiseniae fetida and Periyonyx excavates.

UNIT IV 6Hrs

Vermicompost and Vermiwash

Vermicomposting - different types of bio-degradable wastes, small scale and large scale vermicomposting, maintenance of vermicomposting unit, enemies of earthworms and vermiwash preparation.

UNIT V

Application of vermitechnology 6Hrs

Recycling of different wastes by vermicomposting – food, agricultural, organic, solid and municipal waste management. Application of vermitechnology in horticulture, agriculture and medicine and recent advances in vermitechnology.

Teaching methods :

Chalk and Talk, Power Point presentation/ Seminar/ Assignment/Quiz

Text Books

1. Bhatnagar, R.K. and Palta, R.K., (1996). Vermiculture and Vermicomposting. Kalyani Publishers, New Delhi.

2. Arun K. Sharma. (2002). A hand book of Organic Farming, , Agrobios, Jodhpur, India The Earthworm book, S.A. Ismail. Other India press, Goa - 403 507, India (2005).

3. Gupta P.K. (2008). Vermicomposting for Sustainable Agriculture. Agrobios. India.

Reference Books

1. ArunK.Sharma, (2002). A Hand book of organic forming, Agrobios, Jothpur, India.
2. Edwards, C.A. and J.R. Lofty (1977) "Biology of Earthworms" Chapman and Hall Ltd., London.
3. Lee, K.E. (1985) "Earthworms: Their ecology and Relationship with Soils and Land Use",Academic Press, Sydney.
4. Satchel, J.E. (1983). "Earthworm Ecology", Chapman Hall, London.
5. Ismail S.A. (2005). The Earthworm book, Other India press. Goa 403 507, India
4. Talashilkar & Dosani (2005). Earthworms in Agriculture. Published by Agrobios (India), Chopasani Road Jodhpur- 342003.
5. NPCS Board of Consultants and Engineers (2004). The complete technology book on "Vermiculture and Vermicompost" published by National Institute of Industrial Research, Asia Pacific Business Press, New Delhi.
6. Kale R. D. (2006). Vermicompost- Crown Jewel of organic farming. Author publication, 4- Archana apartment, (S-l), 12 cross, Margosa Rd, Malleswaram, Banglore-560 003, India

MAPPING

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 4
CO1	S	S	H	M	S
CO2	H	M	S	S	H
CO3	H	S	M	H	M
CO4	S	H	S	S	S

S-Strong H- High M-Medium L-Low

Programme Code : 06	M. Sc, Zoology			
Course code: 20PZOOJ1	JOC – ANIMAL HUSBANDRY			
Batch	Semester	Hour/Week	Total hours	Credit
2020 – 2021	2	3	45	2

COURSE OBJECTIVES

1. To give overview on the common breeds of Livestock and their breeding habits.
2. To develop idea about the various management practices and Veterinary Medicine.
3. To have a basic understanding of Veterinary and Dairy Science.

COURSE OUTCOMES

K1-K4	COI	Get knowledge about the production of Livestock.
	CO2	Understand the Livestock and rearing techniques to generate self employment.
	CO3	Apply knowledge into the Livestock production, to avoid production risks and enhance the production level.
	CO4	Analyze technical knowledge for consultancy, marketing and entrepreneurship development in the field of Animal husbandry.

SYLLABUS

UNIT – I **(9 Hrs)**

Basics of Animal Husbandry: Scope and importance; Common breeds of cattle, buffalo, sheep, goat, pig, poultry and rabbits; Animal production systems; Principles of housing for farm animals and routine management practices for various categories of livestock and sick animals. Role of livestock in Indian economy and human health. Socioeconomic aspects of livestock enterprise with special reference to farming community and rural development.

UNIT – II **(9 Hrs)**

Basic Andrology and Artificial Insemination: Cattle - Sexual behavior of males; Pheromones – Definition, role of pheromones; Study of male genitalia and gonads; Male infertility; Semen collection processing and storage; Artificial insemination; Handling of fresh and frozen semen; Semen evaluation; Diseases transmitted through semen. Systems and strategies for improvement of livestock for milk, meat, wool production and poultry for eggs and meat. Breeding of resistance varieties.

UNIT – III **(9 Hrs)**

Animal Nutrition: Principles of animal nutrition; Role of natural and artificial dietary nutrition in animal health and production; Feeds and fodders; Scientific feeding of livestock; Feeding schedule for different categories of livestock; Feed additives; Silage making, Diet formulation for newborn, growing, pregnant, lactating and sick animals. Nutrition deficiencies and their management.

UNIT – IV **(9 Hrs)**

Veterinary Medicine: Major contagious diseases affecting cattle, buffaloes, sheep and goats, pigs, poultry, rabbits. Etiology, symptoms, pathogenicity, diagnosis, treatment and control of major bacterial, viral, and parasitic infections.

Immunization and vaccination: Methods of immunization; Vaccines and their use in animals. Animal Ethics – Society for the prevention of Cruelty to Animals (SPCA)*.

UNIT – V **(9 Hrs)**

Dairy Science: Physico-chemical and nutritional properties of milk. Quality assessment of milk and milk products, Common tests and legal standards. Cleaning and sanitation of dairy equipment. Milk collections, chilling, transportation processing, packaging, storage and distribution. Manufacture of market milk, cream butter, cheese, ice-

cream, condensed and dried milk, by products and Indian Milk products – Economic importance; New Entrepreneur cum Enterprise Development – programmes, schemes, agencies in India.

***Denotes Self Study**

Text Teaching Methods:

Overhead Projector, Powerpoint Presentation, Seminar, Assignment, Discussion, Quiz, Field Visits.

Text Books:

1. Singh C.D.N. **(2010)**, Advanced General Pathology of Animals (PB), IBDC.
2. M.K Shukla **(2011)**, Applied veterinary Andrology and frozen semen technology, NIPA.
3. Banerjee G.C **(2018)**, Principles of Animal Nutrition and Feeds Revised Edition (PB), Oxford & IBH.
4. Reddy **(2018)**, Applied Nutrition: Livestock, Poultry, Rabbits and Laboratory Animals, 3 (edition) (PB), Oxford & IBH.

Reference Books:

1. Bansil P.C **(2006)**, Livestock Economy of India, CBS.
2. Mohiuddin S. M **(2007)**, Infectious Diseases of Domestic Animals, IBDC.
3. Legates **(2014)**, Breeding & Improvement of Farm Animals, McGraw-Hill.
4. Hui Y.H **(2014)**, Dairy Science and Technology Handbook: Principles and Properties, Vol. 1 (PB), John Wiley (WSE & Exclusive Indian Spl. Price Titles).
5. Spreer **(2018)**, Milk and Dairy Product Technology (HB), Taylor & Francis.

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MAPPING

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 4
CO1	S	H	H	H	S
CO2	H	S	H	H	H
CO3	H	M	H	H	H
CO4	H	H	S	H	H

S-Strong H- High M-Medium L-Low

Programme code -06	M.Sc Zoology		
Course code: 20PZO0D1	ALC - Eco tourism		
Batch	Hour/Week	Total hours	Credit
2020-2021	3	60	5

Course Objectives

1. Learn the importance of tourism.
2. Understand the Laws& policies related to tourism.
3. Understand the benefits of tourism.
4. Save the environment through tourism

Course outcomes

K1 - K4	COI	Get knowledge about the tourism industry
	CO2	Understand the National and International relationships with tourism
	CO3	Apply the knowledge of information technology in the tourism industry
	CO4	Analyze the passport and visa formalities

SYLLABUS

UNIT I **12 Hrs**

Definition of Tourism - Terminologies Related To Tourism - Elements of Tourism -Growth of Tourism - Basic Patterns of Tourism - Special Patterns of Tourism -Sectors In The Tourism Industry.

UNIT II **12 Hrs**

Definition - Destination of A's Necessary For A Tourist Destination - Learning To Locate Places by Using Latitudes and Longitudes - International, National & Regional Organizations for Tourism.

UNIT III **12 Hrs**

Advent of Information Technology in the Tourism Industry: Impact of Information Technology in the Tourism Industry.

UNIT IV **12 Hrs**

Travel Formalities - Passport and Visa Formalities* - Health Documents - Health Preventive Measures for Travelers - Travel Insurance.

UNIT V **12Hrs**

Tsunami, Earthquake, Cyclone, Flood, Global warming, Landslides, Soil erosion and volcanoes

*** Self Study**

Teaching Methods:

Over Head Projector, Power Point Presentation, Seminar, Smart class, Assignment, Discussion, Quiz.

Textbooks

1.Stefan Gössling, Johan Hultman (CABI, 2006 Ecotourism in Scandinavia: Lessons in Theory *Volume 4 of Ecotourism book series*and Practice Newdelhi.

2. VatsalaIyengar and Malathi Ragavan.(2003). South India Tourist Guide -. Ecology and Environment -P.D.Sharma, Rastogi Publications, Meerut, India

3. Roy Ballantyne and Jon Packer (2013),International hand book on Eco tourism. University of Queens land School of tourism,Australia.

Reference books

1.Arul, P. A(2004). text book of Environmental Studies. Environmental Agency, Chennai.

2. David A (2007) Feennell Ecotourism Brock University, St Catharines, Ontario, Canada.

3.Dieter and Muller(2007) Department socio economic geography umea university swedan Tourism in pheripheries perspectives from the far north and south.

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MAPPING

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 4
CO1	S	H	M	S	H
CO2	M	S	H	M	S
CO3	H	M	S	H	M
CO4	H	S	H	S	M

S-Strong H- High M-Medium L-Low