Chowgule Education Society's

Parvatibai Chowgule College of Arts and Science
Autonomous

Accredited by NAAC with Grade 'A+'

Best Affiliated College-Goa University Silver Jubilee Year Award

Undergraduate Programme
BSc Zoology

Zoology

SEMESTER V

CORE COURSE:DEVELOPMENTAL BIOLOGY	
COURSE CODE:	ZOO-V.C-7
MARKS:	100 [75 –Theory ; 25- Practicals]
CREDITS:	04 [03 –Theory; 01- Practical]
CONTACT HOURS:	THEORY : 45 HOURS (03 LEC/WEEK) PRACTICALS: 30 HOURS (01 PRACTICAL /WEEK)
COURSE OBJECTIVES:	• To understand the processes of fertilization, polyspermy and activation of egg metabolism • To know the basics of animal development, specifically in sea urchin and chick • To be familiar with the processes that help in the establishment of basic plan of development
COURSE OUTCOME:	Upon successful completion of the course, students will be able to: CO1: Understand the basic plan of animal development. CO2: Know the processes which occur during the course of development in invertebrates and vertebrates. CO3: Have the basic knowledge of developmental biology. CO4: Know the concepts associated with development of embryo.

ZOO-V.C-7: CORE COURSE:DEVELOPMENTAL BIOLOGY		
MODULE	**TOPICS**	**CONTACT HOURS**
MODULE 1: Early embryonic development and early development of model organism: sea urchin	1.1: Introduction to cell division: mitosis and meiosis 1.2: Fertilization: structure of the gametes 1.3: Species recognition specificity of egg and sperm 1.4: Gamete fusion and the prevention of polyspermy 1.5: The activation of egg metabolism 1.6: Fusion of the genetic material 1.7: Rearrangement of the egg cytoplasm 1.8: Sea Urchin: cleavage, gastrulation, blastula formation 1.9: Fate maps and the determination of sea urchin blastomeres, gastrulation 1.10: Embryonic stem cells: Pluripotency and tutipotency	15
MODULE 2: Early development of model organism: chick	2.1: Chick: cleavage, gastrulation, primitive streak, epiboly 2.2: Development upto three days of incubation 2.3: Extra embryonic membranes of chick development, structure and functions of yolk sac, amnion, chorion and allantois	15
MODULE 3: Growth and regeneration	3.1: Nuclear transplantations and embryonic inductions 3.2: Size and proportion, aging, theories of ageing, postnatal disorders of growth and differentiation 3.3: Distribution of regenerative capacity, Planarian regeneration, regeneration of limb and tail in vertebrates 3.4: Hejmadi Mohanty's experiment	15

PRACTICAL COMPONENT OF ZOO-V.C-7 (DURATION -02 HRS /WEEK)		
SR. NO.	**PRACTICAL**	**NO. OF PRACTICALS**
1)	Observation of developmental stages of sea urchin: cleavage, blastula, gastrula (permanent slides)	01
2)	Study of morphogenetic movement *in vivo* in hens egg using vital staining technique by preparing window opening	02
3)	*In vitro* observation of different extra embryonic membrane in a six days old chick embryo	01
4)	Preparation of permanent slides of chick embryo: 24 hours, 36 hours,48 hours, 72 hours	06
5)	Effect of retinoic acid on regeneration of fin in fish	01
6)	Mounting of eye vesicles and limb buds of six day old chick embryo	01

REFERENCE BOOKS:

1. *Gilberts, S.F. (2013). Developmental Biology, Sinauer Associates, Sunderland.*
2. *Jain, P.C. (2013). Elements of developmental biology, Vishal Publications, Jalandhar*
3. *Slack, J.M.W. (2006). Essential developmental biology. Blackwell Publishing, U.K.*

REFERENCE BOOKS FOR PRACTICALS:

1. *Beffa – Mari, M. And J. Knight (2005) Key experiments in practical developmental biology. Cambridge University Press.*
2. *Tyler, M.S. (2000) Developmental biology, a guide for experimental study. Sinauer Associates, Inc. Publishers, Sunderland, MA.*

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ELECTIVE COURSE: MOLECULAR GENETICS AND FORENSIC SCIENCE	
COURSE CODE	ZOO-V.E-9
MARKS	100 [75 – Theory; 25 – Practicals]
CREDITS	04 [03 – Theory; 01 – Practical]
CONTACT HOURS	THEORY : 45 HOURS (03 LECTURE/WEEK) PRACTICALS : 30 HOURS (01 PRACTICAL/WEEK)
COURSE OBJECTIVES	This course will ellucidate the functional aspects of the genetic material at molecular level, focusing on gene expression and gene regulation. It will also expose students to the basics of forensic science and understand diagnostic genetics.
COURSE OUTCOME:	Upon successful completion of the course, students will be able to: CO1: Understand and explain the process of replication, transcription and translation CO2: Differentiate between the gene expression in prokaryotes and eukaryotes CO3: Understand the Branches of forensic science CO4: know the application of molecular tools in genetic diagnosis

ZOO-V.E-9: MOLECULAR GENETICS AND FORENSIC SCIENCE		
MODULE	**TOPICS**	**CONTACT HOURS**
MODULE 1 : Gene Expression and Gene Regulation	1.1 : DNA Replication: DNA Replication in prokaryotes and eukaryotes, mechanism of DNA replication 1.2: Transcription: transcription Unit, mechanism of transcription in prokaryotes and eukaryotes, synthesis of rRNA and mRNA, transcription factors 1.3 : Translation: Genetic code, Process of protein synthesis, Difference between prokaryotic and eukaryotic translation, Post Transcriptional Modifications and Processing of Eukaryotic RNA 1.4: Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from lac-operon and trp-operon; Transcription regulation in eukaryotes: Activators,repressors, enhancers, silencers elements; Gene silencing	15
MODULE 2 : Basics of Forensic Science	2.1 : Definition, overview of Disciplines of Forensic science 2.2: Crime and Crime Scene management: Types of crime scenes – indoor and outdoor. Securing and isolating the crime scene. Crime scene search methods. Safety measures at crime scenes. Legal considerations at crime scenes. Documentation of crime scenes – photography, videography, sketching and recording notes. 2.3: Forms of forensic evidences: -Biological evidence: Bloodstains, hair, semen, DNA -Physical and trace evidence –pattern of blood stains, fingerprints, fibres, weapons - Documents- types of forensic documents (genuine /forged),methods of detecting forged documents(handwriting analysis, Analysis of paper and inks)	15
MODULE 3 : Diagnostic Genetics	3.1 : Cytogenetics/ Molecular Cytogenetics/ Biochemical/ Molecular methods of detecting genetic disorders - Adult and Newborn screening 3.2: Cytogenetics/ Molecular Cytogenetics/ Molecular methods of detecting genetic disorders – Prenatal and Preimplantation screening 3.3: Forensic testing - DNA fingerprinting, paternity testing, personal /individual identification	15

PRACTICAL COMPONENT OF ZOO–V.E-9: MOLECULAR GENETICS AND FORENSIC SCIENCE (DURATION -02 HRS /WEEK)		
SR.NO.	**PRACTICAL**	**NO. OF PRACTICALS**
1	Isolation of DNA from peripheral blood/tissue (chick liver).	01
2	Microscopic examination of Hair a. Human scalp Hair b. Animal Hair	03
3	Sketching and Photography of various type of crime scene.	03
4	Presumptive Tests for Blood a. Phenolphthalin Assay	01
6	To perform ridge tracings and ridge counting	01
7	Analysis of DNA fingerprints	03

REFERENCE BOOKS :

1) *J. Prahlow (2010); Forensic Pathology for Police, Death Investigators, Attorneys, 17 and Forensic Scientists, DOI 10.1007/978-1-59745-404-9_2, C Springer Science + Business Media, LLC (Ebook available)*
2) *Robert Schleif (1993). Genetics and Molecular Biology. S E C O N D E D I T I O N. Department of Biology,The Johns Hopkins University, Baltimore, Maryland. The Johns Hopkins University Press 2715 North Charles Street Baltimore, Maryland 21218-4319, The Johns Hopkins Press Ltd., London (Ebook available)*
3) *Richard Saferstein (2011); Forensic Science,II Edition, Prentice Hall publishers, Sanfrancisco*
4) *Griffith A, Wesseler S, Lewontin R Gelbart W, Suzuki D and Miller J(2000). Introduction to Genetic Analysis. Eigth Edition.(Ebook available)*
5) *Tom Strachan and Read A (2010): Human Molecular Genetics. Fourth Edition. Garland Science Publisher, New York, NY 10017*

REFERENCES BOOKS FOR PRACTICALS:

1) *J. Prahlow (2010); Forensic Pathology for Police, Death Investigators, Attorneys, 17 and Forensic Scientists, DOI 10.1007/978-1-59745-404-9_2, C Springer Science+Business Media, LLC (Ebook available.)*

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ELECTIVE COURSE: ECONOMIC ZOOLOGY	
COURSE CODE	ZOO-V.E-10
MARKS	100 [75 – Theory; 25 – Practicals]
CREDITS	04 [03 – Theory; 01 – Practical]
CONTACT HOURS	THEORY : 45 HOURS (03 LECTURE/WEEK) PRACTICALS : 30 HOURS (01 PRACTICAL/WEEK)
COURSE OBJECTIVES	To study the various aspects of economic zoology To study the species of economic importance, classification To gain an insight whether own business can be started based on studying the zoological species and their products
COURSE OUTCOME:	Upon successful completion of the course, students will be able to: CO1: Understand how zoological species contribute to economic sources. CO2: Gain working knowledge of techniques of rearing organisms. CO3: Get acquainted with maintenance of the species CO4: Understand the underlying principles of harvesting products from species.

ZOO-V.E- 10 : ECONOMIC ZOOLOGY		
MODULE	**TOPICS**	**CONTACT HOURS**
MODULE 1 : Scope of Economic Zoology	1.1 : Economic Zoology, History, Scope, 1.2 : Species of bionomic importance (Honey bee, Silkworm, lac insect, mackerel, domestic fowl, goat, sheep, cow, buffalo, pig, rats, mice) 1.3 : Source, properties, constituents and nutritive value of products of bionomic importance: eggs of poultry, milk, meat, honey, medicinal value of synthetic insulin (recombinant), significance of wool, silk, lac 1.4 : Organizations and their functions: agricultural and processed food products export development authority (APEDA), the marine products exports developmental authority (MPEDA), central silk board (CSB), central bee research and training institute (CBRTI), pharmaceutical and biotechnology industries (Lupin) and contract research organizations (Intox), and research institutes (NIN, Hyderabad)	15
MODULE 2 : Models in Economic Zoology	2.1 : Insects, products and applications : lac insects, honey bees, silkworms 2.2 : Vermiculture: Rearing and maintenance of earthworms 2.3 : Aquaculture : rearing and maintenance of prawns,oysters, edible and ornamental fishes 2.4 : Poultry : rearing and maintenance of domestic fowl, applications and products 2.5 : Business models of apiculture, sericulture, aquaculture and poultry	15
MODULE 3 : Pharma products and biological control	3.1 : Pharmaceuticals from animals and their Applications (antiserum), from transgenic animals (malaria vaccine, alpha 1 antitrypsin, lactoferrin, fibrinogen) 3.2 : Species used in biological control : *Casnoidea indica*, Trichogramma, *Poecilia reticulata / Gambusia affinis* 3.3 : Maintenance and breeding of animals for research: mice, rats, guinea pigs, rabbits, marmosets, guidelines given by committee for the purpose of control and supervision of experiments on animals (CPCSEA)	15

PRACTICAL COMPONENT OF ZOO-V.E-10 ECONOMIC ZOOLOGY (DURATION - 02 HRS /WEEK)		
SR.NO.	**PRACTICAL**	**NO. OF PRACTICALS**
1	Vermicomposting	05
2	Preparation of dairy products from milk : cheese and butter	02
3	Laboratory observations of insects – Honeybee, Silk moth, Lac insect	01
4	Visit to dairy industry/poultry/ piggery/apiary/silk industry/ biotechnology industry/pharmaceutical industry/research institute	04

REFERENCE BOOKS :

1) *G. S. Shukla, V. B. Upadhyay (2008) Economic Zoology, Rastogi Publications, Meerut*
2) *H. Osborn (1908) Economic Zoology an introductory text book in zoology with special reference to its applications in agriculture, commerce and medicine The Macmillan Company*
3) *K. P. Shrivastava, Gs Dhaliwal (2015) Text Book of Applied Entomology Kalyani Publishers*
4) *P. K. Gupta (2011) Vermicomposting for Sustainable Agriculture, Agrobios India Ltd*
5) *S. Singh (1962) Bee-Keeping in India ICAR New Delhi p. 214*

REFERENCE BOOKS FOR PRACTICALS:

1) *A. K. Tripathi(2009) Mulberry Sericulture: Problems And Prospects Aph Publishing Corporation*
2) *C.L. Metcalf and W.P Flint (1962) Destructive and Useful Insects New York, N.Y. : McGraw-Hill*

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ELECTIVE COURSE: BASIC AND APPLIED ENTOMOLOGY	
COURSE CODE	ZOO-VI.E-11
MARKS	100 [75 – Theory; 25 – Practicals]
CREDITS	04 [03 – Theory; 01 – Practical]
CONTACT HOURS	THEORY : 45 HOURS (03 LECTURE/WEEK) PRACTICALS : 30 HOURS (01 PRACTICAL/WEEK)
COURSE OBJECTIVE	• To develop a strong foundation in entomology, including understanding of the importance of insects to the human society. • To review important areas in insect biology such as morphology, physiology, ecology, behaviour, genetics, phylogeny, ontogeny and population biology. • To develop a sufficient background for advanced entomology.
COURSE OUTCOME:	Upon successful completion of the course, students will be able to: CO1: Be familiar with the identification of bio economical species. CO2: Identify entrepreneurial opportunities in entomology. CO3: Important insects and their products. CO4: Insect pests of public health and veterinary importance and their management.

ZOO-VI.E-11: BASIC AND APPLIED ENTOMOLOGY		
MODULE	**TOPIC**	**CONTACT HOURS**
MODULE 1 Fundamentals of Entomology	Unit 1: Class Insecta: • Salient features • Classification of insects up to orders – an overview Unit 2: Morphological studies: • of antenna, wings, legs, Mouth parts Unit 3: Techniques: • Collection of insects • Preservation of insects	15
MODULE 2 Bionomics and control of crop pests and medically important pests	Unit 4: Pest of agricultural importance: • Paddy pests, cashew pests, coconut pests, areca nut pests, stored grain pest, sugarcane pests, vegetable pests, fruit pests (two pests from each of the above) Unit 5: Insects of medicinal importance: • mosquitoes, housefly, sand fly, cockroaches, human lice, bed bug, rat fleas Unit 6:Termites: • social organization, termitaria and termite control measures	15
MODULE 3 Useful insects and pest management	Unit 7: Useful insects: • Honeybees (Apiculture); Mulberry silk worm(sericulture); lac insects (lac culture) Unit 8: Insect pest control methods: • biological, chemical (attractants, pheromones and hormones), Integrated Pest Management (IPM) Unit 9: Role of insects in ecosystem services	15

PRACTICAL COMPONENT OF BASIC AND APPLIED ENTOMOLOGY ZOO-VI.E-14 PRACTICAL (DURATION: 30 HOURS – 02hrs/WEEK)		
SR. NO	**PRACTICAL**	**NO. OF PRACTICALS (12)**
1.	Collection techniques of Insects – light traps, sweep net, Berlese funnel	02
2.	Identification and study of economically important insects.	02
3.	Field trips to ICAR Old Goa / Govt. of Goa agriculture department/ National Malaria Research Institute (NMRI).	02
4.	Study of insects of college campus dragon fly/ pests of different plants.	03
5.	Study of local insect pests of agriculture.	03

REFERENCE BOOKS:

1) *Aitwal, A.S (1993): Agricultural pests of India and South East Asia. Kalyani publication, New Delhi.*
2) *Awasthi,V.B (2007):Introduction to general and applied entomology ,2nd edition. Scientific publishers India Jodhpur.*
3) *David, B.V. and Ananthakrishnan, T.N (2006): General and applied entomology, 2nd edition Tata McGraw hill, New Delhi.*
4) *Reddy,D.S(2010) Applied entomology,2nd edition New Vishal publications*

REFERENCE BOOKS FOR PRACTICALS:

1. *Fenemore, P.G. and Prakash, A. (1995): Applied Entomology, Wiley Eastern Limited new age international.*
2. *Varasi, M.S. (1992): Text book of entomology, Himalaya Publishing House, 1st edition.*

***ELECTIVE COURSE: BASIC AND APPLIED ENTOMOLOGY (AS NON PRACTICAL BSED COURSE)**	
COURSE CODE	ZOO-VI.E-11
MARKS	100 [75 -Theory; 25- Fieldbased]
CREDITS	04
CONTACT HOURS	Theory: 45 HOURS [03 Lectures Per Week] Fieldbased work: 15 HOURS.
COURSE OBJECTIVE	• To develop a strong foundation in entomology, including understanding of the importance of insects to the human society. • To review important areas in insect biology such as morphology, physiology, ecology, behaviour, genetics, phylogeny, ontogeny and population biology. • To develop a sufficient background for advanced entomology.
COURSE OUTCOME:	Upon successful completion of the course, students will be able to: CO1: Be familiar with the identification of bio economical species. CO2: Identify entrepreneurial opportunities in entomology. CO3: Important insects and their products. CO4: Insect pests of public health and veterinary importance and their management.

ZOO-VI.E-11: BASIC AND APPLIED ENTOMOLOGY		
MODULE	**TOPIC**	**CONTACT HOURS**
MODULE 1 Fundamentals of Entomology	Unit 1: Class Insecta: • Salient features • Classification of insects up to orders – an overview Unit 2: Morphological studies: • of antenna, wings, legs, Mouth parts Unit 3: Techniques: • Collection of insects • Preservation of insects	15
MODULE 2 Bionomics and control of crop pests and medically important pests	Unit 4: Pest of agricultural importance: • Paddy pests, cashew pests, coconut pests, areca nut pests, stored grain pest, sugarcane pests, vegetable pests, fruit pests (two pests from each of the above) Unit 5: Insects of medicinal importance: • mosquitoes, housefly, sand fly, cockroaches, human lice, bed bug, rat fleas Unit 6:Termites: • social organization, termitaria and termite control measures	15
MODULE 3 Useful insects and pest management	Unit 7: Useful insects: • Honeybees (Apiculture); Mulberry silk worm(sericulture); lac insects (lac culture) Unit 8: Insect pest control methods: • biological, chemical (attractants, pheromones and hormones), Integrated Pest Management (IPM) Unit 9: Role of insects in ecosystem services	15
MODULE 4 Field based Study	<u>Field based study report:</u> • Identification and study of agricultural pests / pest of fruits / vegetables. • Insect collection techniques: light traps, sweep net, Berlese funnel. • Study of insects of college campus dragon fly/ pests of different plants • Visit to ICAR old Goa/ Gov.t of Goa agriculture department/national Malaria research Institute	15

REFERENCE BOOKS:

1) *Aitwal, A.S (1993): Agricultural pests of India and South East Asia. Kalyani publication, New Delhi.*
2) *Awasthi,V.B (2007):Introduction to general and applied entomology ,2nd edition. Scientific publishers India Jodhpur.*
3) *David, B.V. and Ananthakrishnan, T.N (2006): General and applied entomology, 2nd edition Tata McGraw hill, New Delhi.*
4) *Reddy,D.S(2010) Applied entomology,2nd edition New Vishal publications*

REFERENCE BOOKS FOR PRACTICALS:

1. *Fenemore, P.G. and Prakash, A. (1995): Applied Entomology, Wiley Eastern Limited new age international.*

ELECTIVE COURSE: FISH PRESERVATION AND PROCESSING	
COURSE CODE	ZOO-V.E-12
MARKS	100 [75 – Theory; 25 – Practicals]
CREDITS	04 [03 – Theory; 01 – Practical]
CONTACT HOURS	THEORY : 45 HOURS (03 LECTURE/WEEK) PRACTICALS : 30 HOURS (01 PRACTICAL/WEEK)
COURSE OBJECTIVES	• To familiarize the students with different methods of fish preservation and processing • To acquaint them with techniques and precautions for hygienic fish handling • The course content is locally relevant and prepares students for entrepreneurship and self employment
COURSE OUTCOME:	Upon successful completion of the course, students will be able to: CO1: gain understanding of the economic benefits of fishes. CO2: They will also be able to understand the nutritional values of the fishes CO3: Perform some protocols of Fish processing and preservation. CO4: Aquaint oneself with the processes at fish processing industry

ZOO-V.E- 12 : FISH PRESERVATION AND PROCESSING		
MODULE	**TOPICS**	**CONTACT HOURS**
MODULE 1: Fishery Development	1.1 : Status of Development of the fishery and seafood processing industry. 1.2: Empowerment through Aquatic Products: (Background,Nutritionalsecurity,Role ofFisheries Fisheries Sector,Role of Tifac in Fisheries Sector,Objectives,Integrated Fisheries Project(IFP),Indian national centre for ocean information services (INCOIS), Catch per unit effort (CPUE), Maximum sustainable yield (MSY)	15
MODULE 2: Fish Handling and preservation	2.1: Recent Scenario: Quality Changes and Shelf life of Chilled Fish,Theeffect of Hygiene duringhandling 2.2: Fish Handling Methods: Organoleptic test, Assessment of Fish Quality,Quality assessment of Fresh Fish,Quality Assessment of Fish Products,Physical methods,Assurance of Fresh Fish Quality, Post harvest Changes in Fish,How does a Fish Lose its Quality, fish as vectors of zoonotic diseases 2.3: Fish Preservation: Reasons for Spoilage of Fishes,Methods of Fish.	15
MODULE 3: Value of Fish	3.1:Economic Importance of Fish:Food value,Fish By-Products, surimi, Goan fish para, balchao 3.2: Postmortem changesin Fish,Bacteriological Changes, Lipid Oxidation and Hydrolysis, Chemical Composition,Lipids,Proteins,N- containing Extractives,Vitamins and Minerals, 3.3: Aquatic Resources and their utilization, value added product: chitin	15

PRACTICAL COMPONENT OF ZOO-V.E-12: FISH PRESERVATION AND PROCESSING (DURATION -02 HRS /WEEK)		
SR.NO.	**PRACTICAL**	**NO. OF PRACTICALS**
1	Estimation of Proteins and Lipids form fish tissue	02
2	Determination of moisture and ash content from the fish	01
3	Preparation of fish Fillet	01
4	Study of Fish Parasites – Ectoparasites (gills); endoparasites (gut)	02
5	Method of fish preservation (salting, pickling)	02
6	Visit to Fish Processing Centre/Fishing Co-operative Society /Fishery Institute/Fishery survey of India, Vasco (FSI)	04

REFERENCE BOOKS :

1) Braj Kishore Singh (2008) Applied Fisheries and Aquaculture Swastik Publishers and Distributers
Delhi,India
2) Pandey and Shukla (2015) Fish and Fisheries, IIIrd Revised Edition, Rastogi Publications Meerut, India

REFERENCE BOOKS FOR PRACTICALS:

1) Braj Kishore Singh (2008) Applied Fisheries and Aquaculture Swastik Publishers and Distributers
Delhi,India
2) Pandey and Shukla (2015) Fish and Fisheries, IIIrd Revised Edition, Rastogi Publications Meerut, India

ELECTIVE COURSE: FISH PRESERVATION AND PROCESSING (AS NON-PRACTICAL BASED COURSE)	
COURSE CODE	ZOO-V.E-12
MARKS	100 [75 -Theory; 25- Fieldbased report]
CREDITS	04
CONTACT HOURS	Theory: 45 HOURS [03 Lectures Per Week] Fieldbased work: 15 HOURS.
COURSE OBJECTIVES	• To familiarize the students with different methods of fish preservation and processing • To acquaint them with techniques and precautions for hygienic fish handling • The course content is locally relevant and prepares students for entrepreneurship and self employment
COURSE OUTCOME:	Upon successful completion of the course, students will be able to: CO1: gain understanding of the economic benefits of fishes. CO2: They will also be able to understand the nutritional values of the fishes CO3: Perform some protocols of Fish processing and preservation. CO4: Aquaint oneself with the processes at fish processing industry

ZOO-V.E- 12 : FISH PRESERVATION AND PROCESSING		
MODULE	**TOPICS**	**CONTACT HOURS**
MODULE 1: Fishery Development	1.2 : Status of Development of the fishery and seafood processing industry. 1.2: Empowerment through Aquatic Products: (Background,Nutritionalsecurity,Role ofFisheries Fisheries Sector,Role of Tifac in Fisheries Sector,Objectives,Integrated Fisheries Project(IFP),Indian national centre for ocean information services (INCOIS), Catch per unit effort (CPUE), Maximum sustainable yield (MSY	15
MODULE 2: Fish Handling and preservation	2.1: Recent Scenario: Quality Changes and Shelf life of Chilled Fish,Theeffect of Hygiene duringhandling 2.2: Fish Handling Methods: Organoleptic test, Assessment of Fish Quality,Quality assessment of Fresh Fish,Quality Assessment of Fish Products,Physical methods,Assurance of Fresh Fish Quality, Post harvest Changes in Fish,How does a Fish Lose its Quality, fish as vectors of zoonotic diseases 2.3: Fish Preservation: Reasons for Spoilage of Fishes,Methods of Fish.	15
MODULE 3: Value of Fish	3.1:Economic Importance of Fish:Food value,Fish By-Products, surimi, Goan fish para, balchao 3.2: Postmortem changesin Fish,Bacteriological Changes, Lipid Oxidation and Hydrolysis, Chemical Composition,Lipids,Proteins,N- containing Extractives,Vitamins and Minerals, 3.3: Aquatic Resources and their utilization, value added product: chitin	15
MODULE 4 Field based Study	<u>Field Based study:</u> Visit to Fish Processing Centre/ Fishing Co-operative Society / Fishery Institute/Fishery survey of India, Vasco (FSI) to study the following: 1) Quality control of fishes 2) Fish parasites (ecto and endo) 3) Fish filleting, 4) Fish preservation (salting/ pickling)	15

REFERENCE BOOKS :

1) Braj Kishore Singh (2008) Applied Fisheries and Aquaculture Swastik Publishers and Distributers Delhi,India

2) Pandey and Shukla (2015) Fish and Fisheries, IIIrd Revised Edition, Rastogi Publications Meerut, India

REFERENCE BOOKS FOR PRACTICALS:

1) Braj Kishore Singh (2008) Applied Fisheries and Aquaculture Swastik Publishers and Distributers Delhi,India

2) Pandey and Shukla (2015) Fish and Fisheries, IIIrd Revised Edition, Rastogi Publications Meerut, India.

PARVATIBAI CHOWGULE COLLEGE OF ARTS AND SCIENCE
(Autonomous)
PROGRAMME BSC ZOOLOGY

COURSE CURRICULUM OF SEMESTER 6

SEMESTER	COURSE CODE	COURSES	CREDITS	CONTACT HOURS
SEMESTER VI	ZOO-VI.C-8	Wildlife Biology	Theory = 03 Practicals =01	Theory = 45 Practicals =30
		Wildlife Biology	Theory = 04	Theory = 60
	ZOO-VI.E-13/	Health and Nutrition	Theory = 03 Practicals =01	Theory = 45 Practicals =30
	*ZOO-VI-GE-1	Health and Nutrition	Theory = 04	Theory = 60
	ZOO-VI.E-14	Ecology and Ethology	Theory = 03 Practicals =01	Theory = 45 Practicals =30
	ZOO-VI.E-15	Laboratory Techniques in Pathology	Theory = 03 Practicals =01	Theory = 45 Practicals =30
	ZOO-VI.E-16/	Bio Entrepreneurship	Theory = 03 Practicals =01	Theory = 45 Practicals =30
	*ZOO-VI-SE-2	Bio Entrepreneurship	Theory = 04	Theory = 60

SEMESTER VI

CORE COURSE: WILDLIFE BIOLOGY	
COURSE CODE	**ZOO-VI-C-8**
MARKS	100 [75 –Theory ; 25- Practical]
CREDITS	04 [03 –Theory; 01- Practical]
CONTACT HOURS	THEORY : 45 HOURS (03 LEC/WEEK) PRACTICALS: 30 HOURS (01 PRACTICAL /WEEK)
COURSE OBJECTIVES	This course is designed to enable students to understand the basics of wildlife status, conservation, assessment and management.
COURSE OUTCOME:	Upon successful completion of the course, students will be able to: CO1: Apply the techniques used in assessment and monitoring of wildlife. CO2: Understand the basics of wildlife status, conservation, assessment and management. CO3: Know about the diversity, extent, range of wildlife population dynamics. CO4: Know the rules, regulations and factors governing wildlife

ZOO-VI-C-8: WILDLIFE BIOLOGY		
MODULE	**TOPICS**	**CONTACT HOURS**
MODULE 1: Introduction To Wildlife	UNIT 1: Introduction to wildlife • Values of wildlife - Conservation ethics, Importance of conservation, Causes of depletion, World conservation strategies. UNIT 2: Evaluation and management of wildlife • Habitat analyses, Physical parameters: Topography, Geology, Soil and water. • Biological Parameters: food, cover, forage, browse and ground cover estimation. • Standard evaluation procedures: remote sensing and GIS.	15
MODULE 2: Population Estimation And Protected Areas	UNIT 3: Population estimation • Population density, natality, mortality, fertility schedules and sex ratio computation. • Analysis of scat and dropping of ungulates and carnivores. • Trichotaxonomy, pug marks and census method based on indirect evidences. UNIT 4: Protected areas • Protected Area network (PAN): National parks and wildlife sanctuaries. • Biogeographical features of important features of protected areas in India (any 3). • Tiger conservation - tiger reserves in India, challenges and management of tiger reserves.	15
MODULE 3: Management Of Wildlife	UNIT 5: Management of habitats • Setting back succession, grazing logging, mechanical treatment, advancing the succession process, artificial feeding grounds. • Cover construction, preservation of general genetic diversity, restoration of degraded habitats, UNIT 6: Management planning of wildlife in protected areas • Habitat carrying capacity, visitors carrying capacity, eco tourism / wild life tourism, concept of climax persistence, ecology of perturbance. • Role of national / state statutory bodies on governing wildlife (NBWL, IUCN, CITES, state wildlife boards and forest department). UNIT 8: Management ofcritical population • Radio- telemetry, care of injured and diseased animal, quarantine, common diseases of wild animals, capture and translocation of wildlife. • Captive management – a brief idea.	15

PRACTICAL COMPONENT OF WILDLIFE BIOLOGY ZOO-VI-C-8: (DURATION: 30 HOURS – 02hrs/WEEK)		
SR. NO	**PRACTICAL**	**NO. OF PRACTICALS**
1)	Study of butterflies and their host plants on the campus / molluscs/ ants/ spiders / birds	02
2)	Acquainting oneself with basic equipment needed in wildlife studies; use, care and maintenance (compass, binoculars, spotting scope, range finders, Global Positioning System, various types of cameras and lenses)	02
3)	Familiarization and study of species specific evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers, feathers, etc. – case study	02
4)	Demonstration of various field techniques for flora and fauna: PCQ, Ten tree method, Circular, Square and rectangular plots, Parker's 2 Step and other methods for ground cover assessment, Tree canopy cover assessment, Shrub cover assessment	03
5)	Trail / transect-quadrate monitoring for abundance and diversity estimation of mammals and birds (direct and indirect evidences) (on campus or fieldtrip)	03

REFERENCE BOOKS:

1. *Caughley, G., and Sinclair, A.R.E. (1994). Wildlife Ecology and Management. Blackwell Science.*
2. *Woodroffe R., Thirgood, S. and Rabinowitz, A. (2005). People and Wildlife, Conflict or Co-existence. Cambridge University.*
3. *Bookhout, T.A. (1996). Research and Management Techniques for Wildlife and Habitats, 5th edition. The Wildlife Society, Allen Press.*
4. *Sutherland, W.J. (2000). The Conservation Handbook: Research, Management and Policy. Blackwell Sciences*
5. *Hunter M.L., Gibbs, J.B. and Sterling, E.J. (2008). Problem-Solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory. Blackwell Publishing.*

CORE COURSE: WILDLIFE BIOLOGY (AS NON-PRACTICAL BASED COURSE)	
COURSE CODE	**ZOO-VI-C-8**
MARKS	100 [75 -Theory; 25- Field based]
CREDITS	04
CONTACT HOURS	Theory: 45 HOURS [03 Lectures Per Week] Field based work: 15 HOURS.
COURSE OBJECTIVES	This course is designed to enable students to understand the basics of wildlife status, conservation, assessment and management.
COURSE OUTCOME:	Upon successful completion of the course, students will be able to: CO1: Apply the techniques used in assessment and monitoring of wildlife. CO2: Understand the basics of wildlife status, conservation, assessment and management. CO3: Know about the diversity, extent, range of wildlife population dynamics. CO4: Know the rules, regulations and factors governing wildlife

ZOO-VI-C-8: WILDLIFE BIOLOGY		
MODULE	**TOPICS**	**CONTACT HOURS**
MODULE 1: Introduction To Wildlife	UNIT 1: Introduction to wildlife • Values of wildlife - Conservation ethics, Importance of conservation, Causes of depletion, World conservation strategies. UNIT 2: Evaluation and management of wildlife • Habitat analyses, Physical parameters: Topography, Geology, Soil and water. • Biological Parameters: food, cover, forage, browse and ground cover estimation. • Standard evaluation procedures: remote sensing and GIS.	15
MODULE 2: Population Estimation And Protected Areas	UNIT 3: Population estimation • Population density, natality, mortality, fertility schedules and sex ratio computation. • Analysis of scat and dropping of ungulates and carnivores. • Trichotaxonomy, pug marks and census method based on indirect evidences. UNIT 4: Protected areas • Protected Area network (PAN): National parks and wildlife sanctuaries. • Biogeographical features of important features of protected areas in India (any 3). • Tiger conservation - tiger reserves in India, challenges and management of tiger reserves.	15
MODULE 3: Management Of Wildlife	UNIT 5: Management of habitats • Setting back succession, grazing logging, mechanical treatment, advancing the succession process, artificial feeding grounds. • Cover construction, preservation of general genetic diversity, restoration of degraded habitats, UNIT 6: Management planning of wildlife in protected areas • Habitat carrying capacity, visitors carrying capacity, eco tourism / wild life tourism, concept of climax persistence, ecology of perturbance. • Role of national / state statutory bodies on governing wildlife (NBWL, IUCN, CITES, state wildlife boards and forest department). UNIT 8: Management ofcritical population • Radio- telemetry, care of injured and diseased animal, quarantine, common diseases of wild animals, capture and translocation of wildlife. • Captive management – a brief idea.	15

MODULE 4: Field based Study	Field based study report on: • Study of butterflies and their host plants on the campus / molluscs/ ants/ spiders / birds • Any two biodiversity monitoring by various field techniques for flora and fauna: • Trail / transect-quadrate monitoring for abundance and diversity estimation of mammals and birds (direct and indirect evidences) (on campus or fieldtrip) • Identification of animals through pug marks, hoofmarks, scats, pellet groups, nest, antlers, feathers, etc. • Local case study report of wild life conflict Use of compass, binoculars, spotting scope, range finders, Global Positioning System on field.	15

REFERENCE BOOKS:

1. *Caughley, G., and Sinclair, A.R.E. (1994). Wildlife Ecology and Management. Blackwell Science.*
2. *Woodroffe R., Thirgood, S. and Rabinowitz, A. (2005). People and Wildlife, Conflict or Co-existence. Cambridge University.*
3. *Bookhout, T.A. (1996). Research and Management Techniques for Wildlife and Habitats, 5th edition. The Wildlife Society, Allen Press.*
4. *Sutherland, W.J. (2000). The Conservation Handbook: Research, Management and Policy. Blackwell Sciences*
5. *Hunter M.L., Gibbs, J.B. and Sterling, E.J. (2008). Problem-Solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory. Blackwell Publishing.*

ELECTIVE COURSE: HEALTH AND NUTRITION	
COURSE CODE	**ZOO-VI-E-13 /**
MARKS	100 [75 –Theory ; 25- Practical]
CREDITS	04 [03 –Theory; 01- Practical]
CONTACT HOURS	THEORY : 45 HOURS (03 LEC/WEEK) PRACTICALS: 30 HOURS (01 PRACTICAL /WEEK)
COURSE OBJECTIVES	This course is an introduction to the nutrients, their functions and role in maintaining good health of humans.
COURSE OUTCOME:	Upon successful completion of the course, students will be able to: CO1: Know about nutrients and their function CO2: Read and interprete food labels. CO3: Correlate role of lifestyle and food habits in causing diseases. CO4: Prepare Diet Plans for different age group individuals.

ZOO-VI-E-13: HEALTH AND NUTRITION		
MODULE	**TOPICS**	**CONTACT HOURS**
MODULE 1: BASIC CONCEPT OF FOOD AND NUTRITION	UNIT 1: Overview of health and nutrition • Definition of health and nutrition • Scope of nutrition, food as a source of nutrients • Nutrients and energy • Adequate, optimum and balanced diet • Malnutrition and health. UNIT 2: Nutritional Biochemistry (Overview) • Carbohydrates, lipids, proteins - definition, classification, structure and properties • Significance of acid value, iodine value and saponification value of lipids • Essential and non-essential amino acids • Enzymes- definition, classification, properties(overview). • Coenzymes, vitamins (fat soluble and water soluble), structure and properties • Minerals- iron, calcium, phosphorus, iodine, selenium and zinc and their properties	**15**
MODULE 2: NUTRIENTS AND DIETARY PATTERN FOR HUMANS	UNIT 3: Functions of food components of food-nutrients • Biochemical role and dietary sources of macro and micronutrients (carbohydrates, lipids and proteins, fat soluble vitamins-A, D, E and K , water soluble vitamins – thiamin, riboflavin, niacin, pyridoxine, folate, vitamin B12 and vitamin - C Minerals – calcium, iron and iodine). • Changes of nutrient value during cooking of the following food groups: cereals, pulses and vegetables. Nutrient loss - dry, moist, frying and microwave cooking. UNIT 4: Nutrition and dietetics • Physiological considerations, nutrient needs and dietary pattern for various groups- adults, pregnant and nursing mothers, infants, pre-school and school children, adolescents and geriatric nutrition.	**15**

MODULE 3: DIET RELATED DISEASES	UNIT 5:Health and diseases • Major nutritional deficiency diseases- protein energy malnutrition, Vitamin deficiency, iron deficiency anaemia, iodine deficiency disorders, their causes, symptoms, treatment, prevention and government programmes, if any. • Life style related diseases- obesity, hypertension, hyperurecimia, diabetes mellitus, polycystic ovarian disease (PCOD) - their causes and prevention through dietary/lifestyle modifications. • Social health problems: smoking, alcoholism, drug dependence and Acquired Immune Deficiency Syndrome (AIDS); • Common ailments- irritable bowel disease (IBD), constipation: causes and dietary management UNIT 6: Food hygiene • Potable water- sources and methods of purification at consumer level • Food and water borne infections: bacterial infection: cholera, typhoid, dysentery; viral infection: hepatitis, poliomyelitis, protozoan infection: Amoebiasis, Giardiasis; Parasitic infection: Taeniasis and Ascariasis their causative agent, symptoms, transmission and prevention. • Brief account of food spoilage: Causes and preventive measures	**15**

PRACTICAL COMPONENT OF 'HEALTH AND NUTRITION ZOO-VI-E-13: DURATION (30 HOURS – 02hrs/WEEK)		
SR. NO	**PRACTICAL**	**NO. OF PRACTICALS**
1.	To detect adulteration in a) Ghee b) Sugars c) Tea leaves and d) Turmeric	03
2.	Estimation of lactose in milk	02
3.	Titrametic estimation of: • Ascorbic acid estimation in food • Calcium in food	02
4.	Observation of any two grain pests	01
5.	Project based: • Identify nutrient rich sources of foods, their seasonal availability and price • Study of nutrition labeling on selected foods	04

GENERIC ELECTIVE COURSE: HEALTH AND NUTRITION (For students of other discipline)	
COURSE CODE	***ZOO-VI-GE-1**
MARKS	Theory 100 marks
CREDITS	04 [Theory]
CONTACT HOURS	Theory(4 Lec/week)
COURSE OBJECTIVES	This course is an introduction to the nutrients, their functions and role in maintaining good health of humans.
COURSE OUTCOME:	Upon successful completion of the course, students will be able to: CO1: Know about nutrients and their function CO2: Read and interprete food labels. CO3: Correlate role of lifestyle and food habits in causing diseases. CO4: Prepare Diet Plans for different age group individuals.

***ZOO-VI-GE-1:HEALTH AND NUTRITION (As Generic elective to students of other discipline)**		
MODULE	**TOPICS**	**CONTACT HOURS**
MODULE 1: BASIC CONCEPT OF FOOD AND NUTRITION	UNIT 1: Overview of health and nutrition • Definition of health and nutrition • Scope of nutrition, food as a source of nutrients • Nutrients and energy, principles of meal planning • Adequate, optimum and balanced diet • Malnutrition and health. UNIT 2: Nutritional Biochemistry (Overview) • Carbohydrates, lipids, proteins - definition, classification, structure and properties • Significance of acid value, iodine value and saponification value of lipids • Essential and non-essential amino acids • Enzymes- definition, classification, properties (overview). • Coenzymes, vitamins (fat soluble and water soluble), structure and properties • Minerals- iron, calcium, phosphorus, iodine, selenium and zinc and their properties UNIT 3: Activities related to module 1(5hrs).	**15**
MODULE 2: ROLE OF NUTRIENTS AND CHANGES IN NUTRIENT VALUES	UNIT 4: Functions of food components of food-nutrients • Overview of the Vitamins and minerals - dietary sources of macro and micronutrients. UNIT 5: Changes in nutrient values • Changes of nutrient value during cooking of the following food groups: cereals, pulses, vegetables and meats. • Methods of cooking and Nutrient loss - dry, moist, frying and microwave cooking. Canning of food. UNIT 6: Activities related to module 2(5hrs).	**15**
MODULE 3: DIETARY PATTERN FOR HUMANS	UNIT 7: Nutrition and dietetics Physiological considerations, nutrient needs and dietary pattern for various groups- adults, pregnant and nursing mothers, infants, pre-school and school children, adolescents and geriatric nutrition. UNIT 8: Food based dietary guidelines, enhancing the nutritional quality of the diet, nutritional labeling. UNIT 9: Activities related to Module3 (Comparison of different nutrient labels of various food products). (5hrs).	**15**

MODULE 4: HEALTH AND DISEASES	UNIT 8: Major nutritional deficiency diseases- Protein energy malnutrition, Vitamin deficiency, iron deficiency anaemia, iodine deficiency disorders, their causes, symptoms, treatment, prevention and government programmes, if any. UNIT 9: Life style related diseases- obesity, hypertension, hyperurecimia, diabetes mellitus, polycystic ovarian disease (PCOD) - their causes and prevention through dietary/lifestyle modifications. UNIT 10: Food hygiene: Potable water- sources and methods of purification at consumer level. Brief account of food spoilage: Causes and preventive measures UNIT 11: Activities related to Module 4(5hrs).	**15**

REFERENCE BOOKS:

1) *Mudambi, SR and Rajagopal, MV. (2007). Fundamentals of Foods, Nutrition and Diet Therapy; Fifth Ed; New Age International Publishers.*
2) *Srilakshmi B. (2002). Nutrition Science; New Age International (P) Ltd.*
3) *Srilakshmi B. (2007). Food Science; Fourth Ed; New Age International (P) Ltd.*
4) *Swaminathan M. (2009). Handbook of Foods and Nutrition; Fifth Ed; 1986; BAPPCO.*
5) *Bamji MS, Rao NP, and Reddy V. Text Book of Human Nutrition; Oxford & IBH Publishing Co. Pvt Ltd.*
6) *Wardlaw GM, Hampl JS. (2007). Perspectives in Nutrition; Seventh Ed; McGraw Hill.*
7) *Lakra P, Singh MD. (2008). Textbook of Nutrition and Health; First Ed; Academic Excellence.*

ELECTIVE COURSE: ECOLOGY AND ETHOLOGY	
COURSE CODE	ZOO-V.E-14
MARKS	100 [75 – Theory; 25 – Practicals]
CREDITS	04 [03 – Theory; 01 – Practical]
CONTACT HOURS	THEORY : 45 HOURS (03 LECTURE/WEEK) PRACTICALS : 30 HOURS (01 PRACTICAL/WEEK)
COURSE OBJECTIVES	• To study the distribution of organisms, their interrelations in populations and communities and interactions between biotic and abiotic components • To study impact of anthropogenic activities on ecosystem and study behaviour of organisms under natural conditions
COURSE OUTCOME:	Upon successful completion of the course, students will be able to: CO1: gain better understanding of concepts of ecology. CO2: Acquainted with the basics of animal behaviours CO3: Know strategies of biodiversity conservation, CO4: Understand mechanisms of sustainable development.

ZOO-V.E- 11 : ECOLOGY AND ETHOLOGY		
MODULE	**TOPICS**	**CONTACT HOURS**
MODULE 1 : Basic Ecology	1.1 :Introduction to Ecology : What is Ecology? History of ecology, ecology today, scope of ecology, objective of study,subdivisions of ecology 1.2 : Ecosystem Ecology:kinds of ecosystem,Gaia hypothesis, energy flow within the Ecosystem, food chains, ecological pyramids, ecological niche nutrient and Cycling of trace elements: Cobalt (Co), Molybdenum (Mo) and Lead. 1.3: Population Ecology: survivorship curve and life tables,age distribution,biotic potential of population, growth models, population dispersal, regulation of population, co-operative and disoperative coactions and carrying capacity,predator –prey relationships,symbiosis	
MODULE 2 : Conservation Ecology and Basic Ethology	2.1: Community Ecology:characters of a community, classification of a community,community periodism, community stratification,community succession 2.3:Introduction to Ethology: the history of ethology, types of behavior – instinct and learning,economic and social aspect of behaviour, ethologists and their work – Lorenz, Tinbergen, Goodall, M.K. Chandrashekar, animal behaviour :an evolutionary approach 2.4: Concept of Ethology:stimuluous –response concept,reflexes, innate releasing mechanisms,fixed action pattern,ethogram releaser,motivation or drive with respect to hunger and sexual behaviour	
MODULE 3 : Advanced Ethology	3.1 : Approaches to studying behaviour, methods associated with neurophysiological approach,psychological and ethological approach. 3.2: Pheromones :introduction,types of pheromones,the primer pheromones,the imprinting pheromones 3.3:Hormones: effect of hormones on sexual behaviour,maternal behaviour,territorial marking, learning and memory 3.4:Patterns of behavior :feeding, aggressive and reproductive behavior, biological clocks 3.5:Communication behavior :introduction,communication signals,	

PRACTICAL COMPONENT OF ZOO–V.E-14: ECOLOGY AND ETHOLOGY (DURATION -02 HRS /WEEK)		
SR.NO.	**PRACTICAL**	**NO. OF PRACTICALS**
1	Field Based practicals: • Determination of population density in a natural/ hypothetical community by Quadrats method in intertidal zone. • Report on a visit to National Parks/ Biodiversity Parks/ Wild life sanctuary • Observation of random subjects for understanding human behaviour.	05
2	Study of an aquatic/mangrove ecosystem: Mmeasurement of the area,temperature, turbidity,determination of pH,and dissolved oxygen content (Winkler's method),and free CO_2	03
3	Ethology: • To study the habituation to light stimulus in earthworm/crabs/snails/ spider web • To demonstrate photactic and geotactic responses of the animal provided earthworm/crabs	02
4	Study of Life Tables and plotting of surviourship curves of different types from the hypothetical/real data provided.	02

REFERENCE BOOKS :

1. *Arora, Mohan. P. (2004) : Ecology , Himalaya Publishing House*
2. *Aubrey Manning and stamp Dawkins (1997) : An Introduction to Animal behaviour (fourth edition), Cambridge University Press.*
3. *Dash M. C. (2001) : Fundamental of Ecology , Tata Mc Graw – Hill publishing Company Limited New Delhi*
4. *Felicity Huntingford (1984) : The study of Animal behaviour , Chapman and Hall.*
5. *Hoshang S. Gundevia and Hare Govind Singh (2006) : A Text Book of Animal Behaviour, S. Chand & Company LTD. New Delhi-110055.*
6. *Juneja Kavita (2002) : Ecology , Anmol Publications PVT. LTD. New Delhi-110002 (India)*
7. *Mathur Reena (1994) : Animal Behaviour, Rastogi and Company, Meerut-250002 India.*
8. *Rana, S. V. S.(2003) : Essentials of Ecology and Environmental Science ,Prentice- Hall of India Private Limited , New Delhi-110001*
9. *Ranga, M. M.(2002) : Animal Behaviour Second Enlarged Edition , Agrobios (India)*
10. *Robert A. Wallace (1938) : Animal Behaviour Its Development, Ecology and Evolution , Goodyear Publishing Company, Inc. Santa Monica, California.*
11. *Sharma P.D.(2014-15) : Ecology and Environment, Rastogi Publications. Meerut (12th revised edition) -25002.*
12. *W.H. Thorpe (1979) : The Origins and rise of Ethology, Praeger Publishers.*

ELECTIVE COURSE: LABORATORY TECHNIQUES IN PATHOLOGY	
COURSE CODE	ZOO-VI.E-15
MARKS	100 [75 –Theory; 25- Practical]
CREDITS	04 [03 –Theory; 01- Practical]
CONTACT HOURS	THEORY : 45 HOURS (03 LEC / WEEK) PRACTICAL: 30 HOURS (01 PRACTICAL / WEEK)
COURSE OBJECTIVES	This course is an introduction to the various techniques used in pathological diagnosis.
COURSE OUTCOME:	Upon successful completion of the course, students will be able to: CO1: Perform basic techniques of cell/tissue processing CO2: Be Familiar with procedures of tests done for disease detection CO3: Process various body fluids and tissues for disease detection. CO4: Understand the clinical implication of the pathological tests.

ZOO-VI.E-15: LABORATORY TECHNIQUES IN PATHOLOGY		
MODULE	**TOPICS**	**CONTACT HOURS**
MODULE 1: Blood Analysis	UNIT 1: Introduction to medical lab techniques and its importance UNIT 2: : Analyses of human Blood: • Ways of obtaining blood samples, precautions and complications. • Methods of estimation and clinical significance of: hemoglobin, Packed Cell Volume (PCV), RBC count, WBC count, Complete Blood Count (CBC), platelets, Erythrocyte Sedimentary Rate (ESR), Differential Leucocyte Count (DLC).	15
MODULE 2: Evaluation Of Excretory Material And Gametes	UNIT 3:.Urine Analyses • Physical characteristics, preservation of urine sample • Gross examination, chemical examination, abnormal constituents and its clinical implications. • Microscopy of urinary sediments UNIT 4: Stool Analyses • Stool tests for protozoan parasites and helminth eggs. • Clinical significance. UNIT 5: Semen analyses: • Constituents of semen • Gross and microscopic, cytochemical examination, clinical implications.	15
MODULE 3: Liver Function Cytology Imaging	UNIT 6: Clinical status of liver function - • Function of liver. • Tests of excretion by liver, evaluation of synthesis in liver, evaluation of enzyme activity. UNIT 7: Clinical cytological studies • Fine Needle Aspiration Cytology (FNAC), Ultrasound guided FNAC, aspiration of intra thoracic masses, • Techniques of preparing cell smears, staining techniques UNIT 8: Medical imaging • X-Ray, PET, CT Scan, MRI, Dexa Scan, Ultrasound, Doppler's Test (using photographs/reports etc).	15

PRACTICAL COMPONENT OF: LABORATORY TECHNIQUES IN PATHOLOGY ZOO-VI.E-15 - (30 HOURS – 02hrs/WEEK)		
SR. NO	**PRACTICAL**	**NO. OF PRACTICALS**
1.	Preparation of blood smears and staining techniques (Leishman's staining, Giemsa staining, Field's staining).	02
2.	Use of different types of anticoagulants, obtaining serum from blood, preparation of cell suspension (blood cells).	01
3.	RBC Count, WBC Count, Differential WBC Count	03
4.	Urine analysis – normal and abnormal constituents	02
5.	Blood sugar estimation using glucometer	01
6.	Estimation of hemoglobin (Sahli's method)	01
7.	Estimation of PCV	01
8.	Estimation of ESR (Wintrobe's / Westergreen method)	01

REFERENCE BOOKS:

1. *Sood R (1999). Medical laboratory techniques, Jaypee publishers, New Delhi.*
2. *Park, K. (2007), Preventive and Social Medicine, B.B. Publishers*
3. *Godkar P.B. and Godkar D.P (2007). Textbook of Medical Laboratory Technology, II Edition, Bhalani Publishing House.*
4. *Cheesbrough M (2002)., A Laboratory Manual for Rural Tropical Hospitals, A Basis for Training Courses*
5. *Prakash, G. (2012), Lab Manual on Blood Analysis and Medical Diagnostics, S. Chand and Co. Ltd. New Delhi.*

ELECTIVE COURSE: BIOENTREPRENEURSHIP	
COURSE CODE	Elective: ZOO-VI.E- 16
MARKS	100 [25 -Theory; 75- Practice Based]
CREDITS	04
CONTACT HOURS	Theory: 15 HOURS [01 Lectures Per Week] Practice based: 45 HOURS (03 hrs/week) 15 hrs of intervention by teacher.
COURSE OBJECTIVES	• To help students recognize the opportunities of enterprises in the field of life sciences • To encourage students to think independently and explore new vistas • To familiarise them with the basic skills required for a start-up
COURSE OUTCOME:	Upon successful completion of the course, students will be able to: CO1: understand concept of business Proposals CO2: familiar with the methodologies and regulations required to start an enterprise CO3: Identify opportunities available in life science for start-ups. CO4: Generate Ideas and initiate a Business Plan.

ZOO-VI.E- 16: BIOENTREPRENEURSHIP		
UNIT	**TOPICS**	**CONTACT HOURS**
MODULE 1: Entrepreneurship Development	Unit 1: Introduction to entrepreneurship: • entrepreneurial competencies and goal setting, bio entrepreneurship, building a bio-enterprise : balance management, capital, technology Unit 2: Introduction to innovation: • identifying business opportunities Unit 3: Raising funds: public and private	15
MODULE 2: Business plan And Guidelines and regulations for entrepreneurship in life sciences	Unit 4: Business model canvas Unit 5: Guidelines and regulations: • Certification and licensing, acts, regulations and guidelines, marketing and export process, accessing university technology, research and development agencies in India Unit 6:Role of micro, medium and small scale industry sectors	15
MODULE 3: Start -up, quality, safety and procedural compliances in a bio enterprise	Unit 7: Intellectual Property Rights and trademark of biological resources Unit 8: quality, safety and procedural compliances • Bio safety and its implementations • Quality control in entrepreneurship • WHO Guidelines for setting up of a contract research organization. • Starting a research laboratory in India – guidelines and permits required	15
MODULE 4: Practice based component	**Practice based component:** 1. Lateral thinking and testing entrepreneurial 2. Activities : 1. Brainstorming in Group / market investigation to initiate business ideas for biologists. 2. Preparing Business proposal sketch. 3. Financial Planning. 4. Identifying investors. 5. Developing marketing strategies. 6. Interactions with successful entrepreneur, Banker/ Angel Investors/ Visit to a bio-startup. 7. Formulating and presenting Business model 8. Preparation of final Business execution plan. 9. Submission of the learning process and outcome as Portfolio.	15

ELECTIVE COURSE: BIOENTREPRENEURSHIP	
COURSE CODE	Skill Enhancement Course(SEC): ZOO-SE-2
MARKS	100 [25 -Theory; 75- Practice Based]
CREDITS	04
CONTACT HOURS	Theory: 15 HOURS [01 Lectures Per Week] Practice based: 45 HOURS (03 hrs/week) 15 hrs of intervention by teacher.
COURSE OBJECTIVES	• To help students recognize the opportunities of enterprises in the field of life sciences • To encourage students to think independently and explore new vistas • To familiarize them with the basic skills required for a start-up
COURSE OUTCOME:	Upon successful completion of the course, students will be able to: CO1: understand concept of business Proposals CO2: familiar with the methodologies and regulations required to start an enterprise CO3: Identify opportunities available in life science for start-ups. CO4: Generate Ideas and initiate a Business Plan.

ZOO-VI-SE-2 : BIOENTREPRENEURSHIP		
UNIT	**TOPICS**	**CONTACT HOURS**
MODULE 1: Entrepreneurship Development	Unit 1: Introduction to entrepreneurship: • entrepreneurial competencies and goal setting, bio entrepreneurship, building a bio-enterprise : balance management, capital, technology Unit 2: Introduction to innovation: • identifying business opportunities Unit 3: Raising funds: public and private	05
MODULE 2: Business plan And Guidelines and regulations for entrepreneurship in life sciences	Unit 4: Business model canvas Unit 5: Guidelines and regulations: • Certification and licensing, acts, regulations and guidelines, marketing and export process, accessing university technology, research and development agencies in India Unit 6:Role of micro, medium and small scale industry sector Unit 7: Innovations in research: writing project proposals to various funding bodies such as MHRD, UGC, DST, DBT, etc.	05
MODULE 3: Start -up, quality, safety and procedural compliances in a bio enterprise	Unit 8: Intellectual Property Rights and trademark of biological resources Unit 9: quality, safety and procedural compliances • Bio safety and its implementations • Quality control in entrepreneurship • WHO Guidelines for setting up of a contract research organization. • Starting a research laboratory in India – guidelines and permits required	05
MODULE 4: Practice based component	**Practice based component:** 3. Lateral thinking and testing entrepreneurial 4. Activities : 1. Brainstorming in Group / market investigation to initiate business ideas for biologists. 2. Preparing Business proposal sketch. 3. Financial Planning. 4. Identifying investors. 5. Developing marketing strategies. 6. Interactions with successful entrepreneur, Banker/ Angel Investors/ Visit to a bio-startup. 7. Formulating and presenting Business model 8. Preparation of final Business execution plan. 9. Submission of the learning process and outcome as Portfolio.	45

REFERENCES:

1. *Garg, M.C. (2015) Entrepreneurial development. Guset User.*
2. *Kolchinsky, P. (2004) The entrepreneurs guide to a biotech startup. 4th edition. www.evelexa.com*
3. *Simon, S. 2009. Start with why: How great leaders inspire everyone to take action. Penguin Group (USA) Inc .*
4. *Welch, J. and Byrne, J.A. 2003. Straight from the gut. Business plus publishers.*

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