SWAMI VIVEKANAND SUBHARTI UNIVERSITY
UGC Approved Meerut
NAAC A
AN ISO 21001: 2018 ORGANIZATION

OFFICE OF THE REGISTRAR
Gp Capt M Yakoob
M-in-D (Retd.), M.Tech.
REGISTRAR
registrar@subharti.org

Ref.No.U-508(i)/SVSU/2025/1624 Date:27.01.2025

NOTIFICATION

It is hereby notified for information of all the concerned that the Academic Council in its 34th meeting held on 25-07-2024 vide resolution No.34(9) has approved the revised syllabus (as per NEP-2020) of the following ordinance:

Ordinance No.V-135(B12), relating to B.Sc.-Zoology

The copy of above is enclosed and shall be applicable from Academic Session 2022-23 onwards.

This issues with the approval of the Hon'ble Vice Chancellor.

27.01.2025
Registrar

Ref.No.U-508(i)/SVSU/2025/1624 Date: 27.01.2025

Copy forwarded to information of:

1. Hon'ble Vice-Chancellor
2. Controller of Examination
3. Dean-Academics
4. Director-IQAC
5. Dean-Faculty of Science (for compliance please)
6. CTO (with a request to upload the ordinance on University website)
7. Additional Registrar-Academics
8. Guard File

27.01.2025
Registrar

SWAMI VIVEKANAND SUBHARTI UNIVERSITY

MEERUT

Keral Verma Subharti College of Science

Ordinance Number V 126 B-13

Bachelor of Science in Zoology

All UG Courses offered by Department of Zoology, KVSCOS (Session 2025-26 onwards)									
Sem	I	II	III	IV	V	VI	VII	VIII	Total
Credit	20	20	20	20	20	20	20	20	160
Marks	700	700	800	800	700	800	700	400	5600

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT

KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

Department of Zoology

All UG Courses offered by Department of Zoology (Session 2025-26 onwards)

		I	II	III	IV	V	VI	VII	VIII	Total
1	Major	6	6	9	15	10	14	16	4	80
2	Minor	3	3	3	3	6	3	4	4	29
3	Multi Disciplinary	3	3	3						9
4	Ability Enhancement Course	2	2	2	2					8
5	Skill Enhancement Course	3	3	3						9
6	Value Added Course	3	3							6
7	Internship					4	3			7
8	Research								12	12
	Total	20	20	20	20	20	20	20	20	160

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT

KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

Department of Zoology

Course Name - B.Sc Zoology

Batch:2025 -26 | **SEM:I**

S.No.	Course Type	Course Code	Course Name	Teaching Load			Credits	Internal Assessment			External Assessment	Total	Remark
				L	T	P		Attendance (5)	quiz/PPT/ Assignment (10)	Mid Sem Test (15)	End Sem Exam (70)		
THEORY and PRACTICAL SUBJECTS													
1	Major 1	BMJC050101T	Diversity of Non-Chordates	4	1	0	4	5	10	15	70	100	
2	Practical Major 1	BMJC050101P	Diversity of Non-Chordates Practical	0	0	4	2	5	10	15	70	100	
3	Minor 1	BMIC050101	Aquatic Biology	4	1	0	3	5	10	15	70	100	
4	Multi Disciplinary	BMDC050101	Introduction to Biology	4	1	0	3	5	10	15	70	100	
5	Ability Enhancement Course	AEC-01	English Communication Skill	2	1	0	2	5	10	15	70	100	
6	Skill Enhancement Course	BSEC050101	Apiculture	1	0	3	3	5	10	15	70	100	
7	Value Added Course	BVAC050101	Indian Knowledge System	1	0	3	3	5	10	15	70	100	
8	IKS / Rastra bodh			2	1	0	2	5	5	10	30	50	Qualifying
TOTAL CREDITS / ASSESSMENT							**20**	**35**	**70**	**105**	**490**	**700**	

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT

KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

Department of Zoology

Batch:2025 -26							SEM:II						
S.No.	Course Type	Course Code	Course	Teaching Load			Credits		Internal Assessment		External Assessment	Total	Remark
				L	T	P							
THEORY and PRACTICAL SUBJECTS								Attendance (5)	quiz/PPT/ Assignment (10)	Mid Sem Test (15)	End Sem Exam (70)		
1	Major 2	BMJC050201T	Diversity of Chordates	4	1	0	4	5	10	15	70	100	
2	Practical Major 2	BMJC050201P	Diversity of Chordates Practical	0	0	4	2	5	10	15	70	100	
3	Minor 2	BMIC050201	Agrochemicals & Pest Management	4	1	0	3	5	10	15	70	100	
4	Multi Disciplinary 2	BMDC050201	Lifestyle Disorders	4	1	0	3	5	10	15	70	100	
5	Ability Enhancement Course 2	AEC-02	Environmental Science	2	1	0	2	5	10	15	70	100	
6	Skill Enhancement Course 2	BSEC050201	Aquarium and Fish Keeping	1	0	3	3	5	10	15	70	100	
7	Value Added Course 2	BVAC050201	Health and Wellness	1	0	3	3	5	10	15	70	100	
8	IKS / Rastra bodh			2	1	0	2	5	5	10	30	50	Qualifying
TOTAL CREDITS / ASSESSMENT							**20**	**35**	**70**	**105**	**490**	**700**	

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT

KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

Department of Zoology

Batch:2025 -26 | **SEM:III**

S.No.	Course Type	Course Code	Course	Teaching Load L	T	P	Credits	Internal Assessment: Attendance (5)	quiz/PPT/Assignment (10)	Mid Sem Test (15)	External Assessment: End Sem Exam (70)	Total	Remark
THEORY and PRACTICAL SUBJECTS													
1	Major 3	BMJC050301T	Cell Biology: Structure and Function	3	1	0	3	5	10	15	70	100	
2	Practical 3	BMJC050301P	Cell Biology: Structure and Function Practical	0	0	4	2	5	10	15	70	100	
3	Major 4	BMJC050302T	Fundamentals of Genetics	3	1	0	3	5	10	15	70	100	
4	Practical 4	BMJC050302P	Fundamentals of Genetics Practical	0	0	4	1	5	10	15	70	100	
5	Minor 3	BMIC050301	Wildlife Conservation & Management	4	1	0	3	5	10	15	70	100	
6	Multi Disciplinary 3	BMDC050301	Insect Vector and Disease	4	1	0	3	5	10	15	70	100	
7	Ability Enhancement Course 3 (Disaster Risk Management)	AEC-03	Disaster Risk Management	2	1	0	2	5	10	15	70	100	
8	Skill Enhancement Course 3	BSEC050301	Sericulture	1	0	3	3	5	10	15	70	100	
TOTAL CREDITS / ASSESSMENT							**20**	**40**	**80**	**120**	**560**	**800**	

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT

KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

Department of Zoology

Batch:2025 -26 | **SEM:IV**

S.No.	Course Type	Course Code	Course	Teaching Load L	T	P	Credits	Attendance (5)	Internal Assessment: quiz/PPT/Assignment (10)	Mid Sem Test (15)	External Assessment: End Sem Exam (70)	Total	Remark
THEORY and PRACTICAL SUBJECTS													
1	Major 5	BMJC050401T	Fundamentals of Biochemistry	3	1	0	3	5	10	15	70	100	
2	Practical 5	BMJC050401P	Fundamentals of Biochemistry Practical	0	0	4	2	5	10	15	70	100	
3	Major 6	BMJC050402T	Human Physiology	3	1	0	3	5	10	15	70	100	
4	Practical 6	BMJC050402P	Human Physiology Practical	0	0	4	2	5	10	15	70	100	
5	Major 7	BMJC050403T	Fundamentals of Ecology	3	1	0	3	5	10	15	70	100	
6	Practical 7	BMJC050403P	Fundamentals of Ecology Practical	0	0	4	2	5	10	15	70	100	
7	Minor 4	BMIC050401	Fish and Fisheries	4	1	0	3	5	10	15	70	100	
8	Ability Enhancement Course 3 (Course on NCC/NSS/NGO, s/ Scout Guide / Sports)	AEC-04	NCC/NSS/NGO'S/SCOUT GUIDE/SPORTS	2	1	0	2	5	10	15	70	100	
TOTAL CREDITS / ASSESSMENT							**20**	**40**	**80**	**12**	**560**	**80**	

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SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT

KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

Department of Zoology

Batch:2025 -26							SEM:V						
S.No.	Course Type	Course Code	Course	Teaching Load L	T	P	Credits		Internal Assessment		External Assesment	Total	Remark
			THEORY and PRACTICAL SUBJECTS					Attendance (5)	quiz/PPT/ Assignment (10)	Mid Sem Test (15)	End Sem Exam (70)		
1	Major 8	BMJC050501T	Biochemistry: Metabolic Processes	3	1	0	3	5	10	15	70	100	
2	Practical 8	BMJC050501P	Biochemistry: Metabolic Processes Practical	0	0	4	2	5	10	15	70	100	
3	Major 9	BMJC050502T	Developmental Biology	3	1	0	3	5	10	15	70	100	
4	Practical 9	BMJC050502P	Developmental Biology Practical	0	0	4	2	5	10	15	70	100	
5	Minor 5	BMIC050501	Parasitology	4	1	0	3	5	10	15	70	100	
6	Minor 6	BMIC050502	Integrative Systems Biology and Bioinformatics	4	1	0	3	5	10	15	70	100	
7	Internship		Internship/Project	2	1	0	4	5	10	15	70	100	
TOTAL CREDITS / ASSESSMENT							20	35	70	105	490	700	

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT

KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

Department of Zoology

Batch:2025 -26							SEM:VI						
S.No.	Course Type	Course Code	Course	Teaching Load			Credits		Internal Assessment		External Assessment	Total	Remark
				L	T	P							
THEORY and PRACTICAL SUBJECTS								Attendance (5)	quiz/PPT/ Assignment (10)	Mid Sem Test (15)	End Sem Exam (70)		
1	Major 10	BMJC050601T	Evolutionary Biology	2	1	0	3	5	10	15	70	100	
2	Practical 10	BMJC050601P	Evolutionary Biology Practical	0	0	4	1	5	10	15	70	100	
3	Major 11	BMJC050602T	Principles of Immunology	3	1	0	3	5	10	15	70	100	
4	Practical 11	BMJC050602P	Principles of Immunology Practical	0	0	4	2	5	10	15	70	100	
5	Major 12	BMJC050603T	Cell and Molecular Biology	3	1	0	3	5	10	15	70	100	
6	Practical 12	BMJC050603P	Cell and Molecular Biology Practical	0	0	4	2	5	10	15	70	100	
7	Minor 7	BMIC050601	Biology of Insecta	4	1	0	3	5	10	15	70	100	
8	Minor 8	BMIC050602I	Basics of Neuroscience / INT-I	2	1	0	3	5	10	15	70	100	
TOTAL CREDITS / ASSESSMENT							20	40	80	120	560	800	

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT

KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

Department of Zoology														
Course-B.Sc. Zoology														
Batch:2025-26							SEM:VII							
S.No.	Course Type	Course Code	Course	Teaching Load			Credits		Internal Assessment		External Assessment	Total	Remark	
				L	T	P								
THEORY and PRACTICAL SUBJECTS								Attendance (5)	quiz/PPT/ Assignment (10)	Mid Sem Test (15)	End Sem Exam (70)			
1	Major 13	BMJC050701T	Comparative Anatomy of Vertebrates	3	1	0	3	5	10	15	70	100		
2	Practical 13	BMJC050701P	Comparative Anatomy of Vertebrates Practical	0	0	4	2	5	10	15	70	100		
3	Major 14	BMJC050702T	Animal Behaviour	3	1	0	3	5	10	15	70	100		
4	Practical 14	BMJC050702P	Animal Behaviour Practical	0	0	4	2	5	10	15	70	100		
5	Major 15	BMJC050703T	Animal Biotechnology	4	1	0	4	5	10	15	70	100		
6	Practical 15	BMJC050703P	Animal Biotechnology Practical	0	0	4	2	5	10	15	70	100		
7	Minor 9	BMIC050701	Toxicology	4	1	0	4	5	10	15	70	100		
TOTAL CREDITS / ASSESSMENT							20	35	70	105	490	700		

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT											
KERAL VERMA SUBHARTI COLLEGE OF SCIENCE											
Department of Zoology											
Course-B.Sc. Zoology											
Batch:2025-26					SEM:VIII						
S.N	Course	Course	Course	Teaching Load	EDI	Internal		Exter	T	Rem	

o.	Type	Code						Assessment			nal Assessment	otal	ark
	THEORY and PRACTICAL SUBJECTS			L	T	P		Attendance (5)	Quiz/PPT/ Assignment (10)	Mid Sem Test (15)	End Sem Exam (70)		
1	Major 16	BMJC050801T	Methods in Biostatistics	3	1	0	3	5	10	15	70	100	
	Practical 16	BMJC050801P	Methods in Biostatistics Practical	0	0	2	1	5	10	15	70	100	
2	Minor 10	BMIC050801	Reproductive Biology and Assisted Reproductive Technology (ART)	4	1	0	4	5	10	15	70	100	
4	Research Project / Dissertation	Research Project/	Research Project/	0	0	0	12	5	10	15	70	100	
TOTAL CREDITS / ASSESSMENT							**20**	**20**	**40**	**60**	**280**	**400**	

Semester-wise Titles of the Multidisciplinary Course (MDC) Papers in B.Sc. (Zoology)

Year	Sem.	Course Code	Paper Title	Theory /Practical	Credits
1	I	BMDC050101	Introduction to Biology	Theory	3
	II	BMDC050201	Lifestyle Disorders	Theory	3
2	III	BMDC050301	Insect Vector and Disease	Theory	3

Semester-wise Titles of the Skill Enhancement Course (SEC) Papers in B.Sc. (Zoology)

Year	Sem.	Course Code	Paper Title	Theory /Practical	Credits
1	I	BSEC050101	Apiculture	Theory	3
	II	BSEC050201	Aquarium and Fish Keeping	Theory	3
2	III	BSEC050301	Sericulture	Theory	3

Semester-wise Titles of the Value-Added Course (VAC) Papers in B.Sc. (Zoology)

Year	Sem.	Course Code	Paper Title	Theory /Practical	Credits
1	I	BVAC050101	Indian Knowledge System	Theory	3
	II	BVAC050201	Health & Wellness	Theory	3

Semester-wiseTitlesoftheMajor Course (MJC) PapersinB.Sc.(Zoology)

Year	Sem.	CourseCode	PaperTitle	Theory/Practical	Credits
1	I		Diversity of Non-Chordates	Theory	04
			Diversity of Non-Chordates Practical	Practical	02
	II		Diversity of Chordates	Theory	04
			Diversity of Chordates Practical	Practical	02
2	III		Cell Biology: Structure and Function	Theory	03
			Fundamentals of Genetics	Theory	03
			Genetics& Cell biology Practical	Practical	03
	IV		Fundamentals of Biochemistry	Theory	03
			Fundamentals of Biochemistry Practical	Practical	02
			Human Physiology	Theory	03
			Human Physiology Practical	Practical	02
			Fundamentals of Ecology	Theory	03
			Fundamentals of Ecology Practical	Practical	02
3	V		Biochemistry: Metabolic Processes	Theory	03
			Biochemistry: Metabolic Processes Practical	Practical	02
			Developmental Biology	Theory	03
			Developmental Biology Practical	Practical	02
	VI		Evolutionary Biology	Theory	03
			Evolutionary Biology Practical	Practical	01
			Principles of Immunology	Theory	03
			Principles of Immunology Practical	Practical	02
			Cell and Molecular Biology	Theory	03
			Cell and Molecular Biology Practical	Practical	02
4	VII		Comparative Anatomy of Vertebrates	Theory	03
			Comparative Anatomy of Vertebrates Practical	Practical	02
			Animal Behaviour	Theory	03
			Animal Behaviour Practical	Practical	02
			Animal Biotechnology	Theory	04
			Animal Biotechnology Practical	Practical	02
	VIII		Methods in Biostatistics	Theory	03
			Methods in Biostatistics Practical	Practical	01

Semester-wiseTitlesofthe Minor Course (MIC) PapersinB.Sc(Zoology)

Year	Sem.	CourseCode	PaperTitle	Theory/Practical	Credits
1	I	BMIC050101	Aquatic Biology	Theory	03
	II	BMIC050201	Agrochemicals & Pest Management	Theory	03
2	III	BMIC050301	Wildlife Conservation & Management	Theory	03
	IV	BMIC050401	Fish and Fisheries	Theory	03
3	V	BMIC050501	Parasitology	Theory	03
		BMIC050502	Integrative Systems Biology and Bioinformatics	Theory	03
	VI	BMIC050601	Biology of Insecta	Theory	03
		BMIC050602I	Basics of Neuroscience / INT-I	Theory	03
4	VII	BMIC050701	Toxicology	Theory	04
	VIII	BMIC050801	Reproductive Biology and Assisted Reproductive Technology (ART)	Theory	04

Semester-wiseTitlesoftheMultidisciplinary Course(MDC)PapersinB.Sc.(Zoology)

Year	Sem.	CourseCode	PaperTitle	Theory/Practical	Credits
1	I	BMDC050101	Introduction to Biology	Theory	03
	II	BMDC050201	Lifestyle Disorders	Theory	03
2	III	BMDC050301	Insect Vector and Disease	Theory	03

Semester-wiseTitlesoftheSkill Enhancement Course (SEC)PapersinB.Sc.(Zoology)

Year	Sem.	CourseCode	PaperTitle	Theory/Practical	Credits
1	I	BSEC050101	Apiculture	Theory	03
	II	BSEC050201	Aquarium and Fish Keeping	Theory	03
2	III	BSEC050301	Sericulture	Theory	03

Semester-wiseTitlesoftheValue-Added Course (VAC)PapersinB.Sc.(Zoology)

Year	Sem.	CourseCode	PaperTitle	Theory/Practical	Credits
1	I	BVAC050101	Indian Knowledge System	Theory	03
	II	BVAC050201	Health & Wellness	Theory	03

Semester-wiseTitlesoftheAbility Enhancement Course(AEC)PapersinB.Sc.(Zoology)

Year	Sem.	CourseCode	PaperTitle	Theory/Practical	Credits
1	I	AEC-01	English Communication Skill	Theory	02
	II	AEC-02	Environmental Science	Theory	02
2	III	AEC-03	Course on Disaster Risk Management	Theory	02
	IV	AEC-04	Course on NCC/NSS/NGO'S/SCOUT GUIDE/SPORTS	Theory	02

ProgrammeObjectives(POs)

1. The programme has been designed in such a way so that the students get the flavour ofboth classical and modern aspects of Zoology/Animal Sciences. It aims to enable thestudents to study animal diversity in Indian subcontinent, environmental science andbehaviouralecology.
2. The modern areas including cell biology and genetics, molecular biology, biochemistry,physiology followed by biostatistics, Evolutionary biology, bioinformatics and geneticengineering have been included to make the study of animals more interesting andrelevant tohuman studieswhich istherequirementinrecenttimes.
3. The lab courses have been designed in such a way that students will be trained to joinpublicorprivatelabs.

B.Sc	ProgrammeSpecificOutcomes(PSOs)
PSO1	Students enrolled in B.Sc. (Hons.) degree program in Zoology will study and acquire complete knowledge of disciplinary as well as allied biological sciences.
PSO2	At the end of graduation, they should possess expertise which will provide them competitive advantage in pursuing higher studies from India or abroad; and seek jobs in academia, research or industries.
PSO3	They will alsobe able to describe economic, ecological and medical significance of various animals in human life.
PSO4	The procedural knowledge about identifying and classifying animals will provide students professional advantages in teaching, research and taxonomist jobs in various government organizations; including Zoological Survey of India and National Parks/Sanctuaries.
PSO5	Our students will be acquiring basic experimental skills in various techniques in the fields of genetics; molecular biology; biotechnology; qualitative and quantitative microscopy; enzymology andanalytical biochemistry.
PSO6	Students undertaking skill enhancement courses like aquaculture, sericulture and apiculture will inculcate skills involved in rearing fish, bees and silk moth which would help them in starting their own ventures and generating self-employment making them successful entrepreneurs.

Detailed Syllabus

Major Courses

Programme/Class: Certificate	**Year**:First	**Semester**:First
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Diversity of Non-Chordates	

Courseoutcomes:

By studying this course, students will be able to

1. Learn about the importance of systematics, taxonomy and structural organization of animals.
2. Appreciate the diversity of non-chordates living in varied habit and habitats. ,
3. Understand evolutionary history and relationships of different non-chordates through functional and structural affinities.
4. Critically analyses the organization, complexity and characteristic features of non-chordates making them familiarize with the morphology and anatomy of representatives of variousanimal phyla.
5. Comprehend the economic importance of non-chordates, their interaction with the environment and role in the ecosystem.
6. Enhance collaborative learning and communication skills through practical sessions, teamwork, rou discussions, assignments and oroiects.

Credits: 4	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P:** 4-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	**Introduction to Non-Chordates** General characters; Outline classification up to Classes Of Protozoa ;Locomotion , nutrition& their reproduction cycle.	**10**
II	**Origin of Metazoa.** **Porifera:** Salient features; Sycon's structure, Canal system, Skeleton system &reproduction. **Coelenterates:** Salient features; *Aurelia's*structure, Alternation of generation and reproduction.	**12**
III	**Helminthes:** Salient features; Structure of *Taenia* and *Ascaris* , parasitic adaptations and reproduction. **Annelida:** Salient features; Structure of *Nereis* and *Hirudinaria ;* reproduction, Parasitic adaptations; Trochophore larva and its significance.	**15**
IV	**Arthropoda:** Salient features; Structure of *Palaemon*, respiration, excretion and reproduction; Zoological importance of Peripatus and Limulus; Economic importance of arthropods.	**12**
V	**Mollusca:** Salient features; Structure of*Pila* and *Unio*, respiration and reproduction. **Echinodermata:** Salient features; Structure of *Asterias*, locomotion, water vascular system, mode of feeding and reproduction.	**11**

SUGGESTED READINGS:

1. Bames, RD: Invertebrate Zoology (4th ed.), Holt-Saunders, 1980.
2. Barrington, EJW: Invertebrate Structure and Function, Nelson, 1987.
3. Hickman, Roberts & Hickman: Integrated Principles of Zoology (7th ed) Times-Mirror, Mosby, 1984.
4. Iyer: A Manual of Zoology, Part I. Viswanathan, 1973.
5. Kotpal, RL: Modern Text Book of Zoology: Invertebrates, Rastogi Publications, 12thedition, 2019
6. Marshall & William: Text Book of Zoology, Vol I (Parker & Haswell, 7thed.) Macmillan, 1972.

Subject Code:	Diversity of Non-Chordates Practical	**2 Credits**

Study of museum specimens/slides:

Protozoa: Amoeba, Euglena, Plasmodium, Paramecium, Trichomonas, Trypanosoma, Monocystis, Vorticella

Porifera: Sycon (including T.S. and L.S.), Hyalonema, Euplectella, Euspongia

Coelenterata: Obelia, Physalia, Aurelia, Tubipora, Metridium, Hydra, Gorgonia, Pennatula Platyhelminthes: Taenia solium and study of its life history stages, Schistosoma, Fasciola Nemathelminthes: Male and female Ascaris lumbricoides, Wuchereria, Ancylostoma

Armada: Aphrodite, Nereis, Pheretima, Hirudinaria, Polygordias

Arthropoda: Palaemon, Cancer Limulus, Palamnaeus, Scolopendra, Julus, Periplaneta, Apis, Musca Mollusca: Chiton, Dentalium, Pita, Unio, Loligo, Sepia, Octopus

Echinodermata: Pentaceros, Ophiura, Echinus, Cucumaria, Antedon, Holothuria, Astreas

SuggestedContinuousEvaluationMethods:	
TotalMarks:30	
One Mid Semester written Test (1x15):	15Marks
Project/Seminar/ Quiz / Presentation/ Assignment:	10Marks
Attendance & Conduct:	05Marks

Programme/Class: Certificate	**Year**:First	**Semester**:Second
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Diversity of Chordates	

Courseoutcomes:

By studying this course, students will be able to

1. Correlate the importance of systematics, taxonomy, and structural organization of chordates.
2. Recognize the diversity of chordates living in varied ecological habitats.
3. Critically analyses the organization, complexity and characteristic features of chordates.
4. Comprehend the economic importance of chordates, their interaction with theenvironment and their role in the ecosystem.
5. Enhance collaborative learning and communication skills through practical sessions, teamwork, group discussions, assignments, and projects.

Credits: 4	**Core:** Compulsory
Max.Marks:25+75=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P:** 4-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	**Protochordata** General characteristics of Hemichordata, Urochordata and Cephalochordata; Study of Tornaria and Ascidian larval forms in protochordates. **Agnatha** General characteristics and classification of cyclostomes up to Class.	**10**
II	**Introduction to Chordates** General characteristics and outline classification.Theories of Origin of chordates with detailed concept of Dipleurula and the Echinoderm theory.	**12**
III	**Pisces** General characteristics of Chondrichthyes and Osteichthyes; Classification up to order; Osmoregulation; Swim bladder in fishes. **Amphibia** General characteristics and classification up to order; Origin of Tetrapods ,Parental care.	**15**
IV	**Reptilia** General characteristics and classification up to order; Affinities and evolutionary significance of Sphenodon; Poison apparatus and biting mechanism in snakes. **Aves** General characteristics and classification up to order;Flight adaptations; Migration in birds.	**12**
V	**Mammalia** General characteristics and classification up to order; Adaptive radiation with reference to locomotory appendages.	**11**

Suggestive readings

Young, J.Z. (2004). The Life of Vertebrates. III Edition, Oxford University Press.
Parker T.J. and Haswell W.A. (1972).Text book of Zoology Vertebrates.VII Edition, Volume II.
Pough H. (2018). Vertebrate Life. X Edition, Pearson International.
Darlington P.J. (1966).The Geographical Distribution of Animals. R.E. Krieger Pub. Co.

Subject Code:	Diversity of Chordates Practical	**2 Credits**

Study of museum specimens/slides:

1. Study of whole mount of Euglena, Amoeba, Noctiluca, Paramecium, Binary fission in Paramecium and Conjugation in Paramecium.
2. Examination of pond water collected from different places to observe diversity inProtista.
3. Study of Sycon, Hyalonema, Euplectella, Spongilla, T.S. of Sycon, L.S. of Sycon.
4. Study of Obelia, Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia, Metridium/Adamsia, Pennatula, Fungia, Meandrina, Madrepora.
5. Specimen/slide of any one Ctenophore.
6. Study of adult Fasciola hepatica, Taenia solium and their life stages (Slides/microphotographs).
7. Study of adult Ascaris lumbricoides and its life stages (Slides/microphotographs).
8. To submit a Project Report on the life cycle of any one parasite or pathogen/corals/coral reefs.
9. Examination of soil samples collected from different places to observe diversity in nematodes.
10. Study of Aphrodite, Nereis, Heteronereis, Sabella, Serpula, Chaetopterus, Pheretima, Hirudinaria, Trochophore larva.
11. Study of T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm.
12. Study of Limulus, Palamnaeus, Palaemon, Daphnia, Balanus, Sacculina, Cancer, Eupagurus, Scolopendra, Julus, Bombyx, Periplaneta, termite, Apis, Musca.
13. Study of Peripatus.
14. Study of Chiton, Dentalium, Pila, Doris, Helix, Unio, Patella, Ostrea, Pinctada, Sepia, Octopus, Nautilus.
15. Study of Pentaceros/Asterias, Ophiura, Clypeaster, Echinus, Cucumaria, Antedon; Any two larval forms.
16. Study of mouth parts, digestive system and nervous system of Periplaneta.*
17. Study of the digestive system of Pheretima. *
18. Submit a Project Report on the larval forms in different phyla OR field study of the insect diversity.

*Subject to UGC approval and guidelines

SuggestedContinuousEvaluationMethods:	
TotalMarks:30	
One Mid Semester written Test (1x15):	15Marks
Project/Seminar/ Quiz / Presentation/ Assignment:	10Marks
Attendance & Conduct:	05Marks

Programme/Class: Diploma	**Year**:Second	**Semester**:Third
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Biology of Cell: Structure andFunction	

Courseoutcomes:

By studying this course, students will be able to

1. Understand the fundamental principles of cell biology.
2. Explain the structure and functions of cell organelles involved in diverse cellular processes.
3. Appreciate how cells grow, divide, survive, die, and regulate these important processes.
4. Comprehend the process of cell signaling and its role in cellular functions.
5. Have an insight into how defects in the functioning of cell organelles and regulation of cellular processes can develop into diseases. Learn the advances made in the field of cell biology and their applications.

Credits: 3	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P:** 4-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	**Overview of Cells and Plasma membrane** Prokaryotic and Eukaryotic cells; Various models of plasma membrane structures, Transport across membranes: Cell-cell junctions, structures and functions.	10
II	**Endomembrane System-** Structure and Functions: Endoplasmic Reticulum (ER), Golgi apparatus, Signal hypothesis, Vesicular transport from ER to Golgi apparatus, Protein sorting and transport from Golgi apparatus, Coated Vesicles, Lysosomes, Peroxisomes.	12
III	**Mitochondria:** Structure of Mitochondria, Semiautonomous nature, Endosymbiotic hypothesis; Respiratory chain, Chemiosmotic hypothesis, ATP Synthase. **Cytoskeleton** Structure and Functions: Microtubules, Microfilaments and Intermediate filaments.	15
IV	**Nucleus** Structure of Nucleus, Nuclear envelope, nuclear pore complex, Transport of molecules across nuclear membrane, nucleosome, nucleolus; Chromatin: euchromatin, heterochromatin.	12
V	**Cell Division** Mitosis, Meiosis, Cell cycle and its regulation. **Introduction to Cell Signaling** Cell Signaling through G-protein coupled receptor (GPCR) and role of secondary messenger: cAMP and protein kinase A.	11

SUGGESTED READINGS:

1. Cooper, G.M., Hausman, R.E. (2019) The Cell: A Molecular Approach. VIII Edition, ASM Press and Sinauer Associates.
2. Becker, Kleinsmith, and Hardin (2018) The World of the Cell, IX Edition, Benjamin Cummings Publishing, San Francisco.
3. Karp, G. (2015). Cell and Molecular Biology: Concepts and Experiments, VIII Edition, John Wiley & Sons Inc.
4. Renu Gupta, Seema Makhija and Ravi Toteja (2018). Cell Biology Practical Manual, Prestige Publishers, New Delhi
5. VK Sharma (1991). Techniques in Microscopy and Cell Biology, Tata McGraw-Hill Publishing Company Limited, New Delhi

Programme/Class: Diploma	**Year**:Second	**Semester**:Third
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Fundamentals of Genetics	

Courseoutcomes:

By studying this course, students will be able to

1. Enhance knowledge of the basic principles of inheritance.
2. Develop analytical skills and critical thinking through pedigree analysis.
3. Understand the mechanism of gene transfer and mapping in both prokaryotes and eukaryotes.
4. Learn the mechanisms of mutations and harmful and beneficial effects of mutagens, which help evolve new species over time.
5. Be able to grasp basic concepts of human chromosomal disorders.

Credits: 3	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P:** 4-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	**Mendelian Genetics and its Extensions** Principles of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, penetrance and expressivity, Epistasis, Phenocopy, Pleiotropy, Polygenic Inheritance, Sex-linked, Sex-influenced, and Sex-limited characters inheritance.	10
II	**Linkage, Crossing Over and Chromosome Mapping** Linkage and crossing over, Cytological basis of crossing over, Recombination frequency as a measure of linkage intensity, two-factor and three-factor crosses, Linkage map, Coefficient of Coincidence and Interference, Gene mapping by Somatic cell hybridization.	12
III	**Mutations** Types of gene mutations, Detection of mutations in Drosophila: Crossover suppressor, Lethal, Barred (eye)method, Mutagens: Physical and chemical, molecular basis of spontaneous and induced mutations, Chromosomal aberrations: Structural Variations in chromosomes, Aneuploidy & Polyploidy.	15
IV	**Sex Determination** Basis of sex determination: Genetic and environmental; Sex determination in Drosophila and human; Mechanism of dosage compensation. **Extra-chromosomal Inheritance** Comparison of nuclear and extranuclear inheritance; Organelle inheritance: Antibiotic resistance in Chlamydomonas, Infective heredity in Paramecium. Maternal effects: Shell coiling in Limnaea, pigmentations in Ephestia.	13
V	**Transposable Genetic Elements** Transposons in bacteria, Ty elements in yeast, Ac-Ds elements in maize, P elements in Drosophila, Transposons in humans, Significance of Transposons.	10

SUGGESTED READINGS:

1. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons In.
2. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cumming
3. Pierce, B. A. (2012). Genetics-A Conceptual Approach. IV Edition. W. H. Freeman and Company
4. Peter, J. Russell. (2009), iGenetics: A molecular approach. 3rd Edition. Benjamin Cumming
5. Anthony J.F. Griffiths, Susan R. Wessler, Richard C. Lewontin, Sean B. Carroll (2007). Introduction to Genetic Analysis. 9th Edition. W H Freeman.

Subject Code:	Cell Biology & Genetics Lab	**3 Credits**

1. Simulation exercises using beads or seeds to study the gene interactions: 9:3:4; 12:3:1; 9:7; 9:3:3:1 (comb shapes in roosters) and verification of ratios by usingChi- square analysis.
2. Pedigree analysis of Autosomal Dominant trait, Autosomal recessive trait, X-linked Dominant traits, X-linked recessive traits, Y-linked traits and mitochondrial traits.
3. Use of probability in solving problems of genetics (Sum rule, Multiplication rule & Binomial expansion).
4. Gene mapping (order and distance) using data from interrupted mating experiments in bacteria.
5. Linkage maps based on data (two - point and three - point crossing over) fromDrosophila.
6. Human Karyotypes, Human chromosomal disorders & single gene disorders.
7. Project on Epigenetic, Eugenics, Euthenics and Euphenics.
8. Microscopy: Compound microscope: principle, components and handling; Phase contrast microscope; Electron microscope; Differential Interference Contrast (DIC) Microscope.
9. Principle and types of cell fixation and staining; Cell fractionation.
10. To study prokaryotic cells by Gram staining and eukaryotic cell (cheek cells) by hematoxylin/methylene blue.
11. To study the effect of hypotonic, isotonic, and hypertonic solutions on cell permeability.
12. Preparation of a temporary slide of squashed and stained onion root tip to study various stages of mitosis.
13. Study the effect of colchicine on mitosis at 24 hrs and 48 hrs.
14. Study of various stages of meiosis through permanent slides.
15. Preparation of stained mount to show the presence of Barr body in human female blood cells/cheek cells.
16. Cytochemical demonstration of:
    a. DNA by Feulgen reaction
    b. Mucopolysaccharides by PAS reaction
17. Proteins by Mercuric Bromophenol Blue/Acid Fast Green

SuggestedContinuousEvaluationMethods:	
TotalMarks:30	
One Mid Semester written Test (1x15):	15Marks
Project/Seminar/ Quiz / Presentation/ Assignment:	10Marks
Attendance & Conduct:	05Marks

Programme/Class: Certificate	**Year**:Second	**Semester**:Forth
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Fundamentals of Biochemistry	

Courseoutcomes:

Bystudyingthis course,studentswill beableto

- Interpretthestructure-functionalrelationshipsofcarbohydrates,proteins,lipidsandnucleicacids.
- Understandthequalitativeanalysisof functionalgroups
- understandthepropertiesofvarious biomolecules.
- appreciatetheactionoftheenzyme andthevariousfactorsthataffecttheir actiondetail.

Credits: 4	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P:** 4-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	**Carbohydrates** Structure and biological importance: with emphasis on aldose, ketose, chiral centre, polarizedLight, Fischer nomenclature, Haworth projection formula, mutarotation of glucose, anomers, pyranose, furanose, glycosidic linkage; reducing and non-reducing sugars: monosaccharides, disaccharides, polysaccharides and glycoconjugates.	12
II	**Lipids** Structure and Significance: Physiologically important saturated and unsaturated fatty acids, tri- acylglycerols, phospholipids, glycolipids, steroids.	10
III	**Proteins** Amino acids: Structure, classification and general properties of α-amino acids; physiological importance of essential and non-essential amino acids; proteins: bonds stabilizing protein structure; Levels of organization in protein motifs, folds and domains; Denaturation.	15
IV	**Nucleic Acids** Structure: purines and pyrimidines, nucleosides, nucleotides, nucleic acids; Cot Curves: Base pairing, Denaturation and Renaturation of DNA; Types of DNA and RNA.	10
V	**Enzymes** Nomenclature and classification, cofactors; specificity of enzyme action, Isozymes, Mechanism of enzyme action; Enzyme kinetics; factors affecting rate of enzyme-catalysed reactions; derivation of Michaelis-Menten equation, concept of Km and Vmax, Lineweaver-Burk plot, multi-substrate reactions, enzyme inhibition; Allosteric enzymes and their kinetics; Regulation of enzyme reaction.	13

SUGGESTED READINGS:

1. Nelson, D.L., Cox, M.M. (2017). Lehninger: Principles of Biochemistry (7th ed.). New York, WH: Freeman Company.
2. Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Well, P.A. (2009). Harper's Illustrated Biochemistry. XXVIII Edition, International Edition, The McGraw- Hill Companies Inc.
3. Stryer, L., Berg, J., Tymoczko, J., Gatto, G. (2019). Biochemistry (9th ed.). New York, WH: Freeman.
4. Voet, D., Voet. J. G. (2013). Biochemistry (4th ed.). New Jersey, John Wiley & Sons Asia Pvt. Ltd.

Programme/Class: Certificate	**Year**:Second	**Semester**:Forth
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:HumanPhysiology	

Courseoutcomes:

Upon completion of the course, students will be able to:

- Understand the principles of normal biological function in the human body.
- Outline basic human physiology and correlate it with histological structures.
- Understand the homeostasis in animals in response to changes in their external environment.

Credits: 4	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P: 4**-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	**Tissues** Types of Tissues; Structure and Function of Epithelial, Connective, Muscular and Nervous tissues.Propagation of nerve impulse (myelinated and non-myelinated nerve fibre); Mechanism of muscle contraction (Sliding filament theory).	10
II	**Digestion and Absorption of Food** Structure and function of digestive system; Digestion and absorption of carbohydrates, fats and proteins.	10
III	**Respiratory Physiology** Structure and function of respiratory tract and lungs; Ventilation, External and Internal respiration; Transport of oxygen and carbon dioxide in blood.	10
IV	**Cardiovascular System & Renal Physiology** Structure of heart, Cardiac cycle, Composition of blood. Functional anatomy of kidney	9
V	**Reproductive Physiology** Structure of testis and ovary; Spermatogenesis and Oogenesis.	8

SUGGESTED READINGS:

1. Tortora, G.J. and Derrickson, B.H. (2012). Principles of Anatomy and Physiology. XIIIth Edition, John Wiley and Sons, Inc.
2. Widmaier E, Raff H and Strang K. (2013). Vander's Human Physiology: The Mechanism of Body Functions. XIIIth Edition, McGraw-Hill Education.
3. Guyton,A.C.andHall,J.E.(2011)TextbookofMedicalPhysiology.XIIEdition,Harcourt Asia Pvt. Ltd/ W.B. Saunders Company.
4. Kesar,S.andVashisht,N.(2007)Experimental Physiology.HeritagePublishers.
5. Prakash,G. (2012) LabManualon BloodAnalysisandMedical Diagnostics.S.Chandand Company Ltd.

Programme/Class: Certificate	**Year**:Second	**Semester**:Forth
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Fundamentals of Ecology	

Courseoutcomes:

Upon completion of the course, the students should be able to:

- Demonstrate an understanding of the basic concepts of the subject
- Explain the characteristics, dynamics, and growth of populations
- Understand the characteristics of the community, ecosystem development and climax theories
- Gain knowledge about the relationship of the evolution of various species and the
- environment they live in.
- Design basic field studies, collect data and interpret it Carry out population and community studies

Credits: 4	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P:** 3-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	**Introduction to Ecology** Autecology and Synecology, Laws of limiting factors, Study of physical factors: Temperature and Light. Terrestrial ecosystem, vertical stratification in tropical forest; Food chain: detritus and grazing food chains, linear and Y-shaped food chains, food web; Energy flow through the ecosystem; Ecological pyramids and Ecological efficiencies; Biogeochemical cycle- nitrogen cycle.	10
II	**Population** Unitary and Modular populations; Unique and group attributes of population: density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion; Exponential and logistic growth, equations and patterns, r and k strategies; Intraspecific population regulation: density-dependent and independent factors.	12
III	**Species Interactions** Types of species interactions, Interspecific competition: Lotka-Volterra model of competition, Gause's Principle with laboratory and field examples, Niche concept; Predation: Lotka-Volterra equations, Functional and numerical responses, predator defense mechanisms, Resource partitioning.	15
IV	**Community** Community characteristics: species richness, dominance, diversity, abundance, guilds, ecotone and edge effect; Ecological succession with examples and types.	12
V	**Applied Ecology** Ecology in wildlife conservation and management, Protected areas: National Parks, Biosphere reserves and Sanctuaries; Restoration ecology, Principles of Environmental impact assessment.	11

SUGGESTED READINGS:

1. Odum, E.P. and Barrett G. W. (2008). Fundamentals of Ecology. Indian Edition (5th).Publisher: Brooks/Cole.
2. Smith T. M. and Smith R. L. (2015). Elements of Ecology. 9th International Edition. Publisher: Benjamin Cummings.
3. Saha G.K. and Mazumdar S. (2020) Wildlife Biology, An Indian Perspective. Publisher: PHI Learning Private Limited
4. Zimmer C. and Emlen D. J., (2013) 1st Edition. Evolution: Making Sense of Life, Roberts & Co.
5. Futuyma, Douglas and Mark, Kirkpatrick (2017) 3rd Edition. Evolutionary Biology, Oxford University Press

Subject Code:	Biochemistry, Physiology & Ecology lab	**3 Credits**

Practical components (60 Hours)

1. Understandingthestructuresofbiomoleculesthroughballandstickmodels.
2. Tounderstandthepreparationandrolesoftwoimportantbiological buffersystems:phosphateand bicarbonate;Preparation ofbuffersanddetermination ofpH.
3. Identificationofthe functionalgroupsbyqualitativetests:
   a. Carbohydrates
   b. Lipids
   c. Proteins
4. Separationofaminoacidsbypaperchromatography.
5. Studytheaction ofsalivary amylaseunderoptimumconditions.
6. StudytheeffectofpH,temperatureandinhibitorsontheactionofsalivaryamylase
7. Preparationoftemporarymount ofneuronsandblood cells(bloodfilm preparation).
8. Preparationofhaemin andhaemochromogencrystals.
9. HaemoglobinestimationusingSahli's haemoglobinometer.
10. DeterminationofABOBlood group.
11. Recordingofblood pressureusingaSphygmomanometer.

Examinationanddetailedstudyofpermanenthistologicalsectionsofmammalian Stomach, Duodenum, Liver, Lung, Kidney, Pancreas, Testis and Ovary..

1. Study of life tables and plotting of survivorship curves of different types from hypothetical/ real data

2. Determination of population density in a natural or a hypothetical community by quadrate method and calculation of Shannon-Weiner diversity index.

3. Study of an aquatic ecosystem:

a) Phytoplankton and zooplankton

b) Measurement of temperature, turbidity/penetration of light, determination of pH

c) Dissolved oxygen content (Winkler's method), chemical oxygen demand

d) Free carbon dioxide and alkalinity

4. Study of ten endemic animals of India with slides/pictures/videos.

5. Report on a visit to a National Park/Biodiversity Park/Wildlife Sanctuary.

SuggestedContinuousEvaluationMethods: **TotalMarks:30** **One Mid Semester written Test (1x15)**: **Project/Seminar/ Quiz / Presentation/ Assignment**: **Attendance & Conduct**:	 15Marks 10Marks 05Marks

Programme/Class: Certificate	**Year**:Third	**Semester**:Fifth
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Biochemistry: MetabolicProcesses	

Courseoutcomes:

By studying this course, students will be able to

- Interpret the structure-functional relationships of carbohydrates, proteins, lipids and nucleic acids.
- Understand the clinical knowledge and importance of antioxidants.
- Understand the process of biological oxidation crucial to generation of energy for a living cell.
- Appreciate the action of various types of enzymes under variety of conditions.

Credits: 4	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P:** 4-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	**Carbohydrate Metabolism** Glycolysis, Citric acid cycle, Phosphate pentose pathway, Gluconeogenesis, Glycogenolysis and Glycogenesis.	8
II	**Lipid Metabolism** β-oxidation and omega-oxidation of saturated fatty acids with even number of carbon atoms; Biosynthesis of palmitic acid; Ketogenesis.	11
III	**Protein Metabolism** Catabolism of amino acids: Transamination, Deamination, Urea cycle.	10
IV	**Oxidative Phosphorylation** Redox systems; review of mitochondrial respiratory chain: electron carriers, sites of ATP production, Oxidative phosphorylation; Chemiosmotic hypothesis, mitochondrial shuttle system.	12
V	**Liver as a Major Metabolic Hub** Inter-connection of glucose-6-phosphate, pyruvate and acetyl-CoA; fates of amino acids, fatty acids and glucose in liver cells; cascade of metabolic events in fasting and starvation.	11

SUGGESTED READINGS:

1. Nelson, D.L., Cox, M.M. (2017). Lehninger: Principles of Biochemistry (7th ed.). New York, WH: Freeman Company.
2. Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Well,P.A. (2009). Harper's Illustrated Biochemistry. XXVIII Edition, International Edition, The McGraw- Hill Companies Inc.

Programme/Class: Certificate	**Year**:Third	**Semester**:Fifth
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Developmental Biology	

Courseoutcomes:

By studying this course, students will be able to

- appreciate the events that lead to the formation of a multicellular organism from a single fertilized egg.
- better understand the general patterns and sequential developmental stages during embryogenesis.
- gain knowledge of the general mechanisms involved in morphogenesis.
- comprehend the processes of ageing to improve the overall health and quality of life in aged people.
- acquire basic knowledge and importance of latest techniques like stem cell therapy, in vitro fertilization and amniocentesis etc.
- develop the skill to raise and maintain culture of model system- Drosophila in the laboratory.

Credits: 4	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P: 4**-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	**Introduction** Historical perspectives and basic concepts: Phases of development, Pattern formation, Differentiation and growth, Cytoplasmic determinants.	**10**
II	**Early Embryonic Development** Gametogenesis: oogenesis, spermatogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal), Blocks to polyspermy; Planes and patterns of cleavage; Types of Blastula; Fate maps; Gastrulation in frog and chick, Embryonic induction and organizers.	**12**
III	**Late Embryonic Development** Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, structure, types, and functions of placenta.	**15**
IV	**Post Embryonic Development** Metamorphosis and its hormonal regulation in amphibians and insects;Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each); Ageing: concepts and theories.	**12**
V	**Implications of Developmental Biology** Teratogenesis: Teratogenic agents and their effects on embryonic development; in- vitro fertilization, Embryonic stem cell (ESC), Amniocentesis.	**11**

SUGGESTED READINGS:

1. Baweja, V. and Misra, M. (2021) E-book on Practical Manual of developmental Biology.
2. Arora, R. and Grover, A. (2018) Developmental Biology: Principles and Concepts. I Edition, R. Chand & Company.
3. Wolpert, L. (2002) Principles of Development. II Edition, Oxford University Press.
4. Kalthoff, K. (2001) Analysis of Biological Development. II Edition, McGraw Hill Publishers.

Subject Code:	Biochemistry and Developmental Biology lab	**2 Credits**

Practical (60 hrs)

(Laboratory periods: 15 classes of 4 hours each)

1. **Estimation of total protein in given solutions by Lowry's method.**
2. **Detection of SGOT and SGPT in serum/ tissue.**
3. **Estimation of GST and GSH in serum/ tissue.**
4. **To study the enzymatic activity of Lipase.**
5. **Study of biological oxidation (SDH) [goat liver].**

6. **To perform the Acid and Alkaline phosphatase assay from serum/ tissue.**
7. **Dry Lab: To trace the labelled 'C' atoms of Acetyl-CoA till they evolve as CO2in the TCA cycle through models**
   1. **Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula (Neural plate, Neural fold and Neural tube stages), tail-bud stage, tadpole (external and internal gill stages)**
   2. **Study of whole mounts of developmental stages of chick through permanent slides (Hamburger and Hamilton Stages): Stage 3 (Intermediate Streak)-13 hours, Stage 4 (Definitive Streak)-18 hours, Stage 5 (Head Process)-21 hours, Stage 7- 24 hours, Stage 8-28 hours, Stage10-33 hours, Stage 11-40 hours, Stage 13-48 hours, Stage 19- 72 hours and Stage 24-96 hours of incubation**
   3. **in vivo study of chick embryo development by windowing and candling methods. (Demonstration only)**
   4. **Study of indirect development and metamorphosis by rearing any one insect.**
   5. **Study of different sections of placenta (photomicrographs/ slides).**
   6. **Project report on Drosophila or any insect culture/Visit to Poultry Farm/IVF Centre**
   7. **Student Presentation: Power point presentation on any topic related to developmental biology.**

SuggestedContinuousEvaluationMethods:	
TotalMarks:30	
One Mid Semester written Test (1x15):	15Marks
Project/Seminar/ Quiz / Presentation/ Assignment:	10Marks
Attendance & Conduct:	05Marks

Programme/Class: Certificate	**Year**:Third	**Semester**:Sixth
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Evolutionary Biology	

Courseoutcomes:

By studying this course, students will be able to:

- gain knowledge about the relationship of the evolution of various species and the environment they live in.
- apply knowledge gained, on populations in real time, while studying speciation, behaviour and susceptibility to diseases.
- better understand the study of variations, genetic drift to ensure that conservation efforts for small threatened populations are focused in right direction.
- predict the practical implication of various evolutionary forces acting on the human population in the field of human health, agriculture and wildlife conservation.
- use various software to generate interest towards the field of bioinformatics and coding used in programming language.

Credits: 4	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P: 4**-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	**Historical Review of Evolutionary Concepts** Lamarckism, Darwinism, Neo-Darwinism **Beginning of Life**-Chemogeny, RNA world, biogeny, origin of photosynthesis, endo-symbiotic theory	10
II	**Evidences of Evolution** Paleontological: geological time scale; phylogeny of horse; Molecular: neutral theory of evolution, molecular clock, example of globin gene family, rRNA/Cyt c. **Raw Material for Evolution-**Variations: Heritable variations and their role in evolution	12
III	**Process of Evolution** Qualitative studies: Natural selection, types of natural selection, artificial selection, kin selection, adaptive resemblances, sexual selection, frequency dependent selection. **Quantitative studies**: Natural selection (concept of fitness, selection coefficient), genetic drift (founder's effect, bottleneck phenomenon), migration and mutation (genetic load).	15
IV	**Product of Evolution** Speciation: micro-evolutionary changes (inter-population variations, clines, Ring species, races), species concept, isolating mechanisms. **Extinction**-Mass extinctions (events, causes and effects), Detailed explanation of K-T extinction	12
V	**Origin and Evolution of Man** Unique hominin characteristics contrasted with primate characteristics, primate phylogeny from Dryopithecus leading to Homo sapiens, molecular evidences in evolution of modernhuman.	11

SUGGESTED READINGS:

1. Futuyma, Douglas and Mark, Kirkpatrick (2017) 3rd Ed. Evolutionary Biology, Oxford University Press.
2. Zimmer C. and Emlen D. J., (2013) 1stEd. Evolution: Making Sense of Life, Roberts & Co.
3. Pevsner, J. (2009). Bioinformatics and Functional Genomics. II Edition, Wiley Blackwell.
4. Ridley, M. (2004). Evolution. III Edition, Blackwell publishing.

Programme/Class: Certificate	**Year**:Third	**Semester**:Sixth
Subject:ZOOLOGY		
CourseCode: BMJC050602T	**CourseTitle**:Principles ofImmunology	

By studying this course, students will be able to

- **have a better understanding of the concepts of innate and acquired immunity.**
- **acquire knowledge of the immunogenicity of biomolecules**
- **comprehend and analyze the different cellular and humoral components of the immune system**
- **appreciate the contribution of various components of immune system in health and disease including basis of vaccination, autoimmunity, immunodeficiency and hypersensitivity**

Credits: 4	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P: 4**-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	**Overview of the Immune System** Early theories (Selective and Instructional) and Clonal Selection theory; Innate immunity: components and defensive barriers of innate immunity. Adaptive immune system: Components and attributes of acquired immunity, humoral and cell mediated immunity, active and passive immunity, primary and secondary immune response,	**12**
II	**Antigens and Immunoglobulins** Antigens and immunogens; antigenicity and immunogenicity; factors affecting immunogenicity; antigenic determinants and its properties (B- and T-cell epitopes); Haptens and Adjuvants. Structure and functions of different classes of antibodies; antigenic determinants on immunoglobulin; Production and applications of monoclonal antibodies.	**12**
III	**MHC and Antigen Presentation** Structure and functions of MHC (MHC-I & MHC-II); endogenous and exogenous pathways of antigen processing and presentation.	**10**
IV	**Complement System and Cytokines** Pathways of complement activation and biological consequences of complement activation; properties and functions of cytokines	**12**
V	**Immune System in Health and Diseases** Vaccines and their types; Gell and Coombs classification of hypersensitivity; autoimmunity and immunodeficiency with suitable examples.	**11**

SUGGESTED READINGS:

1. Singh, I. K. and Sharma, P. [Eds.] (2022) An Interplay of Cellular and Molecular Components of Immunology. Taylor & Francis group, CRC Press.
2. Kaur, H., Toteja, R., and Makhija, S. (2021) Textbook of Immunology, I.K International Publishing House and Wiley India Ltd
3. Singh, I. K. and Sharma, P. [Eds.] (2022) Essentials of Immunology, Laboratory Manual; Prestige Publishers.
4. Kenneth Murphy, Casey Weaver (2016) Janeway's Immunobiology; 9th Edition, Garland Science

Programme/Class: Certificate	**Year**:Third	**Semester**:Sixth
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Cell and Molecular Biology	

Courseoutcomes:

By studying this course, students will be able to

- have a better understanding of the diverse cellular processes and cellular interactions.
- have an in-depth knowledge of the defects in cellular functioning and the molecular mechanisms that can lead to various diseases.
- appreciate the importance of homeostasis of the body and the adversities of disturbing it.
- acquire the basic information of cell signaling pathways and to elucidate its roles in gene expression and its regulation in eukaryotes.
- interpret the differences between cellular deaths; stem cells and their applications in therapeutic cloning and regenerative medicine.
- explain post-transcriptional modification mechanisms for the processing of eukaryotic mRNA.
- impart experimental skills used in clinical and research laboratories giving the students an extra edge for taking up higher studies.

Credits: 4	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P:** 4-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	**Cell Signaling** Introduction to cell signaling pathways, target gene and a nuclear receptor pathway. **Cell Death and Cell Renewal** Apoptosis vs. necrosis; intrinsic and extrinsic pathways of programmed cell death; stem cells and maintenance of adult tissues; embryonic and induced pluripotent stem cells.	**10**
II	**DNA and its Replication** DNA replication in prokaryotes and eukaryotes-replication machinery and mechanisms, semi-conservative, bidirectional and semi-discontinuous replication, Replication of circular and linear double stranded DNA, Replication of telomeres.	**12**
III	**Transcription** Machinery and mechanism of transcription in prokaryotes and eukaryotes-RNA polymerases, Transcription unit, Transcription factors, Synthesis of rRNA.	**15**
IV	**Translation** Genetic code, Process of protein synthesis in prokaryotes: fidelity of protein synthesis, aminoacyl-tRNA synthetases and charging of tRNA; Proteins involved in initiation, elongation and termination of polypeptide chain; Difference between prokaryotic and eukaryotic translation.	**12**
V	**Post Transcriptional Modifications** Split genes: concept of introns and exons, splicing mechanism, alternative splicing, and RNA editing. **Gene Regulation** Transcription regulation in prokaryotes: Lac operon; Overview of transcription regulation in eukaryotes: Activators, repressors, enhancers, silencer elements.	**11**

SUGGESTED READINGS:

1. Watson, J. D. Baker T.A. Bell, S. P. Gann, A. Levine, M. and Losick, R. (2008) Molecular Biology of the Gene.VI edition. Cold Spring Harbour Lab. Press, Pearson Pub.
2. Lewin B. (2008). Gene XI. Jones and Bartlett.
3. Gupta, R., Makhija, S. and Toteja, R. (2018). Cell Biology Practical Manual, Prestige Publishers, New Delhi-110003.
4. Sharma, V. K. (1991). Techniques in Microscopy and Cell Biology, Tata McGraw Hill Publishing Company Limited, New Delhi.

Subject Code:	Evolutionary, Immunology & Cell and Molecular Biology Lab	**2 Credits**

Practical (60 hrs)
(Laboratory periods: 15 classes of 4 hours each)

1. **Study of fossils (types, forms and dating) from models/pictures.**
2. **Study of homology, analogy and homoplasy from suitable specimens.**
3. **Study different modes of speciation and Adaptive radiation/macroevolution by suitable examples.**
4. **Study of variations in a sample human population: (a) Continuous variation: Height/Weight in relation to age and sex (b) Discontinuous variation: Ability/Inability to taste Phenylthiocarbamide (PTC).**
5. **Study of Hardy-Weinberg Equilibrium: statement, assumptions, derivation of the equation and its verification by chi square analysis.**
6. **Demonstration of role of natural selection and genetic drift in changing allelic frequencies using simulation studies.**
7. **Construction of cladograms based on morphological characters.**
8. **Introduction and construction of Phylogenetic trees with the help of bioinformatics tools (Clustal X/W, Phylip, MLK/MP/NJ) and its interpretation.**

1. **Study of lymphoid cells and organs in rat/mouse*.**
2. **Histological study of spleen, thymus and lymph nodes through slides/photomicrographs.**
3. **To study various types of white blood cells using Leishman's/Giemsa/Crystal violet stained blood smear.**
4. **To understand the antigen and antibody interactions by**

i) **Ouchterlony's double immunodiffusion method.**
ii) **ABO Blood group antigen determination by heamagglutination test.**
iii) **Demonstration of ELISA.**
iv) **Demonstration of Immunoelectrophoresis.**
v) **FACS**
vi) **RIA**
vii) **Elispot**

1. **Requirement of a Tissue culture laboratory, its equipment and its layout. Concept of cell culture and cell lines; Media preparation for mammalian tissue culture.**
2. **Preparation of permanent slides of mitosis/meiosis*.**
3. **Study of Polytene chromosomes from Chironomous/Drosophila larva.**
4. **Inoculation and culture of E. coli in liquid culture medium (LB).**
5. **Preparation of solid culture medium (LB) and growth of E. coli by spreading and streaking.**
6. **Estimation of the growth kinetics of E. coli from the data provided.**
7. **Quantitative estimation of salmon sperm/calf thymus DNA using colorimeter** (Diphenylaminereagent)orspectrophotometer(A_{260}measurement).
8. **Study and interpretation of electron micrographs/photographs showing: DNA replication, Transcription, and Split genes.**
9. **Project related to topics covered in theory/ project report based on visit to labs/institutions/industry etc.**

***Subject to UGC guidelines**

SuggestedContinuousEvaluationMethods:	
TotalMarks:30	
One Mid Semester written Test (1x15):	15Marks
Project/Seminar/ Quiz / Presentation/ Assignment:	10Marks
Attendance & Conduct:	05Marks

Programme/Class: Certificate	**Year**:Fourth	**Semester**:Seventh
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Comparative Anatomy of Vertebrates	

Courseoutcomes:

By studying this course, students will be able to

- have a better understanding of the evolutionary significance of comparative anatomy.
- understand the importance of morphology and anatomy of organisms in relation to evolution.
- appreciatethecomparativeanatomyamongvertebratesthat provides evolutionary evidences.
- enhance collaborative learning and communication skills through practical sessions, teamwork, group discussions, assignments, and projects.

Credits: 4	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P:** 4-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	Integumentary System-Structure and derivatives of integument. Digestive System -Alimentary canal and associated glands; Dentition.	10
II	Circulatory System-General plan of circulation; Evolution of heart and aortic arches. Respiratory System- Skin, gills, lungs, accessory respiratory organs in fishes, air sacs.	10
III	Skeletal System Outline of axial and appendicular skeleton; Concept of neurocranium, dermatocranium and splanchnocranium; Structure of a typical vertebra and its classification based on centrum; Jaw suspensorium; General plan of girdles and limbs	15
IV	Nervous System Comparative account of brain; Cranial nerves in mammals.	9
V	. Sense Organs Classification of receptors; Structure and function of mammalian eye and ear. Urinogenital System Succession of kidney; Evolution of urinogenital ducts; Types of uteri in mammals.	11

SUGGESTED READINGS:

1. Kardong, K.V. (2005) Vertebrate's Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education.
2. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.
3. Leiem C.F., Bermis W.E, Walker, W.F, Grande, L. (2001) Functional anatomy of the vertebrates, An evolutionary perspective. III Edition, Brookes/Cole, Cengage Learning.

Programme/Class: Certificate	**Year**:Fourth	**Semester**:Seventh
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Animal Behaviour	

Courseoutcomes:

By studying this course, students will be able to

- better understand the various types of animal behaviour and their importance.
- enhance their observation skills, analytical skills, scientific interpretation and documentation skills.
- enable students to evaluate the characteristic features of animal life including static postures, active movements, noises, smells, changes in colour and shape.
- realise, appreciate and develop passion to biodiversity and respect the nature and its surroundings.

Credits: 4	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P: 4**-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	**Introduction to Animal Behaviour** Origin and history of ethology, Pioneers of modern ethology: Karl von Frisch, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen, Four Questions for Ethology.	10
II	Patterns of Behaviour Innate behaviour, Instinct, Sign stimuli, Code breakers, Learning: associative learning and non-associative learning, Classical and operant conditioning, Habituation, Imprinting.	12
III	CommunicationImportance of communication; Role of Chemical, Tactile, Auditory, Visual stimuli in communication.	10
IV	Social Behaviour Concept of Society, Social insects (Honeybee as example), Bee communication, Altruism & Reciprocal altruism, Inclusive fitness, Hamilton's rule.	10
V	Sexual Behaviour Sexual dimorphism, mate choice; Intra-sexual selection (male rivalry); Inter-sexual selection (female choice); Courtship behaviour, Parental care, sexual conflict in parental care, Infanticide.	11

SUGGESTED READINGS:

1. Alcock, J. (2013) Animal Behaviour, Xth Edition, Sinauer Associates Inc., USA.
2. Manning, A. and Dawkins, M. S, (2012) An Introduction to Animal Behaviour, VIth Edition, Cambridge University Press, UK
3. McFarland, D. (1985) Animal Behaviour, Pitman Publishing Limited, London, UK
4. Rubenstein, D. (2022) Animal Behavior, XIIth Edition, Sinauer Associates, Oxford University Press, UK.
5. Gadagkar, R. (2021) Experiments in Animal Behaviour: Cutting-Edge Research at Trifling Cost, Indian Academy of Sciences.

Programme/Class: Certificate	**Year**:Four	**Semester**:Seventh
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:AnimalBiotechnology	

Courseoutcomes:

By studying this course, students will be able to:

- Enable students to make a strategy to manipulate genetic structure of an organism for improvement of any trait.
- Comprehend the ethical and social issues regarding GMOs.
- GainknowledgeofDNAisolation,Agarosegelelectrophoresis, PCR, transformation etc.
- Execute the application of recombinant DNA technology in designing research project.
- Acquire technicalskillsrequiredforjoining researchlabs/industry/institute/pharmaceutical etc. including entrepreneurship.

Credits: 4	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P:** 4-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	Overview of Biotechnology Aim and scope; applications in biotechnology.	9
II	Basic Tools for Gene Manipulation Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, M13, BAC, YAC, MAC and Expression vectors (characteristics); Restriction enzymes; DNA modifying enzymes; Transformation techniques: Calcium chloride method, electroporation and biolistic methods, construction of genomic and cDNA libraries and screening by colony and plaque hybridization.	15
III	Advance Tools and Techniques Gene Editing Tool: Zinc Finger, TALEN, Clustered regularly interspaced short palindromic repeats (CRISPR/Cas9) system.	15
IV	Genetically Modified Animals Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection; Applications of transgenic animals; Production of pharmaceuticals, production of donor organs, knock-out mice.	11
V	Applications of Genetic Engineering Molecular diagnosis of genetic diseases (Cystic fibrosis, Sickle cell anemia): RFLP based, Allele specific oligonucleotide dot blot method, PCR- Oligonucleotide ligation assay; Recombinant DNA in medicines: recombinant insulin and human growth hormone, Gene therapy.	12

SUGGESTED READINGS:

1. Clark, D. P. and Pazdernik, N.J. (2012) Biotechnology, Academic Press.
2. Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007) Recombinant DNA Genes and Genomes-A Short Course. III Edition, Freeman and Co., N.Y., USA.

Subject Code:	Developmental Biology Practical	**2 Credits**

Practical (60 hrs)

(Laboratory periods: 15 classes of 4 hours each)

1. **Study of different types of feathers of birds.**
2. **Study of the disarticulated skeleton of Frog, Varanus, Fowl, Rabbit (Vertebral Column, Sternum,Girdles, Ribs, Limb bones).**
3. **Study of the vertebrate Skull (i) one herbivorous and one carnivorous animal skull; (ii) one monocondylic and one dicondylic skull.**
4. **Study of carapace and plastron of turtle/tortoise.**

5. **Study of the digestive, circulatory and urinogenital system of frog/rat through videos ondissection or through virtual dissections.**
6. **Project related to topics covered in theory.**
7. **Field trips/Documentary film show on vertebrates/Visit to Zoological Park, Biodiversity Park or Sanctuary.**
8. **Student Presentation: Power point presentation on any two animals from two different classes.**

1. **To study nests and nesting behaviour of the birds and social insects.**
2. **To study the behavioural responses of wood lice to dry and humid conditions.**
3. **To study geotaxis behaviour in earthworm.**
4. **To study the phototaxis behaviour in insect larvae.**
5. **Study of different tools, techniques and methods used in preparing ethogram.**
6. **To study courtship behaviour in insects and birds from short videos/movies.**

1. **Isolation of genomic DNA from E. coli.**
2. **Isolation of plasmid (pUC 18/19) from E. coli.**
3. **Detection/ Visualization of DNA using Agarose gel electrophoresis.**
4. **Construction of circular and linear restriction map from the data provided.**
5. **Calculation of transformation efficiency from calcium chloride method.**
6. **Study of different blotting techniques: Southern, Northern and Western.**
7. **DNA sequencing: Sanger method, Next generation sequencing (Illumina).**
8. **Study of Polymerase Chain Reaction (PCR) and DNA microarrays.**
9. **Study and interpretation of DNA fingerprinting.**
10. **Submission of Project report based on any of the topics above (theory/practical)**

SuggestedContinuousEvaluationMethods:	
TotalMarks:30	
One Mid Semester written Test (1x15):	15Marks
Project/Seminar/ Quiz / Presentation/ Assignment:	10Marks
Attendance & Conduct:	05Marks

Programme/Class: Certificate	**Year**:Fourth	**Semester**:Eighth
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Methods in Biostatistics	

Courseoutcomes:

By studying this course, students will be able to

- better understand the basic concepts of Biostatistics and its various applications in different fields of biological sciences.
- acquire basic skills to set up hypothesis and design research studies.
- enable students to differentiate among various experimental designs and apply appropriate statistical tests.
- develop the skills to collect and represent data in tabular and graphical forms.
- analyze data and interpret experimental results using calculator, spread sheets software and online/offline software tools.

Credits:4	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P: 4**-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	Introduction to Biostatistics Aim and scope; applications in biological sciences.	10
II	Statistical Data Sampling methods; Primary and secondary data; Qualitative and quantitative data; Discrete and continuous data; Presentation of data- graphical representation of data.	12
III	Descriptive Statistics Concepts of statistical population and samples, parameter and statistics; Measures of Central tendency and Dispersion - Mean, Median and Mode (grouped and ungrouped data); Variance, Standard Deviation and Standard Error; Coefficient of Variance.	15
IV	Probability and Distributions Normal, Binomial and Poisson; Skewness and Kurtosis. Testing of Hypothesis Null and Alternative hypotheses; Concepts of statistical errors - Type I and Type II errors; Confidence Intervals and Confidence levels.	12
V	Correlation and Regression Correlation Coefficient; Linear regression analysis.	11

SUGGESTED READINGS:

1. Daniel, W.W. and Cross, C.L. (2018) Biostatistics: Basic Concepts and Methodology for the Health Sciences 11th Edition, John Wiley & Sons, Inc.
2. Motulsky, H. (2016) Essential Biostatistics: A Non-mathematical Approach Oxford University Press
3. Zar, Jerrold H. (1999). Biostatistical Analysis, IV Edition, Pearson EducationInc and Dorling Kindersley Publishing Inc. USA

Subject Code:	Developmental Biology Practical	**2 Credits**

Practical (60 hrs)

(Laboratory periods: 15 classes of 4 hours each)

1. **To learn calculation and graphical representation of data with computers (e.g. MS Excel/SPSS/SigmaStat/Prism).**
2. **To compute Coefficient of Variance from data collected and measure variability.**
3. **To collect data on different parameters (e.g. height/weight) of animal/plant samples and test for significance, difference between mean, mode and median.**
4. **To compute 'test of independence' and 'goodness of fit' with samples/data provided using Chi square test.**
5. **To perform Z test/ F test (ANOVA) for given samples/data provided.**

6. **Submission of Project report based on field studies (sample collection, data analysis and interpretation using above statistical tests).**

SuggestedContinuousEvaluationMethods: **TotalMarks:30** **One Mid Semester written Test (1x15)**: **Project/Seminar/ Quiz / Presentation/ Assignment**: **Attendance & Conduct**:	 15Marks 10Marks 05Marks

Detailed Syllabus

Minor Courses

Programme/Class: Certificate	**Year**:First	**Semester**:First
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Aquatic Biology	

Courseoutcomes:

By studying this course, students will be able to

- Be acquainted with the physico-chemical environment, and its role in aquatic ecosystem.
- Learn about adaptations unveiled by organisms to survive in these distinctive conditions.
- well-versed with the laws governing the use of freshwater systems, as well as the local, state, federal, and international agencies that enforce these laws to protect endangered and vulnerable species.
- Understand and apply relevant scientific principles in the area of aquatic biology and educate others or work to conserve our natural resources.
- Realize impact of human activities on aquatic organisms.

Credits: 3	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P:** 4-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	**UNIT-I: Aquatic Biomes 6 hrs** **Brief introduction of the aquatic biomes: Freshwater ecosystem (lakes, wetlands, streams and rivers), Estuaries, Intertidal zones, Oceanic pelagic zone, Marine benthic zone and Coral reefs.**	**4**
II	Lakes 9 hrs Lakes: Origin and classification (Glacial, Tectonic, Volcanic and Fluvial Lakes), Lake as an Ecosystem, Lake morphometry, Physico–Chemical Characteristics: Thermal stratification, Vertical distribution of oxygen in lakes, Dissolved Nitrates and Phosphates, Turbidity.	**8**
III	Streams and Rivers 9 hrs Streams: Different stages of stream development, Physico-chemical environment, Stream flora and fauna. Adaptations of hill stream fishes. Rivers: Origin and characteristics of river. Functions. Concept of watershed management. Ramsar Convention.	**6**
IV	Marine Biology 12 hrs Continental shelf, Salinity and density of sea water, Light attenuation in water: Photic, dysphotic and aphotic zones. Adaptations of deep-sea organisms. Marine mammals and their adaptations. Coral reefs: Formation, distribution, fauna and effect of climate change. Physico-chemical characteristics of estuaries, estuarine ecosystem.	**8**
V	Management of Aquatic Resources 9 hrs Major threats to freshwater systems, including pollution and sand mining. Impact of large dams and fragmentation on river ecology and fishery. Thermal pollution and oil spills; Sewage treatment, Water quality assessment- BOD and COD.	**10**

SUGGESTED READINGS:

1. Sullivan O.P. and Reynolds C.S. (2004) The lakes hand book, Limnology and limnetic ecology. Wiley Blockwell.
2. Brian R. Moss (2018) Ecology of Freshwaters: Earth's Blood stream (5thedition). Wiley.
3. DoddsW.K.andWhilesM.R.(2019).Freshwater Ecology: ConceptsandEnvironmentalApplications of Limnology (3rd edition). Academic Press.
4. Barrick, M., Odum, E.P., Barrett, G.W., (2005). Fundamentals of Ecology. 5thEdition. Cengage Learning.

SuggestedContinuousEvaluationMethods:	
TotalMarks:30	
One Mid Semester written Test (1x15):	15Marks
Project/Seminar/ Quiz / Presentation/ Assignment:	10Marks
Attendance & Conduct:	05Marks

Programme/Class: Certificate	**Year**:First	**Semester**:Second
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Agrochemicals & Pest Management	

Courseoutcomes:

By studying this course, students will be able to:

- create awareness about adverse effects of insecticides on the environment and the need for an environment-friendly approach to the management of insect pests.
- gain knowledge about the concepts and tools of pest management.
- Understand the planning of agricultural ecosystem, tolerance of pest damage, and timing of different pest control tactics to effectively manage the pest population.
- learn about the use of different pest control techniques in a harmonious manner.
- understand the role of IPM in sustainable agriculture as the future of modern plant protection and pest control strategy.

Credits: 3	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P:** 3-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	Diversity of insects 6 hrs Salient features of insects and reasons for their diversity; Outlines of insect classification up to orders. Significance of insects in the ecosystem.	4
II	Insect morphology and development 9 hrs Overview of insect morphology: Distinction between prognathous, hypognathous and opisthognathous head, types of antennae, mouth parts and legs. Insect development and types of metamorphosis.	8
III	Insect crop pests and their management 12 hrs Introduction to different types of pests and their status, Factors responsible for emergence of pest, Pest population dynamics. Bionomics and Control of Crop pests: Leptocorisa acuta, Sesamia inferens, Helicoverpa armigera, Pyrilla perpusilla, Earias vitella, Raphidopalpa faveicollis, Papilio demoleus. Bionomics and strategies for the management of stored grain pests: Sitophilus oryzae, Callosobruchus chinensis, Trogoderma granarium and Corcyra cephalonica.	8
IV	Medically Important and Household Pests 6 hrs Bionomics and management of cockroach, rat flea, mosquitoes, house fly, sand fly, human louse and termites.	6
V	Insect Pest Management 12 hrs Overview of pest management tactics: physical, mechanical, cultural, biological, microbial, botanical and genetic control (SIT/SIRM). Chemical control: Chlorinated hydrocarbons (BHC, Aldrin) organophosphates (Malathion Parathion), carbamates (Carbaryl, Propoxur) and synthetic pyrethroids (Allethrin and Cypermethrin). Integrated pest management (IPM): Definition, principle, components of IPM and advantages.	10

SUGGESTED READINGS:

1. Borror, D.J., Triplehorn, C.A., and Johnson, N.F. (2005) Introduction to the Study of Insects. M Saunders College Publication, USA.
2. Chapman, R.F. (1998) The Insects: Structure and Function. Cambridge University Press, UK.
3. Imms, A. D. (1923) A General Text Book of Entomology. Chapman &Hall, UK.
4. Snodgrass, R. E. (1935) Principles of Insect Morphology. Cornell Univ. Press, USA.
5. Dennis, S. Hill. (2005) Agricultural Insect Pests of the Tropics and Their Management. Cambridge University Press.
6. David, B. V. and Ananthakrishnan, T.N. (2004) General and Applied Entomology. Tata-McGraw Hill, New Delhi.

SuggestedContinuousEvaluationMethods: **TotalMarks:30** **One Mid Semester written Test (1x15)**: **Project/Seminar/ Quiz / Presentation/ Assignment**: **Attendance & Conduct**:	 15Marks 10Marks 05Marks

Programme/Class: Certificate	**Year**:Second	**Semester**:Third
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Wildlife Conservation&Management	

Courseoutcomes:

By studying this course, students will be able to:

- Appreciate wildlife in general and realize its conservation and management in particular.
- Better understand the application of the principles of ecology and animal behaviour to formulate strategies for the management of wildlife populations and their habitats.
- Understand the management practices required to achieve a healthy ecosystem for wildlife population along with emphasis on conservation and restoration.
- comprehend the key factors for loss of wildlife and important strategies for their in situ and ex situ conservation.
- recognize the techniques for estimation, remote sensing and Global Position Tracking for wildlife.
- gain knowledge about the wildlife diseases and the quarantine policies.
- know about the Protected Area Networks and Ecotourism in India.
- Perform critical thinking, literature review; scientific writing as well as presentations; and participation in citizen science initiatives with reference to wildlife.
-

Credits: 3	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P:** 3-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	Introduction to Wildlife 3 hrs Values of wildlife - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion.	4
II	Evaluation and Management of Wildlife 9 hrs Habitat analysis: a) Physical parameters: Topography, Geology, Soil and water; b) Biological Parameters: food, cover, forage; Standard evaluation procedures: Bio- telemetry, Remotesensing and GIS.	8
III	Management of Habitats 9 hrs Setting back succession: Grazing, prescribed fire, mechanical treatment and selective herbicide application; Advancing the successional process and cover construction; Preservation of genetic diversity; Restoration of degraded habitats.	10
IV	Population Estimation 6 hrs Faecal analysis of ungulates and carnivores: Faecal samples, slide preparation and hair identification; Pug marks and census methods.	6
V	Wildlife Health and Rehabilitation 9 hrs Care of injured and diseased animal; Quarantine; Common diseases of wild animals: Zoonosis (Ebola and Salmonella), Rabies, Foot and Mouth Disease, Mycobacterium TB, Bovine and Avian Flu (Any 3 in detail).	8
	Protected Areas and their management 9 hrs National parks and Sanctuaries; Biosphere reserves; Conservation and Community reserve; Important features of Protected Areas in India; Project Tiger- conservation and management challenges in Tiger reserves; Human-wildlife conflict; Eco-tourism.	8

SUGGESTED READINGS:

1. Primack, R.B. (1998). Essentials of Conservation Biology. Sinauer Associates, Inc. Sunderland, MA.
2. Hossetti, B.B. (1997). Concepts in Wildlife Management. Daya Publishing House, Delhi.
3. Sharma, B.D. (1999) Indian Wildlife Resources Ecology and Development. Daya Publishing House, Delhi.

SuggestedContinuousEvaluationMethods: **TotalMarks:30** **One Mid Semester written Test (1x15)**: **Project/Seminar/ Quiz / Presentation/ Assignment**: **Attendance & Conduct**:	 15Marks 10Marks 05Marks

Programme/Class: Certificate	**Year**:Second	**Semester**:Fourth
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Fishand Fisheries	

Courseoutcomes:

By studying this course, students will be able to:

- acquire basic knowledge of physiology and reproduction in fishes.
- analyse different kinds of water and identify/differentiate among various kinds of fishes.
- equip the students with the knowledge on the procedures for artificial and induced breeding which can be learnt by visiting any fish farm or demonstrated in research labs in college/Departments.
- have more knowledge of the in-land and marine Fisheries in India and to explore ways in which it can contribute to the Indian economy.
- know more about the different methods of fishing and fish preservationwhich can be employed for export and storage of commercial fishes.
- develop skills for entrepreneurship or self-employment in fisheries-related business.

Credits: 3	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P:** 3-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	Introduction and Classification 6 hrs General description of fish; Account of systematic classification of fishes (upto classes); Classification based on feeding habit, habitat and manner of reproduction. Brief introduction to transgenic fishes.	6
II	Morphology, Physiology and Behavior 14 hrs Types of fins and their modifications; Locomotion in fishes; Hydrodynamics; Types of Scales,Gillsandgasexchange; Swim Bladder: Typesand rolein Respiration, buoyancy;Osmoregulation in Elasmobranchs, Schooling; Parental care; Migration.	8
III	Fisheries 8 hrs Inland Fisheries; Estuarine Fisheries, Marine Fisheries; Fishing crafts and Gears; Depletion of fisheries resources; Application of remote sensing and GIS in fisheries; Fisheries law and regulations.	6
IV	Aquaculture 17 hrs Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish; Pen and cage culture; Polyculture; Composite fish culture; Brood stock management; Induced breeding of fish;Management of finfish hatcheries; Preparation of compound diets for fish; Role of water quality in aquaculture; Post harvest handling techniques and Fishery by-products.	10

SUGGESTED READINGS:

1. Pandey, K. and Shukla, J.P. (2013) Fish and Fisheries. Rastogi publication,India
2. Chakrabarti, R. and Sharma, J. G. (2008). Aquahouse: New Dimension of Sustainable Aquaculture. DIPAS, Indian Council of Agricultural Research, New Delhi, India.
3. Norman, J.R. A History of Fishes. Hill and Wang Publishers. Khanna, S.S. and Singh,H.R. (2014) A text book of Fish Biology and Fisheries. Narendra, Publishing House.
4. Bone, Q. and Moore, R. (2008) Biology of Fishes. Talyor and Francis Group, CRC Press, U.K.

SuggestedContinuousEvaluationMethods:	
TotalMarks:30	
One Mid Semester written Test (1x15):	15Marks
Project/Seminar/ Quiz / Presentation/ Assignment:	10Marks
Attendance & Conduct:	05Marks

Programme/Class: Certificate	**Year**:Third	**Semester**:Fifth
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Parasitology	

Courseoutcomes:

By studying this course, students will be able to:

- better understand the variation amongst parasites, parasitic invasion in animals; applicable to medical and agriculture aspects
- Identify the stages of the life cycles of parasites and their respective infective stages. develop ecological model, on the base knowledge of population dynamics of parasites.
- comprehend the different methods adopted by parasites to combat with the host immune system.
- develop skills and realize significance of diagnosis of parasitic attack and treatment of patient or host.
- analyse and interpret the case studies to highlight innovative researches, serendipities towards the advancement and enrichment of knowledge in the field of Parasitology.

Credits: 3	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P:** 3-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	Introduction to Parasitology 3 hrs Brief introduction of Parasitism, Parasite, Parasitoid and Vectors; Host parasite relationship	6
II	Parasitic Protists 10 hrs Study of Morphology, Life Cycle, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Entamoeba histolytica, Trypanosoma gambiense and Plasmodium vivax.	8
III	Parasitic Platyhelminthes 10 hrs Study of Morphology, Life Cycle, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Fasciolopsis buski, Schistosoma haematobium and Taenia solium	8
IV	Parasitic Nematodes 10 hrs Study of Morphology, Life Cycle, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Ascaris lumbricoides, Ancylostoma duodenale, Wuchereria bancrofti and Trichinella spiralis.	6
V	Parasitic Arthropoda 8 hrs Biology, importance and control of ticks, mites, Pediculus humanus (Head and Body louse), Xenopsylla cheopis and Cimex lectularius	6
VI	Parasitic Vertebrates 4 hrs A brief account of parasitic vertebrates; Cookicutter Shark, Hood Mockingbird and Vampire bat.	6

SUGGESTED READINGS:

1. Chatterjee, K. D. (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBSPublishers & Distributors (P) Ltd.
2. Arora, D. R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications andDistributors
3. Noble, E.R. and Noble, G.A. (1989) Parasitology: The Biology of Animal Parasites. VIEdition, Lea and Febiger

SuggestedContinuousEvaluationMethods: **TotalMarks:30**	
One Mid Semester written Test (1x15):	15Marks
Project/Seminar/ Quiz / Presentation/ Assignment:	10Marks
Attendance & Conduct:	05Marks

Programme/Class: Certificate	**Year**:Third	**Semester**:Fifth
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:IntegrativeSystemsBiology andBioinformatics	

Courseoutcomes:

By studying this course, students will be able to:

- know more about the basic of systems biology and bioinformatics
- better understand about the availability of experimental data through biological databases, usage of small molecules, nucleic acids, protein sequences, in a variety of biological sciences domains
- gain more knowledge about the gene sequence annotation, protein structure prediction and gene enrichment prediction
- acquire skills to perform and understand pair-wise and multiple sequence alignment
- better understand a variety of computational tools and approaches, as well as their use in in silico drug discovery, structural bioinformatics, and functional genomics etc.

Credits: 3	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P:** 3-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	Introduction to Systems Biology and Bioinformatics 5 hrs Introduction to Systems Biology, Bioinformatics, Genomics, Proteomics, Transcriptomics, Metabolomics, Scope and their applications.	8
II	Systems Biology 10 hrs Computational models, modelling and their basic notions, networks (feed forwardgene circuit,transcription regulatory networks and protein-protein interaction networks)	8
III	Biological Databases 8 hrs Introduction to biological databases; Primary, Secondary and Composite databases; Nucleic acid databases (GenBank, DDBJ, EMBL and NDB); Protein databases (PIR, SWISS-PROT, TrEMBL, PDB); Metabolic pathway database (KEGG, Reactome, EcoCyc, and MetaCyc); Small molecule databases (PubChem, Drug Bank, ZINC, CSD)	10
IV	Sequence Alignment and Phylogeny 10 hrs ScoringMatrices (PAM, BLOSUM), Methods of Alignment (Dotmatrix, Dynamic Programming, BLAST and FASTA); HMM model, Local and global alignment, pair wise and multiple sequence alignments, Molecular Phylogeny.	6
V	Structural Biology and Drug Discovery 12 hrs Protein secondary structure prediction (Chou-Fasman & GOR methods), Protein tertiary structure prediction and its validation (Homology modelling, Threading and Ab-initio methods); Lipinski rule, Molecular docking (rigid and flexible docking), ADMET properties, Molecular Dynamics, Drug-DNA interactions.	10

SUGGESTED READINGS:

1. Alon, U. (2019) An Introduction to Systems Biology 2nd edition, CRC, Taylor & Francis.
2. Jenny Gu, J. and Bourne, P.E.(2011) Structural Bioinformatics 2nd edition, Wiley Blackwell.
3. Harren Jhoti, H. & Leach, A. (2007) Structure-based Drug Discovery, Springer.
4. Kitano, H. (2001) Foundations of Systems Biology, MIT press Cambridge.

SuggestedContinuousEvaluationMethods:	
TotalMarks:30	
One Mid Semester written Test (1x15):	15Marks
Project/Seminar/ Quiz / Presentation/ Assignment:	10Marks
Attendance & Conduct:	05Marks

Programme/Class: Certificate	**Year**:Third	**Semester**:Sixth
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Biology of Insecta	

Courseoutcomes:

By studying this course, students will be able to:

- better appreciate the diversity of insects.
- better understand the physiology of Insects which has made them the most successful animalsin terms of numbers and variety of species.
- get acquainted with the highly organized social life of insects.
- to make the students aware about the possible scope of the subject which includes research and applied aspects including entrepreneurial skill.

Credits: 3	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P:** 3-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	Introduction 4 hrs General features of Insects and their diversity; Classification of insects up to orders.	4
II	General Morphology of Insects 12 hrs Head: Eyes, Types of antennae, Mouth parts w.r.t. feeding habits; Thorax: wings- Typical structure of insect wing and its modifications, Types of Legs; Abdomen: Typical structure.	8
III	Physiology of Insects 18 hrs General aspects of the Integumentary (structure of integument and process of moulting), digestive, excretory, circulatory, respiratory, reproductive, and nervous system (using cockroach as the type representative); Metamorphosis: Types & hormonal control.	10
IV	Insect behaviour6 hrs Insect-Plant Interactions: Host-plant selection by phytophagous insects.	6
V	Insect behaviour6 hrs Insect-Plant Interactions: Host-plant selection by phytophagous insects.	6

SUGGESTED READINGS:

1. Snodgrass, R. E. Principles of Insect Morphology. Cornell Univ. Press, USA.
2. Borror, D. J., Triplehorn, C. A., and Johnson, N. F. Introduction to the Study of Insects. M Saunders College Publication, USA.

SuggestedContinuousEvaluationMethods: **TotalMarks:30** **One Mid Semester written Test (1x15)**: **Project/Seminar/ Quiz / Presentation/ Assignment**: **Attendance & Conduct**:	 15Marks 10Marks 05Marks

Programme/Class: Certificate	**Year**:Third	**Semester**:Sixth
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Basics of Neuroscience / INT-I	

Courseoutcomes:

By studying this course, students will be able to:

- understand the fundamentals of neuroscience, key concepts, and the relationship between the nervous system and behaviour/cognition.
- comprehend the neural basis of sleep, emotions, learning and memory and related aspects of cognition.
- have a detailed understanding of how different neuroimaging techniques are used to assess brain function and explore questions in clinical and behavioural neuroscience.
- explore potential developments to current research, design, execute and communicate a substantive research project in the field of neuroscience or its application.

Credits: 3	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P:** 3-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	**Introduction to Nervous System** 6 hrs Origins of Neuroscience; Neuron doctrine; Classification of the nervous system. Structure of the Brain 5 hrs Gross anatomy of the human brain, Meninges, ventricular System, Blood-brain Barrier, Cranial nerves.	6
II	**Cellular and Molecular Neurobiology** 10 hrs Classification of neurons; Structure of prototypical neuron; Electrophysiology of membrane potentials-resting and action potentials, generation, and propagation; Ion Channels and Membrane Ion Currents; Types of Synapses, synaptic transmission and integration; Post synaptic potentials - EPSPs and IPSPs; tripartite synapse.	8
III	**Neurotransmitters** 4 hrs Types of neurotransmitters; transmitter-gated channels; neurotransmitter receptors Ionotropic and metabotropic receptors; G-protein coupled receptors and effectors	6
IV	**Cognitive and Behavioural Neuroscience** 10 hrs Neurobiology of visual perception; Molecular basis of learning and memory: Classification ofmemory, amnesia, case of H.M. (Henry Malaison); Synaptic plasticity, Long-term potentiation (LTP), Long-term depression (LTD); Memory consolidation.	6
V	**Neurophysiology of Sleep** 4 hrs Neurophysiology of sleep and wakefulness, electroencephalogram rhythms (EEG). **Neuroimaging and Neuropathology** 6 hrs Computed Tomography Scan (CT), Magnetic Resonance Imaging (MRI), functional Magnetic Resonance Imaging (fMRI), Positron Emission Tomography (PET); Neurological disorders (in brief)- Epilepsy, Schizophrenia; Aetiology and Molecular pathogenesis - Parkinson's, Alzheimer's.	10

SUGGESTED READINGS:

1. Carter, R. (2014). The Human Brain Book. D. K. Publishers.
2. Stephan M. Stahl (2000) Essential Psychopharmacology- Neuroscientific Basis and Practical Applications. II Edition. Cambridge University Press.
3. Ramachandran, V. S. and Blakeslee, S. (1998). Phantoms in the Brain: Probing the Mysteries of the Human Mind. William Morrow, New York.

SuggestedContinuousEvaluationMethods: **TotalMarks:30** **One Mid Semester written Test (1x15)**: **Project/Seminar/ Quiz / Presentation/ Assignment**: **Attendance & Conduct**:	 15Marks 10Marks 05Marks

Programme/Class: Certificate	**Year**:Fourth	**Semester**:Seventh
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Toxicology	

Courseoutcomes:

By studying this course, students will be able to:

- acquire in-depth knowledge of the principles of toxicology, exposure and dose- response assessment.
- use technical and analytical skills to quantify the level and effect of xenobiotics on environment.
- better understand the mechanism of action and effects of toxic chemicals at multiple levels of biological organization.
- identify relationship between chemical exposure and its effect on physiological system.
- perform, analyse and interpret technical aspects and experimental approaches for toxicological research testing and risk assessment.

Credits: 3	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P:** 4-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	Principles of Toxicology 8 hrs History and scope of toxicology, nature and classification of toxins, mechanism of toxicity, risk assessment-animal bioassays, dose-response assessment.	6
II	Toxicokinetics: 10 hrs Transportation, absorption, distribution, metabolism and excretion of toxins, enzyme mediated biotransformation (hydrolysis, reduction, oxidation, conjugation), and toxicokinetics (one-and two-compartment, elimination, clearance, saturation).	8
III	Applied Toxicology 20 hrs Environmental Toxicology: Ecotoxicology, Food, Agrochemical and Industrial Toxicology- Fertilizers and pesticide toxicology, radioactive toxicity. Medical, and Forensic Toxicology: toxicity, Poisons: definition, classification of poisons, types of poisoning, mode of action, antidotes & factors modifying the action of poisons, Nanotoxicology, Carcinogens, Immunotoxicity. Developmental and Occupational Toxicity: span of exposures and standards, dose determination, diseases/ ailments, risk evaluation.	10
IV	Tools and Techniques in Toxicology:4 hrs Instruments (Chromatography- TLC, GLC, HPLC), Soxhlet apparatus, flash evaporator, Lyophilization	6
V	Regulatory Units 3 hrs Role of institutes viz. EPA (Environmental Protection Agency), TERI, CSE (Center for science and environment) and CPCB, FAO, European union norms etc.	8

SUGGESTED READINGS:

1. Pani, B (2019). Textbook of Toxicology, Dreamtech press.
2. Gad, S. C. (2018). Regulatory Toxicology, III edition, CRC press, Taylor and Francis Group.
3. Casarett & Doull's Essentials of Toxicology (2015), III Edition, A & L Lange Series.
4. Pandey, G. and Sahni, Y. (2013) Toxicology Laboratory manual. International E- Publication.
5. Freifelder, D. (1999). Physical Biochemistry: Applications to Biochemistry and Molecular Biology, Second Edition, W. H. Freeman and Company.

SuggestedContinuousEvaluationMethods: **TotalMarks:30**	
One Mid Semester written Test (1x15):	15Marks
Project/Seminar/ Quiz / Presentation/ Assignment:	10Marks
Attendance & Conduct:	05Marks

Programme/Class: Certificate	**Year**:Fourth	**Semester**:Eighth
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Reproductive Biology and Assisted Reproductive Technology (ART)	

Courseoutcomes:

By studying this course, students will be able to:

- get an in-depth understanding of morphology, anatomy, and histology of male and female reproductive organs.
- know different processes in reproduction starting from germ cell formation to fertilization and consequent pregnancy, parturition, and lactation.
- compare estrous and menstrual cycles and their hormonal regulation.
- comprehend the interplay of various hormones in the functioning and regulation of the male and female reproductive systems.
- know about the diagnosis and management of infertility, including the latest methods, technologies, and infrastructure in assisted reproduction.
- better understand the modern methods of contraception and their use in family planning strategies.
- translate their understanding into the development of products like non-hormonal contraceptives; contribute to drug discovery programs as well as neonatal andmaternal health programmes and work with family planning teams to understand the needs and preferences of individuals belonging to lower socioeconomic groups.

Credits: 3	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P:** 4-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	Reproductive Endocrinology 8 hrs Hypothalamo–hypophyseal–gonadal axis; Regulation of gonadotropins and gonadal steroids secretion in male and female; Steroidogenesis; Mechanism of action of hormones related to reproduction.	8
II	Male Reproductive System 9 hrs Anatomy of the male reproductive system: Testis, epididymis, vas deferens, prostate gland, seminal vesicle; Spermatogenesis and its regulation; Sperm transport and maturation in the male genital tract.	8
III	Female Reproductive System 12 hrs Anatomy of the female reproductive system: Ovary, fallopian tubes/oviducts, uterus, cervix, and vagina; Folliculogenesis; Oocyte maturation and ovulation; Menstrual cycle and its hormonal regulation. Lactation and its regulation.	10
IV	Fertilization 8 hrs Fertilization; Implantation; Feto-placental unit; Hormonal regulation of gestation; Parturition and its hormonal regulation;	6
V	Reproduction 8 hrs Modern contraceptive methods; Infertility in males and females- causes and diagnosis Assisted Reproductive Technologies (ART): sperm banks, IVF, frozen embryos, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST. Ethical issues in ART.	8

SUGGESTED READINGS:

1. Johnson, M.H. and Everitt, B.J. (2018) Essential reproduction. IV Edition, London, Blackwell Science.
2. Jones, R.E. and Lopez, K.H. (2014) Human Reproductive Biology. IV Edition, Elsevier.
3. Franklyn F. Bolander (2012) Molecular Endocrinology. III Edition, USA, Academic Press.
4. De-Groot, L.J. and Jameson, J.L. (eds) (2001) Endocrinology. W.B. Saunders and Company.

SuggestedContinuousEvaluationMethods: **TotalMarks:30** **One Mid Semester written Test (1x15)**: **Project/Seminar/ Quiz / Presentation/ Assignment**: **Attendance & Conduct**:	 15Marks 10Marks 05Marks

Detailed Syllabus

Multidisciplinary Course (MDC)

Programme/Class: Certificate	**Year**:First	**Semester**:First
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Introduction to Biology	

Courseoutcomes:

By studying this course, students will be able to

- learn the importance of Biology in everyday life, understand the conditions and processes that led to biochemical origin of life on earth.
- compare and contrast evolutionary theory and their application to populations.
- appreciate the different cell types and cellular processes.
- know the basic structure and functioning of cell such as division, processes of information transfer from DNA to proteins.
- have an in-depth understanding of the role and importance various biomolecules like nucleic acids, proteins, lipids and carbohydrates.
- demonstrate practical knowledge of using basic laboratory instrumentation such as microscopes, micropipettes and their applications.
- learn the diverse techniques taught in practical like chromatography, biochemical test, spectrophotometric analysis and also computational biology will hone their analytical skills.

Credits: 3	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P:** 3-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	Introduction to concepts of biology 2 hrs Themes in the study of biology; a closer look at ecosystem; a closer look at cell; process of science, biology and everyday life.	4
II	Evolutionary history of biological diversity 4 hrs Early earth and the origin of life; major events in the history of life; classifying the diversity of various Kingdoms of Life.	8
III	Darwinian view of life and origin of species 9 hrs Darwin's theory of evolution; evolution of populations (Hardy-Weinberg principle); Concepts of species; mechanism of speciation.	8
IV	Genetic approach to Biology 7 hrs Cell and organelles; cell cycle: Mitosis and meiosis; Mendel's laws and variations; model organisms for the genetic analysis.	6
V	Chemical context of living systems 8 hrs Structure and function of biomolecules: carbohydrate, protein, lipid, and nucleic acid.	6

SUGGESTED READINGS:

1. Campbell, N.A. and Reece, J. B.(2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.
2. Raven, P. Hetal (2006) Biology 7th edition Tata McGraw Hill Publications, New Delhi
3. Karp, G. (2010). Cell & Molecular Biology: Concepts & Experiments. VI edition, John Wiley& Sons Inc.
4. De Roberties, E.D.P. & De Roberties. E.M.F. (2009). The cell & Molecular Biology, Lippincott Williams, Wilkins, Philadelphia.
5. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition, John Wiley & Sons Inc.

SuggestedContinuousEvaluationMethods: **TotalMarks:30** **One Mid Semester written Test (1x15)**: **Project/Seminar/ Quiz / Presentation/ Assignment**:	 15Marks 10Marks

Attendance & Conduct:	05Marks

Programme/Class: Certificate	**Year**:First	**Semester**:Second
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Lifestyle Disorders	

Courseoutcomes:

By studying this course, students will be able to

- have a better understanding of lifestyle choices and the diseases associated with them.
- have an in-depth understanding of making better lifestyle decisions.
- learn about various techniques for preliminary diagnosis of lifestyle disorders

Credits: 3	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P:** 3-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	Introduction to Lifestyle 05 Hours Traditional Indian lifestyle vs modern Indian lifestyle, lifestyle diseases – definition, risk factors- erratic sleep patterns, wrong food choices, smoking, alcohol abuse, stress, lack of optimum physical activity, illicit drug use, Obesity, respiratory diseases, diet and exercise.	8
II	Diabetes and Obesity 05 Hours Types of Diabetes mellitus; Blood glucose regulation; Complications of diabetes-paediatric and adolescent obesity-weight control and BMI (Body Mass Index), Prediabetes, PCOS/PCOD.	8
III	Cardiovascular Diseases 06 Hours Coronary atherosclerosis-Coronary artery disease, Causes-Fat and lipid, Alcohol Abuse-Diagnosis, Electrocardiograph, Echocardiograph, Treatment, Exercise and Cardiac rehabilitation.	8
IV	Cancer 05 Hours Introduction to Cancer and general diagnostic methods to detect cancer; Lung Cancer, Mouth Cancer: associated lifestyle choices, symptoms and treatment. Hypertension 04 Hours Risk factors, complications (brain, heart, eye and kidney) and management of hypertension.	6
V	WHO Global action plan and Monitoring 05 Hours WHO Global action plan and Monitoring framework for prevention and control of non-communicable diseases, NPHCE (National Programme for the Health Care of Elderly), Fit India movement (Yoga and meditation).	10

SUGGESTED READINGS:

1. James M.R, Lifestyle Medicine, 2nd Edition, CRC Press,2013,
2. Tortora, G.J. and Grabowski, S. (2006). Principles of Anatomy & Physiology. XI edition. John Wiley & Sons
3. Cooper, G.M., Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition, ASM Press and Sinauer Associate

SuggestedContinuousEvaluationMethods: **TotalMarks:30** **One Mid Semester written Test (1x15)**: **Project/Seminar/ Quiz / Presentation/ Assignment**: **Attendance & Conduct**:	 15Marks 10Marks 05Marks

Programme/Class: Certificate	**Year**:Second	**Semester**:Third
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Insect Vector and Disease	

Courseoutcomes:

By studying this course, students will be able to

- identify different insects and classify them based on their morphology and behaviour.
- describe the host-pathogen relationships and the role of the host reservoir on transmission of parasite.
- explain various modes of transmission of parasite by insect vectors.
- recognize various possible modern tools and methodologies for laboratory diagnosis, surveillance and treatment of diseases.
- develop a critical understanding of insect transmitted diseases such as Zoonotic, Vertical and Horizontal transmission, host specificity etc.
- spread awareness on public health programs about insect borne diseases and their control.
- To use advanced management strategies in disease control with respect to parasite evolution

Credits: 3	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P:** 3-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	Introduction to Insects 8 hrs General Features of Insects, Classification of insects up to Orders- General features of orders, Morphological features: Head, legs and types of antennae. Types of Insects mouth parts w.r.t. feeding habits: siphoning type (butterfly), sponging type (housefly), biting and chewing type (cockroach), piercing and sucking type (mosquito), chewing and lapping type (honey bee).	10
II	Concept of Vectors 5 hrs Brief introduction to carriers and vectors (mechanical and biological vector); Insect reservoirs; Host-vector relationship; Vectorial capacity; Host Specificity; Modes of disease transmission - vertical and horizontal transmission. Insects as vectors: General adaptations in insects to act as vectors.	8
III	Dipterans as disease Vectors-I 7 hrs Dipterans as important insect vectors–Mosquitoes. Study of mosquito borne diseases– Malaria, Dengue, Chikungunya, Filariasis, Viral encephalitis. Control and prevention/cure of diseases caused by mosquitoes. Study of sand fly-borne diseases- Visceral Leishmaniasis, Cutaneous Leishmaniasis; Control of Sand fly; Study of house fly as important mechanical vector, Control of house fly.	10
IV	Siphonapterans as disease vectors 5 hrs Fleas as insect vectors; Study of flea borne diseases – Plague, typhus fever; Control and prevention/cure of diseases caused by fleas.	6
V	Siphunculata as disease vectors 5 hrs Human louse (head, body and pubic louse) as disease vectors; study of louse borne diseases – Typhus fever, relapsing fever, vagabond's disease, phthiriasis; Control of human louse and prevention/cure of diseases caused by them.	8

SUGGESTED READINGS:

1. Mullen and Darden (2009) Medical and Veterinary Entomology, 3rd Edition, Academic Press.
2. Service, M.W. (1980) A Guide to Medical Entomology, Macmillan Press.
3. Burgess, N.R.H and Cowan, G.O. (1993) A colour atlas of medical entomology. Springer Science and Business Media, B. V. House.

SuggestedContinuousEvaluationMethods: **TotalMarks:30** **One Mid Semester written Test (1x15)**: **Project/Seminar/ Quiz / Presentation/ Assignment**: **Attendance & Conduct**:	 15Marks 10Marks 05Marks

Detailed Syllabus

Skill Enhancement Course (SEC)

Programme/Class: Certificate	**Year**:First	**Semester**:First
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Apiculture	

By studying this course, students will be able to:

- develop an understanding of the beneficial higher and lower organisms in terms of economic prospective.
- aquatic organisms and agriculturally important insect pests based on their morphological characteristics/structures.
- develop a critical understanding of the contribution of organisms to the welfare of society.
- examine the diversity of insect pests of different orders in the agro-ecosystem and sustainable pest management strategies.

Credits: 3	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P:** 3-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	Biology of Bees 07 Classification and biology of Honey Bees, Social Organization of Bee colony	4
II	Rearing of Bees 10 Different species of Honeybee, types of beehives - Newton and Langstroth, Bee Keeping equipment, Methods of extraction of honey (Indigenous and Modern) and its processing.	8
III	Disease and Enemies 05 Bee Diseases and Enemies control and preventive measures	6
IV	Bee Economy 04 Products of apiculture industry (Honey, Bees Wax, Propolis, Royal jelly, Pollen etc.) and their uses.	8
V	Entrepreneurship in Apicultre 04 Bee-Keeping Industry-Recent efforts, Modern methods in employing artificial beehives for cross pollination in horticultural gardens	6

SUGGESTED READINGS:

1. Shukla, G.S. and Upadhyay, V.B.: Economic Zoology, 4e, 2002, Rastogi.
2. D. B. Tembhare. (2017) Modern Entomology. Published by Himalaya Publishing House (ISO 9001: 2008 Certified).
3. P.J. Prost, (1962) Apiculture, Oxford and IBH, New Delhi.
4. D.S. Bisht, Apiculture, ICAR Publication.

SuggestedContinuousEvaluationMethods: **TotalMarks:30** **One Mid Semester written Test (1x15)**: **Project/Seminar/ Quiz / Presentation/ Assignment**: **Attendance & Conduct**:	 15Marks 10Marks 05Marks

Programme/Class: Certificate	**Year**:First	**Semester**:Second
Subject:ZOOLOGY		
CourseCode:	**CourseTitle: PISCICULTURE**	

Courseoutcomes:

After successful completion of this course students will be able to:-

1. Illustrate the types of fishes, aquaculture systems and integrated farming systems.
2. Understand the biology and rearing of different fishes.
3. Understand the entrepreneurship in pisciculture.

Credits: 3	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P:** 3-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	Introduction: Present status, hindrances / problems / constraints and prospects for fish farming in global and Indian perspective. Development process, different supports and driving factors for production enhancement.	4
II	Aquaculture systems: Extensive, semi-intensive and intensive culture of fish. Partitioned aquaculture systems: raceways, tanks, flow-through systems polyculture, and composite fish culture. Cages and enclosure. Peri-urban aquaculture systems: aquaponics, RAS, flowthrough systems, bio-floc technology and land based aquaculture systems.	8
III	Aquaculture practices for cultivable species: carps, catfish, snakeheads, feather backs, tilapia, mahseer, trouts. Grow out practices: pre stocking, post stocking management, harvesting and BMP. Other alternative species for high production. Species selection and crop planning. Economics of different fish farming Systems.	10
IV	Integrated farming systems: Design, farming practices, constraints and economics of IFS of fish with vegetables, fodder, paddy, cattle, pig, poultry, duck, rabbit and quail. IMTA, Freshwater pearl culture, multi-level integrated system. Resource utilization and conversion of waste to wealth.	6
V	Wastewater-fed aquaculture: Water treatment methods, species selection, culture practices,harvesting and depuration process. Merits and demerits of wastewater fed aquaculture systems. Pre-requisites and precautions to be taken in the technology adoption.	6

SUGGESTED READINGS:

1. AAHRI. 1998. Health Management in Shrimp Ponds. Aquatic Animal Health Research Institute (AAHRI), Department of Fisheries, Thailand.
2. Agarwal SC. 2008. A Handbook of Fish Farming. 2nd Ed. Narendra Publ. House.
3. Beveridge MCM & Mc Andrew BJ. 2000. Tilapias: Biology and Exploitations. Kluwer.
4. De Silva SS. (Ed.). 2001. Reservoir and Culture Based Fisheries: Biology and Management. ACAIR Proceedings.
5. Midlen & Redding TA. 1998. Environmental Management for Aquaculture. Kluwer.
6. Pillay TVR. 1990. Aquaculture: Principles and Practices. Fishing News Books, Cambridge University Press, Cambridge.
7. Venugopal S. 2005. Aquaculture. Pointer Publ.
8. Welcomme RL. 2001. Inland Fisheries: Ecology and Management. Fishing News Books.

SuggestedContinuousEvaluationMethods:	
TotalMarks:30	
One Mid Semester written Test (1x15):	15Marks
Project/Seminar/ Quiz / Presentation/ Assignment:	10Marks 05Marks

Attendance & Conduct:	

Programme/Class: Certificate	**Year**:Second	**Semester**:Third
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Sericulture	

Courseoutcomes:

By studying this course, students will be able to:

- Illustrate the types of silkworms, exotic and indigenous races and mulberry and non-mulberry sericulture.
- better understand the modern methods of the rearing of silkworms.
- get an in-depth understanding of the entrepreneurship in sericulture.

Credits: 3	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P:** 3-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	Introduction 5 Sericulture: Definition, history and present status; Silk route Types of silkworms, Distribution and Races Exotic and indigenous races Mulberry and non-mulberry Sericulture	6
II	Biology of Silkworm 4 Life cycle of Bombyx mori Structure of silk gland and secretion of silk	8
III	Rearing of Silkworms 10 Selection of mulberry variety and establishment of mulberry garden Rearing house and rearing appliances Disinfectants: Formalin, bleaching powder, RKO Silkworm rearing technology: Early age and Late age rearing Types of mountages Spinning, harvesting and storage of cocoons	10
IV	Pests and Diseases 7 Pests of silkworm: Uzi fly, dermestid beetles and vertebrates Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial Control and prevention of pests and diseases	6
V	Entrepreneurship in Sericulture 4 Prospectus of Sericulture in India: Sericulture industry in different states, employment, potential in mulberry and non-mulberry sericulture. Visit to various sericulture centres.	8

SUGGESTED READINGS:

1. Handbook of Practical Sericulture: S.R. Ullal and M.N. Narasimhanna CSB, Bangalore
2. Appropriate Sericultural Techniques; Ed. M. S. Jolly, Director, CSR & TI, Mysore.
3. Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, Fuzi Pub. Co. Ltd., Tokyo, Japan1972.
4. Manual of Silkworm Egg Production; M. N. Narasimhanna, CSB, Bangalore 1988.
5. Silkworm Rearing; Wupang—Chun and Chen Da-Chung, Pub. By FAO, Rome 1988.
6. A Guide for Bivoltine Sericulture; K. Sengupta, Director, CSR & TI, Mysore 1989.
7. Improved Method of Rearing Young age silkworm; S. Krishnaswamy, reprinted CSB, Bangalore, 1986.

SuggestedContinuousEvaluationMethods: **TotalMarks:30**	
One Mid Semester written Test (1x15):	15Marks
Project/Seminar/ Quiz / Presentation/ Assignment:	10Marks
Attendance & Conduct:	05Marks

Detailed Syllabus

Value Added Courses (VAC)

Programme/Class: Certificate	**Year**:First	**Semester**:Second
Subject:ZOOLOGY		
CourseCode:	**CourseTitle**:Aquarium and Fish Keeping	

Courseoutcomes:

By studying this course, students will be able to:

- developanunderstandingofthebeneficialhigherandlowerorganismsintermsofeconomicprospective.
- aquaticorganismsandagriculturallyimportantinsectpestsbasedontheirmorphologicalcharacteristics/structures.
- develop a critical understanding of the contribution of organisms to the welfare of society.

Credits: 3	**Core:** Compulsory
Max.Marks:30+70=100	**Min.Passing Marks:** 45

TotalNo.ofLectures-Tutorials-Practical (inhoursperweek):**L-T-P:** 3-1-0

Unit	Topics	TotalNo.of Lectures(60)
I	Aquaculture 05 Hours Definition, scope, and significance of Aquaculture, Prawn culture, Pearl culture, Edible Oyster culture.	6
II	Pisciculture 07 Hours Basic concept on mono and composite fish culture (Carp culture); Fish diseases caused by Ichthyophthirius multifilis, Trichodinia sp. and Ichthyobodo sp., symptoms and control; Maintenance of aquarium.	8
III	Fish Processing Technology 05 Methods of preservation of fish (chilling, freezing, quick freezing, salting, drying, freeze drying, smoking, canning), Rigor mortis in fish, fish spoilage-bacteria & chemical.	6
IV	Fish nutrition & feed Technology 06 Feed formulation strategies & methods, types of feed & their ingredients, Formulation of feed for larvae, fry, fingerlings, adults & brood stock, formulation of nutritionally balanced & cost-effective diets.	10
V	Fish Transport & Marketing 04 Handling and transportation of fresh water fish, whole sale and retail markets, fisheries cooperatives.	6

SUGGESTED READINGS:

1. Dawes, J. A. (1984) The Freshwater Aquarium, Roberts Royee Ltd. London.
2. S.S. Khanna & H.R. Singh. A Textbook of Fish Biology & Fisheries Published by Narendra Publishing House.3rdEdition. (ISBN13: 9789384337124)

SuggestedContinuousEvaluationMethods: **TotalMarks:30** **One Mid Semester written Test (1x15)**: **Project/Seminar/ Quiz / Presentation/ Assignment**: **Attendance & Conduct**:	 15Marks 10Marks 05Marks

COURSE NAME: Heredity Disorder **COURSE CODE: VAC-Z-005**

Credits = 03 **Total Hours= 16**

Course Objectives: This paper is aimed to introducing the students for genetics and various genetic disorders and their possible treatment.

Course Content:

Module-I:

Mendelian principles:– Dominance, segregation, independent assortment, deviations from Mendelian inheritance.

Chromosomes:- Structural and numerical alterations of chromosomes, Molecular anatomy of eukaryotic, heterochromatin and euchromatin, giant chromosomes, polytene and lambrush chromosomes, sex chromosomes

Module-II:

Genetic disorders:- chromosomal disorders. Inborn errors of metabolism. Tay-sachs disease, albinism, phenylketonuria. Lesch-nvhan syndrome.

Pedigree analysis:- Pedigree introduction and pedigree analysis of some human inherited traits.

Module-III:

Mutations:- Types of gene mutations (Classification), Types of chromosomal aberrations (Classification, figures and with one suitable example of each), Molecular basis of mutations in relation to UV light and chemical mutagens; Detection of mutations: CLB method, attached X method.

Suggested Literature:

1. Principles of Genetics, Snustad and Simmons, John Wiley & Sons, USA [Latest edition].

2. Modern Genetic Analysis: Integrating Genes and Genomes, Griffiths, J.F., Gilbert,

M., Lewontin, C. and Miller, W. H. Freeman and Company, New York, USA [Latest edition]

3. Genetics, J. Russell, Benjamin-Cummings Publishing Company, San Francisco, California, USA [Latest edition]