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List of Employability/ Entrepreneurship/ Skill Development Courses with Course Contents

Colour Codes		
Employability Contents	Green	
Entrepreneurship Contents	Light Blue	
Skill Development Contents	Pink	
Name of the Subjects/Related to all three Components (Employability/ Entrepreneurship/ Skill Development)	Yellow	



**List of Courses Focus on Employability/ Entrepreneurship/
Skill Development**

Department : Zoology

Programme Name : B. Sc

Academic Year : 2021-22

List of Courses Focus on Employability/ Entrepreneurship/Skill Development

Sr. No.	Course Code	Name of the Course
1.	ZOUATG1	Exploring the brain: Structure and Function
2.	ZOUALG1	Lab course
3.	AEC I	Human Health and Sex Education
4.	SEC I	Aquaculture
5.	ZOUBTT2	Cell Biology and Histology
6.	ZOUBLT2	Lab course
7.	ZOUBTG1	Vectors, Diseases and Management
8.	ZOUBLG1	Lab course
9.	AEC II	Human Nutrition
10.	SEC II	Sericulture
11.	LS/ZOO/CC-301 L	Diversity of Chordates
12.	LS/ZOO/CC-301 P	Lab Course
13.	LS/ZOO/CC-302 L	Physiology: Controlling and Coordinating Systems
14.	LS/ZOO/CC-302 P	Lab Course
15.	LS/ZOO/CC-303 L	Fundamentals of Biochemistry
16.	LS/ZOO/CC-303 P	Lab Course
17.	LS/ZOO/GE-301 P	Food Nutrition and Health
18.	LS/ZOO/GE-302 L	Lab Course
19.	LS/ZOO/SEC-301 P	Sericulture
20.	LS/ZOO/SEC-302 L	Lab Course
21.	LS/ZOO/CC-401 L	Comparative Anatomy of Vertebrates
22.	LS/ZOO/CC-401 P	Lab Course
23.	LS/ZOO/CC-402 L	Physiology: Life Sustaining Systems

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Guru Ghasidas Vishwavidyalaya, Bilaspur



24.	LS/ZOO/CC-402 P	Lab Course
25.	LS/ZOO/CC-403 L	Biochemistry of Metabolic Processes
26.	LS/ZOO/CC-403 P	Lab Course
27.	LS/ZOO/GE-401 P	Insect Vectors and Diseases
28.	LS/ZOO/GE-402 L	Lab Course
29.	LS/ZOO/SEC-401 P	Medical Diagnostics
30.	LS/ZOO/SEC-402 L	Lab Course
31.	LS/ZOO/CC-501 L	Molecular Biology
32.	LS/ZOO/CC-501 P	Lab Course
33.	LS/ZOO/CC-502 L	Principles of Genetics
34.	LS/ZOO/CC-502 P	Lab Course
35.	LS/ZOO/DSE-501 (B) L	Endocrinology
36.	LS/ZOO/DSE-501 (B) P	Lab Course
37.	LS/ZOO/DSE-502 (C) L	Reproductive Biology
38.	LS/ZOO/DSE-502 (C) P	Lab Course
39.	LS/ZOO/CC-601 L	Developmental Biology
40.	LS/ZOO/CC-601 P	Lab Course
41.	LS/ZOO/CC-602 L	Evolutionary Biology
42.	LS/ZOO/CC-602 P	Lab Course
43.	LS/ZOO/DSE-601 (A) L	Biology of Insecta
44.	LS/ZOO/DSE-601 (A) P	Lab Course
45.	LS/ZOO/DSE-601 (B) L	Fish and Fisheries
46.	LS/ZOO/DSE-601 (B) P	Lab Course

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Scheme and Syllabus

B.Sc. Hon's (Zoology): LOCF 2021-2022

Department of Zoology, School of Life Sciences

Course Offered	Course Code	Name of the course	Credit	Hour/ week	Internal Assess	End Sem Exam
Semester I						
CC-1 Theory	ZOUATT1	Systematics and Diversity of Life- Protists to Chordates	3	3	30	70
CC-1 Practical	ZOUATL1	Lab Course	2	4	30	70
CC-2 Theory	ZOUATT2	Developmental Biology and Evolution	3	3	30	70
CC-2 Practical	ZOUALT2	Lab Course	2	4	30	70
GEC-1 Theory	ZOUATG1	Exploring the Brain: Structure and Function	3	3	30	70
GEC-1 Practical	ZOUALG1	Lab Course	2	4	30	70
AEC-1 Theory		To be drawn from the pool of AEC	1	1	30	70
AEC-1 Practical		To be drawn from the pool of AEC	1	2	30	70
SEC-1 Theory		To be drawn from the pool of SEC	1	1	30	70
SEC-1 Practical		To be drawn from the pool of SEC	1	2	30	70
		Additional Credit Course				
TOTAL			19	27	300	700
Semester II						
CC-3 Theory	ZOUBTT1	Comparative Anatomy and Physiology of Non Chordates	3	3	30	70
CC-3 Practical	ZOUBLT1	Lab Course	2	4	30	70
CC-4 Theory	ZOUBTT2	Cell Biology and Histology	3	3	30	70
CC-4 Practical	ZOUBLT2	Lab Course	2	4	30	70
GEC-2 Theory	ZOUBTG1	Vectors, Diseases and Management	3	3	30	70
GEC-2 Practical	ZOUBLG1	Lab Course	2	4	30	70
AEC-2 Theory		To be drawn from the pool of AEC	1	1	30	70
AEC-2 Practical		To be drawn from the pool of AEC	1	2	30	70
SEC-2 Theory		To be drawn from the pool of SEC	1	1	30	70
SEC-2 Practical		To be drawn from the pool of SEC	1	2	30	70
		Additional Credit Course				
Total			19	27	300	700
Semester III						
CC-5 Theory	ZOUCTT1	Comparative Anatomy and Physiology of Chordates	3	3	30	70
CC-5 Practical	ZOUCTL1	Lab Course	2	4	30	70
CC-6 Theory	ZOUCTT2	Genetics	3	3	30	70
CC-6 Practical	ZOUCTL2	Lab Course	2	4	30	70
CC-7 Theory	ZOUCTT3	Biochemistry	3	3	30	70
CC-7 Practical	ZOUCTL3	Lab Course	2	4	30	70
GEC-3 Theory	ZOUCTG1	Food, Nutrition and Health	3	3	30	70
GEC-3 Practical	ZOUCTL1	Lab Course	2	4	30	70
AEC-3 Theory		To be drawn from the pool of AEC	1	1	30	70
AEC-3 Practical		To be drawn from the pool of AEC	1	2	30	70
		Additional Credit Course				
Total			22	31	300	700
Semester IV						
CC-8 Theory	ZOUBTT1	Behaviour and Chronobiology	3	3	30	70
CC-8 Practical	ZOUBLT1	Lab Course	2	4	30	70
CC-9 Theory	ZOUBTT2	Ecology	3	3	30	70
CC-9 Practical	ZOUBLT2	Lab Course	2	4	30	70
CC-10 Theory	ZOUBTT3	Molecular Biology	3	3	30	70
CC-10 Practical	ZOUBLT3	Lab Course	2	4	30	70
GEC-4 Theory	ZOUBTG1	Global Environmental Issues	3	3	30	70
GEC-4 Practical	ZOUBLG1	Lab Course	2	4	30	70
AEC-4 Theory		To be drawn from the pool of AEC	1	1	30	70
AEC-4 Practical		To be drawn from the pool of AEC	1	2	30	70
		Additional Credit Course				
TOTAL			22	31	300	700
		Summer Internship*	6	90*	30	70

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Semester-wise Theory Papers/ Practical: B.Sc. Hon's (Zoology)
Department of Zoology, School of Life Science

SEMESTER I						
Course Opted	Course Code	Name of the course	Credit	Hours/week	Internal Assessment	End Semester Exam.
Core Course-1 Theory	LS/ZOO/CC-101 L	Non Chordates - I (Protista to Pteridophyta)	4	4	30 (15+15)	70
Core Course-1 Practical	LS/ZOO/CC-101 P	Lab Course	2	4	30 (15+15)	70
Core Course-2 Theory	LS/ZOO/CC-102 L	Principles of Ecology	4	4	30 (15+15)	70
Core Course-2 Practical	LS/ZOO/CC-102 P	Lab Course	2	4	30 (15+15)	70
Generic Elective-1 Theory	LS/ZOO/GE-101 L	Aquatic Biology	4	4	30 (15+15)	70
Generic Elective-1 Practical	LS/ZOO/GE-101 P	Lab Course	2	4	30 (15+15)	70
Ability Enhancement Compulsory Course-1 Extracurricular Activity	LS/ZOO/AE-101/EC	English Communication / Hindi Communication Tour/ Field visit/ Industrial training/ NSS/ Swachhita/ Vocational Training/ Sports/ others	4*	4	30 (15+15)	70
TOTAL			24	28	30	70
SEMESTER II						
Core Course-3 Theory	LS/ZOO/CC-201 L	Non Chordates - II (Coelomates)	4	4	30 (15+15)	70
Core Course-3 Practical	LS/ZOO/CC-201 P	Lab Course	2	4	30 (15+15)	70
Core Course-4 Theory	LS/ZOO/CC-202 L	Cell Biology	4	4	30 (15+15)	70
Core Course-4 Practical	LS/ZOO/CC-202 P	Lab Course	2	4	30 (15+15)	70
Generic Elective-2 Theory	LS/ZOO/GE-201 L	Environment and Public Health	4	4	30 (15+15)	70
Generic Elective-2 Practical	LS/ZOO/GE-201 P	Lab Course	2	4	30 (15+15)	70
Ability Enhancement Compulsory Course-2 Extracurricular Activity	LS/ZOO/AE-201/ES	Environmental Science Tour/ Field visit/ Industrial training/ NSS/ Swachhita/ Vocational Training/ Sports/ others	4*	4	30 (15+15)	70
TOTAL			24	28	30	70
Summer Internship: 15 days		Swayam Swachhita / NSS / Industrial/ others	2	6h/day	-	100
SEMESTER III						
Core Course-5 Theory	LS/ZOO/CC-301 L	Diversity of chordates	4	4	30 (15+15)	70
Core Course-5 Practical	LS/ZOO/CC-301 P	Lab Course	2	4	30 (15+15)	70
Core Course-6 Theory	LS/ZOO/CC-302 L	Physiology, Controlling and Coordinating systems	4	4	30 (15+15)	70
Core Course-6 Practical	LS/ZOO/CC-302 P	Lab Course	2	4	30 (15+15)	70
Core Course-7 Theory	LS/ZOO/CC-303 L	Fundamentals of Bio-chemistry	4	4	30 (15+15)	70

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Core Course-7 Practical	LS/ZOO/CC-303 P	Lab Course	2	4	30 (15+15)	70
Generic Elective-3 Theory	LS/ZOO/GE-301 L	Food Nutrition and Health	4	4	30 (15+15)	70
Generic Elective-3 Practical	LS/ZOO/GE-301 P	Lab Course	2	4	30 (15+15)	70
Skill Enhancement Course-1	LS/ZOO/SEC-301 L	Statistics	2	2	30 (15+15)	70
Skill Enhancement Course-1	LS/ZOO/SEC-301 P	Lab Course	2	4	30 (15+15)	70
TOTAL			18	34	30	70
SEMESTER IV						
Core Course-8 Theory	LS/ZOO/CC-401 L	Comparative anatomy of vertebrates	4	4	30 (15+15)	70
Core Course-8 Practical	LS/ZOO/CC-401 P	Lab Course	2	4	30 (15+15)	70
Core Course-9 Theory	LS/ZOO/CC-402 L	Physiology: Life Sustaining Systems	4	4	30 (15+15)	70
Core Course-9 Practical	LS/ZOO/CC-402 P	Lab Course	2	4	30 (15+15)	70
Core Course-10 Theory	LS/ZOO/CC-403 L	Biochemistry of Metabolic Processes	4	4	30 (15+15)	70
Core Course-10 Practical	LS/ZOO/CC-403 P	Lab Course	2	4	30 (15+15)	70
Generic Elective-4 Theory	LS/ZOO/GE-401 L	Insect Vectors and Diseases	4	4	30 (15+15)	70
Generic Elective-4 Practical	LS/ZOO/GE-401 P	Lab Course	2	4	30 (15+15)	70
Skill Enhancement Course-2	LS/ZOO/SE-401	Medical Diagnostics	2	2	30 (15+15)	70
Skill Enhancement Course-2	LS/ZOO/SE-401	Lab Course	2	4	30 (15+15)	70
TOTAL			28	34	30	70
Summer Internship: 15 days	Swayam Swachhita / NSS / Industrial/ others		2	60/day	-	100
SEMESTER V						
Core Course-11 Theory	LS/ZOO/CC-501 L	Molecular Biology	4	4	30 (15+15)	70
Core Course-11 Practical	LS/ZOO/CC-501 P	Lab Course	2	4	30 (15+15)	70
Core Course-12 Theory	LS/ZOO/CC-502 L	Principles of Genetics	4	4	30 (15+15)	70
Core Course-12 Practical	LS/ZOO/CC-502 P	Lab Course	2	4	30 (15+15)	70
Discipline Specific Elective-1 Theory	LS/ZOO/DSE-501(A) L	*A. Biology of Insect (MOOCs)	4	4	30 (15+15)	70
	LS/ZOO/DSE-501(B) L	*B. Immunology (MOOCs)				
Discipline Specific Elective-1 Practical	LS/ZOO/DSE-501(A) P	Lab Course A	2	4	30 (15+15)	70
	LS/ZOO/DSE-501(B) P	Lab Course B				
Discipline Specific Elective-2 Theory	LS/ZOO/DSE-502(A) L	A. Basics of Neuroscience	4	4	30 (15+15)	70
	LS/ZOO/DSE-502(B) L	B. Reproductive Biology				
Discipline Specific Elective-2 Practical	LS/ZOO/DSE-502(A) P	Lab Course A	2	4	30 (15+15)	70
	LS/ZOO/DSE-502(B) P	Lab Course B				
TOTAL			24	32		

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Semester V				
Core Course-11 Theory	LS/ZOO/CC-501 L	Molecular Biology	4	4
Core Course-11 Practical	LS/ZOO/CC-501 P	Lab Course	2	4
Core Course-12 Theory	LS/ZOO/CC-502 L	Principles of Genetics	4	4
Core Course-12 Practical	LS/ZOO/CC-502 P	Lab Course	2	4
Discipline Specific Elective-1 Theory	LS/ZOO/DSE-501(A) L LS/ZOO/DSE-501(B) L LS/ZOO/DSE-501(C) L	A. Basics of Neuroscience B. Endocrinology C. Immunology	4	4
Discipline Specific Elective-1 Practical	LS/ZOO/DSE-501(A) P LS/ZOO/DSE-501(B) P LS/ZOO/DSE-501(C) P	Lab Course A Lab Course B Lab Course C	2	4
Discipline Specific Elective-2 Theory	LS/ZOO/DSE-502(A) L LS/ZOO/DSE-502(B) L LS/ZOO/DSE-502(C) L	A. Animal Behavior and Chemobiology B. Parasitology C. Reproductive Biology	4	4
Discipline Specific Elective-2 Practical	LS/ZOO/DSE-502(A) P LS/ZOO/DSE-502(B) P LS/ZOO/DSE-502(C) P	Lab Course A Lab Course B Lab Course C	2	4
TOTAL			24	32
Semester VI				
Core Course-13 Theory	LS/ZOO/CC-601 L	Developmental Biology	4	4
Core Course-13 Practical	LS/ZOO/CC-601 P	Lab Course	2	4
Core Course-14 Theory	LS/ZOO/CC-602 L	Evolutionary Biology	4	4
Core Course-14 Practical	LS/ZOO/CC-602 P	Lab Course	2	4
Discipline Specific Elective-3 Theory	LS/ZOO/DSE-601(A) L LS/ZOO/DSE-601(B) L LS/ZOO/DSE-601(C) L	A. Biology of Insects B. Fish and Fisheries C. Wild Life Conservation and Management	4	4
Discipline Specific Elective-3 Practical	LS/ZOO/DSE-601(A) P LS/ZOO/DSE-601(B) P LS/ZOO/DSE-601(C) P	Lab Course A Lab Course B Lab Course C	2	4
Dissertation/ Project work / Academic Visit followed by report submission and seminar	LS/ZOO/DW/PW/AV		5+1=6	8
TOTAL			24	32
TOTAL CREDITS			152 + 4 (SI)	

As per UOC CDCS guidelines, University / departments have liberty to offer GE and SEC courses offered by any department to students of other departments. The No. of GE course is four. One GE course is compulsory in first 4 semesters each. In present scheme it is proposed to have minimum two GE courses (from one subject) in first two semester after which student shall change two GE for another subject in IIIrd and IVth semester, so that all the student can have exposure of one additional subject.
(Subject to approval by the competent authority)

Changela External Expert
Dr. Rohit Seth 06/07/18
Dr. Santosh Singh 06/07/18
Moulik 06/07/18
Head of the Department

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Generic Elective Courses (GEC): ZOUATGI and ZOUALGI

Semester	Core Course	Course Title	Credits
I	GEC-I	Exploring the Brain: Structure and Function	Theory: 03 Practical: 02

About the course

The course provides an insight into the structure of brain, its associated functions, its gradual evolution with increased cranial capacity, mechanism of neurotransmission and the associated neurodegenerative disorders.

Learning outcomes

After successfully completing this course, the students will be able to understand:

- The early and current status of neuroscience.
- The structure of brain cells and their circuit.
- Evolution and adaptation of brain.
- Brain development, aging and imaging.
- Neurotransmitters and their action.
- The process of learning and memory.
- Different type of brain disorders.

Theory

UNIT I: Scope of Neuroscience, Brain structure

11 Lectures

Introduction to Neuroscience and its scope. Classical views and latest advances in Neuroscience. Brain cells, types: Neurons – types and structure; Glia- types and structure; Neuronal circuit.

UNIT II: Evolution and development of brain

12 Lectures

Evolution and Adaptation of Brain: Theories of brain evolution. Evolution of brain in vertebrates and associated behavioral adaptation. Organization and development of brain in human. Divisions of the brain. Structure-function relationship. Neuroimaging- CT and MRI.

UNIT III: Neurotransmitters and mechanism of neurotransmission

13 Lectures

Neurotransmitters and neurotransmission: Noradrenergic, serotonergic, dopaminergic and cholinergic system. Mechanism of neurotransmission and drug action. Learning and memory. Types, mechanism, disorders.

UNIT IV: Managing brain health

16 Lectures

Brain aging: Structural and chemical changes. Functional changes. Maintenance of healthy brain. Brain disorders: Neurodegenerative diseases- Epilepsy, Stroke, Alzheimer's, Parkinson's. Neuropsychiatric disorders- Anxiety, Depression, Mood disorders, Schizophrenia.

Recommended readings

1. Squire, L. et al. (2003) Fundamental Neuroscience, Academic Press.
2. Kandel, E. (2000) Principles of Neural Science, McGraw Hill

Practical

1. Dissection and study of chicken brain.
2. Observation and quantization of *Drosophila* behavior in response to food.
3. Experiments based on the course contents.

Group discussion or Seminar presentation on one or two related topics from the list.

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Ability Enhancement Course (AEC): A1

Semester	Core Course	Course Title	Credits
I-V	AEC-I	Human Health and Sex Education	Theory: 01, Practical: 01

About the course

The course is designed to address problems associated with health and sex thereby, promoting fitness and well being.

Learning outcomes

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

- understand the importance of good health.
- observe clean sexual habits thereby warding off sexually transmitted diseases.

Theory

Unit I: Health: Physical and spiritual

Health as a state of wellbeing, health awareness, Physical health, immunization and vaccination, healthy food, balanced diet, food supplements, proper sleep, exercise and keeping away from stress, pathogens and pollution. Reproductive health, adolescence, senescence. Prevention from mental illness and disabilities, alcoholism, tobacco addiction, de-addiction, lifestyle diseases. Spiritual health, yoga and meditation.

Unit II: Human reproductive and developmental cycle

Human reproductive system: structural details of male reproductive system, semen, hormonal control. Female reproductive system- structure of ovary, puberty, reproductive cycles and hormonal control, gestation period, hysterectomy, menopause. Events of human reproduction: Gametogenesis- spermatogenesis and oogenesis, ovulation, fertilization, embryonic development, parturition.

Unit III: Infertility and assisted reproductive techniques

Human intervention in reproduction: Contraception and birth control-barrier method, hormonal methods, natural methods, sterilization, termination of pregnancy. Infertility-male and female infertility, causes and treatment for infertility. Advanced Reproductive Technologies- IVF, GIFT, ZIFT, Donor Insemination (DI). Sperm transfer techniques, Surrogacy.

Unit IV: Sex education and prevention from Sexually transmitted diseases

Sexually transmitted diseases: Syphilis, chlamydia, trichomoniasis, gonorrhoea, AIDS. Sex education: Adolescent sexual activity, teenage pregnancy, sexual harassment, sexual awareness and policies (legal aspects), lesbian and gay sex, bisexual, transgender youth, adolescent stress management

Recommended readings

1. Kothari P. (1994) Common sexual problems and solutions by, LBS Publishers and Distributors Ltd.
2. Hadley, Mac. E., (2004) Endocrinology, (5th edition) Pearson Education, Singapore.
3. Taylor, D.J., Green, N.P.O., Stout G. W. (2005) Biological Science, (Editor R. Soper) 3rd Edition, Cambridge University Press.
4. The Complete Manual of Fitness and Well-being, The Reader's Digest Association, Inc. Pleasantville, New York / Montreal.
5. Guyton, A.C. and Hall, J.E., Textbook of Medical Physiology.

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Skill Enhancement Course (SEC): L1

Semester	Core Course	Course Title	Credits
I-II	SEC-I	Aquaculture	Theory: 01, Practical: 01

About the course

This course will give the students an understanding of the principles of aquaculture, including production systems, water quality, nutrition, spawning, larval culture and culture methodologies with special reference to fish, and prawn. The course will include an opportunity to conduct hands-on activities related to culture and husbandry of animals.

Learning outcomes

- After completing this course the learners will be able to
- .. Understand the aquaculture systems
 - .. Understand conditioning factors and how they can be manipulated
 - .. Describe water depuration mechanisms
 - .. Understand the environmental impacts of aquaculture

Theory

Unit I: Freshwater aquaculture systems

Aquaculture concept, Culture systems: Freshwater prawn culture, fish culture in paddy fields, Brackish water culture, Mariculture: Oyster culture, Crab culture, Lobster culture, mussel culture, culture of Tels, Culture of aquatic weeds. Composite fish culture: Definition and various patterns, Mixed fish farming in India. Techniques of composite culture. Culture of buffalo fish ..Culture of Catfishes. Culture of miscellaneous fishes. Cray fish culture.

Unit II: Preparation and management of fish culture ponds

Nursery ponds. Predatory and Weed fishes and their control. Fish toxicants. Fertilization. Aquatic insects and their control. Fish food organisms and their production. Supplementary feeding. Transport of fish seed and Brood fish. Causes of mortality in transport. Methods for packaging and transport. Open systems. Closed systems. Use of chemicals in live fish transport. Anesthetic drugs. Antiseptics and Antibiotics.

Unit III: Fish pathology

Parasitic infections, Fungus infections, Protozoan diseases, saryodata, Worm diseases. Non parasitic diseases. Rearing ponds, Stocking ponds. Fish breeding: Natural and artificial. Harvesting: Fishing techniques, preservation & processing of fish, Fresh water prawn culture, Introduction. Breeding characteristics. Juvenile prawn migration. Seasonal & regional distribution of seeds. Identification of juveniles. Controlled breeding. Culture: Ponds, Monoculture, Mixed culture.

Unit IV: Technologies in Fisheries development

Role of hard water in culture of Macrobrachium species. Fertilization & feeds. Pearl culture: Introduction, Pearl producing mollusks, pearl formation, collection of oysters, Rearing of oysters, insertion of nucleus, harvesting of pearls, composition & quality of pearl. Recirculation technology, Geographic Information System (GIS) technology, passive Acoustics in fisheries, Use of Information Communication Technology (ICT) in fishes: production aspects, marketing aspects

Recommended readings

1. Jingran, V. G. (1983) Fish and fisheries of India, Hindustan pub. corp. New Delhi.
2. Hite, M. and Kaha, H. (2000) Textbook of fish culture, Blackwell Scientific Publication, Australia.
3. Srinivasulu, M., Reddy, K.R.S., Rao, S. (1999) Text book of Aquaculture, Discovery Publishing House New Delhi.
4. Yawn Mehta, Fisheries & Aquaculture Biotechnology (2011) Campus Books International, Prahalad street, Ansari Road, Durga Ganj, New Delhi.

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Core Courses (CC): ZOUBTT2 and ZOUBLT2

Semester	Core Course	Course Title	Credits
II	CC-IV	Cell Biology and Histology	Theory: 05 Practical: 02

About the course

The course provides a detailed insight into basic concepts of cellular structure and function. It also gives an account of the complex regulatory mechanisms that control cell function.

Learning outcomes

After successfully completing this course, the students will be able to:

Understand the functioning of nucleus and extra nuclear organelles and understand the intricate cellular mechanisms involved.

Acquire the detailed knowledge of different pathways related to cell signaling and apoptosis thus enabling them to understand the anomalies in cancer.

Develop an understanding how cells work in healthy and diseased states and to give a 'health forecast' by analyzing the genetic database and cell information.

Get new insights of joining research in areas such as genetic engineering of cells, cloning, vaccines development, human fertility programs, organ transplant, etc.

Understand how tissues are produced from cells in a normal course and about any malfunctioning which may lead to benign or malignant tumor.

Theory

UNIT-I: The structure and organelles of prokaryotic and eukaryotic cells. 13 Lectures

Cell biology, its scope in modern perspective. Cell theory and its modern version and interpretation. General structure of prokaryotes, bacteria, archaea and eukaryotes. Extra nuclear cell organelles. Ultrastructure and functions of endoplasmic reticulum, ribosomes, Golgi apparatus, lysosomes, peroxisomes, Mitochondria, Organelles, structure, composition, genome organization and function. Cytoskeleton: composition and functions; microtubules and microfilaments. MT vs Actin - their organization, association with membrane. Nucleus: size, shape, structure and functions of interphase nucleus. Ultrastructure of nuclear membrane and pore complex. Nucleolar general organization, chemical composition and functions, nuclear sap, nuclear matrix, nuclei-cytoplasmic interactions.

UNIT-II: Cell membrane and transport mechanism 12 Lectures

Cell membrane organization: cell membrane structure, composition, models and function. Fluid mosaic model. Lipid Composition, inner and outer leaflets. Structure and functions of membrane proteins: integral, peripheral and lipid-anchored membrane proteins. Junctional complexes, membrane receptor modifications: microvilli, desmosomes and plasmodesmata. Receptor mobility and clustering in the lipid bilayer. Cell receptor function - cellular trafficking. Transport across membrane - diffusion and osmosis, Active and passive transport, endocytosis and exocytosis.

UNIT-III: Cell cycle, cell signaling and cell culture. 14 Lectures

Cell cycle, cell division- mitosis and meiosis. Cell division check points and their regulation. Role of growth factors. Mutations in the genes that regulate cell cycle and division and their role in causing cancer. Programmed cell death (Apoptosis). Cell regulation and Cell signaling. Signaling molecules and their receptors. Functions of cell surface receptors. Regulation of signaling pathways. Cell culture. Types of cell culture- monolayer and suspension culture. Types of culture media. Sterilization methods for culture vessels and culture media. Maintenance of a cell line and storage of cells. Subcellular fractionation by differential centrifugation.

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UNIT-IV: Structural and functional significance of animal tissues 13 Lectures

Introduction to tissues. Epithelial tissue: types, structure and characteristics, surface modifications. Basement membrane: structure and characteristics. Cell junctions. Exocrine and endocrine glands: types and structure. Connective tissue cells. Structure and function of loose, dense and adipose tissue. Cartilage and bone; classification, and fine structure. Structure and function of spleen. Membranes of the brain and spinal cord.

Recommended readings

1. Karp, G. (2010) Cell and Molecular Biology: Concepts and Experiments (6th edition) John Wiley & Sons, Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006) Cell and Molecular Biology (8th edition) Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. (2009) The Cell: A Molecular Approach. (5th edition) ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M.; Kleinsmith, L.J.; Hardin, J. and Bertoni, G. P. (2009) The World of the Cell. (7th edition) Pearson Benjamin Cummings Publishing, San Francisco.

Practical

1. Study of prokaryotic and eukaryotic cell types with the help of chart, slide and video.
2. Separation and isolation of cells by sedimentation velocity in unit gravity.
3. Disruption of cells, isolation and identification of subcellular components, isolation of nuclei.
4. Isolation of mitochondria by differential centrifugation and identification of succinic dehydrogenase in the mitochondrial pellet.
5. Chromosome segregation in mitosis and meiosis.
6. Preparation of chromosome squashes from grasshopper/cockroach testes for the observation of stages of meiosis.
7. Study of types of tissue through permanent slides: epithelial, connective, muscular, nervous etc.
8. Study of histology of tissues by preparing permanent stained slides through microtomy.
9. Isolation and estimation of DNA.

Group discussion or Seminar presentation on one or two related topics from the list.

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Generic Elective Courses (GEC): ZOUBTG1 and ZOUBLG1

Semester	Core Course	Course Title	Credits
II	GEC-II	Vectors, Diseases and Management	Theory: 03 Practical: 02

About the course

The course provides an insight into the common vector-borne diseases, their ecology, role of vectors in their spread, host-parasite relationship and finally the strategies to manage these vectors.

Learning outcomes

After successfully completing this course, the students will be able to:

- Develop awareness about the causative agents and control measures of many commonly occurring diseases.
- Develop understanding about the favourable breeding conditions for the vectors.
- Devise strategies to manage the vectors population below threshold levels, public health importance.
- Undertake measures or start awareness programmes for reinforcement of hygienic conditions, avoidance of contact with vector, destruction of breeding spots in the vicinity of houses and wide spread by public health education campaigns.

Theory

Unit I: Vector and vector bionomics

13 Lectures

Brief introduction, types and morphological peculiarities of vectors such as mosquitoes, flies, bees, locs, bugs, ticks and mites. Host-vector relationship. Primary and secondary vector concepts. Vectorial capacity. Vector bionomics-larval habitat and host biting preferences, forests and animal biting indices. Evolution of vector bionomics and its effect on disease transmission. Vector fecundation. Human practices and the recurrence of pests.

Unit II: Disease vectors and the causes of disease outbreaks

12 Lectures

Salient features of the vectors belonging to Diptera, Siphonaptera, Siphonulata, Hymenoptera, Arachnida, Blattaria, Acarina (Mites) (Ixodidae and Argasidae) etc. Role of non-blood seeking flies in myiasis; of blood sucking flies in transmission of plague and typhus; of lice (body, head, pubic) in transmission of typhus, relapsing and trench fever; Vaginal's disease and Phlebotomus; of bugs in transmission of Chagas' disease of. Brief account of ticks and its associated diseases. Population biology. Factors affecting abundance, Density dependence and independence, How do people cause outbreak?

Unit III: Vector management strategies

13 Lectures

Control of vector flies by surveillance, fly traps, electrocution, poison baits and indoor residual sprays; biological control by natural predators and predators. Chemical control. Efficacy of synthetic pyrethroids, control spray of insecticides, treated bed nettings and fumigation. Biological control of mosquitoes by the use of viruses, bacteria, fungi, parasites, nematodes and larvivorous fishes. Sticky board technique. Evaluation, Other genetic approaches. Phenoxies/allochamicals. Attract-and-kill. Mating disruption, alarm pheromones and repulsion disruption.

Unit IV: Emerging concepts and approaches to vector management

13 Lectures

Legislation and regulation. Methods of sampling and monitoring, sampling plan. Allocation of sampling units. Exclusion and mass of entry. Controlled atmosphere. Risk assessment. The recognized control IPM approach. Damage thresholds estimation, forecasting, increasing agroecological sustenance, Pesticide selection, Production vector control. Up to what limit IPM should be adapted. Decision support.

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Recommended readings

1. Inoué, A.D. (1977). A General Text Book of Entomology. Chapman & Hall, UK.
2. Chapman, R.F. (1998). The Insects: Structure and Function IV Edition, Cambridge University Press, UK.
3. Mshwili, G. (2011). Integrated Vector Management: Controlling Vectors of Malaria and other Insect Vector-borne Diseases. Wiley-Blackwell.
4. Belding, D.E. (1942). Textbook of Clinical Parasitology. Appleton-Century Co., Inc., New York.
5. Roy, D.N. and Bhowik, A.W.A. (2004). Entomology. Biotech Books, Delhi.

Practical

1. Study of mouth parts of different insects.
2. Study of permanent slides of the following insect vectors: *Aedes*, *Culex*, *Anopheles*, *Pedicular humanus corporis*, *Pediculus humanus capitis*, *Phthirus pubis*, *Xenopsylla cheopis*, *Musca domestica*, *Cercar lectularius*, *Phlebotomus argentipes* through permanent slides/videos.
3. State the diseases transmitted by above insect vectors.
4. Project report submission on any one of the insect vectors and the disease transmitted.

Group discussion or Seminar presentation on one or two related topics from the list.

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Ability Enhancement Course (AEC): A2

Semester	Core Course	Course Title	Credits
I-V	AEC-II	Human Nutrition	Theory: 01, Practical: 01

About the course

The course deals with the importance of nutrition in maintaining health; the essential nutrients, balanced diet, the calories associated with different food items and the factors affecting the fitness in humans, food sanitation and hygiene.

Learning outcomes

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

- Know about essential nutrients and required macro and micro nutrients
- Cultivate proper feeding habits. □ Know caloric value of the food items
- Learn the proper and scientific value of different food items.

Theory

Unit I: Carbohydrate and protein as important food sources

Carbohydrates: Functions, classification, food sources, storage in body. Brief outline of metabolism: glycogenesis & glycogenolysis (in brief), glycolysis, citric acid cycle.

Proteins: Functions, classification, food sources, composition, essential & nonessential amino acids, protein deficiency. Metabolism: Transformation, Decarboxylation, Ammonia formation & transport, Urea cycle.

Unit II: Fat as a source of energy

Fats & oils: Function of fats, classification, food sources, composition, saturated and unsaturated fatty acids, biomedical importance, essential fatty acids. Brief out-line of metabolism: Beta oxidation of fatty acids, Ketosis, Cholesterol. **Vitamins and Minerals:** sources and functions, deficiency status. Bioavailability and deficiency of Calcium, Iron, Iodine, Sodium & Potassium. **Water:** importance as a nutrient, function, sources, requirement, water balance & effect of deficiency.

Unit III: Nutritional requirements and calories of a balanced diet

Basal metabolic rate, energy requirements of man, women, infants and children. Nutritional value of foods - cereals, fruits, milk, egg, meat, fish. Balanced diet, Nutrition requirements as per physiological stages of pregnancy, food selection, complication of pregnancy. Nutrition requirements during lactation and during infant growth and development, breast feeding, infant formula, Supplementary diet.

Unit IV: Malnutrition and health requirements

Nutritional requirement and growth in preschool children growth, Nutritional requirement of school children, importance of snacks, school lunch. Nutritional needs and feeding pattern during adolescence and adulthood. Geriatric nutrition: Factors affecting food intake and nutrition related problems, Foods of nutritional value, Balanced diet, Malnutrition, Use of food in body, Role of fibres in human nutrition; Effect of cooking and heat processing on the nutritive value of foods; Processed supplementary foods; Food sanitation in hygiene.

Recommended readings

1. Gopalan, C., Ramasastri, B.S. & Balasubramanian, S.C. (1971). Nutritive value of Indian foods. National Institute of Nutrition, Hyderabad.
2. Gopalan, D. & Vijayaraghavan, K. (1971). Nutrition atlas of India, ICMR, New Delhi.
3. Ghosh, S. (1981). The feeding care of infants and young children, UNICEF, New Delhi.
4. Madambi, S.R. (1995). Fundamentals of food and nutrition. New age international, New Delhi.
5. Swaminathan, M. (1989). Handbook of food and nutrition. Bappa, Bangalore.
6. Swaminathan, M. (1974). Essentials of food and nutrition. Vol I & II, Ganesh and Co. Madras.

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Skill Enhancement Course (SEC): L2

Semester	Core Course	Course Title	Credits
I-II	SEC-II	Sericulture	Theory: 01, Practical: 01

About the course

The course gives insight into the principles of sustainable sericulture and how these principles can guide your silkworm rearing into an enduring practice. The students will know about the laws and by laws governing keeping silkworm.

Learning outcomes

Upon successful completion of this course, the student should be able to:

- Generation of skilled man power in the field of sericulture,
- To impart training in extension management and transfer of technology,
- To impart training in Post Cocoon Technology, and
- To provide field exposure

Theory

Unit I: Silkworm distribution and races

The silkworms, its morphological characteristics, Distribution and types of races, Exotic and indigenous races of silkworm, World silk production World map and silk road, spread of Sericulture to Europe, South Korea, Japan, India and other countries. Sericultural practices in tropical and temperate climate.

Unit II: Biology of silkworm

Mulberry and non-mulberry Sericulture, Biology of silkworm, Selection of mulberry variety and establishment of mulberry garden, Rearing house and rearing appliances, Silkworm rearing technology: Early age and Late age rearing Selection of silkworm races/breeds for rearing, Incubation- definition, requirement of environmental conditions, incubation devices; identification of stages of development, black boxing and its importance.

Unit III: Diseases of silk worm and prevention and control

Diseases of silkworm, Disinfectants: Formalin, bleaching powder RKO, Types of mountages, Spinning, harvesting and storage of cocoons, Introduction; classification of silkworm diseases, Protozoan disease: symptomatology due to Nosema bombycis infection, source, mode of infection and transmission, cross infectivity, prevention and control. Bacterial, Viral, Fungal diseases: causative agents, symptoms, transmission prevention and control.

Unit IV: Prospects of Sericulture in India

Sericulture Types- natural and synthetic fibres- types of silk produced in India; Importance of mulberry silk, Silk industry in different states, employment, potential in mulberry and nonmulberry sericulture, Employment generation in sericulture: Role of women in sericulture. Sericultural practices in rain-fed and irrigated conditions; traditional and non-traditional areas; Sericulture organization in India; role of state departments of Sericulture, Central Silk Board, Universities and NGOs in Sericulture development .

Recommended readings

1. Manual on sericulture (1976). Rome : Food and Agriculture Organization of the United Nations, Agricultural Services Division.
2. Ulal, S.R. and , Narasimhanna, M.N. (1987) Handbook of Practical Sericulture: CSB, Bangalore
3. Silkworm Rearing and Disease of Silkworm (1956) Pd. By Director of Ptg., Sm. & Pub. Govt. Press, Bangalore
4. Jelly, M. S. (1986) Appropriate Sericultural Techniques; Ed., Director, CSR & TI, Mysore.
5. Handbook of Silkworm Rearing: Agriculture and Technical Manual-1 (1972) Fuzi Pub. Co. Ltd., Tokyo, Japan.
6. Narasimhanna, M. N. (1988) Manual of Silkworm Egg Production; CSB, Bangalore.
7. Sengupta, K. (1989) A Guide for Bivoltine Sericulture. CSR & TI, Mysore.

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Department of Zoology, School of Life Sciences, GGV, Bilaspur (CG)

CORE COURSE V

LS/ZOO/CC-301 L

DIVERSITY OF CHORDATA

THEORY

(Credits 4)

Unit 1: Introduction and origin of Chordates	5
General characteristics and outline classification, Dipleurula concept and the Echinoderm theory of origin of chordates, Advanced features of vertebrates over protochordates.	
Unit 2: Zoogeography	8
Zoogeological time scale, Zoogeographical realms, Theories pertaining to distribution of animals, Plate tectonic and Continental drift theory, Distribution of vertebrates in different realms.	
Unit 3: Protochordata	8
General characteristics of Hemichordata, Urochordata and Cephalochordata, Study of larval forms in Protochordates, Retrogressive metamorphosis in Urochordata.	
Unit 4: Agnatha and Pisces	10
General characteristics and classification of cyclostomes up to orders; General characteristics of Chondrichthyes and Osteichthyes and Classification up to orders, Skin and Scales, Migration, Osmoregulation and Parental care in fishes.	
Unit 5: Amphibia and Reptilia	13
Origin of <i>Tetrapoda</i> (Evolution of terrestrial ectotherms), General characteristics and classification of Amphibia up to orders, Parental care in Amphibians; General characteristics and classification of Reptilia up to orders, Affinities of <i>Sphenodon</i> , Poisonous and non-poisonous snakes, Poison apparatus and biting mechanism.	
Unit 6: Aves and Mammalia	16
General characteristics and classification of Aves up to orders; <i>Archaeopteryx</i> - a connecting link; Principles and aerodynamics of flight, Flight adaptations, Migration in birds; General characters and classification of Mammalia up to orders, Affinities of Prototheria, Metatheria, Adaptive radiation- in mammals: locomotory appendages.	

Course Objective:

- To get information about the diversity of chordates
- To have awareness about the beneficial and harmful chordates
- To know about the endangered species of chordates
- To know about the management of chordates

Course Outcomes:

By the study of diversity of chordates, it would be easy to know about the species of chordates surviving in different ecological areas of world. It would also be very useful that how these species may be harmful or useful for mankind.



Department of Zoology, School of Life Sciences, GGV, Bilaspur (CG)

CORE COURSE V

LS/ZOO/C-C-301 P

DIVERSITY OF CHORDATA

PRACTICALS

(Credits 2)

1. Protochordata

Balanoglossus, Herdmania, Branchiostoma, Colonial Urochordata, Sections of *Balanoglossus* through proboscis and branchiogenital regions, Sections of *Amphioxus* through pharyngeal, intestinal and caudal regions, Permanent slide of *Herdmania* spicules.

1. Agnatha and Fishes

Petromyzon, Myxine, Scoliodon, Sphyrna, Pristis, Torpedo, Chimaera, Myxus, Heteropneustes, Labes, Catla, Cirrhinus Etacoeus, Echinis, Anguilla, Hippocampus, Tetradon, Diodon, Anabas, Flat fish.

2. Amphibia and Reptilia

Ichthyophis, Necturus, Rana, Bufo, Hyla, Alytes, Salamandra, Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Ophiostaurus, Draco, Bungarus, Vipera, Naja, Hydrophis, Zamenis, Crocodylus, Key for identification of poisonous and non-poisonous snakes.

3. Aves and Mammalia

Study of common birds from different orders, Types of beaks and claws, *Sorex*, Bat (Insectivorous and Frugivorous), *Ratus*, *Funambulus*, *Loris*, *Herpestes*, *Erinaceus*, Internal ear of scoliodon/Mount of weberian ossicles of *Mystus/ pecten* from Fowl head/Power point/ Study of afferent and efferent arteries of fish (scoliodon).

SUGGESTED READINGS

- Young JZ (2004). The Life of Vertebrates. III Edition. Oxford university press.
- Darlington PJ. The Geographical Distribution of Animals, R.E. Krieger Pub Co.
- Hall BK and Hallgrímsson B (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.
- Doerit, Walker and Barnes (1991). Zoology. Brooks Cole; 1 Edition.
- Nigam (1997). Biology of Chordates, S. Chand.
- Kotpal : Modern text book of Zoology: Vertebrates, Rastogi Publication.


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CORE COURSE VI

LS/ZOO/CC-302 L

ANIMAL PHYSIOLOGY: CONTROLLING AND COORDINATING SYSTEMS

THEORY

(Credits 4)

Unit 1: Tissues	6
Structure, location, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue.	
Unit 2: Bone and Cartilage	4
Structure and types of bones and cartilages, Ossification, bone growth and resorption.	
Unit 3: Muscle	12
Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor unit, summation and tetanus.	
Unit 4: Nervous System	10
Structure and classification of neuron, resting membrane potential, Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers; Types of synapse, Synaptic transmission and, Neuromuscular junction, Reflex action and its types - reflex arc; Physiology of hearing and vision.	
Unit 5: Endocrine System	18
Histology of endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; hormones secreted by them and their mechanisms of action; Classification of hormones; Regulation of their secretion; Mode of hormone action, Signal transduction pathways for steroidal and non-steroidal hormones; Hypothalamus (neuroendocrine gland) - principal nuclei involved in neuroendocrine control of anterior pituitary and endocrine system; Placental hormones.	
Unit 6: Reproductive System	10
Histology of testis and ovary; Physiology of male and female reproduction; Puberty, Methods of contraception in male and female.	

Course Objective:

To familiarize students with the principles and basic facts of animal physiology. Emphasis will be placed on control and coordination of tissues, bone and cartilage, muscle, nervous, endocrine and reproductive system.

Course Outcomes:

To understand fundamental principles of animal physiology and how these principles are incorporated into the adaptations of different animal groups.
To understand control and coordination of various organ systems in animals i.e. tissues, bone and cartilage, muscle, nervous, endocrine and reproductive system in animals. To gain experience in discussing, and answering questions about animal physiology.

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Department of Zoology, School of Life Sciences, GGV, Bilaspur (CG)

CORE COURSE VI

LS/ZOO/CC-302 P

ANIMAL PHYSIOLOGY: CONTROLLING AND COORDINATING SYSTEMS

PRACTICALS

(Credits 2)

1. Recording of simple muscle twitch with electrical stimulation (or Virtual)
2. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex)
3. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres and nerve cells
4. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid
5. Microtomy: Preparation of permanent slide of mammalian tissues
6. Study of eggs and tadpoles of frogs
7. Study of whole mount preparation of chick embryo

SUGGESTED BOOKS

- Guyton AC and Hall JE (2006). Textbook of Medical Physiology. XI Edition. Harcourt Asia PTE Ltd, W.B. Saunders Company.
- Teeter GJ and Grabowski S (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons
- Victor P Eroschenko (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition, Lippincott W. & Wilkins.

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CORE COURSE VII

LS/ZOO/CC-303 I

FUNDAMENTALS OF BIOCHEMISTRY

THEORY

(Credits 4)

Unit 1: Biomolecules

Chemistry of Living system: Scope and importance; Biomolecules: Organizational principle, Configuration and confirmation; Water as a biological solvent.

4

Unit 2: Carbohydrates

Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates: Aldose, ketose, chiral centre, polarized light and Fischer's nomenclature, cyclization reaction of glucose, anomers, pyranose, furanose, glycosidic linkage, reducing and non-reducing sugars.

8

Unit 3: Lipids

Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids, Steroids.

8

Unit 4: Proteins

Amino acids: Structure, Classification and General properties of α -amino acids; Physiological importance of essential and non-essential α -amino acids Proteins: Bonds stabilizing protein structure; Levels of organization in proteins; Denaturation; Introduction to simple and conjugate proteins.

14

Unit 5: Enzymes

Nomenclature and classification; Cofactors; Specificity of enzyme action; Mechanism of enzyme action; Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions; Derivation of Michaelis-Menten equation, Concept of K_m and V_{max} , Lineweaver-Burk plot; Enzyme inhibition; Allosteric enzymes and their kinetics; Regulation of enzyme action.

14

Unit 6: Nucleic Acids

Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids, Cot Curves: Base pairing, Denaturation and Renaturation of DNA Types of DNA and RNA.

12

Course Objective:

Course is aimed to provide molecular structure of biological macromolecules (Carbohydrates, protein, lipids and nucleic acids) and their significance in living system. How enzymes work to perform biochemical reaction during metabolism.

Course Outcomes:

Students will be able to analyses and understand the basic concept of chemical reaction occur in living system that enables them to explore the applied science beneficial for mankind.

14



Department of Zoology, School of Life Sciences, GGV, Bilaspur (CG)

CORE COURSE VII

LS/ZOO/CC-303 P

FUNDAMENTALS OF BIOCHEMISTRY

PRACTICALS

(Credits 2)

1. Qualitative tests of functional groups in carbohydrates: Benedict's test for reducing sugars, Iodine test for starch
2. Qualitative tests of proteins
3. Qualitative tests of lipids
4. Paper chromatography of amino acids.
5. Action of salivary amylase under optimum conditions.
6. Effect of pH, temperature and inhibitors on the action of salivary amylase.
7. Structural study of DNA and RNA through models.
8. Preparation and roles of phosphate and bicarbonate buffers

SUGGESTED READING

- Cox MM and Nelson DL (2008). Lehninger's Principles of Biochemistry, V Edition, W.H. Freeman and Co., New York.
- Berg JM, Tymoczko JL and Stryer L. (2007). Biochemistry, VI Edition, W.H. Freeman and Co., New York.
- Murray RK, Bender DA, Botham KM, Kennelly PJ, Rodwell VW and Weil PA (2009). Harper's Illustrated Biochemistry, XXVIII Edition, International Edition, The McGraw-Hill Companies Inc.
- Hames BD and Hooper NM (2000). Instant Notes in Biochemistry, II Edition, BIOS Scientific Publishers Ltd., U.K.
- Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R. (2008). Molecular Biology of the Gene, VI Edition, Cold Spring Harbor Lab. Press, Pearson Pub.



Department of Zoology, School of Life Sciences, GGV, Bilaspur (CG)

SKILL ENHANCEMENT COURSES

LS/ZOO/SEC-301 L

SERICULTURE

THEORY

(Credits 4)

Unit	Credits
Unit 1: Introduction Sericulture: Definition, history and present status of sericulture; Types of silkworms; Exotic and indigenous species. Mulberry and non-mulberry sericulture.	5
Unit 2: Biology of Silkworm Types of silkworms: Exotic and indigenous species. Mulberry and non-mulberry; Sericulture, Life cycle of <i>Bombyx mori</i> ; Structure of silk gland and secretion of silk.	10
Unit 3: Rearing of Silkworms Selection of mulberry variety, propagation and establishment of mulberry garden; Rearing house and rearing appliances. Disinfectants: Formalin, bleaching powder, RKO. Silkworm rearing technology; Early age and Late age rearing, Mounting Types of mountages, Spinning, harvesting and storage of cocoons.	15
Unit 4: Post harvesting management and Processing Quality and storage of cocoons, stifling and reeling	10
Unit 5: Pests and Diseases Pests of silkworm: Uzi fly, dermestid beetles and vertebrates. Protozoan, viral, fungal and bacterial diseases. Control and prevention of pests and diseases.	10
Unit 6: Entrepreneurship In Sericulture Prospects of Sericulture in India; Sericulture industry in different states, employment, potential in mulberry and non-mulberry sericulture.	10

Course Objectives:

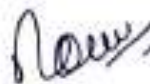
- To know about importance of sericulture in the rural development
- To increase the economy of rural people and country
- To fulfill the demand of precious silk threads to the textile industry
- To gain more and more foreign currency
- To provide employment to the rural people

Course Outcomes:

Sericulture is mainly women labor based rural industry which is playing a significant role to upgrade the life style of rural people. It is also one of the industries which is earning foreign exchange in great amount. It provides employment about 15% to the rural people.


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S. K. W.


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Department of Zoology, School of Life Sciences, GGV, Bilaspur (CG)

SKILL ENHANCEMENT COURSES

LS/ZOO/SEC-301 P

SERICULTURE.

PRACTICALS

(Credits 2)

1. Study of different specimen and cocoons.
2. Study of mouth parts and silk gland.
3. Study of insect wings and their venation in adult worm.
4. Study of various diseases.
5. Study of any three beneficial insects and their products.

SUGGESTED READINGS

- Manual on Sericulture; Food and Agriculture Organisation, Rome 1976
- Handbook of Practical Sericulture: S.R. Ullal and M.N. Narasimhanna CSB, Bangalore
- Silkworm Rearing and Disease of Silkworm, 1956, Ptd. By Director of Ptg., Stn. & Pub. Govt. Press, Bangalore
- Appropriate Sericultural Techniques; Ed. M. S. Jolly, Director, CSR & TI, Mysore.
- Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, Fuzi Pub. Co. Ltd., Tokyo, Japan 1972.
- Manual of Silkworm Egg Production; M. N. Narasimhanna, CSB, Bangalore 1988.
- Silkworm Rearing; Wupang—Chun and Chen De-Chung. Pub. By FAO, Rome 1988.
- A Guide for Bivoltine Sericulture; K. Sengupta, Director, CSR & TI, Mysore 1989.
- Improved Method of Rearing Young age silkworm; S. Krishnaswamy, reprinted CSB, Bangalore, 1986.

SUGGESTED ACTIVITY

Visit to local sericulture units.

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CORE COURSE VIII

LS/ZOO/CC-401 L

COMPARATIVE ANATOMY OF VERTEBRATES

THEORY	(Credits 4)
Unit 1: Integumentary and Skeletal System Structure, functions and derivatives of integument, functions of skin; Overview of axial and appendicular skeleton; Jaw suspensorium; Viscoeral arches; Vertebrae.	14
Unit 2: Digestive and Respiratory System Alimentary canal and associated glands; dentition; Skin, Gills, Lungs and air sacs; Accessory respiratory organs.	14
Unit 3: Circulatory System General plan of circulation; Evolution of heart and aortic arches.	8
Unit 4: Urinogenital System Succession of kidney; Evolution of urinogenital ducts; General plan of gonads; Accessory reproductive organs; Types of mammalian uteri.	8
Unit 5: Nervous System Comparative account of brain; Autonomic nervous system; Spinal cord; Cranial nerves in mammals.	8
Unit 6: Sense Organs Classification of receptors, Brief account of visual and auditory receptors in human.	8

Course Objectives:

To learn the basic of vertebrates anatomy to understand how different anatomies function have evolved and develop.

To learn the basic morphological features of representative chordates system.

Course Outcomes:

Describe the major architectural features of the integumentary skeletal nervous muscular digestive respiratory circulatory excretory and reproductive systems.

Develop an understanding of the application of comparative anatomy in current scientific method / literature.



Department of Zoology, School of Life Sciences, GGV, Bilaspur (CG)

CORE COURSE VIII

LS/ZOO/CC-401 P

COMPARATIVE ANATOMY OF VERTEBRATES

PRACTICALS

(Credits 2)

1. Study of different types of feathers in birds.
2. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs
3. Histological slides of different tissues and organs of vertebrates (Skin, Stomach, Pancreas, Duodenum, Liver, Lungs, Ovary, Testes).
4. Disarticulated skeleton of Frog, Varanus, Fowl, Rabbit
5. Carapace and plastron of turtle/tortoise
6. Mammalian skulls. One herbivorous and one carnivorous animal
7. Study of structure of any two organs (heart, lung, kidney, eye and ear) from video recording (may be included if dissection not permitted)
8. Project on skeletal modifications/GI tract/Respiratory organs in vertebrates.
9. Study of digestive, circulatory and urogenital system of frog/sat through videos on dissection or through virtual dissection.

SUGGESTED READINGS

- Kardong KV (2005). Vertebrates' Comparative Anatomy, Function and Evolution IV Edition. McGraw-Hill Higher Education
- Kent GC and Carr RK (2000). Comparative Anatomy of the Vertebrates: IX Edition. The McGraw-Hill Companies
- Hilderbrand M and Gaslow GE. Analysis of Vertebrate Structure, John Wiley and Sons
- Walter HE and Sayles LP, Biology of Vertebrates, Khosla Publishing House



Department of Zoology, School of Life Sciences, GGV, Bilaspur (CG)

CORE COURSE IX

LS/ZOO/CC-402 L

ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS

THEORY

(Credits 4)

Unit 1: Integumentary system	6
Cell junction, epithelial and connective tissue, structure, type and function of skin, accessory structure of skin	
Unit 2: Digestion	14
Structural organization and functions of gastrointestinal tract and associated glands; Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins; Hormonal control of secretion of enzymes in Gastrointestinal tract.	
Unit 3: Respiration	10
Histology of trachea and lung; Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood; Respiratory pigments, Carbon monoxide poisoning; Control of respiration	
Unit 4: Renal Physiology	12
Structure of kidney and its functional unit; Mechanism of urine formation; Regulation of water balance; Regulation of acid-base balance	
Unit 5: Blood	8
Components of blood and their functions; Structure and functions of haemoglobin; Haemostasis: Blood clotting system, Complement system and fibrinolytic system, Haemopoiesis Blood groups: Rh factor, ABO and MN	
Unit 6: Physiology of Heart	10
Structure of mammalian heart; Coronary circulation; Structure and working of conducting myocardial fibers. Origin and conduction of cardiac impulses Cardiac cycle; Cardiac output and its regulation, nervous and chemical regulation of heart rate. Electrocardiogram, Blood pressure and its regulation	

Course Objective:

To acquaint students with the principles and basic facts of animal physiology in relation with integumentary system, digestion, respiration, renal physiology, blood and physiology of heart to promote student understanding.

Course Outcomes:

To Understand fundamental principles of animal physiology and life sustaining systems.

To understand the processes involved in formation and functioning of integumentary system, digestion, respiration, renal physiology, blood and physiology of heart in animals.

To gain experience in discussing and answering questions about animal physiology.

18



Department of Zoology, School of Life Sciences, GGV, Bilaspur (CG)

CORE COURSE IX

LS/ZOO/CC-402 P

ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS

PRACTICALS

(Credits 2)

1. Determination of ABO Blood group
2. Enumeration of red blood cells and white blood cells using haemocytometer
3. Estimation of haemoglobin using Sahli's haemoglobinometer
4. Preparation of haemin and haemochromogen crystals
5. Recording of frog's heart beat under *in situ* and perfused conditions*
6. Recording of blood pressure using a sphygmomanometer
7. Examination of sections of mammalian oesophagus, stomach, duodenum, ileum, rectum liver, trachea, lung, kidney through permanent slides.

SUGGESTED READINGS

- Guyton AC and Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Harcourt Asia PTE Ltd. W.B. Saunders Company.
- Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons,
- Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins.
- Vander A, Sherman J, and Luciano D. (2014). Vander's Human Physiology: The Mechanism of Body Function. XIII Edition, McGraw Hills

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Department of Zoology, School of Life Sciences, GGV, Bilaspur (CG)

CORE COURSE X

LS/ZOO/CC-403 L

BIOCHEMISTRY OF METABOLIC PROCESSES

THEORY

(Credits 4)

Unit 1: Bioenergetics	4
ATP as "Energy Currency of cell"; coupled reactions; Use of reducing equivalents and cofactors.	
Unit 2: Overview of Metabolism	6
Catabolism vs Anabolism, Stages of catabolism, Compartmentalization of metabolic pathways, Shuttle systems and membrane transporters; Intermediary metabolism and regulatory mechanisms.	
Unit 3: Carbohydrate Metabolism	16
Sequence of reactions and regulation of glycolysis, Citric acid cycle, Pentose Phosphate pathway, Gluconeogenesis, Glycogenolysis and Glycogenesis.	
Unit 4: Lipid Metabolism	14
β -oxidation and omega-oxidation of saturated fatty acids with even and odd number of carbon atoms; Biosynthesis of palmitic acid; Ketogenesis.	
Unit 5: Protein Metabolism	10
Catabolism of amino acids: Transamination, Deamination, Urea cycle; Fate of C-skeleton of Glucogenic and Ketogenic amino acids.	
Unit 6: Oxidative Phosphorylation	10
Redox systems; Review of mitochondrial respiratory chain, Electron carriers, sites of ATP production, Inhibitors and uncouplers of Electron Transport System, Structure of ATPase complex, chemiosmotic hypothesis.	

Course Objective:

- To learn the basic elements of bioenergetics and energy metabolism.
- To make the student learn and understand the basics of carbohydrate, protein and lipid metabolisms.
- To make the students understand oxidative Phosphorylation

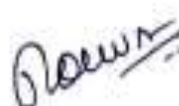
Course Outcomes:

At the end of the course, the students will acquire basic knowledge of bioenergetics and energy metabolism. The students will acquire knowledge about various biomolecules that constitute the living organisms. Students will understand composition and metabolism of carbohydrate, protein and lipids.


S.K. Sharma

20

J.K. Sharma


P. Sharma



Department of Zoology, School of Life Sciences, GGV, Bilaspur (CG)

CORE COURSE X

LS/ZOO/CC-403 P

BIOCHEMISTRY OF METABOLIC PROCESSES

PRACTICALS

(Credits 2)

1. Estimation of total protein in given solutions by Lowry's method.
2. Estimation of carbohydrate by toluene method.
3. Detection of SGOT and SGPT or GST and GSH in serum/ tissue
4. Detection of GSH in serum/ tissue
5. To study the enzymatic activity of Trypsin and Lipase /SOD and Catalase
6. Study of biological oxidation (LPO) [Rat liver]
7. To perform the Acid and Alkaline phosphatase assay from serum/ tissue.
8. To estimate the bilirubin by clinical method and to know the physiological significance of the bilirubin.

SUGGESTED READINGS

- Cox, M.M and Nelson, D.L. (2008). *Lehninger Principles of Biochemistry*, V Edition, W.H. Freeman and Co., New York.
- Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). *Biochemistry*, VI Edition, W.H. Freeman and Co., New York.
- Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Weil, P.A. (2009). *Harper's Illustrated Biochemistry*, XXVIII Edition, International Edition, The McGraw-Hill Companies Inc.
- Hames, B.D. and Hooper, N.M. (2000). *Instant Notes in Biochemistry*, II Edition, BIOS Scientific Publishers Ltd., U.K.


S.A. Khosla


S.K. Khosla





Department of Zoology, School of Life Sciences, GGV, Bilaspur (CG)

GENERIC ELECTIVE COURSES

LS/ZOO/GE-401 L

INSECT VECTORS AND DISEASES

THEORY

(Credits 4)

Unit I: Introduction to Insects

6

General Features of Insects, Morphological features, Head - Structure and orientation of Head, Eyes, Types of antennae, Mouth parts w.r.t. feeding habits. Outline classification of insects up to orders, detailed features of orders with insects as vectors - Diptera, Siphonaptera, Siphunculata, Hemiptera.

Unit II: Insect Vectors

14

Brief introduction of Carrier and Vectors (mechanical and biological vectors), Reservoirs, Host-pathogen interaction and relationship.

Unit III: Diptera as Disease Vectors

24

Dipterans as important insect vectors - Mosquitoes, Sand fly, Houseflies; Study of mosquito-borne diseases - Malaria, Dengue, Filariasis, Control of mosquitoes; Study of sand fly-borne diseases - Visceral Leishmaniasis, Phlebotomus fever; Control of Sand fly; Study of house fly as important mechanical vector, Myiasis, Control of house fly.

Unit IV: Siphonaptera as Disease Vectors

6

Fleas as important insect vectors; Host-specificity, Study of Flea-borne diseases - Plague, Typhus fever; Control of fleas.

Unit V: Siphunculata as Disease Vectors

4

Human louse (Head, Body and Pubic louse) as important insect vectors; Study of louse-borne diseases - Trench fever, Vagabond's disease, Control of human louse.

Unit VI: Hemiptera as Disease Vectors

6

Bugs as insect vectors; Blood-sucking bugs; Cimex Chagas disease, Bed bugs as mechanical vectors, Control and prevention measures.

Course Objective:

Insect vectors cause many diseases which lead to millions of deaths across the world especially in developing countries. The rate of pathogen spread by insects is increasing at an alarming pace posing a growing threat to the human population. Disease transmission by these insects can be prevented only by studying their biology, modes of transmission of pathogens by them, evaluation of associated risk factors, devise effective methods to control these insects and resolve the challenges posed.

Course outcomes

Describe the host-pathogen relationships and the role of the host reservoir on transmission of parasite. Explain control methods of insect vector diseases including preventing their spread, spreading awareness on public health programs and mitigating insect borne diseases. Employ the use of advanced management strategies in disease control with respect to parasite evolution.

48



Department of Zoology, School of Life Sciences, GGV, Bilaspur (CG)

GENERIC ELECTIVE COURSES

LS/ZOO/GE-401 P

INSECT VECTORS AND DISEASES

PRACTICALS

(Credits 2)

1. Study of different kinds of mouth parts of insects.
2. Study of different kinds of legs of insects.
3. Study of following insect vectors through permanent slides/ photographs: *Aedes*, *Culex*, *Anopheles*, *Pediculus humanus capitis*, *Pediculus humanus corporis*, *Phthirus pubis*, *Xenopsylla cheopis*, *Cimex lectularius*, *Phlebotomus argentipes*, *Musca domestica*, through permanent slides/ photographs.
4. Study of different diseases transmitted by above insect vectors through charts/models.

SUGGESTED READINGS

- Inms, A.D. (1977). *A General Text Book of Entomology*. Chapman & Hall, UK.
- Chapman, R.F. (1998). *The Insects: Structure and Function*. IV Edition, Cambridge University Press, UK.
- Pedigo L.P. (2002). *Entomology and Pest Management*. Prentice Hall Publication.
- Mathews, G. (2011). *Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases*. Wiley

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SKILL ENHANCEMENT COURSES

LS/ZOO/SEC-401 L

MEDICAL DIAGNOSTICS

THEORY

(Credits 4)

Unit 1: Introduction to Medical Diagnostics and its Importance 10
Functional components of Chemical Laboratories, Identification of common equipment, principle and care of laboratory instruments. Basic needs of clinical laboratory technician, awareness of soft skills. NAEL and SOP. Basic causes of accidents in laboratories.

Unit 2: Collection of Specimen and Disposal of waste 10
General principles, containers, rejection. Samples-Urine, Faeces, Sputum, Pus, Body Fluids, Swab, Blood. Importance of biomedical waste. Disposal of laboratory/hospital waste. Non-infectious waste, infected sharp waste disposal, infected non-sharp waste disposal.

Unit 3: Basic Haematological Techniques 10
Preparation of blood collection-Basic steps for drawing blood by vein, capillary and artery puncture. Complications during and after blood collection. Specimen rejection criteria for blood. Anticoagulants-types and concentration. Transport of blood sample. Effect of storage on blood cell morphology. Universal precautions.

Unit 4: Diagnostic Methods Used for Analysis of Blood 10
Blood composition, Preparation of blood smear and Differential Leukocyte Count using Leishman's stain, Platelet count using haemocytometer, Erythrocyte Sedimentary Rate, Packed Cell Volume.

Unit 5: Diagnostic Methods Used for Urine Analysis 10
Urine analysis: Physical characteristics: Abnormal constituents, Urine culture. Urinary tract infection, Kidney Disease and diabetes

Unit 6: Clinical Microbiology, Culture and Staining 10
Culture media: Definition, uses, basic requirements, classification, Agar, Peptone; Transport, Sugar and Anaerobic media, Containers and forms of media. Staining methods: Simple, Gram staining, Ziehl-Neelsen staining or AFB staining. Negative impregnation, Antibiotic sensitivity test

Course Objective:

To impart adequate knowledge on the diagnostics methods used for analysis of blood and urine. To understand the fundamental principles and applications of medical imaging using X-Ray, PET, MRI and CT Scan

Course Outcomes:

Students will learn how doctors diagnose patients using diagnostic tools and resources. Students will be aware of different methods and machines doctors use every day to diagnose patients.

52



Department of Zoology, School of Life Sciences, GGV, Bilaspur (CG)

SKILL ENHANCEMENT COURSES

LS/ZOO/SEC-401 P

MEDICAL DIAGNOSTICS

PRACTICAL

(Credits 2)

1. Determination of ABO Blood group
2. Enumeration of red blood cells and white blood cells using haemocytometer
3. Estimation of haemoglobin using Sahli's haemoglobinometer
4. Haemoglobin electrophoresis
5. Blood urea estimation
6. Total cholesterol estimation
7. Platelet count using haemocytometer, Erythrocyte
8. Serum bilirubin total and Bilirubin direct estimation
9. Serum amylase estimation
10. Serum SGOT (AST) and SGPT (ALT) estimation
11. Recording of blood pressure using a sphygmomanometer

SUGGESTED READINGS

- Park, K. (2007), *Preventive and Social Medicine*, B.B. Publishers
- Godkar P.B. and Godkar D.P. *Textbook of Medical Laboratory Technology*, II Edition, Bhalani Publishing House
- Cheesbrough M., *A Laboratory Manual for Rural Tropical Hospitals, A Basis for Training Courses*
- Gayton A.C. and Hall J.E. *Textbook of Medical Physiology*, Saunders
- Robbins and Cotran, *Pathologic Basis of Disease*, VIII Edition, Saunders
- Prakash, G. (2012), *Lab Manual on Blood Analysis and Medical Diagnostics*, S. Chand and Co. Ltd.

SUGGESTED ACTIVITY

Visit to local hospital units.





Department of Zoology, School of Life Sciences, GGV, Bilaspur (CG)

CORE COURSE XI

LS/ZOO/CC-501 L

MOLECULAR BIOLOGY

THEORY

(Credits 4)

Unit 1: Nucleic Acids

8

Salient features of DNA and RNA Watson and Crick model of DNA; Ribo-switches, Different types of RNAs

Unit 2: DNA Replication

12

DNA Replication in prokaryotes and eukaryotes, mechanism of DNA replication, Semi-conservative, bidirectional and semi-discontinuous replication, RNA priming, Replication of circular and linear ds-DNA, replication of telomeres, Concept of DNA repairing

Unit 3: Transcription

10

RNA polymerase and transcription Unit, mechanism of transcription in prokaryotes and eukaryotes, synthesis of rRNA and mRNA, transcription factors

Unit 4: Translation

12

Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; Process of protein synthesis in prokaryotes; Ribosome structure and assembly in prokaryotes, fidelity of protein synthesis, aminoacyl tRNA synthetases and charging of tRNA; Proteins involved in initiation, elongation and termination of polypeptide chain; Inhibitors of protein synthesis; Difference in prokaryotic and eukaryotic translation

Unit 5: Post Transcriptional Modifications and Processing of RNA

8

Split genes: concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, Processing of tRNA

Unit 6: Gene Regulation

10

Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from *lac* operon and *trp* operon; Transcription regulation in eukaryotes: Activators, repressors, enhancers, silencer elements; Gene silencing, Genetic imprinting, RNA interference.

Course Objective:

Course is designed to understand the life process at sub-cellular and molecular level. Define the molecular mechanisms by which DNA controls development, growth or morphological characteristics of cell and organisms.

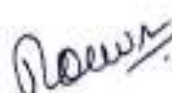
Course Outcomes:

Students will be able to understand the molecular mechanism of living system that enables them to designed knowledge in applied science.


S.K. Sharma

22


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Department of Zoology, School of Life Sciences, GGV, Bilaspur (CG)

CORE COURSE XI

LS/ZOO/CC-501 P

MOLECULAR BIOLOGY

PRACTICALS

(Credits 2)

1. Study the structure of nucleotides, DNA and RNA through model/ charts.
2. Study of Polytene chromosomes from Chironomus / Drosophila larvae
3. Preparation of agar culture plate and raise culture of bacteria (*E. coli*)
4. Preparation of liquid culture medium
5. Demonstration of DNA extraction process
6. Demonstration of RNA extraction process
7. Study and interpretation of electron micrographs/ photograph showing
(a) DNA replication
(b) Transcription
(c) Split genes

SUGGESTED READINGS

- Becker, W.M., Kleinsmith, L.J., Hardin, J. and Bertoni, G. P. (2009). *The World of the Cell*. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
- Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter: *Molecular Biology of the Cell*, IV Edition.
- Cooper G. M. and Robert E. Hausman R. E. *The Cell: A Molecular Approach*, V Edition, ASM Press and Sinauer Associates.
- De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
- Karp, G. (2010) *Cell and Molecular Biology: Concepts and Experiments*, VI Edition. John Wiley and Sons, Inc.
- Lewin B. (2008). *Gene XI*, Jones and Bartlett.
- McLennan A., Bates A., Turner, P. and White M. (2015). *Molecular Biology* IV Edition. GS, Taylor and Francis Group, New York and London.



Department of Zoology, School of Life Sciences, GGV, Bilaspur (CG)

CORE COURSE XII

LS/ZOO/CC-502 L

PRINCIPLES OF GENETICS

THEORY

(Credits 4)

Unit 1: Mendelian Genetics and its Extension

8

Principles of inheritance (Mendel's Laws), Incomplete dominance and co-dominance, Multiple alleles, lethal alleles, Epistasis, Pleiotropy, Sex-linked, sex influenced and sex-limited characters inheritance, concept of gene

Unit 2: Linkage, Crossing Over and Chromosomal Mapping

16

Linkage and crossing over, Recombination frequency as a measure of linkage intensity, Two factor and three factor crosses, Interference and coincidence; Introduction to conjugation, transformation and transduction

Unit 3: Mutations

12

Types of gene mutations (Classification) and causes, Chromosomal aberrations, Molecular basis of mutations in relation to UV light and chemical mutagens;

Unit 4: Sex Determination and Extra-chromosomal Inheritance

12

Chromosomal mechanisms of sex determination in *Drosophila* and *Man*, Extra-chromosomal inheritance with suitable example, Mitochondrial DNA

Unit 5: Polygenic Inheritance

4

Polygenic inheritance with suitable examples; numericals based on it.

Unit 6: Transposable Genetic Elements

8

Transposition; Transposons in bacteria, P elements in *Drosophila*, Transposons in humans, Transposons as mutagens.

Course Objective:

- To study the structure and function of gene.
- To study how gene is hereditary material.
- To study how is gene contribute to an organism's wellbeing.

Course Outcomes:

- Develop in-depth knowledge of gene function and development.
- Students will develop understanding about how gene inherits from generation to generation.
- Students will develop understanding about how gene related disease can alter the life of an organism.

Shreyas

24



Department of Zoology, School of Life Sciences, GGV, Bilaspur (CG)

CORE COURSE XII

LS/ZOO/CC-502 P

PRINCIPLES OF GENETICS

PRACTICALS

(Credits 2)

1. To study the Mendelian laws with suitable examples.
2. Chi-square analyses using seeds/heads/*Drosophila*.
3. Linkage maps based on data from conjugation, transformation and transduction.
4. *Drosophila* biology: Sexual dimorphism, Life cycle and different mutant's types.
5. Linkage maps based on data from *Drosophila* crosses.
6. Study of human karyotype (normal and abnormal).
7. Pedigree analysis of some human inherited traits.

SUGGESTED READINGS

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. Wiley India
- Snustad, D.P., Simmons, M.J. (2009). *Principles of Genetics*. V Edition. John Wiley and Sons Inc
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). *Concepts of Genetics*. X Edition. Benjamin Cummings
- Russell, P. J. (2009). *Genetics- A Molecular Approach* III Edition. Benjamin Cummings
- Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. *Introduction to Genetic Analysis*. IX Edition. W. H. Freeman and Co
- Fletcher H. and Hickey I. (2015). *Genetics*. IV Edition. GS, Taylor and Francis Group, New York and London.



Department of Zoology, School of Life Sciences, GGV, Bilaspur (CG)

DISCIPLINE SPECIFIC ELECTIVE COURSE

LS/ZOO/DSE-502(B) L

REPRODUCTIVE BIOLOGY

THEORY

(Credits 4)

Unit 1: Functional anatomy of male reproduction

12

Outline and histology of male reproductive system in human; Testes: Cellular functions, germ cell; Epididymal function and sperm maturation; Accessory glands functions; Sperm transportation in male tract.

Unit 2: Functional anatomy of female reproduction

12

Reproductive cycles (rat and human) and their regulation, changes in the female tract; Outline and histological of female reproductive system in human; Ovary: folliculogenesis ovulation, corpus luteum formation and regression; secretion of ovarian hormones.

Unit 3: Gametogenesis

12

Spermatogenesis: kinetics and hormonal regulation; Androgen synthesis and metabolism; Oogenesis, Hormonal regulation of Oogenesis, Steroidogenesis Pathway and regulation, STAR, SRBPE.

Unit 4: 12

Hormonal regulation of gestation, pregnancy diagnosis, foeto-maternal relationship; Mechanism of parturition and its hormonal regulation; Lactation and its regulation.

Unit 5: Reproductive Endocrinology

12

Mechanism of action of Gonadal hormone, steroids, glycoprotein hormones, prostaglandins, hypothalamo - hypophyseal - gonadal axis, regulation of gonadotrophin secretion in male and female; Reproductive System: Development and differentiation of gonads, genital ducts, external genitalia, mechanism of sex differentiation.

Unit 6: Reproductive Health

12

Infertility in male and female: causes, diagnosis and management; Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, in vitro fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; Modern contraceptive technologies; Demographic terminology used in family planning.

Course Objective:

Aims to understand the scientific principles that govern reproduction in humans and other mammals.

Course Outcomes:

Advances in this field provided the knowledge for assisted conception and revolutionized reproductive medicine and veterinary practice.

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36



Department of Zoology, School of Life Sciences, GGV, Bilaspur (CG)

DISCIPLINE SPECIFIC ELECTIVE COURSE

LS/ZOO/DSE-502(B) P

REPRODUCTIVE BIOLOGY

PRACTICALS

(Credits 2)

1. Study of animal house: set up and maintenance of animal house, brooding techniques, care of normal and experimental animals.
2. Examination of vaginal smear rats from live animals.
3. Surgical techniques: principles of surgery in endocrinology. Ovariectomy, hysterectomy, castration and vasectomy in rats.
4. Examination of histological sections from photomicrographs/ permanent slides of rat/human: testis, epididymis and accessory glands of male reproductive systems; Sections of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina.
5. Human vaginal exfoliate cytology.
6. Sperm count and sperm motility in rat
7. Study of modern contraceptive devices
8. Mini projects involving survey, data collection, statistical analysis, and submission of a project report on reproductive health of a small human population.

SUGGESTED READINGS

- Austin, C.R. and Short, R.V. reproduction in Mammals. Cambridge University Press.
- Degroot, L.J. and Jameson, J.L. (eds). Endocrinology. W.B. Saunders and Company.
- Knobil, E. et al. (eds). The Physiology of Reproduction. Raven Press Ltd.
- Hatcher, R.A. et al. The Essentials of Contraceptive Technology. Population Information Programme.



Department of Zoology, School of Life Sciences, GGV, Bilaspur (CG)

CORE COURSE XIII

LS/ZOO/CC-601 L

DEVELOPMENTAL BIOLOGY

THEORY

(Credits 4)

Unit 1: Introduction	12
Historical perspective and basic concepts: Phases of development, Cell-Cell interaction, Pattern formation (Axis formation in <i>Drosophila</i>), Differential gene expression, Cytoplasmic determinants and asymmetric cell division; Basic concept of induction, competence, specification and differentiation.	
Unit 2: Gamete Biology and Fertilization	10
Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal); Sperm-egg interaction; Changes in gametes, Blocks to polyspermy	
Unit 3: Early Embryonic Development	10
Planes and patterns of cleavage; Types of Blastula; Fate maps (including Techniques); Early development of frog and chick up to gastrulation; Embryonic induction and organizers	
Unit 4: Late Embryonic Development	8
Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta)	
Unit 5: Post Embryonic Development	12
Metamorphosis: Changes, hormonal regulations in amphibians and insects; Regeneration: Modes of regeneration, epimorphic regeneration of Salamander limbs, morphallactic regeneration in <i>Hydra</i> and compensatory regeneration in mammalian liver; Ageing: concept and theories.	
Unit 6: Implications of Developmental Biology	8
Teratogenesis: Teratogenic agents and their effects on embryonic development; <i>In vitro</i> fertilization, Stem cell (ESC), Amniocentesis	

Course objective

The main aim of the paper on Developmental Biology is to provide an in-depth knowledge on the embryonic and post embryonic developmental processes. The course explains the basic principles and concepts underlying the developmental processes at the cellular and molecular level. By understanding the developmental processes the students can relate to errors occurring in during development leading to congenital disorder and human diseases. The paper also addresses the problem of infertility in humans and how to overcome this

Course Outcomes

Students will be able to understand the fundamentals of developing process. Knowledge regarding embryonic and post embryonic developments will be imparted to students.

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Department of Zoology, School of Life Sciences, GGV, Bilaspur (CG)

CORE COURSE XIII

LS/ZOO/CC-601 P

DEVELOPMENTAL BIOLOGY

PRACTICALS

(Credits 2)

1. Collection, preparation and Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages)
2. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages)
3. Window preparation to study chick embryo development
4. Study of the developmental stages and life cycle of *Drosophila* from stock culture
5. Study of different sections of placentas (photomicrograph/ slides)
6. Project report on *Drosophila* culture/chick embryo development
7. A visit to Poultry farm/TVF centre

SUGGESTED READINGS

- Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA
- Balinsky B. I. and Fabian B. C. (1981). An Introduction to Embryology, V Edition, International Thompson Computer Press
- Carlson, R. F. Patten's Foundations of Embryology
- Kalthoff (2008). Analysis of Biological Development, II Edition, McGraw- Hill Publishers
- Lewis Wolpert (2002). Principles of Development. II Edition, Oxford University Press



Department of Zoology, School of Life Sciences, GGV, Bilaspur (CG)

CORE COURSE XIV

LS/ZOO/CC-602 L

EVOLUTIONARY BIOLOGY

THEORY

(Credits 4)

Unit 1: Origin of Life Chemogeny and Biogeny, RNA world.	4
Unit 2: Historical Review of Evolutionary Concept Lamarckism, Darwinism, Neo-Darwinism.	10
Unit 3: Evidences of Evolution: Fossil record (types of fossils, transitional forms, geological time scale, evolution of horse, Molecular (universality of genetic code and protein synthesizing machinery, neutral theory of molecular evolution, molecular clock, example of globin gene family, rRNA/cyt c, role of heritable variations in evolution.	16
Unit 4: Population Genetics: Hardy-Weinberg Law; Natural selection (concept of fitness, selection coefficient, types of selection, genetic drift (mechanism, founder's effect, bottleneck phenomenon; Role of Migration and Mutation in changing allele frequencies.	12
Unit 5: Product of Evolution Micro evolutionary changes (inter-population variations, clines, races, species concept, isolating mechanisms, modes of speciation—allopatric, sympatric, Adaptive radiation / macroevolution (exemplified by Galapagos finches Phylogenetic trees, Multiple sequence alignment, construction of phylogenetic trees, interpretation of trees.	8
Unit 6: Species Concepts and Species Attribute The "Modern Synthesis". The nature of evolutionary units; Species concepts, The Biological Species concept.	10

Course Objective:

The course aims to provide students with a deeper insight into the evolutionary processes - both selective and random which can explain the genetic composition of populations, form, behavior and distribution of organisms, and to teach students the basic methods of analyzing the evolutionary relationships between species.

Course Outcome:

A student who has completed the course should have solid knowledge of: natural selection as key to understanding the natural world; how natural selection produces adaptation; the origins of genetic variation; population genetic consequences of selection, mutation, migration (gene flow), inbreeding; genetic drift, an important evolutionary force; evolution of social behavior and kin selection; sexual selection; evolution of life history characters.

28



Department of Zoology, School of Life Sciences, GGV, Bilaspur (CG)

CORE COURSE XIV

LS/ZOO/CC-602 P

EVOLUTIONARY BIOLOGY

PRACTICALS

(Credits 2)

1. Study of fossils from models/ pictures
2. Study of homology and analogy from suitable specimens
3. Study and verification of Hardy-Weinberg Law by chi square analysis
4. Demonstration of role of natural selection and genetic drift in changing allele frequencies using simulation studies
5. Graphical representation and interpretation of data of height/ weight of a sample of 100 humans in relation to their age and sex.
6. Construction of phylogenetic trees with the help of bioinformatics tools (Clustal X, Phylip, NJ) and its interpretation
7. Construction of cladograms based on morphological characters.

SUGGESTED READINGS

- Ridley, M (2004) Evolution III Edition Blackwell publishing
- Hall, B.K. and Hallgrimson, B (2008). Evolution IV Edition, Jones and Barlett, Publishers.
- Campbell, N.A. and Reece J.B (2011). Biology. IX Edition. Pearson, Benjamin Cummings.
- Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.
- Snustad, S. Principles of Genetics.
- Pevsner, J (2009). Bioinformatics and Functional Genomics. II Edition Wiley Blackwell



Department of Zoology, School of Life Sciences, GGV, Bilaspur (CG)

DISCIPLINE SPECIFIC ELECTIVE COURSE

LS/ZOO/DSE-601(B) L

FISH AND FISHERIES

THEORY

(Credits 4)

Unit 1: Introduction and Classification

6

General characters of fish; Account of systematic classification of fishes (upto classes); Classification based on feeding habit, habitat and manner of reproduction. Ornamental and weed fishes; Fin formula.

Unit 2: Morphology and Physiology

16

Different types of fins and scales; Use of scales in classification and determination of age of fish; Gills and gas exchange; Swim Bladder; types and role in respiration, buoyancy; Osmoregulation and ionic balance in fishes; Reproductive strategies (special reference to Indian fishes); Electric organs, Bioluminescence; Schooling; Parental care; Migration.

Unit 3: Fisheries

10

Inland Fisheries; Marine Fisheries; Fishing crafts and Gears; Depletion of fisheries resources; Application of remote sensing and GIS in fisheries; Fisheries law and regulations.

Unit 4: Aquaculture

16

Sustainable Aquaculture; Qualities of culturable species of fishes; Types of pond in a fish farm; Pen and cage culture; Integrated fish farming; Composite fish culture; Brood stock management; Induced breeding of fish; Hatchery; Preparation of compound diets for fish; Role of water quality in aquaculture; Fish by-products.

Unit 5: Fish Pathology and Cure

8

Sign of sickness in fishes, defensive devices in fishes against diseases, diseases of fishes: Nutritional diseases, bacterial disease (Infectious dropy, Tail rot or fin rot), Fungal diseases (Dermatomycoses, Branchiomycoses) and protozoan diseases (Ichthyophthiriusiasis, Costiaasis).

Unit 6: Fish in research

4

Transgenic fish, Zebra fish as a model organisms in research.

Course Objectives:

To know about the diversity of fishes

To know about the edible and non-edible fish

To fulfill the great demands of nutritious food

To promote the fish industry basically based on fish byproducts

Course Outcomes:

Class Pisces is the largest group of the vertebrates. This group provides us highly nutritious food at the low cost. Fish byproducts are also used for various purposes. Therefore, it is utmost need in the present era to involve more and more people in the fish industry.

-40-



Department of Zoology, School of Life Sciences, GGV, Bilaspur (CG)

DISCIPLINE SPECIFIC ELECTIVE COURSE

LS/ZOO/DSE-601(B) P

FISH AND FISHERIES

PRACTICALS

(Credits 2)

1. Morphometric and meristic characters of fishes
2. Study of *Petromyzon*, *Myxine*, *Pristigaster*, *Chamaera*, *Exocoetis*, *Hippocampus*, *Gambusia*, *Labeo*, *Heteropneustes*, *Anabas*
3. Study of different types of scales (through permanent slides/ photographs).
4. Study of crafts and gears used in Fisheries
5. Study of air breathing organs in *Channa*, *Heteropneustes*, *Anabas* and *Clarias*
6. Study of ventilation rate of an air-breathing fish under different experimental conditions.
7. Determination of gonadosomatic index
8. Demonstration of induced breeding in Fishes (video)
9. Demonstration of parental care in fishes (video)
10. Project Report on a visit to any fish farm/ pisciculture unit/Zebrafish rearing Lab.

SUGGESTED READINGS

- Q Bone and R Moore, Biology of Fishes, Taylor and Francis Group, CRC Press, U.K.
- D. H. Evans and J. D. Claiborne, The Physiology of Fishes, Taylor and Francis Group, CRC Press, UK von der Emde, R.J. Mogdans and B.G. Kapoor. The Senses of Fish: Adaptations for the Reception of Natural Stimuli, Springer, Netherlands
- C.B.L. Srivastava, Fish Biology, Narendra Publishing House
- J.R. Norman, A history of Fishes, Hill and Wang Publishers
- S.S. Khanna and H.R. Singh, A text book of Fish Biology and Fisheries, Narendra Publishing House