Scheme for 03 / 04 Years Undergraduate Programme in Zoology as per NEP 2020 (Batch 2025)

Department of Zoology, Central University of Kashmir, Ganderbal (J&K) – India.

CURRICULUM FRAMEWORK AND CREDIT DISTRIBUTION FOR UG PROGRAMME AT CUK

Semester	Major Course	Minor Course	MDC	AEC	SEC	VAC	Internship	Research Dissertation	Total Credits
Semester - I	6	4	3	2	3	2	--	--	20
Semester - II	6	4	3	2	3	2	--	--	20
Semester - III	6	4	3	2	3	2	--	--	20
Semester - IV	12	4	--	2	--	2	--	--	20
Semester - V	12	8	--	--	--	--	--	--	20
Semester – VI	18	--	--	--	--	--	2	--	20
Total Credits of 03 Years Degree	*60*	*24*	*09*	*08*	*09*	*08*	*02*	*--*	*120*
Simple Honors (4-Years)									
Semester – VII	8	8	--	--	--	--	4	--	20
Semester - VIII	12	8	--	--	--	--	--	--	20
Honors With Research (4-Years)									
Semester – VII	12	8	--	--	--	--	--	--	20
Semester - VIII	8	--	--	--	--	--	--	12	20
Total Credits of 04 Years Degree	*80*	*32*	*09*	*08*	*09*	*08*	*02*	*12*	*160*

Scheme for 03 / 04 Years Undergraduate Programme in Zoology as per NEP 2020 (Batch 2025)

Department of Zoology, Central University of Kashmir, Ganderbal (J&K) – India.

SEMESTER - I

Course Type	Course Code	Course Title	Course Credits	Total Credits
MAJOR	**GCC.11.101**	Non-Chordates Zoology	**4**	**06**
	GCC.11.101-P	Lab Course	**2**	
MINOR	*A student shall have to take **one Minor Course** offered by any other Department / School.*		**4**	**04**
MDC	*A student shall have to take **one Multidisciplinary Course** which is not studied at higher secondary level (12th class) from any discipline.*		**3**	**03**
AEC	*A student shall have to take **one Ability Enhancement Course** offered by Language Departments.*		**2**	**02**
SEC *(Choose any one course along with Experiential Learning)*	**GCC.15.101**	Introduction to Apiculture	**2**	**03**
	GCC.15.101-P	Experiential Learning	**1**	
	GCC.15.102	Introduction to Sericulture	**2**	
	GCC.15.102-P	Experiential Learning	**1**	
VAC	**GCC.16.101**	Environment Education - I	**2**	**02**
Total Credits of Semester				**20**

Scheme for 03 / 04 Years Undergraduate Programme in Zoology as per NEP 2020 (Batch 2025)

Department of Zoology, Central University of Kashmir, Ganderbal (J&K) – India.

SEMESTER - II

Course Type	Course Code	Course Title	Course Credits	Total Credits
MAJOR	**GCC.11.151**	Chordates Diversity and Comparative Anatomy	**4**	**06**
	GCC.11.151-P	Lab Course	**2**	
MINOR	*A student shall have to take **one Minor Course** offered by any other Department / School.*		**4**	**04**
MDC	*A student shall have to take **one Multidisciplinary Course** which is not studied at higher secondary level (12th class) from any discipline.*		**3**	**03**
AEC	*A student shall have to take **one Ability Enhancement Course** offered by Language Departments.*		**2**	**02**
SEC *(Choose any one course along with Experiential Learning)*	**GCC.15.151**	Bee Keeping Technology	**2**	**03**
	GCC.15.151-P	Experiential Learning	**1**	
	GCC.15.152	Silkworm Rearing Technology	**2**	
	GCC.15.152-P	Experiential Learning	**1**	
VAC	**GCC.16.151**	Health and Hygiene	**2**	**02**
Total Credits of Semester				**20**

Note: *Students exiting the programme after securing **40 credits** will be awarded **UG Certificate** in **Zoology** provided they have undergone a minimum **04** credits skill enhancement course over and above the **40** credits earned for completing level 4.5.*

Scheme for 03 / 04 Years Undergraduate Programme in Zoology as per NEP 2020 (Batch 2025)

Department of Zoology, Central University of Kashmir, Ganderbal (J&K) – India.

SEMESTER - III

Course Type	Course Code	Course Title	Course Credits	Total Credits
MAJOR	**GCC.11.201**	Economic Zoology	**4**	**06**
	GCC.11.201-P	Lab Course	**2**	
MINOR	*A student shall have to take **one Minor Course** offered by any other Department / School.*		**4**	**04**
MDC	*A student shall have to take **one Multidisciplinary Course** which is not studied at higher secondary level (12th class) from any discipline.*		**3**	**03**
AEC	*A student shall have to take **one Ability Enhancement Course** offered by Language Departments.*		**2**	**02**
SEC *(Choose any one course along with Experiential Learning)*	**GCC.15.201**	Bee Products and Disease Management	**2**	**03**
	GCC.15.201-P	Experiential Learning	**1**	
	GCC.15.202	Sericulture Products and Disease Management)	**2**	
	GCC.15.202-P	Experiential Learning	**1**	
VAC	**GCC.16.201**	Biodiversity and Conservation Biology	**2**	**02**
Total Credits of Semester				**20**

Scheme for 03 / 04 Years Undergraduate Programme in Zoology as per NEP 2020 (Batch 2025)

Department of Zoology, Central University of Kashmir, Ganderbal (J&K) – India.

SEMESTER - IV

Course Type	Course Code	Course Title	Course Credits	Total Credits
MAJOR	**GCC.11.251**	Ecology and Limnology	**4**	**12**
	GCC.11.251-P	Lab Course	**2**	
	GCC.11.252	Cell Biology	**4**	
	GCC.11.252-P	Lab Course	**2**	
MINOR	*A student shall have to take **one Minor Course** offered by any other Department / School **OR** via MOOC from UGC-SWAYAM.*		**4**	**04**
AEC	*A student shall have to take **one Ability Enhancement** Course offered by Language Departments.*		**2**	**02**
VAC	**GCC.16.251**	Environment Education - II	**2**	**02**
Total Credits of Semester				**20**

Note: *Students exiting the programme after securing **80 credits** will be awarded **UG Diploma** in **Zoology** provided they have undergone a minimum **04** credits skill enhancement course over and above the **80** credits earned for completing level 5.*

Scheme for 03 / 04 Years Undergraduate Programme in Zoology as per NEP 2020 (Batch 2025)

Department of Zoology, Central University of Kashmir, Ganderbal (J&K) – India.

SEMESTER - V

Course Type	Course Code	Course Title	Course Credits	Total Credits
MAJOR	**GCC.11.301**	Animal Physiology	**4**	**12**
	GCC.11.301-P	Lab Course	**2**	
	GCC.11.302	Reproductive Biology and Endocrinology	**4**	
	GCC.11.302-P	Lab Course	**2**	
MINOR	*A student shall have to take **two Minor Courses** offered by any other Department / School **OR** via MOOC from UGC-SWAYAM.*		**8**	**08**
Total Credits of Semester				**20**

Scheme for 03 / 04 Years Undergraduate Programme in Zoology as per NEP 2020 (Batch 2025)

Department of Zoology, Central University of Kashmir, Ganderbal (J&K) – India.

SEMESTER - VI

Course Type	Course Code	Course Title	Course Credits	Total Credits
MAJOR	GCC.11.351	Fundamentals of Biochemistry	4	18
	GCC.11.351-P	Lab Course	2	
	GCC.11.352	Genetics and Cytogenetics	4	
	GCC.11.352-P	Lab Course	2	
	GCC.11.353	Immunology	4	
	GCC.11.353-P	Lab Course	2	
INTERNSHIP	GCC.17.351	Internship	2	02
Total Credits of Semester				**20**

Note:

- *Students who have earned a total of **120** credits by completing level 5.5 shall be awarded **B.Sc.** in **Zoology,** provided he/she want to exit the programme.*
- *Students can undergo an **internship** in the Department/other Universities/Research institutes/skill based industries.*

Scheme for 03 / 04 Years Undergraduate Programme in Zoology as per NEP 2020 (Batch 2025)

Department of Zoology, Central University of Kashmir, Ganderbal (J&K) – India.

SEMESTER – VII
(Simple Honors)

Course Type	Course Code	Course Title	Course Credits	Total Credits
MAJOR	**GCC.11.401**	Systematics and Evolutionary Biology	**4**	**08**
	GCC.11.402	Fundamentals of Biostatistics	**4**	
MINOR	*A student shall have to take **two Minor Courses** offered by any other Department / School.*		**8**	**08**
INTERNSHIP	**GCC.17.401**	Internship	**4**	**04**
Total Credits of Semester				**20**

Note:

- *Students can undergo an **internship** in the Department/other Universities/Research institutes/skill-based industries.*

Scheme for 03 / 04 Years Undergraduate Programme in Zoology as per NEP 2020 (Batch 2025)

Department of Zoology, Central University of Kashmir, Ganderbal (J&K) – India.

SEMESTER – VIII
(Simple Honours)

Course Type	Course Code	Course Title	Course Credits	Total Credits
MAJOR	**GCC.11.451**	Tools and Techniques in Biology	**4**	**12**
	GCC.11.451-P	Lab Course	**2**	
	GCC.11.452	Molecular Biology	**4**	
	GCC.11.452-P	Lab Course	**2**	
MINOR	*A student shall have to take **two Minor Courses** offered by any other Department / School.*		**8**	**08**
Total Credits of Semester				**20**

Note:

- *After the Completion of 04 years (08 Semesters) the students shall be awarded the degree of **B.Sc. Honours** in **Zoology** provided they secure **160** credits and want to exit the programme.*

Scheme for 03 / 04 Years Undergraduate Programme in Zoology as per NEP 2020 (Batch 2025)

Department of Zoology, Central University of Kashmir, Ganderbal (J&K) – India.

SEMESTER – VII
(Honours with Research)

Course Type	Course Code	Course Title	Course Credits	Total Credits
MAJOR	**GCC.11.401**	Tools and Techniques in Biology	**4**	**12**
	GCC.11.401-P	Lab Course	**2**	
	GCC.11.402	Molecular Biology	**4**	
	GCC.11.402-P	Lab Course	**2**	
MINOR	*A student shall have to take **two Minor Courses** offered by any other Department / School.*		**8**	**08**
Total Credits of Semester				**20**

Scheme for 03 / 04 Years Undergraduate Programme in Zoology as per NEP 2020 (Batch 2025)

Department of Zoology, Central University of Kashmir, Ganderbal (J&K) – India.

SEMESTER – VIII
(Honours with Research)

Course Type	Course Code	Course Title	Course Credits	Total Credits
MAJOR	**GCC.11.451**	Systematics and Evolutionary Biology	**4**	**08**
	GCC.11.452	Research Methodology	**4**	
OR				
A student can opt 01 Course of Zoology (04 credits) and a Research Methodology Course via MOOC from UGC-SWAYAM provided the courses chosen have not been studied from 1st – 7th Semesters.				**08**
DISSERTATION	**GCC.18.451**	Research Dissertation	**12**	**12**
Total Credits of Semester				**20**

Note:

- *After the Completion of 04 years (08 Semesters) with Research Dissertation the students shall be awarded the degree of **B.Sc. Honours with Research** in **Zoology** provided they secure **160** credits and want to exit the programme.*

Syllabi

for

03/04 Years Undergraduate Programme in Zoology

(As Per NEP 2020)

Department of Zoology
School of Life Sciences
Central University of Kashmir
Ganderbal (J&K), India-191201

Semester - I

Semester - I

Course Code	GCC.11.101	Course Title	NON-CHORDATES ZOOLOGY

Scheme of Instruction		Scheme of Evaluation	
Total Duration	**60 Hours**	**Max. Marks**	**100**
Hours/Week	**04 Hours**	**CIA**	**45**
Credits	**04**	**Attendance**	**05**
Instruction Delivery	**Theory**	**ESE**	**50**
Course Type	**Major**	**Exam Duration**	**2.30 Hr.**
Instruction Mode	**Regular**	**Evaluation**	**Grade**

Course Objectives	• *This course is designed to understand all general characteristics and classifications of non-chordates.* • *The course provides knowledge about coelom, nutrition, digestion, respiration, excretion, larval forms and parasites of non-chordates.* • *This course also focuses on the taxonomic status of the non-chordates and compares the functional aspects of their different systems.* • *The course is designed to inculcate the importance of lower animals in the environment.*
Course Outcomes	***After successfully completing this course, the students will be able to*** • Recall the levels of organisation among different groups of Non-Chordates. • Bring out the general characters of Non-Chordates. • Classify the Phyla of Non-Chordates up to class level. • Distinguish between acoelomates and coelomates Non-Chordates. • Predict the systematic position of Non-Chordates.

Unit I:	**Module-1** General characters and classification of Phylum Protozoa up to class level with distinctive features and suitable examples of each class. **Module-2** General characters and classification of Phylum Porifera and Coelenterata up to class level with distinctive features and suitable examples of each class. **Module-3** General characters and classification of Phylum Platyhelminths and Annelida up to class level with distinctive features and suitable examples of each class. **Module-4** General characters and classification of Phylum Arthropoda up to class level with distinctive features and suitable examples of each class. **Module-5** General characters and classification of Phylum Mollusca

	and Echninodermata up to class level with distinctive features and suitable examples of each class.
Unit II:	**Module-1** Morphology and Sexual reproduction in *Paramecium*. **Module-2** Life cycle and pathogenesis of *Entamoeba*. **Module-3** Reproduction and Life cycle of *Monocystis*. **Module-4** Canal system and Skeletal system in Porifera. **Module-5** Polymorphism in Coelenterata, Coral and Coral reefs. General organization and Evolutionary significance of Ctenophora.
Unit III:	**Module-1** Digestive System, Excretory System of *Pheretima*. **Module-2** Digestive System, Excretory System of Cockroach. **Module-3** Evolutionary significance of Onychophora. **Module-4** Digestive System and Nervous System of *Pila*. **Module-5** Torsion and detorsion in Gastropods, Water vascular system in Asteroidea.
Unit IV:	**Module-1** Types and Evolution Coelom. **Module-2** Types and Evolution of Metamerism, Filter feeding in Polychaetes. **Module-3** Photoreceptors in Arthropods, Respiration in arthropods. **Module-4** Parasitism in Crustaceans, Larval form in Echinodermata. **Module-5** Balanoglossus, morphology and affinities, Tornaria larva.

Reference Books:

1. Barnes, R.D. (1982). Invertebrate Zoology, V Ed. Holt Saunders International Edition.
2. Boolotian & Stiles. 1981. College Zoology (10thEd.)
3. Dorit, Walker &Barnes. 1991.Zoology(Saunders)
4. Marshall & Williams. 1972. Text book of Zoology. Vol. I (Parker & Haswell, 7th Ed.)
5. Nigam. 1997. Biology of Non-Chordates (S. Chand)
6. Villee, Walker & Baranes. 1979. General Zoology 5th Ed. Saunders
7. Hoar, 2005. General and Comparative Physiology (5th Ed. Cambridge)

Semester - I

Course Code	GCC.11.101-P	Course Title	LAB COURSE

Scheme of Instruction		Scheme of Evaluation	
Total Duration	60 Hours	Max. Marks	50
Hours/Week	04 Hours	CIA	20
Credits	02	Attendance	05
Instruction Delivery	Practical	ESE	25
Course Type	Major	Exam Duration	01 Hr.
Instruction Mode	Regular	Evaluation	Grade

1. Study of the salient features of the following Non-chordates: (*Amoeba, Euglena, Trypanosoma, Paramecium, Leucosolenia, Sycon, Euplectella, Spongilla, Euspongia, Hydra, Aurelia, Tubipora, Medrepora, Milipora, Metridium, Planaria, Fasciola, Taenia, Nereis, Pheretima, Hirudo, Peripatus, Palaeomon, Limulus,* Scorpion, Tick, Honey bee, Louse, Butterfly, beetle, *Chiton, Unio, Sepia, Octopus,* Starfish, *Holothuria*).
2. Slide preparation of the Septal nephridia of the Earthworm.
3. Study of the Digestive system, Reproductive system & Nerve ring of the Earthworm through dissection.
4. Any other practical found feasible by the teacher and approved by the Coordinator/Head.

Course Code	GCC.15.101	Course Title	INTRODUCTION TO APICULTURE

Scheme of Instruction		Scheme of Evaluation	
Total Duration	30 Hours	Max. Marks	50
Hours/Week	02 Hours	CIA	20
Credits	02	Attendance	05
Instruction Delivery	Theory	ESE	25
Course Type	SEC	Exam Duration	1.30 Hr.
Instruction Mode	Regular	Evaluation	Grade

Course Objectives	• *This course has been designed to inculcate the importance of Beekeeping concerning entrepreneurship development.* • *The course gives detailed knowledge about various types of honey bees, their diagnostic characters, and behaviour.*
Course Outcomes	***After successfully completing this course, the students will be able to*** • Know about the scope and importance of apiculture for entrepreneurship. • Understand the Biology of honey bees and traditional and modern methods of beekeeping.

Unit I:	**Module-1** Apiculture, scope and importance. **Module-2** History and growth of modern beekeeping in India. **Module-3** Traditional and Modern beekeeping. **Module-4** Classification of honey bees, morphological characters and identification of rock bee (*Apis dorsata*), little bee (*Apis florea*) Indian bee (*Apis cerana*), European bee (*Apis mellifera*). **Module-5** Life cycle of Honey bee, pollen baskets structure and function.
Unit II:	**Module-1** Nesting behaviour & Sense organs. **Module-2** Honey bee dances, types and stages, Evolution of dances and bee communication. **Module-3** Role of pheromones in bee communication, Social organization in honey bees. **Module-4** Importance of bee pasturage and their relative utility to honey bees. **Module-5** Role and need of planned bee pollination in agriculture.

Reference Books:

1. Dewey M. Caron, 2013. Honey Bee Biology and Beekeeping, Revised Edition. Wicwas Press, Kalamazoo.
2. Eva Crane, 1999. The World History of Beekeeping and Honey Hunting. Routledge, India.

3. Ted Hooper, 2010. Guide to Bees and Honey: The World's Best Selling Guide to Beekeeping. Northern Bee Books, Oxford.
4. Prospective in Indian Apiculture - R.C. Mishra
5. Rearing queen bees in India - M.C. Surya narayana et. al.
6. Bee Keeping in India - G. K. Ghosh
7. Technology and value addition of Honey - Dr. D. M. Wakhle and K. D. Kamble.

Semester - I

Course Code	GCC.15.101-P	Course Title	EXPERIENTIAL LEARNING

Scheme of Instruction		Scheme of Evaluation	
Total Duration	30 Hours	Max. Marks	50
Hours/Week	02 Hours	CIA	20
Credits	01	Attendance	05
Instruction Delivery	Practical	ESE	25
Course Type	SEC	Exam Duration	01 Hr.
Instruction Mode	Regular	Evaluation	Grade

Activities:

1. To study the morphology of honey bee.
2. Identification of different species of honey bee.
3. Identification of honey bee castes.
4. To study different stages in life cycle of Honey bee.
5. Study of bee hive structure and handling.
6. Colony inspection, maintenance, writing up of inspection report.
7. Visit to Apiary.

Semester - I

Course Code	GCC.15.102	Course Title	INTODUCTION TO SERICULTURE

Scheme of Instruction		Scheme of Evaluation	
Total Duration	30 Hours	Max. Marks	50
Hours/Week	02 Hours	CIA	20
Credits	02	Attendance	05
Instruction Delivery	Theory	ESE	25
Course Type	SEC	Exam Duration	1.30 Hr.
Instruction Mode	Regular	Evaluation	Grade

Course Objectives	• *The course has been designed with the sericulture industry's scope, needs, and demands in mind.* • *The course focuses on technological aspects of sericulture and increases the students' employability opportunities.*
Course Outcomes	***After successfully completing this course, the students will be able to*** • Know the scope and importance of sericulture in J&K and India and the silkworm species' biology. • Know the popular mulberry varieties, commercial races of silkworms, methods of rearing and the optimum conditions required for mulberry cultivation.

Unit I:	**Module-1** Origin, history and scope of sericulture, Distribution of mulberry and Non-mulberry sericulture industry in India. **Module-2** Silk route, Popular mulberry varieties of temperate region. **Module-3** Optimum conditions for mulberry growth, Mulberry planting system. **Module-4** Methods of mulberry propagation (Seedling, Vegetative and Micro propagation). **Module-5** Irrigation methods and frequency, Pruning objectives and types.
Unit II:	**Module-1** Silk producing organisms (Tasar, Muga, Eri). **Module-2** Morphology of various stages (Egg, Larva, Pupa, and Moth) of Mulberry Silkworms. **Module-3** Biology of *Bombyx mori* and its life cycle. **Module-4** Anatomy of *Bombyx mori* (Digestive system and Reproductive System). **Module-5** Commercial races of silkworm in India (Multivoltine and Bivoltine), Structure of silk gland.

Suggested Books

1. Charsley, S.R. (1982). Culture and Sericulture. Academic Press Inc., New York, U.S.A

2. Dokuhon, Z.S. (1998). Illustrated Textbook on Sericulture. Oxford and IBH publishing Co., Pvt. Ltd. Calcutta.
3. Ganga, G., and J. Sulochana Chetty. (1991) An introduction to sericulture. Oxford and IBH Publishing Company.
4. Hasao Aruga (1994). Principles of Sericulture (Translated from Japanese) Oxford and IBH publishing Co., Pvt. Ltd. New Delhi.
5. Madan Mohan Rao, M. (1999) Comprehensive Sericulture Manual. PS Publications, Hyderabad.

Semester - I

Course Code	GCC.15.102-P	Course Title	EXPERIENTIAL LEARNING

Scheme of Instruction		Scheme of Evaluation	
Total Duration	30 Hours	Max. Marks	50
Hours/Week	02 Hours	CIA	20
Credits	01	Attendance	05
Instruction Delivery	Practical	ESE	25
Course Type	SEC	Exam Duration	01 Hr.
Instruction Mode	Regular	Evaluation	Grade

Activities:

1. Morphology of silkworm egg, larva, pupa and moth.
2. Comparative study of Mulberry and non-mulberry silkworms.
3. Identification of different developmental stages.
4. Identification of different races of silkworm.
5. Methods of mulberry cultivation.
6. Visit to different sericulture stations for field study.

Semester - I

Course Code	GCC.16.101	Course Title	ENVIRONMENT EDUCATION - I

Scheme of Instruction		Scheme of Evaluation	
Total Duration	30 Hours	Max. Marks	50
Hours/Week	02 Hours	CIA	20
Credits	02	Attendance	05
Instruction Delivery	Theory	ESE	25
Course Type	VAC	Exam Duration	1.30 Hr.
Instruction Mode	Regular	Evaluation	Grade

Course Objectives	• *The course has been designed to understand aspects of the environment and ecosystems.* • *The course focuses on different types of natural resources, their overexploitation, and the need for conservation.*
Course Outcomes	***After successfully completing this course, the students will be able to*** • Gain knowledge about the importance of the environment, implement conservation strategies for the environment, and be aware of problems of environmental pollution and its impact on humans and the ecosystem. • Learn about natural resources, their importance and the environmental impacts of human activities on natural resources.

Unit I:	**Module-1** Environment concept and importance; Components of environment, Environmental Movements (Chipko and Appiko Movement). **Module-2** Concept of Ecosystem, Structure and Function, Causes, effects and control measures of Air and Water pollution. **Module-3** Causes, effects and control measures of Soil, Noise and Solid waste pollution. **Module-4** Global environmental issues: Greenhouse effect, Climate change, Stratospheric ozone layer depletion and Acid rain. **Module-5** Man-Environment interaction, Industrial Revolution, and its impact on the environment.
Unit II:	**Module-1** Definition of resource, Classification of natural resources (biotic and abiotic). **Module-2** Energy resources: Sources of energy and their classification, renewable and non-renewable sources of energy; Conventional and Non-conventional energy sources. **Module-3** Consequences of over-exploitation of Forest resources; Consequences of over-utilization of Water resources. **Module-4** Global land use patterns, concept of land degradation and

	desertification. **Module-5** Sustainable Development Goals (SDGs), targets and indicators, challenges and strategies for SDGs.

Reference Books:

1. Panigrahi, A.K. and Alaka Sahu, 2014 - A text book of Environmental studies. Giribala Publications, Berhampur.
2. Carson, R. 2002 - Silent spring. Houghton Mittlin Harcourt
3. Gleeson, B. and Low, N. (eds) 1999 - Global ethics and environment. London
4. Odum, EP, Odum, HT and Andrews, J. 1971- Fundamentals of Ecology, Philadelphia, Saunders.
5. Singh, JS, Singh, SP and Gupta SR. 2014 - Ecology, Environmental Science and conservation. S. Chand Publications, New Delhi.
6. Smith, R.L. (2008); Ecology and Field biology, USA

Semester - II

Semester - II

Course Code	GCC.11.151	Course Title	CHORDATES DIVERSITY AND COMPARATIVE ANATOMY

Scheme of Instruction		Scheme of Evaluation	
Total Duration	60 Hours	Max. Marks	100
Hours/Week	04 Hours	CIA	45
Credits	04	Attendance	05
Instruction Delivery	Theory	ESE	50
Course Type	Major	Exam Duration	2.30 Hr.
Instruction Mode	Regular	Evaluation	Grade

Course Objectives	• *This course is designed to understand all Chordates' general characteristics, classification and taxonomic status.* • *The course provides knowledge about the nutrition, digestion, respiration, excretion and development of chordates.* • *This course also focuses on the comparative study of the structural and functional aspects of different systems of Vertebrates.* • *Overall the course outlines the importance and role of higher animals in the ecosystems.*
Course Outcomes	***After successfully completing this course, the students will be able to*** • Recall the levels of organization among different groups of Chordates. • Bring out the general characters of Protochordates and Euchordates. • Classify the sub-phyla of chordates according to class level and order level. • Predict the systematic position of Chordates.

Unit I:	**Module-1** General characters and classification of Protochordates (Urochordates and Cephalochordates) along with the suitable examples of each category. **Module-2** General characters and classification of Cyclostomata and Pisces along with the suitable examples of each category. **Module-3** General characters and classification of Amphibia and Reptilia along with the suitable examples of each category. **Module-4** General characters and classification of Aves along with the suitable examples of each category. **Module-5** General characters and classification of Mammalia and Reptilia along with the suitable examples of each category.
	Module-1 Digestive System and Circulatory system of *Herdmania*. Retrogressive Metamorphosis.

Unit II:	**Module-2** Migration and Osmoregulation in fishes. **Module-3** Neoteny in amphibians. Poison apparatus and biting mechanism in poisonous snakes, Snake Venom. **Module-4** Characters and evolutionary significance of *Archaeopteryx* and *Sphenodon*. **Module-5** Flightless birds and their distribution. Flight adaptations in birds.
Unit III:	**Module-1** Integumentary system and function of integument. **Module-2** Epidermal derivatives: glands & Epidermal Scales. **Module-3** Jaw suspensions in Vertebrates, Types of Vertebrae in Vertebrates. **Module-4** Cutaneous receptors and Chemoreceptors. **Module-5** Alimentary canal and associated glands in Vertebrates. Structure of stomach in ruminants.
Unit IV:	**Module-1** Respiratory organs (gills and lungs) Accessory respiratory organs of fishes. **Module-2** Evolution of heart and Modification of aortic arches in Vertebrates. **Module-3** Vertebrate kidney, Pronephros, Mesonephros and Metanephros. **Module-4** Gonads and their ducts in Vertebrates. **Module-5** Central Nervous system in Vertebrates (Elasmobranchs, Teleosts, Amphibia, Reptilia, Aves and Mammalia).

Reference Books:

1. Nigam: Biology of Chordates (1997, S. Chand)
2. Kotpal Series of Chordates (Rastogi Publications)
3. Parker & Haswell. 2005. Text book of Zoology Vol. II (Macmillan)
4. Kardong, K. V. 2005. Vertebrate's Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education.
5. Kent, G.C. and Carr, R. K. 2000. Comparative Anatomy of the Vertebrates. IX Edition the McGraw-Hill Company.
6. Weichert, C.K. and William Presch. 1970. Elements of Chordate Anatomy. Tata McGraw Hills.
7. Hilderbrand, M. and Gaslow, G.E. Analysis of Vertebrate Structure. John Wiley and sons.

Semester - II

Course Code	GCC.11.151-P	Course Title	LAB COURSE

Scheme of Instruction		Scheme of Evaluation	
Total Duration	60 Hours	Max. Marks	50
Hours/Week	04 Hours	CIA	20
Credits	02	Attendance	05
Instruction Delivery	Practical	ESE	25
Course Type	Major	Exam Duration	01 Hr.
Instruction Mode	Regular	Evaluation	Grade

1. Study of salient features of the following Museum Specimens: (*Herdmania, Amphioxus,* Lamprey, *Myxine, Scoliodon, Torpedo, Trygon, Chimaera, Labeo, Cattla, Cyprinus, Schizothorax, Tor, Protopterus, Uraeotyphlus, Ambystoma, Alytes, Hyla, Salamander,* Tortoise, Turtle, Cobra, *Hydrophis, Viper,* Sparrow, Kiwi, Duck, Platypus, Rat).
2. Identification of Poisonous and Non-Poisonous snakes.
3. Dissection of Fish to show Gills, Digestive system and Reproductive system.
4. Field survey for Photography and Identification of the local fauna (Amphibian, Reptiles & Birds).
5. Study of fowl skeletal system.
6. Study of swim bladder and gills in fishes.
7. Any other practical found feasible by the teacher and approved by the Coordinator/Head.

Semester - II

Course Code	GCC.15.151	Course Title	BEE KEEPING TECHNOLOGY

Scheme of Instruction		Scheme of Evaluation	
Total Duration	30 Hours	Max. Marks	50
Hours/Week	02 Hours	CIA	20
Credits	02	Attendance	05
Instruction Delivery	Theory	ESE	25
Course Type	SEC	Exam Duration	1.30 Hr.
Instruction Mode	Regular	Evaluation	Grade

Course Objectives	• *The course has been designed to give students knowledge about various techniques of Beekeeping to make them self-sustainable for entrepreneurship.* • *The course focuses on the techniques of bee hive construction and its maintenance.*
Course Outcomes	***After successfully completing this course, the students will be able to*** • Understand the handling of bee-keeping appliances, the structure of bee hives, methods of beekeeping and bee multiplication. • Develop strategies for the management of bee colonies around the year for income generation.

Unit I:	**Module-1** Appliances for bee keeping, Bee hive types and parts. **Module-2** Newtons's bee hive, BIS hive, Marthandam hive, Latest BIS specifications for bee hive, bee comb. **Module-3** Methods of beekeeping (Indigenous and Modern) and their advantages and disadvantages. **Module-4** Bee swarming, hive densities, hive placement, water provisions, transportation of hives. **Module-5** Methods of protecting honeybees from pesticides.
Unit II:	**Module-1** Methods of colony multiplication, Commercial queen rearing. **Module-2** Methods of rearing queens, (Hopkins Method, Alley Method and Miller Method). **Module-3** Dequeening method, Raising Queen on double and Whole Brood Comb. **Module-4** Management of bee during autumn and winter. **Module-5** Special bee management operations, swarming management, capturing the swarm, control of robbing in the apiary.

Reference Books:

1. Laidlaw, H.H., 1997. Contemporary queen rearing. Published by Dadant and Sons. R. A. Morse,

2. Rearing queen honey bees. Wicwas press, NY.
3. Alison Benjamin, By (author) Brian McCallum, 2008. Keeping Bees and Making Honey. David and Charles, Newton Abbot.
4. Kim Pezza, 2013. Backyard Farming: Keeping Honey Bees: From Hive Management to Honey Harvesting and More. Hatherleigh Press, U.S.

Semester - II

Course Code	GCC.15.151-P	Course Title	EXPERIENTIAL LEARNING

Scheme of Instruction		Scheme of Evaluation	
Total Duration	30 Hours	Max. Marks	50
Hours/Week	02 Hours	CIA	20
Credits	01	Attendance	05
Instruction Delivery	Practical	ESE	25
Course Type	SEC	Exam Duration	01 Hr.
Instruction Mode	Regular	Evaluation	Grade

Activities:

1. Identification of queen cells and drone cells.
2. Sugar feeding of colonies in scarcity period.
3. Study of beekeeping appliances and hive.
4. Methods of multiplication of bee colonies.
5. Steps for strengthening of colonies and Requeening technique.
6. Measures to be taken while transporting colonies.
7. Visit to Apiary.

Semester - II

Course Code	GCC.15.152	Course Title	SILKWORM REARING TECHNOLOGY

Scheme of Instruction		Scheme of Evaluation	
Total Duration	**30 Hours**	**Max. Marks**	**50**
Hours/Week	**02 Hours**	**CIA**	**20**
Credits	**02**	**Attendance**	**05**
Instruction Delivery	**Theory**	**ESE**	**25**
Course Type	**SEC**	**Exam Duration**	**1.30 Hr.**
Instruction Mode	**Regular**	**Evaluation**	**Grade**

Course Objectives	• *The course has been designed to know the rearing technology of young and late-age silkworms for raising assured cocoon crops.* • *The course focuses on rearing steps and methods, rearing appliances and optimum conditions for silkworm rearing.*
Course Outcomes	***After successfully completing this course, the students will be able to*** • Understand the breeding stations of silkworms, incubation methods, design of rearing house and appliances used in silkworm rearing. • Know methods of disinfection, feeding and cleaning during rearing and also techniques of cocoon harvesting.

Unit I:	**Module-1** Breeding Stations (P_4, P_3, P_2, and P_1), Selection of seed, Cocoon Rearer. **Module-2** Grainages and their procedures, Types of Eggs (Diapausing and Non-Diapausing Eggs), Storage of Eggs. **Module-3** Incubation (Constant Temperature, Raised Temperature Incubation, Embryonic method of Incubation). **Module-4** Transport of Eggs and Cocoons, Design of Rearing Houses. **Module-5** Rearing Appliances (Feeding, Bed Cleaning, Spacing), Rearing Appliances used for maintaining optimum conditions.
Unit II:	**Module-1** Disinfection (Physical and Chemical methods), Brushing (Brushing from loose eggs in egg boxes, egg cards). **Module-2** Maintenance of optimum conditions for Rearing, Feeding; Quantity, Frequency and Quality, Preparation of leaf for feeding. **Module-3** Bed Cleaning (Frequency of bed cleaning, Methods of Bed Cleaning, Spacing), Moulting; Care during moulting, Process of spinning. **Module-4** Methods of Moulting, Precautions to be taken during moulting, harvesting. **Module-5** Chawki Rearing (Paraffin Paper rearing, Box, New-net Method, Co-operative Rearing)Rearing of Nature Larvae.

Reference Books:

1. Omura, S. (1973) Silkworm Rearing Techniques in Tropics. Overseas Technical Cooperation Agency, Tokyo, Japan.
2. Rajan, R.K. and Himantharaj, H.T. (2005) Silkworm Rearing Technology. Central Silk Board, Bangalore.
3. Tazima, Y. (1972) Handbook of Silkworm Rearing. Fuji Pub. rCo. Ltd., Tokyo, Japan.
4. Hiratsuka. (1999) Silkworm Breeding Oxford and IBH publishing Co, Pvt. Ltd. New Delhi. Calcutta.
5. Narasimhanna. M.N. (1998). Manual on Silkworm egg Production. CSB., Govt. of India, Bangalore.

Semester - II

Course Code	GCC.15.152	Course Title	EXPERIENTIAL LEARNING

Scheme of Instruction		Scheme of Evaluation	
Total Duration	30 Hours	Max. Marks	50
Hours/Week	02 Hours	CIA	20
Credits	01	Attendance	05
Instruction Delivery	Practical	ESE	25
Course Type	SEC	Exam Duration	01 Hr.
Instruction Mode	Regular	Evaluation	Grade

Activities:

1. Plan of model rearing house.
2. Study of Rearing appliances.
3. Methods of disinfection of the rearing rooms and appliances.
4. Methods of brushing, rearing young age worms, feeding, cleaning and spacing schedule for chawki silkworm rearing.
5. Late stage rearing, feeding, cleaning, and spacing, temperature, humidity, requirements.
6. Different-types of mountages, methods of mounting, Harvesting and cocoon assessment.
7. Data recording during silkworms rearing.
8. Visit to sericulture station for studying silkworm rearing techniques.

Semester - II

Course Code	GCC.16.151	Course Title	HEALTH AND HYGIENE

Scheme of Instruction		Scheme of Evaluation	
Total Duration	30 Hours	Max. Marks	50
Hours/Week	02 Hours	CIA	20
Credits	02	Attendance	05
Instruction Delivery	Theory	ESE	25
Course Type	VAC	Exam Duration	1.30 Hr.
Instruction Mode	Regular	Evaluation	Grade

Course Objectives	• *This course is designed to know about various biochemical components of foods and their properties and gives ideas and awareness about public health and hygiene.* • *The course provides an opportunity to understand the importance of balanced nutrition for Health and also nutrient deficiency control programmes.*
Course Outcomes	***After successfully completing this course, the students will be able to*** • Understand the foods, nutrients, their deficiencies and schemes for combating the malnutrition. • Identify current national and global public health problems, national health care schemes and the importance of environmental and public hygiene programmes.

Unit I:	**Module-1** Nutrition, definition and importance, Good nutrition and malnutrition. **Module-2** Balanced Diet, Macro and micro minerals: functions, effects of deficiency. **Module-3** Functions, dietary sources, effects of deficiency of carbohydrates, lipids, proteins and vitamins. **Module-4** National Health Policy of Govt. of India-2017. **Module-5** Functioning of various nutrition and health organizations in India viz., NIN (National Institution of Nutrition), FNB (Food and Nutrition Board), IDA (Indian Dietetics Association).
Unit II:	**Module-1** Health, Key Health Indicators, Environment health & Public health. **Module-2** Health Education: Principles and Strategies. National Health: NRHM and NUHM Framework. **Module-3** Women & Child Health Care Schemes: Janani Shishu Suraksha Karyakaram (JSSK), Rashtriya Bal Swasthya Karyakram (RBSK), India Newborn Action Plan (INAP). **Module-4** Adolecent Heatlh: Rashtriya Kishor Swasthya Karyakram (RKSK). Hygiene: Personal, Community, Medical and Culinary

	hygiene. WASH (WAter, Sanitation and Hygiene) programme. Rural Community Health. **Module-5** Accredited Social Health Activist (ASHA), Rogi Kalyan Samitis. Environmental Sanitation and Sanitation in Public places.

Reference Books:

1. Mary Jane Schneider (2011) Introduction to Public Health.
2. Muthu, V.K. (2014) A Short Book of Public Health.
3. Detels, R. (2017) Oxford Textbook of Public Health (6th edition).
4. Gibney, M.J. (2013) Public Health Nutrition.
5. Wong, K.V. (2017) Nutrition, Health and Disease.

Semester - III

Semester - III

Course Code	GCC.11.201	Course Title	ECONOMIC ZOOLOGY

Scheme of Instruction		Scheme of Evaluation	
Total Duration	60 Hours	Max. Marks	100
Hours/Week	04 Hours	CIA	45
Credits	04	Attendance	05
Instruction Delivery	Theory	ESE	50
Course Type	Major	Exam Duration	2.30 Hr.
Instruction Mode	Regular	Evaluation	Grade

Course Objectives	• *This course is designed to familiarise the students with the significance of fish culture, prawn culture and pearl culture.* • *The course also briefly explains the scope and methods of apiculture, sericulture and lac culture.* • *Further it provides knowledge on vermiculture, poultry and dairy farming for becoming an entrepreneur.* • *The course also outlines the role of earthworms in mitigating waste management problems.*
Course Outcomes	***After successfully completing this course, the students will be able to*** • Analyse the rearing methods of fish and freshwater prawns. • Know about the benefits of insects for human health and livelihood. • Learn the rearing of methods of economically important insects. • Start entrepreneurship after becoming familiar with poultry and dairy farming. • Understand and implement the vermiculture technique for by-products and waste management.

Unit I:	**Module-1** Aquaculture scope and importance, Freshwater prawn culture, Pearl Culture. **Module-2** Fish pond: Breeding Pond, Hatching pond & rearing ponds. **Module-3** General account of Trout culture and carp culture, Composite fish farming. **Module-4** Induced breeding in fish, Fish by products. **Module-5** Fish diseases and management (bacterial, Viral and Fungal).
Unit II:	**Module-1** Apiculture: Life history and social behaviour of *Apis*. Methods of Bee keeping. **Module-2** Extraction of honey. Disease and their control. Importance of bee colonies in crop pollination. **Module-3** Lac culture: Lac insect and its life cycle. Cultivation of lac

	insect, Uses of lac. **Module-4** Sericulture: Types of silk; appliances of silkworm culture. **Module-5** Life history of silkworm, Diseases and their control.
Unit III:	**Module-1** Dairy: Indigenous and exotic breeds of cow and buffalo. **Module-2** Loose and conventional housing systems. Milk and milk products. **Module-3** Cattle Diseases and their management. **Module-4** Poultry: Breeds of fowl and their management. Rearing methods, Housing and Equipment. **Module-5** Feed formulations for chicks, Nutritive value of egg and meet. Diseases and control measures.
Unit IV:	**Module-1** Vermiculture: History and Scope. **Module-2** Biology of *Eisenia foetida*. Rearing of earthworms. **Module-3** Tools and devices used in vermiculture. **Module-4** Vermicomposting, harvest and processing, Nutritional composition of vermicompost. **Module-5** Vermiwash Collection, Composition and uses.

Reference Books:

1. Prost, P.J. (1962). Apiculture. Oxford and IBH, New Delhi
2. Hafez, E.S.E. (1962). Reproduction in Farm Animals, Lea and Fabiger Publishers
3. Srivastava, C. B. L. (1999). Fishery Science and Indian Fisheries. Kitab Mahal Publ.
4. Sardar Singh, Beekeeping in India. Indian Council of Agricultural Research. New Delhi.

Semester - III

Course Code	GCC.11.201-P	Course Title	LAB COURSE

Scheme of Instruction		Scheme of Evaluation	
Total Duration	60 Hours	Max. Marks	50
Hours/Week	04 Hours	CIA	20
Credits	02	Attendance	05
Instruction Delivery	Practical	ESE	25
Course Type	Major	Exam Duration	01 Hr.
Instruction Mode	Regular	Evaluation	Grade

1. Morphological characterization of common culture able fish species.
2. Mounting of the Cycloid scales.
3. Castes study of bees and whole mount preparation of the 3 pairs of legs for studying modification.
4. Mounting of sting apparatus of Honey Bee.
5. Study of morphological characters of *Bombyx mori.*
6. Collection of insect pollinators.
7. Fish farm visit for studying induced breeding and pond design.
8. Histopathology of microbial and parasitic infected fish.
9. Study of dairy and poultry breeds.
10. Collection of plant wastes & bed preparation for vermicompositing.
11. Collection and application of earthworms on beds.
12. Monitoring and harvesting of vermicompost.
13. Any other practical found feasible by the teacher and approved by the Coordinator/Head.

Semester - III

Course Code	GCC.15.201	Course Title	BEE PRODUCTS AND DISEASE MANAGEMENT

Scheme of Instruction		Scheme of Evaluation	
Total Duration	**30 Hours**	**Max. Marks**	**50**
Hours/Week	**02 Hours**	**CIA**	**20**
Credits	**02**	**Attendance**	**05**
Instruction Delivery	**Theory**	**ESE**	**25**
Course Type	**SEC**	**Exam Duration**	**1.30 Hr.**
Instruction Mode	**Regular**	**Evaluation**	**Grade**

Course Objectives	• *The course has been designed to inculcate the importance of honey and its processing for entrepreneurship.* • *The students will know about various techniques of honey processing and its marketing to make them self-sustainable.* • *The course also focuses on the honey bee disease and their management.*
Course Outcomes	***After successfully completing this course, the students will be able to*** • Know various products of honey bees and develop strategies for honey bee disease management. • Understand the honey processing unit, methods of honey extraction, medicinal values of honey, marketing of honey and problems related to marketing. • Formulate guidelines for appropriate technology development in honey production.

Unit I:	**Module-1** Bee products and their values, Types of honey. **Module-2** Extraction, handling and processing of honey. **Module-3** Honey processing unit, Honey testing. **Module-4** Properties and application in various fields, value added honey products. Chemical composition of honey. **Module-5** Honey adulteration, honey granulation and fermentation. Effects of forage on flavour.
Unit II:	**Module-1** Marketing of honey, (domestic and international) and marketing problems. **Module-2** Marketing of Bees for pollination services, Marketing of Bee products. **Module-3** Enemies of honeybees. **Module-4** Diseases of bee brood and adult bees. **Module-5** Management and control measures of viral, bacterial and fungal honey bee diseases.

References Books:

1. Roger A. Morse, Kim Flottum, 1998. Honey Bee Pests, Predators and Diseases. Wicwas Pr; 3rd edition.
2. Alethea Morrison (Author), Mars Vilaubi (Photographer), 2013. Homegrown Honey Bees: An Absolute Beginner's Guide to Beekeeping Your First Year, from Hiving to Honey Harvest. Storey Publishing, LLC; 1 edition.
3. Hunt, G.J., 2000. Using honey bees in pollination Purdue University.

Semester - III

Course Code	GCC.15.201-P	Course Title	EXPERIENTIAL LEARNING

Scheme of Instruction		Scheme of Evaluation	
Total Duration	30 Hours	Max. Marks	50
Hours/Week	02 Hours	CIA	20
Credits	01	Attendance	05
Instruction Delivery	Practical	ESE	25
Course Type	SEC	Exam Duration	01 Hr.
Instruction Mode	Regular	Evaluation	Grade

Activities:

1. Extraction of honey, moisture reduction, packing and storing of Honey.
2. Honey testing; physical and chemical methods of analysis.
3. Fermentation and granulation of honey.
4. Identification of symptoms of bee diseases.
5. Application of antibiotics to colonies, disinfection of frames.
6. Management of colonies and bee hive.
7. Natural enemies and predators of honeybees.
8. Visit to honey processing and packaging industry.

Semester - III

Course Code	GCC.15.202	Course Title	SERICULTURE PRODUCTS AND DISEASE MANAGEMENT

Scheme of Instruction		Scheme of Evaluation	
Total Duration	30 Hours	Max. Marks	50
Hours/Week	02 Hours	CIA	20
Credits	02	Attendance	05
Instruction Delivery	Theory	ESE	25
Course Type	SEC	Exam Duration	1.30 Hr.
Instruction Mode	Regular	Evaluation	Grade

Course Objectives	• *The course has been designed to learn the various cocoon marketing aspects.* • *The course provides knowledge about the processing and sorting of cocoons for marketing.* • *Further, the course also focuses on the diseases of silkworms and host plants and their management.*
Course Outcomes	***After successfully completing this course, the students will be able to*** • Know the processing, sorting and marketing of cocoons. • Understand the silk reeling operations and appliances and by-products of the sericulture industry. • Know the diseases of mulberry and silkworm to develop strategies for management.

Unit I:	**Module-1** Cocoon marketing and transport, Physical characteristics of cocoons for commercial purposes. **Module-2** Defective cocoons, Cocoon markets, Silk reeling, Storage and sorting of cocoons. **Module-3** Deflossing, Cocoon riddling, Brushing, Reeling operations and appliances. **Module-4** Raw silk testing, By-products of sericulture, By products of moriculture. **Module-5** By products of rearing, Grainage operations. Pupal and reeling wastes.
Unit II:	**Module-1** Disease of *Bombyx mori* (Protozoan & Bacterial). **Module-2** Disease of *Bombyx mori* (Viral and Fungal). **Module-3** Pests of silkworm, Deficiency diseases of macronutrients. **Module-4** Disease of mulberry (Fungal, Bacterial, Viral and Nematodes). **Module-5** Pest of mulberry (Leaf Eating Pests, Sap Feeders, Borer Pests), Control measures for mulberry pests in general.

Reference Books:

1. Diseases and Pests of mulberry and their control. Sen Gupta, Govindaiah and Pradeep Kumar CSR and TI Mysore (1991).
2. Govindan, R. and T.K. Narayanaswamy, Devaiah (1998). Principles and silkworm pathology-text book.
3. Hand book of pests and disease control of mulberry and silkworm; United Nation Publication, Bangkok, Thailand (1990).
4. Lu Yup Lian (1995). Silkworm diseases: oxford and IBH Publication. Co. Pvt. Ltd.

Semester - III

Course Code	GCC.15.202-P	Course Title	EXPERIENTIAL LEARNING

Scheme of Instruction		Scheme of Evaluation	
Total Duration	30 Hours	Max. Marks	50
Hours/Week	02 Hours	CIA	20
Credits	01	Attendance	05
Instruction Delivery	Practical	ESE	25
Course Type	SEC	Exam Duration	01 Hr.
Instruction Mode	Regular	Evaluation	Grade

Activities:

1. Identification and preservation of different diseased mulberry leaf/plant parts based on external symptoms.
2. Collection and identification of the pests from mulberry tree and silkworm rearing house.
3. Observation on morphological and anatomical symptoms of silkworm diseases.
4. Identification of silkworm pests.
5. Methods of application of insecticide /bed disinfectant / fungicide / formalin solution and management of silkworm diseases.
6. Visit to different sericulture stations for field study.

Semester - III

Course Code	GCC.16.201	Course Title	BIODIVERSITY AND CONSERVATION BIOLOGY

Scheme of Instruction		Scheme of Evaluation	
Total Duration	30 Hours	Max. Marks	50
Hours/Week	02 Hours	CIA	20
Credits	02	Attendance	05
Instruction Delivery	Theory	ESE	25
Course Type	VAC	Exam Duration	1.30 Hr.
Instruction Mode	Regular	Evaluation	Grade

Course Objectives	• *This course is designed to introduce various aspects of biodiversity, including its values and reasons for depletion and also to raise awareness on preventing its loss.* • *Further emphasis is given to various Wildlife management and conservation methods for maintaining ecological balance.*
Course Outcomes	***After successfully completing this course, the students will be able to*** • Know about various aspects of biodiversity, like values and significance, and analyze various threats to our biodiversity to suggest appropriate measures for conservation strategies. • Convey the message of sustainable use of resources, wildlife protection policies and biodiversity conservation to the public and young generation.

Unit I:	**Module-1** Biodiversity definition and types, Values of biodiversity, Causes of biodiversity loss. **Module-2** India as a mega diversity nation, biogeographical regions of India. **Module-3** Hotspots of biodiversity, Criteria for determining hot spots. Indo-Burma (Eastern Himalaya), Western Ghats and Sri Lanka. **Module-4** Endangered and endemic species of India. **Module-5** Human-wildlife conflict and its management. Poaching and illegal trading.
Unit II:	**Module-1** Conservation of biodiversity (Insitu and Exsitu), Important National Parks, sanctuaries and biosphere reserves of India. **Module-2** Protected areas of J and K, biological resources and gene banks, botanical gardens, bio-parks. **Module-3** Wildlife Protection Act (1972) and its detailed structure, Project Tiger & tiger reserves. **Module-4** Project Hangul, Concept of Buffer zones, Wildlife corridors. **Module-5** Treaties for wetland conservation, RAMSAR and Bonn Convention.

Reference Books:

1. Krausman, P.R. and Cain, W.J. 2013. Wildlife management and conservation, Contemporary Principles and Practices.
2. Frysell, J.M. and Sinclair, A.R.E. 2014. Wildlife Ecology, Conservation and Management.
3. Morrison, M. L. and Mathewson, H.A. 2015. Wildlife Habitat Conservation: Concepts, Challenges and Solutions (Wildlife Management and Conservation.

Semester - IV

Semester - IV

Course Code	GCC.11.251	Course Title	ECOLOGY AND LIMNOLOGY

Scheme of Instruction		Scheme of Evaluation	
Total Duration	60 Hours	Max. Marks	100
Hours/Week	04 Hours	CIA	45
Credits	04	Attendance	05
Instruction Delivery	Theory	ESE	50
Course Type	Major	Exam Duration	2.30 Hr.
Instruction Mode	Regular	Evaluation	Grade

Course Objectives	• *This course has been designed to understand the key aspects of ecology and ecosystem.* • *The course covers different aspects of population, community and their interaction.* • *Further, it provides knowledge of aquatic ecosystems' physico-chemical and biological properties and their impact on aquatic life.* • *The course also enables students to study the diversity of aquatic organisms and pollution status of local water bodies.*
Course Outcomes	***After successfully completing this course, the students will be able to*** • Develop an understanding of ecological key interactions and processes. • Know the factors that affect population size, density, distribution, Distribution and dynamics. • Analyse the pollution status/health of water bodies for conserving aquatic biodiversity. • Criticize various kinds of pollutants in the environment and their impact on the ecosystem. • Design novel mechanisms for the prevention of water bodies' pollution and destruction.

Unit I:	**Module-1** History and importance of ecology, Autecology and synecology. **Module-2** Levels of organization in ecology, Laws of limiting factors: Liebig's law; Law of tolerance. **Module-3** Ecosystem Structure and types, productivity of ecosystem. **Module-4** Food chain & Food web, Energy flow in ecosystem, ecological pyramid. **Module-5** Ecological succession Causes, types and process of succession. Theories pertaining to climax community.
	Module-1 Population characteristics, Life tables, Survivorship curves. **Module-2** Population dynamics and dispersion, Exponential and

Unit II:	Logistic growth. **Module-3** r and k strategies, Density dependent and density independent population regulation factors. **Module-4** Gause's Principle, Lotka- Volterra model. Nature and structure of community. **Module-5** Ecological interdependence and interactions (Positive and Negative interactions).
Unit III:	**Module-1** Lentic and Lotic water bodies; Lakes, types and thermal classification and stratification. **Module-2** Light as a physical factor, penetration of Light and its relation with aquatic organisms. **Module-3** Temperature as a factor and its impact on aquatic living organism. **Module-4** Nitrogen, its forms and role in aquatic ecosystem; Phosphorus, its forms and role in aquatic ecosystem. **Module-5** Methods of dissolved oxygen and carbon dioxide determination in water.
Unit IV:	**Module-1** Plankton: types, classification and distribution (Vertical & Horizontal). **Module-2** Zooplankton: types, Seasonal cycles and top down control of zooplankton. **Module-3** Diel migration and Cyclomorphosis in zooplankton. **Module-4** Phytoplankton: types, seasonal cycle in phytoplankton. **Module-5** Benthos: Classification of benthic regions and benthic communities, factors affecting their distribution in lakes and significance.

Reference Books:

1. Colinvaux, P.A. (1993). Ecology. II Edn. Wiley, John and Sons. Inc.
2. Krebs, C. J. (2001). Ecology. VI edn. Benjamin Cummings.
3. Odum, E.P. (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole.
4. Robert Leo Smith, Ecology and field biology Harper and Row publisher.
5. Rucklefs, R.E. (2000). Ecology. V. edn. Chiron Press

Semester - IV

Course Code	GCC.11.251-P	Course Title	LAB COURSE

Scheme of Instruction		Scheme of Evaluation	
Total Duration	60 Hours	Max. Marks	50
Hours/Week	04 Hours	CIA	20
Credits	02	Attendance	05
Instruction Delivery	Practical	ESE	25
Course Type	Major	Exam Duration	01 Hr.
Instruction Mode	Regular	Evaluation	Grade

1. Determination of population density in a natural community by Quadrant method and calculation of Shannon-Weiner diversity index for the same community.
2. Physico-chemical analysis of water (Measurement of temperature, turbidity/ penetration of light, determination of pH, DO, FCO2, Carbonates and Bicarbonates).
3. Collection, preservation and estimation (Qualitative and quantitative) of Zooplankton.
4. Collection and identification of macrophytes from local water bodies (lakes and pond streams and canals)
5. Collection and identification of macrobenthos from local water bodies (lakes and ponds, streams and canals)
6. Estimation of primary productivity in freshwater bodies.
7. Any other practical found feasible by the teacher and approved by the Coordinator/Head.

Semester - IV

Course Code	GCC.11.252	Course Title	CELL BIOLOGY

Scheme of Instruction		Scheme of Evaluation	
Total Duration	**60 Hours**	**Max. Marks**	**100**
Hours/Week	**04 Hours**	**CIA**	**45**
Credits	**04**	**Attendance**	**05**
Instruction Delivery	**Theory**	**ESE**	**50**
Course Type	**Major**	**Exam Duration**	**2.30 Hr.**
Instruction Mode	**Regular**	**Evaluation**	**Grade**

Course Objectives	• *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.*
Course Outcomes	***After successfully completing this course, the students will be able to*** • Understand the basic structure of cell and cell membrane. • Acquire the detailed knowledge of different cell organelles. • Understand the components of cell cytoplasm and cell-cell communication. • Know the mechanism of cell division and its regulation. • Acquire knowledge on mechanism of cell signaling.

Unit I:	**Module-1** Structure of prokaryotic and eukaryotic cell. **Module-2** Cell theory, Cell membrane: structure, composition and function. **Module-3** Fluid mosaic model. Lipid Composition, inner and outer leaflets. **Module-4** Structure and functions of membrane proteins: Integral, peripheral and lipid-anchored membrane proteins. **Module-5** Transport across membrane: diffusion and osmosis. Active and passive transport, endocytosis and exocytosis.
Unit II:	**Module-1** Structure and function of Endoplasmic reticulum, Golgi complex: structure, biogenesis and functions. **Module-2** Lysosomes: Vacuoles and micro bodies: Structure and functions. **Module-3** Ribosomes, structures and function including role in protein synthesis. **Module-4** Structure and function of Mitochondria and Chloroplasts. **Module-5** Structure and function of Peroxisomes and Nucleus.
	Module-1 Structure and function of microtubules. **Module-2** Microfilaments, Intermediate filaments. **Module-3** Cell-matrix interactions and cell-cell interactions. .

Unit III:	**Module-4** Adherence junctions, tight junctions, gap junctions. **Module-5** Desmosomes, hemidesmosomes, focal adhesions and plasmodesmata.
Unit IV:	**Module-1** Cell cycle, cell division- mitosis and meiosis. **Module-2** Cell division check points and their regulation. **Module-3** Signaling molecules and their receptors. GPCR structure and signalling, **Module-4** Role of Second Messengers in signaling and signal transduction (cAMP, cGMP, IP3). **Module-5** Second Messengers in signaling (DAG, Ca^{2+}). Receptor tyrosine kinases.

Reference Books:

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.

Semester - IV

Course Code	GCC.11.252-P	Course Title	LAB COURSE

Scheme of Instruction		Scheme of Evaluation	
Total Duration	60 Hours	Max. Marks	50
Hours/Week	04 Hours	CIA	20
Credits	02	Attendance	05
Instruction Delivery	Practical	ESE	25
Course Type	Major	Exam Duration	01 Hr.
Instruction Mode	Regular	Evaluation	Grade

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 sub-cellular 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 histology of tissues by preparing permanent stained slides through microtomy.
8. Isolation and estimation of DNA.
9. Any other practical found feasible by the teacher and approved by the Coordinator/Head.

Semester - IV

Course Code	GCC.16.251	Course Title	ENVIRONMENT EDUCATION - II

Scheme of Instruction		Scheme of Evaluation	
Total Duration	30 Hours	Max. Marks	50
Hours/Week	02 Hours	CIA	20
Credits	02	Attendance	05
Instruction Delivery	Theory	ESE	25
Course Type	VAC	Exam Duration	1.30 Hr.
Instruction Mode	Regular	Evaluation	Grade

Course Objectives	• *The course has been designed to understand about international treaties and how the nation works together for environment.* • *The course focuses on role of international organizations and their contributions in environment conservation.*
Course Outcomes	***After successfully completing this course, the students will be able to*** • Learn about the major international treaties and our country's stand on and responses to the major international agreements. • Learn about major international institutions and programmes and the role played by them in the protection and preservation of the environment.

Unit I:	**Module-1** Convention on Biological Diversity (CBD); Cartagena Protocol on Biosafety; Nagoya Protocol on Access and Benefit-sharing. **Module-2** Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES); Ramsar Convention on Wetlands of International Importance. **Module-3** United Nations Convention to Combat Desertification (UNCCD); Vienna Convention for the Protection of the Ozone Layer; Montreal Protocol on Substances that Deplete the Ozone Layer. **Module-4** Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal; Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade; Stockholm Convention on Persistent Organic Pollutants. **Module-5** Minamata Convention on Mercury; United Nations Framework Convention on Climate Change (UNFCCC); Kyoto Protocol; Paris Agreement.
	Module-1 The Wild Life (Protection) Act, 1972; The Water (Prevention and Control of Pollution) Act, 1974.

Unit II:	**Module-2** The Forest (Conservation) Act, 1980; The Air (Prevention and Control of Pollution) Act, 1981; The Environment (Protection) Act, 1986. **Module-3** The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006; Noise Pollution (Regulation and Control) Rules, 2000; Industry-specific environmental standards. **Module-4** Major International organisations and initiatives: United Nations Environment Programme (UNEP), International Union for Conservation of Nature (IUCN), World Commission on Environment and Development (WCED). **Module-5** United Nations Educational, Scientific and Cultural Organization (UNESCO), Intergovernmental Panel on Climate Change (IPCC), and Man and the Biosphere (MAB) programme.

Reference Books:

1. UNEP (2007) Multilateral Environmental Agreement Negotiator's Handbook, University of Joensuu, ISBN 978-952-458-992-5.
2. Ministry of Environment, Forest and Climate Change (2019) A Handbook on International Environment Conventions & Programmes. https://moef.gov.in/wp- content/uploads/2020/02/ convention-V-16-CURVE-web.pdf
3. Kanchi Kohli and Manju Menon (2021) Development of Environment Laws in India, Cambridge University Press.
4. India Code – Digital repository of all Central and State Acts: https://www.indiacode.nic.in/
5. Bohra, Saroj, Judicial Intervention and Evolution of Environmental Principles and Doctrines (January 7, 2019). Available at SSRN: https://ssrn.com/abstract=3311406 or http://dx.doi. org/10.2139/ssrn.3311406

Semester - V

Semester - V

Course Code	GCC.11.301	Course Title	ANIMAL PHYSIOLOGY

Scheme of Instruction		Scheme of Evaluation	
Total Duration	60 Hours	Max. Marks	100
Hours/Week	04 Hours	CIA	45
Credits	04	Attendance	05
Instruction Delivery	Theory	ESE	50
Course Type	Major	Exam Duration	2.30 Hr.
Instruction Mode	Regular	Evaluation	Grade

Course Objectives	• *The course has been designed to understand how animals work at all levels as a whole integrated organism from cells to tissues to organs.* • *This course especially focuses on different physiological systems like digestive, nervous, respiratory, circulatory and muscular systems.* • *The course concentrates on the coordination and integration of physiological systems of organisms across the animal kingdom with special emphasis on humans.* • *This course focuses on the molecular basis of the functioning of the physiological systems.*
Course Outcomes	***After successfully completing this course, the students will be able to*** • Understand the process of digestion and its control. • Develop an understanding of muscle structure, contraction mechanism, kidney structure and regulation of urine formation. • Learn the process of respiration and transport of gases. • Gain insights on the controlling and coordinating systems of the body. • Understand heart structure and functioning.

Unit I:	**Module-1** Digestion and absorption of macronutrients. **Module-2** Pancreas (Islets of Langerhans); Structure and hormones. **Module-3** Gastro-Intestinal hormones and regulation of Digestion, Cellulose digestion in ruminants. **Module-4** Pulmonary ventilation, Respiratory centres, organization and function, Surfactant, Gaseous exchange through respiratory membrane and tissues. **Module-5** Mechanism of O_2 and CO_2 transport, Diving adaptations in Vertebrates; Altitudinal adaptations to low oxygen pressure (mountain sickness).
	Module-1 Blood, Haemopoiesis, Haemostasis, Haemoglobin: Structure and function.

Unit II:	**Module-2** Blood Coagulation, Anti-Coagulants, Blood buffers. **Module-3** Lymph: composition and functions, origin and conduction of Cardiac impulse, Cardiac cycle. **Module-4** Excretion, Urine formation, Glomerular filtration, Tubular reabsorption and secretion, Counter current mechanism. **Module-5** Juxta-glomerular apparatus, Hormonal regulation, Acid-base balance and homeostasis.
Unit III:	**Module-1** Comparative molecular structure and function of skeletal, smooth and cardiac muscles. **Module-2** Ultrastructure of skeletal muscle fibers, Muscle proteins. **Module-3** Sequence of events in contraction and relaxation of skeletal muscle. **Module-4** Sliding filament theory of muscle contraction, Energetics of muscle contraction. **Module-5** Muscle twitch, summation, tetanus and fatigue, Isotonic and isometric contraction.
Unit IV:	**Module-1** Nervous system, Axonal transmission, Motor neuron and other types of neurons. **Module-2** Genesis of membrane potential and action potential, Sodium-potassium pump. **Module-3** Synaptic transmission, Types of synapses and synaptic knobs, Excitatory and inhibitory post-synaptic potential. **Module-4** Chemical transmission, neurotransmitters (acetylcholine, or catecholamines, serotonin and GABA). **Module-5** Autonomic nervous system (Sympathetic and parasympathetic).

Reference Books:

1. Guyton, A.G. 1986. Text book of Medical Physiology, 7th Edn.
2. West, J.B. 1985. Best and Taylor's Physiological basis of Medical practice (Williams& Wilkins).
3. Hoar, W.S. 1983. General and comparative animal physiology, 3rd edn. (prentice Hall).
4. Eckert, R. and D. Randall. 1983.Animal Physiology. 2nd edn. W.H. Freeman & Co.

Semester - V

Course Code	GCC.11.301-P	Course Title	LAB COURSE

Scheme of Instruction		Scheme of Evaluation	
Total Duration	60 Hours	Max. Marks	50
Hours/Week	04 Hours	CIA	20
Credits	02	Attendance	05
Instruction Delivery	Practical	ESE	25
Course Type	Major	Exam Duration	01 Hr.
Instruction Mode	Regular	Evaluation	Grade

1. Adrenalin and insulin induced changes in blood glucose levels in rat/mice.
2. Preparation of Slide of Haemin crystal.
3. Finding of BT and CT of blood.
4. Counting of mammalian RBCs and WBCs.
5. Determination of Sedimentation rate of Erythrocytes.
6. Estimation of Hemoglobin.
7. Digestion of starch by salivary amylase at different pH and temperature.
8. Any other practical found feasible by the teacher and approved by the Coordinator/Head.

Semester - V

Course Code	GCC.11.302	Course Title	REPRODUCTIVE BIOLOGY AND ENDOCRINOLOGY

Scheme of Instruction		Scheme of Evaluation	
Total Duration	60 Hours	Max. Marks	100
Hours/Week	04 Hours	CIA	45
Credits	04	Attendance	05
Instruction Delivery	Theory	ESE	50
Course Type	Major	Exam Duration	2.30 Hr.
Instruction Mode	Regular	Evaluation	Grade

Course Objectives	• *This course focuses on the reproductive organs, reproductive complications and reproduction in animals.* • *The course provides knowledge about assisted reproductive techniques and prenatal diagnosis.* • *The course will provide detailed knowledge about the structure of endocrine glands and the various types of hormones they produce.* • *Further, the course also focuses on the role of hormones in the human body and the abnormalities induced by them.*
Course Outcomes	***After successfully completing this course, the students will be able to*** • Know the process of reproduction, gametogenesis and the anatomical structures of gametes. • Gain a fundamental understanding of the basic biological aspects of animal reproductive anatomy and physiology. • Understand selected technologies associated with reproductive control. • Understand the structure, functions and abnormalities of endocrine glands. • Understand the types of hormones, their biosynthesis and signalling pathways.

Unit I:	**Module-1** Modes of asexual reproduction in animals, Parthenogenesis, types and significance. **Module-2** Structure of testis and ovary in human. Reproductive glands in male and female. **Module-3** Mechanism and site of spermatogenesis, Oogenesis process. **Module-4** Structure of sperm and egg, Mechanism of vitellogenesis. **Module-5** Regeneration, types, modes of regeneration in invertebrates, Mechanism of limb regeneration in amphibians.

Unit II:	**Module-1** Estrous cycle and menstrual cycle, Changes and hormonal regulation of reproductive cycle. **Module-2** Menstrual disorders. Mechanism of ovulation and its regulation. **Module-3** Follicular atresia, Corpus luteum formation and regression, Semen analysis technique. **Module-4** Pre-implantation genetic diagnosis (PGD), In vitro fertilization, Cryopreservation of gametes & embryos. **Module-5** Prenatal diagnostic techniques, Amniocentesis, ultrasonography and chronic villus sampling.
Unit III:	**Module-1** Hypothalamus: Structure and function, Hormones of Adenohypophysis and Neurohypophysis. **Module-2** Thyroid Gland: Structure and its hormones, their function and Disorders, Regulation of thyroid secretions. **Module-3** Parathyroid Gland and its hormones. Role PTH and Calcitonin in maintaining Ca^{2+} level of Blood. **Module-4** Adrenal Gland: Structure and hormones. **Module-5** Pineal and Thymus Gland: structure and their hormones.
Unit IV:	**Module-1** Characteristics of hormones, Classification of hormones. **Module-2** Mechanism of hormone action. **Module-3** Biosynthesis of thyroid hormones and adrenal medullary hormones. **Module-4** Synthesis of insulin hormone. Renin-Angiotensin System. **Module-5** Gonadal hormones and their role in the differentiation of male and female gonads.

Reference Books:

1. Gilbert, S.F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts(USA).
2. Balinsky, B.I. and Fabian, B.C. (1981). An Introduction to Embryology, V Edition, International Thompson Computer Press.
3. Kalthoff (2008). Analysis of Biological Development, II Edition. McGraw-Hill Pub.
4. Lewis Wolpert (2002). Principles of Development. II Edition, Oxford Univ. Press.

Semester - V

Course Code	GCC.11.302-P	Course Title	LAB COURSE

Scheme of Instruction		Scheme of Evaluation	
Total Duration	60 Hours	Max. Marks	50
Hours/Week	04 Hours	CIA	20
Credits	02	Attendance	05
Instruction Delivery	Practical	ESE	25
Course Type	Major	Exam Duration	01 Hr.
Instruction Mode	Regular	Evaluation	Grade

1. Study of spermatogenesis and identification of its various stages with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.
2. Study of Reproductive organs in fishes/rats.
3. Demonstration of oogenesis with the help of already available permanent slides/ ICT tools/ charts/ photographs etc.
4. Histological study of different endocrine glands using permanent slides.
5. To study effect of testosterone on chick comb.
6. To study effect of Thyroxine on metamorphosis.
7. Extraction of pituitary gland from fish.
8. Any other practical found feasible by the teacher and approved by the Coordinator/Head.

Semester - VI

Semester - VI

Course Code	GCC.11.351	Course Title	FUNDAMENTALS OF BIOCHEMISTRY

Scheme of Instruction		Scheme of Evaluation	
Total Duration	60 Hours	Max. Marks	100
Hours/Week	04 Hours	CIA	45
Credits	04	Attendance	05
Instruction Delivery	Theory	ESE	50
Course Type	Major	Exam Duration	2.30 Hr.
Instruction Mode	Regular	Evaluation	Grade

Course Objectives	• *The course's main objective is to provide students with an understanding of biomolecules, the basic building blocks of living organisms, mainly focusing on their structural, biological roles and/or functions.* • *The course will emphasis on structure and function of various biomolecules at the molecular and cellular levels and techniques used for structure determination and analysis.* • *The course covers basic aspects of sample preparation for analysis and aims to enlighten the students on how structural information can be utilised for a better understanding of biological processes.* • *Emphasis will be placed on the association between the structure and function of various biomolecules at a chemical level, from a biological perspective, a hands-on approach, and laboratory techniques.*
Course Outcomes	***After successfully completing this course, the students will be able to*** • Understanding of Biochemistry as a discipline and milestone discoveries in life sciences that led to the establishment of Biochemistry as a separate discipline. • Fundamental properties of elements, their role in the formation of biomolecules and in chemical reactions within living organisms • Understand the structure and biological significance of carbohydrates, amino acids, proteins, lipids and nucleic acids. • Understand the carbohydrate, protein and lipid metabolism process and its regulation.

	Module-1 Amino Acids and Proteins: Structure and function. **Module-2** Structure and properties of Amino acids, Types of proteins and their classification. **Module-3** Forces stabilizing protein structure and shape. Different

Unit I:	level of structural organization of proteins. **Module-4** Protein purification. Denaturation and renaturation of proteins. **Module-5** Fibrous and globular proteins. Glycoproteins and their biological functions.
Unit II:	**Module-1** Carbohydrates: Structure and properties of Monosaccharides. **Module-2** Disaccharides and Polysaccharides. **Module-3** Homo & Hetero Polysaccharides, Mucopolysaccharides. **Module-4** Lipids: Structure and functions- Classification, nomenclature and properties of fatty acids, essential fatty acids. **Module-5** Phospholpids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol.
Unit III:	**Module-1** Enzymes: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, cofactors, coenzyme, prosthetic groups, metalloenzyme. **Module-2** Monomeric & oligomeric enzymes, Activation energy and transition stage. **Module-3** Common features of active sites, Enzyme specificity: types & theories. **Module-4** Nucleic acids: Structure, physical and chemical properties of Nucleic acids. **Module-5** Nucleosides & Nucleotides, purines and pyrimidines. Denaturation and renaturation of DNA.
Unit IV:	**Module-1** Carbohydrate metabolism: Glycolysis, Pentose phosphate pathway and its significance, TCA cycle. **Module-2** Gluconeogenesis and Glycogenolysis. **Module-3** Glycogenesis, Electron Transport Chain, Oxidative phosphorylation. **Module-4** Catabolism of amino acids: Transamination & Deamination. **Module-5** Urea cycle, Biosynthesis and β- oxidation of fatty acids.

Reference Books:

1. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H. Freeman & Co.
2. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants. American Society of plant Biologists.
3. Nelson, D. L., Cox, M.M. (2004). Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York.

Semester - VI

Course Code	GCC.11.351-P	Course Title	LAB COURSE

Scheme of Instruction		Scheme of Evaluation	
Total Duration	60 Hours	Max. Marks	50
Hours/Week	04 Hours	CIA	20
Credits	02	Attendance	05
Instruction Delivery	Practical	ESE	25
Course Type	Major	Exam Duration	01 Hr.
Instruction Mode	Regular	Evaluation	Grade

1. Quantitative estimation of protein.
2. To study the effect of pH, temperature on the activity of salivary amylase.
3. Qualitative tests for carbohydrates, lipids and proteins.
4. Estimation of blood glucose by glucose oxidase method.
5. Separation of Amino acids by paper chromatography.
6. Enzyme assay: effect of time and temperature, effect of substrate.
7. Any other practical found feasible by the teacher approved by Coordinator /Head.

Semester - VI

Course Code	GCC.11.352	Course Title	GENETICS AND CYTOGENETICS

Scheme of Instruction		Scheme of Evaluation	
Total Duration	**60 Hours**	**Max. Marks**	**100**
Hours/Week	**04 Hours**	**CIA**	**45**
Credits	**04**	**Attendance**	**05**
Instruction Delivery	**Theory**	**ESE**	**50**
Course Type	**Major**	**Exam Duration**	**2.30 Hr.**
Instruction Mode	**Regular**	**Evaluation**	**Grade**

Course Objectives	• *The main aim of the course is to provide students with an understanding of classical and modern genetics concepts.* • *The students will learn about transmission and molecular genetics, mapping techniques and chromosomal aberration.* • *The course is designed to revise basic concepts of Mendelian genetics and then move on to advanced concepts.* • *Some key aspects of genetics and cytogenetics, like the mechanism of inheritance, gene structure and function, gene mutations, etc. will be covered.*
Course Outcomes	***After successfully completing this course, the students will be able to*** • Learn the fundamentals of Mendelian and non-Mendelian genetics, chromosomal mapping and interaction of genes. • Understand and provide knowledge on linkage, crossing over, sex determination and the role of extra-chromosomal inheritance. • Know about the causes and consequences of mutations and their role in evolution. • Know the organization of chromosomes in prokaryotes and eukaryotes. • Understand the cause and effect of alterations in chromosome number and structure.

Unit I:	**Module-1** Mendel's selection of experimental plants, Phenomenon of dominance. **Module-2** Variation in dominance (Incomplete dominance and Codominance), Law of Segregation. **Module-3** Law of independent assortment, Monohybrid and dihybrid cross, Back cross and test cross. **Module-4** Epistasis; dominant and recessive epistasis, Complementary and supplementary genes. **Module-5** Pleiotropy and Multiple alleles.

Unit II:	**Module-1** Linkage, complete and incomplete linkage, linkage groups and significance. **Module-2** Mechanism of crossing over; Two factors and three factor crosses; tetrad analysis. Sex linked inheritance in human beings. **Module-3** Maternal inheritance in *Limnae*a, Extra-Nuclear inheritance in *Paramecium* (Kappa particles). **Module-4** Mutations; kinds of mutations, Types of mutagens, Genetic disorder- Huntington disease. **Module-5** Genetic disorders-Heamophilia, Thalasemia, and Cystic fibrosis.
Unit III:	**Module-1** Chromosome structure in pro-and eukaryotes, nucleosome model. **Module-2** Lampbrush and Polytene chromosomes. **Module-3** Karyotype symmetry and symbols. Structural changes, Types and meiotic behaviour of deletions, duplications. **Module-4** Types and meiotic behaviour inversions and translocations. **Module-5** Robertsonian translocation. Cri du Chat, Fragile X syndrome.
Unit IV:	**Module-1** Numerical changes, Polyploidy, induction and types. **Module-2** Autopolyploids meiotic behaviour, segregation. Effect of autopolyploidy. **Module-3** Allopolyploids, classification, meiotic behaviour, Aneuploidy: types of aneuploids. **Module-4** Numerical disorders; Patau's syndrome and Edward's syndrome. **Module-5** Down's syndrome, Turner's syndrome and Klinefelter's syndrome.

Reference Books:

1. Gardner, E. J., Simmons, M. J., Snustad, D.P. (2008). Principles of Genetics. VIII. Ed. Wiley India.
2. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of genetics. X Ed. Benjamin Cummings.
3. Russell, P.J. (2009). Genetics a molecular approach. III Ed. Benjamin Cummings.
4. Burnham, C.R. (1962): Discussions in Cytogenetics Burgess Publ. Co. Minneapolis.
5. Garber, G.B. (1972): Cytogenetics. McGraw Hill. Pub. Co. Ltd.

   P.K. Gupta, Rastogi Publ. Merrut. 1994. Cytogenetics, Genetics and Evolution.

Semester - VI

Course Code	GCC.11.352-P	Course Title	LAB COURSE

Scheme of Instruction		Scheme of Evaluation	
Total Duration	60 Hours	Max. Marks	50
Hours/Week	04 Hours	CIA	20
Credits	02	Attendance	05
Instruction Delivery	Practical	ESE	25
Course Type	Major	Exam Duration	01 Hr.
Instruction Mode	Regular	Evaluation	Grade

1. Structure of salivary gland chromosomes of *Drosophila*/Chironomus larva.
2. Familiarization with techniques of handling *Drosophila*, identifying males, females and setting up cultures.
3. Study of mode of inheritance of the traits by pedigree charts.
4. Idiogram preparation and determination of karyotype asymmetry in Homo sapiens.
5. Study of human karyotypes and numerical alterations (Down syndrome, Klinefelter syndrome and Turner syndrome).
6. Any other practical found feasible by the teacher approved by Coordinator/ Head.

Semester – VI

Course Code	GCC.11.353	Course Title	IMMUNOLOGY

Scheme of Instruction		Scheme of Evaluation	
Total Duration	**60 Hours**	**Max. Marks**	**100**
Hours/Week	**04 Hours**	**CIA**	**45**
Credits	**04**	**Attendance**	**05**
Instruction Delivery	**Theory**	**ESE**	**50**
Course Type	**Major**	**Exam Duration**	**2.30 Hr.**
Instruction Mode	**Regular**	**Evaluation**	**Grade**

Course Objectives	• *This course has been designed to provide the students with fundamental knowledge of the immune system and its protective roles against diseases.* • *In this course, the primary emphasis is on the mechanisms of immune responses, including antigen recognition, activation of immune cells, and the role of cytokines.* • *The course will explore how the immune system maintains health, as well as its role in diseases like allergies, autoimmune disorders, and cancer.* • *The course will demonstrate how immunology principles can be applied in various fields, including medicine, diagnostics, and therapeutics.*
Course Outcomes	***After successfully completing this course, the students will be able to*** • Understand the fundamental concepts of immunity and the contributions of the organs and cells in immune responses. • Acquire knowledge of the MHC molecule's function and the host encounters an immune insult. • Understand the antibodies and complement system and how the immune system distinguishes self from non-self. • Understand the mechanisms involved in the initiation of specific immune responses and differentiate the humoral and cell-mediated immune mechanisms • Comprehend the overreaction by our immune system, autoimmunity, and immunologic processes governing graft rejection. • Know the therapeutic modalities for immune suppression in transplantation.

	Module-1 Immune system: Innate and adaptive immunity, humoral and cell-mediated immune responses. **Module-2** Cells of the immune system (Phagocytes, NK cells, Mast cells & basophils and dendritic cells).

Unit I:	**Module-3** Innate molecular defence system (complement system, Acute phase proteins and cytokines). **Module-4** Toll-like receptors; Inflammation; Lymphoid tissues: primary and secondary lymphoid organs (MALT); Lymphocyte traffic and recirculation. **Module-5** Origin and maturation of T and B lymphocytes, Self/Non self-recognition, T and B cell activation, Clonal selection of lymphocytes.
Unit II:	**Module-1** Antibodies: Structure, Classes of immunoglobulins, Antibody genes, Monoclonal and polyclonal antibodies. **Module-2** Antigens: factors affecting immunogenicity of an antigen, Epitopes of antigen: Features of B and T cell epitopes, Haptens. **Module-3** Antigen processing and presentation: Cytosolic and Endocytic pathways of Antigen processing. **Module-4** Antigen-antibody interactions: Antibody affinity, antibody avidity, cross reaction. **Module-5** Complement system: Classical, alternative and Lectin pathways, Major Histocompatibility Complex (MHC) structure and function.
Unit III:	**Module-1** Hypersensitivity: Classification of hypersensitivity reactions; Type-I Anaphylactic hypersensitivity. **Module-2** Type-II Antibody-mediated cytotoxic hypersensitivity. **Module-3** Type-III Immuno-complex mediated hypersensitivity; Type-IV Cell-mediated (Delayed) hypersensitivity. **Module-4** Autoimmune diseases: Organ-specific autoimmune disease: Insulin–dependent diabetes mellitus (type–I diabetes). **Module-5** Systemic autoimmune disease: Rheumatoid arthritis. Treatment of autoimmune diseases.
Unit IV:	**Module-1** Transplantation: Historical perspective, Types of grafts and rejection problems. **Module-2** Transplantation antigens: blood group & MHC; Rejection mechanisms. **Module-3** Prevention of graft rejection (Familial grafting, tissue typing, cross matching, immunosuppression and fetal transplant. **Module-4** Origin and host defence against tumors, Tumor antigens, Immune responses to tumors & Immunodiagnosis. **Module-5** Cytokine and cellular immunotherapy of tumors, Immunotherapy of tumors with antibodies & Tumor vaccines.

Reference Books:

1. Immunology, Kuby, W.F. Freeman, U.S.A
2. Fundamentals of Immunology, W.Paul
3. Essentials of Immunology, I.M. Roitt
4. Immunology A Foundation Test by Basiro Davey
5. An introduction to immunology, by Ian R. Tizard

Semester - VI

Course Code	GCC.11.353-P	Course Title	LAB COURSE

Scheme of Instruction		Scheme of Evaluation	
Total Duration	60 Hours	Max. Marks	50
Hours/Week	04 Hours	CIA	20
Credits	02	Attendance	05
Instruction Delivery	Practical	ESE	25
Course Type	Major	Exam Duration	01 Hr.
Instruction Mode	Regular	Evaluation	Grade

1. Identification of human blood groups
2. Perform Differential Leukocyte Count of the given blood sample
3. Perform Total Leukocyte Count of the given blood sample
4. Separation of mononuclear cells by Ficoll-Hypaque method.
5. Separate serum and plasma from the blood sample (demonstration).
6. Perform Rapid Plasma Reagin (RPR) Test
7. Perform immunodiffusion by Single Radial Immunodiffusion (SRID)/Ouchterlony Double Diffusion
8. Perform immunoelectrophoresis
9. Perform Enzyme Linked Immunosorbent Assay (ELISA) – Plate
10. Study Immunoprecipitation/Western Blotting
11. Any other practical found feasible by the teacher approved by Coordinator /Head.

Semester – VII

(Simple Honors)

Semester – VII

Course Code	GCC.11.401	Course Title	SYSTEMATICS AND EVOLUTIONARY BIOLOGY

Scheme of Instruction		Scheme of Evaluation	
Total Duration	**60 Hours**	**Max. Marks**	**100**
Hours/Week	**04 Hours**	**CIA**	**45**
Credits	**04**	**Attendance**	**05**
Instruction Delivery	**Theory**	**ESE**	**50**
Course Type	**Major**	**Exam Duration**	**2.30 Hr.**
Instruction Mode	**Regular**	**Evaluation**	**Grade**

Course Objectives	• *This course is designed to introduce various aspects of systematics through studies on species concept, taxonomy, identification and nomenclature of species.* • *This course also focuses on the origin of life and evolutionary trends through the study of evolutionary theories and experiments.*
Course Outcomes	***After successfully completing this course, the students will be able to*** • Concepts of systematics, scope of taxonomic studies in classifications. • Species phylogeny, identification, nomenclature following ICZN and also documentation of taxa. • Recall the origin and evolution of life. • Categorize the evidences and theories of organic evolution. • Know the mechanism of evolution and natural selection.

Unit I:	**Module-1** Introduction to taxonomy, systematics and classification. **Module-2** Contribution of systematics to Biology; Binomial and Trinomial nomenclature. **Module-3** Taxonomic collections, Curating of collections. **Module-4** Identification; Taxonomic characters. Types of taxonomic material. **Module-5** Taxonomic publication, kinds and major features of taxonomic publications.
Unit II:	**Module-1** Typological & Nominlistic species concept, their advantages and limitations. **Module-2** Evolutionary & Biological species concept, their advantages and limitations. **Module-3** Sibling species, Polymorphic species, polytypic species. **Module-4** Allopatric, sympatric and parapatric species. Law of priority. **Module-5** Homonymy & Synonymy; Articles of ICZN regarding date

	of publication, validity of names.
Unit III:	**Module-1** Origin of Life on the earth. **Module-2** Lamarckism & Neo-Lamarckism. **Module-3** Darwinism and Neo-Darwinism. **Module-4** Mutation theory of evolution, Evidences of evolution. **Module-5** Evolutionary history and stages of man; Phylogeny of horse.
Unit IV:	**Module-1** Natural selection, Types of Natural selection, Industrial melanism. **Module-2** Molecular clock concept. Convergent and Divergent evolution. **Module-3** Micro-evolution, Macro-evolution and Mega-evolution. **Module-4** Reproductive Isolating mechanisms. Hardy-Weinberg equilibrium. **Module-5** Genetic drift and gene flow, Founder effect and Bottleneck effect.

Reference Books:

1. Ernst Mayr, 1960. Principles of Systematic Zoology
2. Verma, A. 2015. Principles of Animal Taxonomy, Alpha Science.
3. Kapoor, V.C. 2017. Theory and Practice of Animal Taxonomy and Biodiversity, 8th Edn.
4. Simpson, G.G. 1961. Principles of Animal Taxonomy.
5. Ridley, M. 2004. Evolution. III. Edition. Blackwell Publishing co.
6. Maynard Smith J (1989). Evolutionary Genetics, Oxford University press.
7. Spiess. E (1989). Genes in Population, 2nd Edition. Wiley-Liss, New

Semester – VII

Course Code	GCC.11.402	Course Title	FUNDAMENTALS OF BIOSTATISTICS

Scheme of Instruction		Scheme of Evaluation	
Total Duration	60 Hours	Max. Marks	100
Hours/Week	04 Hours	CIA	45
Credits	04	Attendance	05
Instruction Delivery	Theory	ESE	50
Course Type	Major	Exam Duration	2.30 Hr.
Instruction Mode	Regular	Evaluation	Grade

Course Objectives	• *The course has been designed to provides an introduction to the fundamentals of statistics and its significance in the biomedical field.* • *It emphasises the importance of understanding how data is collected, classified, and analysed, offering essential tools for interpreting research findings.* • *The course equips learners with the skills to describe and summarise data accurately, ensuring meaningful insights are drawn from research.* • *Additionally, the course focuses on sampling techniques, determining appropriate sample sizes and analysis of samples for different types of studies.*
Course Outcomes	***After successfully completing this course, the students will be able to*** • Demonstrate application of principles of Descriptive and Inferential Statistics in research. • Demonstrate use of appropriate statistical tests in research. • Analyze and present research data using suitable statistical methods, tools, and software. • Evaluate and interpret statistical data from research papers and publications.

Unit I:	**Module-1** Definition of Statistics; Fundamentals of Statistics and its applications to the biomedical field (Biostatistics), Use and misuse of Statistics. **Module-2** Data and its collection; Classification of data: Primary & Secondary data. **Module-3** Variables: Discrete and continuous variable. **Module-4** Sampling techniques and Sample size determinations. **Module-5** Frequency distribution: relative frequency distribution & cumulative frequency distribution, frequency table.

Unit II:	**Module-1** Measures of Central tendency – Mean & Median. **Module-2** Measures of Central tendency – Mode & Percentile. **Module-3** Measures of Dispersion- Range, Quartile deviation and Mean deviation. **Module-4** Measures of Dispersion- Standard deviation and Co-efficient of variation. **Module-5** Probability - Definitions, types, and laws of probability. Probability Distributions.
Unit III:	**Module-1** Graphical representation of grouped (histogram, polygon & Ogives). **Module-2** Graphical representation ungrouped data (Line graph, bar graph and pie chart). **Module-3** Analysis of data; Tools of statistics and software applications, SPSS for statistical analysis. **Module-4** Tests of significance- Z-test, Paired & unpaired t-test, F-test. **Module-5** Chi-square test and ANOVA.
Unit IV:	**Module-1** Null and alternate hypotheses, Type I and type II errors. **Module-2** Measures of disease Frequency: Incidence and prevalence. **Module-3** Simple linear correlation, Karl Pearson's correlation coefficient, Spearman's rank correlation. **Module-4** Linear and multiple regression analysis of their application and interpretation. **Module-5** P-value calculation, interpretation and statistical significance.

Reference Books:

1. Le CT (2003) Introductory biostatistics. 1st edition, John Wiley, USA
2. Glaser AN (2001) High Yield TM Biostatistics. Lippincott Williams and Wilkins, USA
3. Edmondson A and Druce D (1996) Advanced Biology Statistics, Oxford University Press.
4. Danial W (2004) Biostatistics: A foundation for Analysis in Health Sciences, John Wiley and Sons Inc.
5. Arora P.N. and Malhan, P.K., (2012) Biostatistics, Himalaya Publishing House
6. K. Sharma (2008) A. K. Sharma Vol I & II Discovery Publishing House Pvt. Ltd

Semester – VIII

(Simple Honors)

Semester – VIII

Course Code	GCC.11.451	Course Title	TOOLS AND TECHNIQUES IN BIOLOGY

Scheme of Instruction		Scheme of Evaluation	
Total Duration	**60 Hours**	**Max. Marks**	**100**
Hours/Week	**04 Hours**	**CIA**	**45**
Credits	**04**	**Attendance**	**05**
Instruction Delivery	**Theory**	**ESE**	**50**
Course Type	**Major**	**Exam Duration**	**2.30 Hr.**
Instruction Mode	**Regular**	**Evaluation**	**Grade**

Course Objectives	• *This course provides a full hands-on approach to expose the students to modern techniques and methodologies.* • *The diverse techniques, from microscopy to spectroscopy, calorimetry, chromatography, tissue culture to cloning etc., are included to make the students well-versed with these protocols and methods.*
Course Outcomes	***After successfully completing this course, the students will be able to*** • Understand the purpose of the technique, its proper use and possible modifications. • Learn the theoretical basis of technique, its principle of working and its correct application. • Know how to maintain laboratory equipment, as well as safety hazards and precautions. • Understand the process of preparing buffers and preparing solutions for given percentages and molarities. • Understand cell and tissue culture techniques and separation of amino acids, proteins and nucleic acids.

Unit I:	**Module-1** Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE). **Module-2** 2-D gel electrophoresis, Agarose-gel electrophoresis, pulse field gel electrophoresis. **Module-3** immuno-electrophoresis and Immunodiffusion; Immunoblotting and immune-florescence. **Module-4** Blotting techniques; Western Blotting & Northern Blotting. **Module-5** Southern Blotting and Far Eastern Blotting.
	Module-1 Centrifugation; basic principle & different types (differential centrifugation, density gradient centrifugation, ultra-centrifugation). **Module-2** Cell fractionation, isolation of sub-cellular organelles and particles.

Unit II:	**Module-3** Introduction to different types of chromatography; Paper chromatography, thin layer chromatography. **Module-4** Column chromatography; gel filtration, affinity and ion exchange chromatography. **Module-5** Gas chromatography & HPLC.
Unit III:	**Module-1** Principle & applications of microscopy (bright field & dark field). **Module-2** Phase contrast, florescence & confocal microscopy. **Module-3** Transmission Electron microscopy (TEM) and its applications. **Module-4** Scanning Electron Microscope (SEM) and its applications. **Module-5** Scanning probe microscopy (Scanning tunneling microscope & AFM - atomic force microscope).
Unit IV:	**Module-1** Cell culture techniques, Culture media, essential components and preparation. **Module-2** Cell viability testing; Flow cytometry. **Module-3** Chromosomal Banding techniques. **Module-4** Insitu hybridization (radiolabelled & non-radiolabelled), FISH. **Module-5** Cryopreservation of cells; Freeze fracture, Freeze drying.

Reference Books:

1. Wilson & Walker (2010) Principles and Techniques of Biochemistry and Molecular Biology Cambridge University Press.
2. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D., Wiley Blackwell
3. David Plummer (2001) An Introduction to Practical Biochemistry, McGraw Hill Education
4. Karp, G. 2010 (2013) Cell and Molecular Biology: Concepts and Experiments, John Wiley& Sons. Inc.
5. Cooper, G.M. and Hausman, R.E (2015) The Cell: A Molecular Approach, ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

Semester - VIII

Course Code	GCC.11.451-P	Course Title	LAB COURSE

Scheme of Instruction		Scheme of Evaluation	
Total Duration	60 Hours	Max. Marks	50
Hours/Week	04 Hours	CIA	20
Credits	02	Attendance	05
Instruction Delivery	Practical	ESE	25
Course Type	Major	Exam Duration	01 Hr.
Instruction Mode	Regular	Evaluation	Grade

1. Preparation of buffer and determination of pH.
2. Identification of amino acids in the mixture using paper chromatography.
3. Verification of laws of spectrophotometry.
4. Separation of proteins using SDS-PAGE.
5. Tissue fixation, paraffin block preparation, sectioning.
6. Polyacrylamide gel electrophoresis.
7. Principles of Colorimetry: (i) Verification of Beer's law, estimation of protein (ii) To study relation between absorbance and % transmission.
8. Preparation of permanent slides of microscopic organisms/ small insects.
9. Any other practical found feasible by the teacher approved by Coordinator/Head.

Semester - VIII

Course Code	GCC.11.452	Course Title	MOLECULAR BIOLOGY

Scheme of Instruction		Scheme of Evaluation	
Total Duration	60 Hours	Max. Marks	100
Hours/Week	04 Hours	CIA	45
Credits	04	Attendance	05
Instruction Delivery	Theory	ESE	50
Course Type	Major	Exam Duration	2.30 Hr.
Instruction Mode	Regular	Evaluation	Grade

Course Objectives	• *The course provides an account of the complex regulatory mechanisms that control cell function.* • *The course provides an insight into the life processes at the subcellular and molecular levels.* • *Further, the course gives knowledge on the flow of information from genes to proteins and its regulation.*
Course Outcomes	***After successfully completing this course, the students will be able to*** • Explain the ultrastructure and functions of Cytoskeletons and Plasma membrane. • Discuss the complexity of eukaryotic genome organization and its replication in Prokaryotes & Eukaryotes. • Describe the process of transcription and post-transcriptional • modification in Eukaryotes. • Evaluate the regulation of transcription and translation in Prokaryotes & Eukaryotes. • Assess the events of the cell cycle, cell signalling pathways and cell death.

Unit I:	**Module-1** DNA as genetic material, Structure of DNA and types of DNA. **Module-2** Replication of DNA in prokaryotes, Rolling circle replication. **Module-3** Replication of DNA in eukaryotes: Semiconservative nature of DNA replication. **Module-4** Bi-directional replication, Unique aspects of eukaryotic chromosome replication. **Module-5** DNA polymerases, Fidelity of replication. Telomere replication.
	Module-1 Recombination; Homologous recombination (Holliday model). **Module-2** Recombination; Meselson-Radding modification & Protein involved recombination.

Unit II:	**Module-3** DNA damage and repair: Physical and chemical DNA-damaging agents, Causes and types of DNA damage. **Module-4** Mechanisms of DNA repair. **Module-5** SOS response system of DNA repair in *E. coli*.
Unit III:	**Module-1** Transcription in prokaryotes: RNA polymerases, mechanism of transcription initiation, elongation and termination. **Module-2** Transcription in eukaryotes: RNA polymerases, mechanism of transcription initiation, elongation and termination. **Module-3** RNA structure and types, Post-transcriptional modifications of mRNA (5' Cap, Poly A tails & Splicing). **Module-4** Regulation of transcription in Eukaryotes (Acetylation, Methylation, Phosphorylation and other modifications). **Module-5** Transport of mRNA by NPC.
Unit IV:	**Module-1** Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system). **Module-2** Genetic code and its characteristics, Prokaryotic translation: Mechanism of initiation, elongation and termination of polypeptides, Inhibitors of translation. **Module-3** Eukaryotic translation: ribosome structure and assembly, charging of tRNA, aminoacyl tRNA synthetases. **Module-4** Eukaryotic translation: Mechanism of initiation, elongation and termination of polypeptides, Inhibitors of translation. **Module-5** Post-translational modifications of proteins, Protein folding and transport.

Reference Books:

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.

Semester - VIII

Course Code	GCC.11.452-P	Course Title	LAB COURSE

Scheme of Instruction		Scheme of Evaluation	
Total Duration	60 Hours	Max. Marks	50
Hours/Week	04 Hours	CIA	20
Credits	02	Attendance	05
Instruction Delivery	Practical	ESE	25
Course Type	Major	Exam Duration	01 Hr.
Instruction Mode	Regular	Evaluation	Grade

1. Isolation and estimation of DNA (Diphenylamine reagent) or spectrophotometer (A260 nm measurement).
2. Quantitative estimation of RNA using Orcinol reaction.
3. Agarose gel Electrophoresis of DNA.
4. DNA amplification by PCR.
5. Gel Documentation.
6. Preparation of liquid culture medium (LB) and raise culture of *E. coli.*
7. Estimation of the growth kinetics of *E. coli* by turbidity method.
8. Preparation of solid culture medium (LB) and growth of *E. coli* by spreading and streaking.
9. Any other practical found feasible by the teacher approved by Coordinator/Head.

Semester – VII

(Honors with Research)

Semester - VII

Course Code	GCC.11.401	Course Title	TOOLS AND TECHNIQUES IN BIOLOGY

Scheme of Instruction		Scheme of Evaluation	
Total Duration	60 Hours	Max. Marks	100
Hours/Week	04 Hours	CIA	45
Credits	04	Attendance	05
Instruction Delivery	Theory	ESE	50
Course Type	Major	Exam Duration	2.30 Hr.
Instruction Mode	Regular	Evaluation	Grade

Course Objectives	• *This course provides a full hands-on approach to expose the students to modern techniques and methodologies.* • *The diverse techniques, from microscopy to spectroscopy, calorimetry, chromatography, tissue culture to cloning etc., are included to make the students well-versed with these protocols and methods.*
Course Outcomes	***After successfully completing this course, the students will be able to*** • Understand the purpose of the technique, its proper use and possible modifications. • Learn the theoretical basis of technique, its principle of working and its correct application. • Know how to maintain laboratory equipment, as well as safety hazards and precautions. • Understand the process of preparing buffers and preparing solutions for given percentages and molarities. • Understand cell and tissue culture techniques and separation of amino acids, proteins and nucleic acids.

Unit I:	**Module-1** Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE). **Module-2** 2-D gel electrophoresis, Agarose-gel electrophoresis, pulse field gel electrophoresis. **Module-3** immuno-electrophoresis and Immunodiffusion; Immunoblotting and immune-florescence. **Module-4** Blotting techniques; Western Blotting & Northern Blotting. **Module-5** Southern Blotting and Far Eastern Blotting.
	Module-1 Centrifugation; basic principle & different types (differential centrifugation, density gradient centrifugation, ultra-centrifugation). **Module-2** Cell fractionation, isolation of sub-cellular organelles and particles.

Unit II:	**Module-3** Introduction to different types of chromatography; Paper chromatography, thin layer chromatography. **Module-4** Column chromatography; gel filtration, affinity and ion exchange chromatography. **Module-5** Gas chromatography & HPLC.
Unit III:	**Module-1** Principle & applications of microscopy (bright field & dark field). **Module-2** Phase contrast, florescence & confocal microscopy. **Module-3** Transmission Electron microscopy (TEM) and its applications. **Module-4** Scanning Electron Microscope (SEM) and its applications. **Module-5** Scanning probe microscopy (Scanning tunneling microscope & AFM - atomic force microscope).
Unit IV:	**Module-1** Cell culture techniques, Culture media, essential components and preparation. **Module-2** Cell viability testing; Flow cytometry. **Module-3** Chromosomal Banding techniques. **Module-4** Insitu hybridization (radiolabelled & non-radiolabelled), FISH. **Module-5** Cryopreservation of cells; Freeze fracture, Freeze drying.

Reference Books:

1. Wilson & Walker (2010) Principles and Techniques of Biochemistry and Molecular Biology Cambridge University Press.
2. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D., Wiley Blackwell
3. David Plummer (2001) An Introduction to Practical Biochemistry, McGraw Hill Education
4. Karp, G. 2010 (2013) Cell and Molecular Biology: Concepts and Experiments, John Wiley& Sons. Inc.
5. Cooper, G.M. and Hausman, R.E (2015) The Cell: A Molecular Approach, ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

Semester - VII

Course Code	GCC.11.401-P	Course Title	LAB COURSE

Scheme of Instruction		Scheme of Evaluation	
Total Duration	60 Hours	Max. Marks	50
Hours/Week	04 Hours	CIA	20
Credits	02	Attendance	05
Instruction Delivery	Practical	ESE	25
Course Type	Major	Exam Duration	01 Hr.
Instruction Mode	Regular	Evaluation	Grade

1. Preparation of buffer and determination of pH.
2. Identification of amino acids in the mixture using paper chromatography.
3. Verification of laws of spectrophotometry.
4. Separation of proteins using SDS-PAGE.
5. Tissue fixation, paraffin block preparation, sectioning.
6. Polyacrylamide gel electrophoresis.
7. Principles of Colorimetry: (i) Verification of Beer's law, estimation of protein (ii) To study relation between absorbance and % transmission.
8. Preparation of permanent slides of microscopic organisms/ small insects.
9. Any other practical found feasible by the teacher approved by Coordinator/Head.

Semester - VII

Course Code	GCC.11.402	Course Title	MOLECULAR BIOLOGY

Scheme of Instruction		Scheme of Evaluation	
Total Duration	60 Hours	Max. Marks	100
Hours/Week	04 Hours	CIA	45
Credits	04	Attendance	05
Instruction Delivery	Theory	ESE	50
Course Type	Major	Exam Duration	2.30 Hr.
Instruction Mode	Regular	Evaluation	Grade

Course Objectives	• *The course provides an account of the complex regulatory mechanisms that control cell function.* • *The course provides an insight into the life processes at the subcellular and molecular levels.* • *Further, the course gives knowledge on the flow of information from genes to proteins and its regulation.*
Course Outcomes	***After successfully completing this course, the students will be able to*** • Explain the ultrastructure and functions of Cytoskeletons and Plasma membrane. • Discuss the complexity of eukaryotic genome organization and its replication in Prokaryotes & Eukaryotes. • Describe the process of transcription and post-transcriptional • modification in Eukaryotes. • Evaluate the regulation of transcription and translation in Prokaryotes & Eukaryotes. • Assess the events of the cell cycle, cell signalling pathways and cell death.

Unit I:	**Module-1** DNA as genetic material, Structure of DNA and types of DNA. **Module-2** Replication of DNA in prokaryotes, Rolling circle replication. **Module-3** Replication of DNA in eukaryotes: Semiconservative nature of DNA replication. **Module-4** Bi-directional replication, Unique aspects of eukaryotic chromosome replication. **Module-5** DNA polymerases, Fidelity of replication. Telomere replication.
	Module-1 Recombination; Homologous recombination (Holliday model). **Module-2** Recombination; Meselson-Radding modification & Protein involved recombination.

Unit II:	**Module-3** DNA damage and repair: Physical and chemical DNA damaging agents, Causes and types of DNA damage. **Module-4** Mechanisms of DNA repair. **Module-5** SOS response system of DNA repair in *E. coli*.
Unit III:	**Module-1** Transcription in prokaryotes: RNA polymerases, mechanism of transcription initiation, elongation and termination. **Module-2** Transcription in eukaryotes: RNA polymerases, mechanism of transcription initiation, elongation and termination. **Module-3** RNA structure and types, Post-transcriptional modifications of mRNA (5' Cap, Poly A tails & Splicing). **Module-4** Regulation of transcription in Eukaryotes (Acetylation, Methylation, Phosphorylation and other modifications). **Module-5** Transport of mRNA by NPC.
Unit IV:	**Module-1** Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system). **Module-2** Genetic code and its characteristics, Prokaryotic translation: Mechanism of initiation, elongation and termination of polypeptides, Inhibitors of translation. **Module-3** Eukaryotic translation: ribosome structure and assembly, charging of tRNA, aminoacyl tRNA synthetases. **Module-4** Eukaryotic translation: Mechanism of initiation, elongation and termination of polypeptides, Inhibitors of translation. **Module-5** Post-translational modifications of proteins, Protein folding and transport.

Reference Books:

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.

Semester - VII

Course Code	GCC.11.402-P	Course Title	LAB COURSE

Scheme of Instruction		Scheme of Evaluation	
Total Duration	60 Hours	Max. Marks	50
Hours/Week	04 Hours	CIA	20
Credits	02	Attendance	05
Instruction Delivery	Practical	ESE	25
Course Type	Major	Exam Duration	01 Hr.
Instruction Mode	Regular	Evaluation	Grade

1. Isolation and estimation of DNA (Diphenylamine reagent) or spectrophotometer (A260 nm measurement).
2. Quantitative estimation of RNA using Orcinol reaction.
3. Agarose gel Electrophoresis of DNA.
4. DNA amplification by PCR.
5. Gel Documentation.
6. Preparation of liquid culture medium (LB) and raise culture of *E. coli.*
7. Estimation of the growth kinetics of *E. coli* by turbidity method.
8. Preparation of solid culture medium (LB) and growth of *E. coli* by spreading and streaking.
9. Any other practical found feasible by the teacher approved by Coordinator/Head.

Semester – VIII

(Honors with Research)

Semester – VIII

Course Code	GCC.11.451	Course Title	SYSTEMATICS AND EVOLUTIONARY BIOLOGY

Scheme of Instruction		Scheme of Evaluation	
Total Duration	**60 Hours**	**Max. Marks**	**100**
Hours/Week	**04 Hours**	**CIA**	**45**
Credits	**04**	**Attendance**	**05**
Instruction Delivery	**Theory**	**ESE**	**50**
Course Type	**Major**	**Exam Duration**	**2.30 Hr.**
Instruction Mode	**Regular**	**Evaluation**	**Grade**

Course Objectives	• *This course is designed to introduce various aspects of systematics through studies on species concept, taxonomy, identification and nomenclature of species.* • *This course also focuses on the origin of life and evolutionary trends through the study of evolutionary theories and experiments.*
Course Outcomes	***After successfully completing this course, the students will be able to*** • Concepts of systematics, scope of taxonomic studies in classifications. • Species phylogeny, identification, nomenclature following ICZN and also documentation of taxa. • Recall the origin and evolution of life. • Categorize the evidences and theories of organic evolution. • Know the mechanism of evolution and natural selection.

Unit I:	**Module-1** Introduction to taxonomy, systematics and classification. . **Module-2** Contribution of systematics to Biology; Binomial and Trinomial nomenclature. **Module-3** Taxonomic collections, Curating of collections. **Module-4** Identification; Taxonomic characters. Types of taxonomic material. **Module-5** Taxonomic publication, kinds and major features of taxonomic publications.
Unit II:	**Module-1** Typological & Nominlistic species concept, their advantages and limitations. **Module-2** Evolutionary & Biological species concept, their advantages and limitations. **Module-3** Sibling species, Polymorphic species, polytypic species. **Module-4** Allopatric, sympatric and parapatric species. Law of priority. **Module-5** Homonymy & Synonymy; Articles of ICZN regarding date

	of publication, validity of names.
Unit III:	**Module-1** Origin of life on the earth. **Module-2** Lamarckism & Neo-Lamarckism. **Module-3** Darwinism and Neo-Darwinism. **Module-4** Mutation theory of evolution, Evidences of evolution. **Module-5** Evolutionary history and stages of man; Phylogeny of horse.
Unit IV:	**Module-1** Natural selection, Types of Natural selection, Industrial melanism. **Module-2** Molecular clock concept. Convergent and Divergent evolution. **Module-3** Micro-evolution, Macro-evolution and Mega-evolution. **Module-4** Reproductive Isolating mechanisms. Hardy-Weinberg equilibrium. **Module-5** Genetic drift and gene flow, Founder effect and Bottleneck effect.

Reference Books:

1. Ernst Mayr, 1960. Principles of Systematic Zoology
2. Verma, A. 2015. Principles of Animal Taxonomy, Alpha Science.
3. Kapoor, V.C. 2017. Theory and Practice of Animal Taxonomy and Biodiversity, 8th Edn.
4. Simpson, G.G. 1961. Principles of Animal Taxonomy.
5. Ridley, M. 2004. Evolution. III. Edition. Blackwell Publishing co.
6. Maynard Smith J (1989). Evolutionary Genetics, Oxford University press.
7. Spiess. E (1989). Genes in Population, 2nd Edition. Wiley-Liss, New York.

Semester – VIII

Course Code	GCC.11.452	Course Title	RESEARCH METHODOLOGY

Scheme of Instruction		Scheme of Evaluation	
Total Duration	60 Hours	Max. Marks	100
Hours/Week	04 Hours	CIA	45
Credits	04	Attendance	05
Instruction Delivery	Theory	ESE	50
Course Type	Major	Exam Duration	2.30 Hr.
Instruction Mode	Regular	Evaluation	Grade

Course Objectives	• To familiarize the students with the Basics of Research. • To explain the Quantitative approach in media research with a focus on surveys, experimental studies and the statistics involved therein. • To explain the logic of the Qualitative approach with a focus on Observation, Participatory research, ethnography, etc • To familiarize students with Milestones in Communication research. To teach them proper Applications, Research Report writing and the Ethical issues involved.
Course Outcomes	***After successfully completing this course, the students will be able to*** • Understand about the basics of research, its relevance to biology and also to select the most appropriate design for the research study. • Understand various types of data and select appropriate statistical tool for data analysis • Understand process of preparing research proposal, reports etc. keeping in view the ethical research and suggest ways for observing ethics in research. • Take appropriate safety measures while working in laboratories and apply advanced research methods molecular studies.

Unit I:	**Module-1** Research; meaning, objectives, types, basic and applied research, essential steps in research, importance and application. Criteria for good research. **Module-2** General methods in biological research; natural observation, field study, and experimentations. Problems encountered by Researcher in India. **Module-3** Research Design; Meaning, need and features of research design. Sampling and Non Sampling Error, Types of Sampling designs. **Module-4** Data collections: methods for primary data- observation,

	interview, questionnaire methods, and experiments. **Module-5** Methods for secondary data; scientific journals, books, reports, databases.
Unit II:	**Module-1** Graphical representation of grouped (histogram, polygon & Ogives). **Module-2** Graphical representation ungrouped data (Line graph, bar graph and pie chart). **Module-3** Measures of central tendency; Mean, Median & Mode. **Module-4** Analysis of data; Tools of statistics and software applications, SPSS for statistical analysis. **Module-5** Tests of significance- Z-test, paired & unpaired t-test, F-test, Chi-square test and ANOVA.
Unit III:	**Module-1** Research report writing, Significance of report writing, Different steps in writing a report. Types of reports. **Module-2** Layout of Research report, Components of research reports. **Module-3** Writing of dissertations, project proposals, project reports, research papers. **Module-4** Intellectual Property Rights; Biopiracy, copyrights, patent and traditional knowledge and plagiarism. **Module-5** Code of Ethics in Research, Importance of Ethics in Research.
Unit IV:	**Module-1** Laboratory safety; Biohazardous agents, biosafety levels, lab acquired infections, other hazards; Laboratory good practices. **Module-2** Animal Ethics; Animal Use, Cases and Controversies. Moral value of animals, Rules and Regulations on animals use in research. **Module-3** Bioinformatics, Relevance and Uses of bioinformatics. Biological databases. **Module-4** Proteomics and genomic analysis, nucleic acid and protein sequencing databases. **Module-5** Role of information and communication tools in Wildlife Management (GIS, GPS, Remote Sensing and Radio tracking).

Reference Books:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International.418p.
3. Arora, P.N. & Malhon, P.K.1996. Biostatistics. Himalaya Publishing House Mumbai.
4. Jogdand SN. 2004. Gene Biotechnology Published by Himalaya Publishing House, Mumbai.
5. Baxevanis, A.D. & Ouellette, B.F.F. 2001. Bioinformatics: A practical guide to the analysis of genes and proteins, Wiley Inter science, New York.