



**Guru Jambheshwar University of Science
and Technology Hisar-125001,
Haryana**
(‘A⁺’ NAAC Accredited State Govt. University)



**Scheme & Syllabi of Examination of
additional courses for
Dual degree B.Sc. (Hons) Biotechnology-
M.Sc. Biotechnology**

(With effect from 2016-17 Batch)

**Department of Biotechnology
Guru Jambheshwar University of Science and Technology
Hisar-125001, Haryana**



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Scheme & Syllabus of Examination of Additional Courses for
Dual Degree B.Sc. (Hons) Biotechnology-M.Sc. Biotechnology

FIRST YEAR

SEMESTER-I

Course Code	Nomenclature of Paper /Course	Credits	Internal Marks	External Marks	Total Marks	Duration of Exam (Hr)
BBL103AD	Botany-I (Cryptogams)	4	30	70	100	3
BZL104AD	Zoology-I (Invertebrates)	4	30	70	100	3
BBP105AD	Botany Lab-I (Cryptogams-Lab)	2	30	70	100	3
BZP106AD	Zoology Lab-I (Invertebrates-Lab)	2	30	70	100	3

SEMESTER-II

Course Code	Nomenclature of Paper/Course	Credits	Internal Marks	External Marks	Total Marks	Duration of Exam (Hr)
BBL203AD	Botany-II (Phanerogams)	4	30	70	100	3
BZL204AD	Zoology-II (Vertebrates)	4	30	70	100	3
BBP205AD	Botany Lab-II (Phanerogams-Lab)	2	30	70	100	3
BZP206AD	Zoology Lab-II (Vertebrates-Lab)	2	30	70	100	3

SECOND YEAR

SEMESTER –III

Course Code	Nomenclature of Paper/Course	Credits	Internal Marks	External Marks	Total Marks	Duration of Exam (Hr)
BBL313AD	Botany-III (Plant Physiology and Metabolism)	4	30	70	100	3
BZL314AD	Zoology-III (Reproductive Biology)	4	30	70	100	3
BBP315AD	Botany Lab-III (Plant Physiology and Metabolism-Lab)	2	30	70	100	3
BZP316AD	Zoology Lab-III (Reproductive Biology-Lab)	2	30	70	100	3

SEMESTER –IV

Course Code	Nomenclature of Paper/Course	Credits	Internal Marks	External Marks	Total Marks	Duration of Exam (Hr)
BBL412AD	Botany-IV (Plant Anatomy and Embryology)	4	30	70	100	3
BZL413AD	Zoology-IV (Applied Zoology)	4	30	70	100	3
BBP414AD	Botany Lab-IV (Plant Anatomy and Embryology-Lab)	2	30	70	100	3
BZP415AD	Zoology-Lab (Applied Zoology-Lab)	2	30	70	100	3

THIRD YEAR**SEMESTER – V**

Course Code	Nomenclature of Paper/Course	Credits	Internal Marks	External Marks	Total Marks	Duration of Exam (Hr)
BBL513AD	Botany-V (Ecology and Environmental Botany)	4	30	70	100	3
BBP514AD	Botany Lab-V (Ecology and Environmental Botany-Lab)	2	30	70	100	3

SEMESTER –VI

Course Code	Nomenclature of Paper/Course	Credits	Internal Marks	External Marks	Total Marks	Duration of Exam (Hr)
BBL613AD	Botany-VI (Ethnobotany)	4	30	70	100	3
BBP614AD	Botany Lab-VI (Ethnobotany-Lab)	2	30	70	100	3

Discipline Specific Course	
BBL103AD BOTANY-I (CRYPTOGAMS)	Credits: 4+0

External Marks	70
Internal Marks	30
Total Marks	100
Time	3 H

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

UNIT-I [15 Lectures]

Thallophyta – Algae & Fungi: Algae: General characteristics: Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and life-cycles and economic importance of the following: *Chlamydomonas*, *Volvox*, *Spirogyra*, *Laminaria*, *Polysiphonia*

Fungi: Introduction- General characteristics, Structure, reproduction, and life cycle of *Rhizopus*, *Agaricus*, *Puccinia*. Lichens & Mycorrhizae – ecological significance.

UNIT-II [15 Lectures]

Bryophyta – Non-Vascular Land Plants: Introduction to Archegoniate: Unifying features of archegoniate, Transition to land habit, Alternation of generations.

Bryophytes: General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification (up to family), morphology, anatomy, and reproduction of *Marchantia* and *Funaria*. Ecology and economic importance of bryophytes with special mention of Sphagnum.

UNIT-III [15 Lectures]

Pteridophyta – First Vascular Plants: Pteridophytes: General characteristics, classification, Early land plants (*Cooksonia* and *Rhynia*). Classification (up to family), morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris*. Heterospory and seed habit, Stellar evolution. Ecological and economical importance of Pteridophytes.

UNIT-IV [15 Lectures]

Applied Cryptogamy: Cryptogams in Biotechnology & Environment, Algae in food, medicine, biofuels, and wastewater treatment, Fungi in antibiotics (Penicillin), fermentation, and biocontrol, Bryophytes & Pteridophytes in soil conservation & ecosystem balance

Recommended Textbooks and References:

1. Evert, R.F., Eichhorn, S.E. (2012). *Raven Biology of Plants*, 8th edition, New York, NY: W.H. Freeman and Company.
2. Kumar, H.D. (1999). *Introductory Phycology*, 2nd edition. Delhi, Delhi: Affiliated East-West Press Pvt. Ltd.
3. Puri, P. (1985). *Bryophytes*. New Delhi, Delhi, Atma Ramand Sons.
4. Sethi, I. K and Walia, S.K. (2018). *Textbook of Fungi and their Allies*. (2nd Edition), Medtech Publishers, Delhi.
5. P.C. Vashishta, A.K. Sinha, Anil Kumar (2010), *Cryptogams: Algae, Bryophyta, and Pteridophyta*. S. Chand & Company Pvt. Ltd.

Discipline Specific Course	
BZL104AD ZOOLOGY-I (INVERTEBRATES)	CREDITS: 4+0

External Marks	70
Internal Marks	30
Total Marks	100
Time	3 H

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

UNIT-I [15 Lectures]

Outline of classification of non-chordates up to subclasses. Coelomata, Acoelomata, Symmetries, Deuterostomes, Protostomes.

Protozoa: Locomotion, Reproduction, evolution of Sex, General features of Paramoecium and Plasmodium. Pathogenic protozoans Porifera: General characters, outline of Classification; skeleton, Canal System

UNIT – II [15 Lectures]

Coelenterata: General Characters, Outline of classifications Polymorphism, Various types of stinging cells; Metagenesis, coral reefs and their formation.

Platyhelminthes- General Characters; Outline of classification; Pathogenic flatworms: Parasitic adaptations.

Aschelminthes: General features, Outline of classification, Pathogenic roundworms and their vectors in relation to man: Parasite adaptation.

UNIT –III [15 Lectures]

Annelida: - General features, Outline of classification, Coelom: Metameric segmentation, General features of Earthworm, Vermicomposting.

Arthropoda: General Features, Outline of Classification; Larval forms of crustacean, Respiration in Arthropoda; Metamorphosis in insects; Social insects; Insect vectors of diseases; Apiculture, Sericulture.

UNIT –IV [15 Lectures]

Mollusca: general features, Outline of classification, Shell Diversity; Torsion in Gastropoda, Echinodermata: General features, Outline of Classification Larval forms

Hemichordata: Phylogeny: Affinities of Balanoglossus

Recommended Textbooks and References:

1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. & J.I., Spicer (2002) *The Invertebrates: A New Synthesis. III Edition. Blackwell Science.*
2. Barrington, E.J.W. (1979) *Invertebrate Structure and Functions. II Edition. E.L.B.S. and Nelson.*
3. Boradale, L.A. and Potts, E.A. (1961) *Invertebrates: A Manual for the use of Students. Asia Publishing Home.*
4. Bushbaum, R. (1964) *Animals without Backbones. University of Chicago Press.*
5. Kent, G.C. and Carr R.K. (2000). *Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.*

Discipline Specific Course	
BBP105AD BOTANY-I (CRYPTOGAMS LAB)	Credits: 0+2

External Marks	70
Internal Marks	30
Total Marks	100
Time	3 H

LIST OF EXPERIMENTS

1. To study and compare the thallus organization in selected algae.
2. To observe spore germination and prothallus development in ferns.
3. To isolate and identify common fungi from spoiled food materials.
4. To identify and classify different types of lichens based on morphology.
5. To survey and analyze the diversity and distribution of bryophytes in various microhabitats.
6. To assess algal blooms in water bodies and relate findings to water quality.
7. To prepare and study spore prints of mushrooms for identification purposes.
8. To demonstrate phototactic behavior in cyanobacteria under directional light.
9. To compare the structure and types of rhizoids in mosses and liverworts.
10. To observe vascular tissue organization in pteridophytes through temporary mounts.

Discipline Specific Course	
BZP106AD ZOOLOGY-I (INVERTEBRATES LAB)	Credits: 0+2

External Marks	70
Internal Marks	30
Total Marks	100
Time	3 H

LIST OF EXPERIMENTS

1. To study the external morphology and segmentation of the earthworm.
2. To observe and document the metamorphosis in insects such as butterflies or houseflies.
3. To dissect and mount various types of insect mouthparts and study their structural adaptations.
4. To collect, identify, and classify freshwater invertebrates from natural habitats.
5. To observe and compare molluscan shells for classification based on external features.
6. To study behavioral responses of earthworms or snails to environmental stimuli.
7. To understand the water canal system and filtration mechanism in sponges.
8. To prepare temporary mounts of salivary glands or trachea in cockroaches for anatomical study.
9. To compare adaptive features of aquatic and terrestrial invertebrates.
10. To conduct a biodiversity survey of invertebrates in a local ecosystem.

Discipline Specific Course	
BBL203AD BOTANY-II (PHANEROGAMS)	Credits: 4+0

External Marks	70
Internal Marks	30
Total Marks	100
Time	3 H

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

UNIT-I

[15 Lectures]

Gymnosperms- General characteristic features, reproduction, Fertilization & seed development in Gymnosperms, broad classification, evolutionary trends in Gymnosperm, affinities with Pteridophytes. Brief account of Cycas and Pinus. Study of Fossil Gymnosperms (*Medullosa, Cycadeoidea and Caytonia*).

UNIT-II

[15 Lectures]

Angiosperm Morphology & Reproductive Structures: Angiosperm Vegetative Morphology: Root, Stem, and Leaf Modifications, Types of Venation & Phyllotaxy; Reproductive Morphology: Flower Structure & Function, Inflorescence types (racemose, cymose, special types), Pollination Mechanisms (Wind, Water, Insects), Fruit & Seed Development, Types of Fruits (Simple, Aggregate, Multiple), Seed structure, dispersal, and germination

UNIT-III

[15 Lectures]

Angiosperm Taxonomy & Systematics: Concept of natural, artificial and phylogenetic systems of classification, Numerical Taxonomy and Chemotaxonomy. Detailed Study of Important Angiosperm Families, Dicotyledons: *Fabaceae* (Leguminosae), *Solanaceae*, *Asteraceae*; Monocotyledons: *Poaceae* (Gramineae), *Orchidaceae*, *Liliaceae*

UNIT-IV

[15 Lectures]

Applied Aspects of Phanerogams: Economic & Ecological Importance of Phanerogams, Economic significance of Gymnosperms (Timber, Resins, Medicine), Economic importance of Angiosperms (Cereals, Pulses, Oils, Fibers, Beverages, Medicinal Plants), Recent Trends in Plant Taxonomy & Molecular Phylogenetics, DNA Barcoding in plant identification, Phylogenetic relationship studies using molecular markers.

Recommended Textbooks and References:

1. Parihar, N.S. (1991). *An Introduction to Embryophyta. Vol.II. Pteridophytes. Prayagraj: U.P: Central Book Depot.*
2. Singh, V., Pandey, P.C., Jain, D.K. (2001). *A Text Book of Botany. Meerut, UP: Rastogi and Co.*
3. Bhatnagar, S.P., Moitra, A. (1996). *Gymnosperms. New Delhi, Delhi: New Age International (P) 4 Ltd Publishers*
4. Evert, R.F., Eichhorn, S.E. (2012). *Raven Biology of Plants, 8th edition, New York, NY: W.H. Freeman and Company.*
5. Kochhar, S.L. (2016) *Economic Botany in the Tropics, Cambridge University Press India.*

Discipline Specific Course	
BZL204AD ZOOLOGY-II (VERTEBRATES)	CREDITS: 4+0

External Marks	70
Internal Marks	30
Total Marks	100
Time	3 H

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

UNIT-I [15 Lectures]

Proto-chordates: Outline of classification, General features and important characters of Herdmania, Branchiostoma, Origin of Chordates

Pisces: Migration in Pisces, Outline of classification Amphibia: Classification, Origin, Parental care, Paedogenesis

UNIT – II [15 Lectures]

Reptelia: Classification, Origin

Aves: Classification, Origin, flight- adaptations, migration Mammalia: Classification, Origin, dentition

UNIT –III [15 Lectures]

Comparative anatomy of vertebrate systems, including the integumentary system (skin, scales, feathers, glands), digestive system (alimentary canal adaptations for varied diets), and respiratory system (gills, lungs, and air sacs). Evolutionary trends, structural-functional relationships, and adaptations to diverse habitats, providing insights into vertebrate physiology and evolutionary biology.

UNIT –IV [15 Lectures]

Comparative Anatomy of vertebrates – heart and aortic arches (circulatory adaptations), kidney and urinogenital system (excretory and reproductive structures), brain, eye, and ear (neuro-sensory organs). Autonomic nervous system in mammals: structural-functional relationships, evolutionary trends, and adaptations across vertebrate classes for diverse habitats and lifestyles.

Recommended Textbooks and References:

1. Hall B.K. and Hallgrimsson B. (2008). *Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.*
2. Kardong, K.V. (2005) *Vertebrates Comparative Anatomy, Function and evolution. IV Edition. McGraw-Hill Higher Education.*
3. Kent, G.C. and Carr R.K. (2000). *Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.*
4. Weichert, C.K. (1970). *Anatomy of Chordate. McGraw Hill.*
5. Young, J.Z. (2004). *The life of vertebrates. III Edition. Oxford university press.*

Discipline Specific Course	
BBP205AD BOTANY-II (PHANEROGAMS LAB)	Credits: 0+2

External Marks	70
Internal Marks	30
Total Marks	100
Time	3 H

LIST OF EXPERIMENTS

1. To study the external morphology and reproductive structures of selected gymnosperms (e.g., Cycas, Pinus).
2. To compare leaf anatomy in xerophytic, mesophytic, and hydrophytic angiosperms using hand sections.
3. To examine the floral structure and floral formula of selected angiosperm families (e.g., Fabaceae, Solanaceae, Lamiaceae).
4. To perform pollen viability and germination tests using sucrose solutions.
5. To study the structure of dicot and monocot stems through hand sections and staining.
6. To observe different types of placentation in angiosperm ovaries using fresh specimens.
7. To identify and differentiate types of inflorescences in angiosperms with examples from local flora.
8. To study seed structure and germination types in monocots and dicots.
9. To examine the anatomy of root nodules in leguminous plants to observe symbiotic nitrogen fixation.
10. To collect and classify economically important plants based on their uses (e.g., medicinal, food, timber).

Discipline Specific Course	
BZP206AD ZOOLOGY-II (VERTEBRATES LAB)	Credits: 0+2

External Marks	70
Internal Marks	30
Total Marks	100
Time	3 H

LIST OF EXPERIMENTS

1. To study the external morphology and adaptive features of local fish species.
2. To observe and compare skull types in vertebrates using available models or images (e.g., fish, amphibians, reptiles, birds, mammals).
3. To perform morphometric and meristic analysis of fish for taxonomic identification.
4. To study the structure and function of bird feathers and identify types (contour, down, flight feathers).
5. To examine the structure of vertebrate heart (e.g., fish or frog) through dissection or model observation.
6. To observe limb modifications and adaptations in tetrapods using preserved specimens or visual resources.
7. To prepare and study blood smears of vertebrates for identification of RBCs and WBCs (from prepared slides or animal samples, if permitted).
8. To analyze the vertebral column in different vertebrate groups through models or skeletal remains.
9. To study dentition patterns in mammals and relate them to dietary habits using skulls or dental casts.
10. To observe respiratory structures (gills in fish, lungs in frog/mammal) using dissection or secondary resources.

Discipline Specific Course	
BBL313AD BOTANY- III (PLANT PHYSIOLOGY AND METABOLISM)	CREDITS: 4+0

External Marks	70
Internal Marks	30
Total Marks	100
Time	3 H

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

UNIT-I [15 Lectures]

Plant-Water Relations & Mineral Nutrition: Importance of water to plant life, Diffusion, Osmosis, Plasmolysis, Imbibition, Guttation, Transpiration, Absorption of Water (Active & Passive), Ascent of Sap, Stomatal Regulation. Essential Elements (Macronutrients & Micronutrients), Nutrient Deficiency Symptoms & Their Physiological Roles, Mechanism of Nutrient Uptake (Active & Passive Transport)

UNIT-II [15 Lectures]

Photosynthesis & Respiration: the four major complexes of thylakoids: Light and Dark Reactions, path of carbon in photosynthesis (C₂, C₃ and CAM plants). Rubisco, structure and its association with the mechanism of carboxylation and oxygenation of RUBP. Glycolysis, Krebs Cycle (TCA Cycle), Electron Transport System (ETS) & ATP Production, Anaerobic Respiration (Fermentation).

UNIT-III [15 Lectures]

Growth, Development & Plant Hormones: Phases of Growth, Growth Curves, Seed Dormancy & Germination, Photoperiodism & Vernalization, Plant Growth Regulators (PGRs), Auxins, Gibberellins, Cytokinins, Abscisic Acid (ABA), Ethylene, Role of PGRs in Germination, Dormancy, Flowering, and Senescence, Plant Responses to Environmental Stimuli, Tropisms (Phototropism, Geotropism, Thigmotropism), Stress Physiology: Drought, Salinity, Heat & Cold Stress

UNIT-IV [15 Lectures]

Nitrogen Metabolism & Secondary Metabolites: Biological Nitrogen Fixation (Symbiotic & Non-Symbiotic), Nitrate & Ammonia Assimilation, Role of Nitrate Reductase & Glutamine Synthetase, Secondary Metabolites & Their Applications, Types: Alkaloids, Phenolics, Terpenoids, Flavonoids, Functions: Plant Defence, Growth Regulation, Human Applications (Medicine & Industry).

Recommended Textbooks and References:

1. Taiz, L. and Zeiger, E. (2018), *Plant Physiology and Development*. Sinauer Associates, USA.
2. Salisbury, F.B., Ross, C.W. (1992) – "*Plant Physiology*" (Wadsworth Publishing)
3. Hopkins, W.G., Huner, N.P. (2008) – "*Introduction to Plant Physiology*" (John Wiley & Sons)
4. Hopkins, W.G. and Hüner, N.P.A., 2009, *Introduction to Plant Physiology (4th Ed.)* Wiley & Sons. Inc. USA.
5. Davies P J. (2004). *Plant Hormones: Biosynthesis, Signal Transduction, Action*. 3rd Edition, Kluwer Academic Publisher, Dordrecht, The Netherlands.
6. Jordan, B.R. (2006). *The Molecular Biology and Biotechnology of Flowering*, 2nd Edition, CAB International, U.K

Discipline Specific Course	
BZL314AD ZOOLOGY-III (REPRODUCTIVE BIOLOGY)	Credits: 4+0

External Marks	70
Internal Marks	30
Total Marks	100
Time	3 H

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

UNIT-I [15 Lectures]

Reproductive System and Endocrinology: Reproductive System: Development and differentiation of gonads, genital ducts, external genitalia, mechanism of sex differentiation. Gonadal hormones and mechanism of hormone action, steroids, glycoprotein hormones, and prostaglandins.

UNIT-II [15 Lectures]

Functional anatomy of male reproduction: Outline and histology of male reproductive system in human; Testis: Cellular functions, germ cell, system cell renewal; Spermatogenesis: kinetics and hormonal regulation; Androgen synthesis and metabolism; Epididymal function and sperm maturation; Accessory glands functions.

UNIT-III [15 Lectures]

Functional anatomy of female reproduction: Outline and histology of female reproductive system in human; Ovary: folliculogenesis, ovulation, corpus luteum formation; Steroidogenesis and secretion of ovarian hormones; Reproductive cycles and their regulation, changes in the female tract; Ovum transport in the fallopian tubes; Sperm transport in the female tract, Fertilization: Definition, mechanism and types of fertilization, prevention of polyspermy

UNIT-IV [15 Lectures]

Reproductive Health: Infertility in male and female: causes, diagnosis and management; Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, in vitro fertilization, Embryo Transfer, Modern contraceptive technologies; Demographic terminology used in family planning.

Recommended Textbooks and References:

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

Discipline Specific Course	
BBP315AD BOTANY- III (PLANT PHYSIOLOGY AND METABOLISM LAB)	CREDITS: 0+2

External Marks	70
Internal Marks	30
Total Marks	100
Time	3 H

LIST OF EXPERIMENTS

1. To demonstrate the process of osmosis using a potato osmometer or dialysis membrane.
2. To study the effect of different concentrations of salt or sugar solutions on plasmolysis in epidermal cells.
3. To measure the rate of transpiration under different environmental conditions using a simple potometer.
4. To demonstrate the process of photosynthesis by observing oxygen evolution in aquatic plants (e.g., Hydrilla).
5. To compare the rate of photosynthesis under different wavelengths of light using simple light filters.
6. To analyze the effect of pH and temperature on enzyme activity (e.g., amylase or catalase).
7. To separate plant pigments using paper chromatography.
8. To estimate chlorophyll content in plant leaves using acetone extraction and spectrophotometric method (or color comparison if spectrophotometer not available).
9. To demonstrate aerobic respiration by measuring CO₂ evolution using a simple respirometer.
10. To determine the water potential of plant tissues using the gravimetric method or sucrose solutions.

Discipline Specific Course	
BZP316AD ZOOLOGY-III (REPRODUCTIVE BIOLOGY LAB)	Credits: 0+2

External Marks	70
Internal Marks	30
Total Marks	100
Time	3 H

LIST OF EXPERIMENTS

1. To study the structure and types of ovules and placentation in angiosperms using fresh plant materials.
2. To observe stages of microsporogenesis and megasporogenesis in permanent or temporary plant slides.
3. To analyze pollen viability and germination using sucrose solution under laboratory conditions.
4. To identify and classify different types of inflorescence and floral adaptations related to pollination.
5. To observe stages of embryo development in dicot and monocot seeds.
6. To study the reproductive anatomy of model organisms (e.g., frog, rat) using diagrams, models, or dissection (if permitted).
7. To examine sperm motility and morphology using low-magnification microscopy (from prepared slides or safe samples, if available).
8. To identify and study different types of contraceptive devices and explain their mechanisms.
9. To observe and compare male and female reproductive systems through anatomical models or charts.
10. To understand the process of fertilization and early embryonic development through prepared slides, models, or video demonstrations

Discipline Specific Course	
BBL412AD BOTANY-IV (PLANT ANATOMY AND EMBRYOLOGY)	CREDITS: 4+0

External Marks	70
Internal Marks	30
Total Marks	100
Time	3 H

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

UNIT-I [15 Lectures]

Plant Anatomy – Tissue Systems & Vascular Structures: The shoot and root apical meristem and its histological organization, Simple and complex permanent tissues, Primary structure of shoot and root, Xylem & Phloem, Secondary growth, Growth rings, Leaf anatomy (dorsiventral and isobilateral leaf).

UNIT-II [15 Lectures]

Morphogenesis, Organ Development & Anomalies: Root, Stem, & Leaf Anatomy, Monocot vs. Dicot Root & Stem Anatomy, Structure & Types of Leaves, Kranz Anatomy (C4 Plants), Anomalous Secondary Growth, Anomalous growth in Dracaena, Boerhaavia, Bignonia, Achyranthes, Vascular Cambium & Secondary Phloem Variations

UNIT-III [15 Lectures]

Reproductive Structures, Flower & Gametophyte Development, Structure of Anther & Microsporogenesis, Development of Male Gametophyte (Pollen Formation), Ovule Types & Megasporogenesis, Development of Female Gametophyte (Embryo Sac). Pollination, Fertilization & Double Fertilization, Types of Pollination & Mechanisms, Self-Incompatibility & Pollen-Pistil Interaction, Process of Fertilization & Triple Fusion

UNIT-IV [15 Lectures]

Embryo Development & Seed Formation: Stages of Embryo Development in Monocots & Dicots, Endosperm Formation (Nuclear, Cellular, Helobial), Apomixis, Seed Development and Dormancy.

Process of seed development in Angiosperms: Structure of Seeds: Testa, Cotyledons, Embryo Seed Dormancy: Mechanisms and Overcoming Dormancy. Seed germination, Concept of photoperiodic and vernalization.

Recommended Textbooks and References:

1. Dickinson, W.C. 2000 *Integrative Plant Anatomy*. Harcourt Academic Press, USA.
2. Esau, K. 1977 *Anatomy of Seed Plants*. Wiley Publishers.
3. Fahn, A. 1974 *Plant Anatomy*. Pergmon Press, USA and UK.
4. Mauseth, J.D. 1988 *Plant Anatomy*. The Benjamin/Cummings Publisher, USA.
5. Salisbury, F.B. and Ross, C.W. 1991 *Plant Physiology*, Wadsworth Publishing Co. Ltd.
6. Esau, K. "Anatomy of Seed Plants" (John Wiley & Sons, 1977)
7. Ravishankar, K. – "Plant Embryology" (Oxford & IBH Publishing, 2004)
8. Stewart, W.N., & Rothwell, G.W. – "Paleobotany and the Evolution of Plants" (Cambridge University Press, 1993)
9. Bhatnagar, S.P., & Bhatnagar, M. – "Embryology of Angiosperms" (Sterling Publishers, 2000).

Discipline Specific Course	
BZL413AD ZOOLOGY-IV (APPLIED ZOOLOGY)	Credits: 4+0

External Marks	70
Internal Marks	30
Total Marks	100
Time	3 H

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

UNIT-I [15 Lectures]

Aquaculture: Types of Fisheries; Fresh Water Fish and Prawn culture, Fresh water fishing gears and crafts; Induced Breeding. Hatchery design and Management of fish and prawn; Transportation of fish and prawn seed. Preservation, Processing and By-products of fishes. Fish Diseases and control measures

UNIT-II [15 Lectures]

Sericulture: Life cycle of Bombyx mori, Structure of silk gland and secretion of silk, Silkworm rearing technology, Spinning, harvesting and storage of cocoons. Silk worm Pests and Diseases: Uzi fly; Protozoan, Viral, Fungal and Bacterial; Control and prevention. Prospects of Sericulture in India

UNIT-III [15 Lectures]

Apiculture: Selection of Bee Species for Apiculture. Bee Keeping Equipment. Methods of Extraction of Honey (Indigenous and Modern). Bee Diseases and Enemies. Products of Apiculture Industry and its Uses (Honey, Bees Wax).

UNIT-IV [15 Lectures]

Vermiculture: Introduction of Vermiculture and Vermicomposting. Vermiculture techniques. Bedding, Essential parameters for Vermiculture and Management. Methods of Harvesting (Manual & Mechanical). Economic Importance of Vermiculture.

Recommended Textbooks and References:

1. Singh S., *Beekeeping in India, Indian council of Agricultural Research, New Delhi.*
2. Ullal S.R. and Narasimhanna, M.N. *Handbook of Practical Sericulture: CSB, Bangalore*
3. Jolly. M. S. *Appropriate Sericultural Techniques; Ed., Director, CSR & TI, Mysore.*
4. Narasimhanna, M. N. *Manual of Silkworm Egg Production; CSB, Bangalore 1988.*
5. Wupang Chun and Chen Da-Chung, *Silkworm Rearing; Pub. By FAO, Rome 1988.*
6. Sengupta, K. *A Guide for Bivoltine Sericulture; Director, CSR & TI, Mysore 1989.*
7. Krishnaswamy, S. *Improved Method of Rearing Young age silkworm; CSB, Bangalore, 1986.*
8. Jhingran. V.G. *Fish and fisheries in India.,*
9. Khanna. S.S, *An introduction to fishes*
10. Santanam, B. et al, *A manual of freshwater aquaculture,*
11. Boyd. C. E. & Tucker. C. S, *Pond aquaculture water quality management,*
12. Biswas K.P, *Fish and prawn diseases,*

Discipline Specific Course	
BBP414AD BOTANY-IV (PLANT ANATOMY AND EMBRYOLOGY LAB)	CREDITS: 0+2

External Marks	70
Internal Marks	30
Total Marks	100
Time	3 H

LIST OF EXPERIMENTS

1. To prepare and study transverse sections of dicot and monocot stems to compare their anatomical features.
2. To observe and compare the anatomy of dicot and monocot roots using hand sections.
3. To study the structure of leaf through transverse sections of dorsiventral and isobilateral leaves.
4. To examine the types and distribution of vascular bundles in different plant organs.
5. To identify and differentiate types of stomata using epidermal peels from various plant species.
6. To observe different types of plant tissues (meristematic and permanent) using prepared or temporary slides.
7. To study the structure and types of ovules in angiosperms using dissection or slides.
8. To observe stages of microsporogenesis and development of male gametophyte using permanent slides.
9. To examine the development of the embryo sac (female gametophyte) using permanent or prepared slides.
10. To study the structure of mature embryos in dicot and monocot seeds through dissection.

Discipline Specific Course	
BZP415AD ZOOLOGY-IV (APPLIED ZOOLOGY LAB)	Credits: 0+2

External Marks	70
Internal Marks	30
Total Marks	100
Time	3 H

LIST OF EXPERIMENTS

1. To study the morphology and anatomy of common freshwater and marine fish species relevant to local fisheries.
2. To observe and identify economically important aquatic organisms used in fish farming.
3. To demonstrate the techniques of fish breeding and spawning in controlled or semi-controlled environments.
4. To study the life cycle and rearing methods of silkworms (*Bombyx mori*) in sericulture.
5. To identify different types of silkworm diseases and pests and suggest management practices.
6. To observe the structure and behavior of honeybee castes and understand the hive organization in apiculture.
7. To demonstrate techniques of hive management and honey extraction in apiculture.
8. To study the types and benefits of earthworms used in vermiculture and their role in organic waste management.
9. To observe the anatomy and feeding habits of earthworms relevant to vermiculture.
10. To demonstrate vermicomposting techniques and analyze the quality of vermicompost produced.

Discipline Specific Course	
BBL513AD BOTANY-V (ECOLOGY AND ENVIRONMENTAL BOTANY)	Credits: 4+0

External Marks	70
Internal Marks	30
Total Marks	100
Time	3 H

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

UNIT-I [15 Lectures]

Our Environment: Geological Consideration of Atmosphere, Hydrosphere, Lithosphere Scope of Ecology. Development & Evolution of Ecosystem. Principles & Concepts of Ecosystem. Structure of ecosystem. Strata of an ecosystem. Types of ecosystem including habitats. Cybernetics & Homeostasis. Biological control of the chemical environment.

UNIT-II [15 Lectures]

Energy transfer in an Ecosystem. Food chain, food web, Energy budget, Production & decomposition in a system. Ecological efficiencies, Trophic structure & energy pyramids, Ecological energetic, principles pertaining to limiting factors, Bio-geochemical cycles (N, C, P cycles).

UNIT-III [15 Lectures]

Pollution & Environmental Health related to Soil, Water, Air, Food, Pesticides, Metals, Solvents, Radiations, Carcinogen, Poisons. Detection of Environmental pollutants. Indicators & detection systems. Bio-transformation, Plastic, Aromatics, Hazardous wastes Environmental cleanup: Case studies

UNIT-IV [15 Lectures]

Environmental biotechnologies: Biotechnologies in protection and preservation of environment. Bioremediation, Waste disposal. Role of Plants in Mitigating Climate Change: Carbon sequestration, plant-based solutions for global warming, Phytoremediation: Use of plants in the removal of pollutants from air, soil, and water (heavy metals, pesticides).

Recommended Textbooks and References:

1. Chapman, J.L., Reiss, M.J. 1999. *Ecology: Principles and applications (2nd edition)* Cambridge University Press.
2. Divan Rosencraz, *Environmental laws and policies in India*, Oxford Publication.
3. Ghosh, S.K., Singh, R. 2003. *Social forestry and forest management*. Global Vision Publishing House
4. Joseph, B., *Environmental studies*, Tata Mc Graw Hill.
5. Michael Allabay, *Basics of environmental science*, Routledge Press.
6. Miller, G.T. 2002. *Sustaining the earth, an integrated approach. (5th edition)* Books/Cole, Thompson Learning, Inc.
7. Mohapatra *Textbook of environmental biotechnology* IK publication.
8. Rana SVS, *Environmental pollution – health and toxicology*, Narosa Publication
9. Sinha, S. 2010. *Handbook on Wildlife Law Enforcement in India*. TRAFFIC, India.
10. Thakur, I S, *Environmental Biotechnology*, I K Publication.

Discipline Specific Course	
BBP514AD BOTANY-V (ECOLOGY AND ENVIRONMENTAL BOTANY LAB)	Credits: 0+2

External Marks	70
Internal Marks	30
Total Marks	100
Time	3 H

LIST OF EXPERIMENTS

1. To study the vegetation types and perform quadrat sampling for plant species diversity in a local habitat.
2. To analyze the frequency, density, and abundance of plant species using simple ecological methods.
3. To measure and compare soil pH, moisture, and texture from different ecological zones.
4. To study the effect of environmental factors on seed germination and seedling growth.
5. To assess the impact of pollution on local plant species through field observation and sample analysis.
6. To estimate the biomass and productivity of herbaceous plants in a defined area.
7. To observe and record phenological stages (flowering, fruiting) of selected plant species.
8. To identify and classify indicator plant species for specific environmental conditions.
9. To perform simple water quality analysis for parameters like turbidity, dissolved oxygen, and presence of nitrates.
10. To study plant adaptations to different environmental stresses (e.g., xerophytes, hydrophytes, halophytes).

Discipline Specific Course	
BBL613AD BOTANY- VI (ETHNOBOTANY)	CREDITS: 4+0

External Marks	70
Internal Marks	30
Total Marks	100
Time	3 H

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

UNIT-I [15 Lectures]

Ethnobotany & its Methodology: Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous use.

UNIT-II [15 Lectures]

Application & legal aspects of ethnobotany: Ethnobotanical sources in India; Significance of the following plants in ethnobotanical practices (along with their habitat and morphology) a) *Azadirachta indica* b) *Ocimum sanctum* c) *Vitex negundo*, d) *Gloriosa superba* e) *Tribulusterrestris* f) *Pongamia pinnata* g) *Cassia auriculata* h) *Indigofera tinctori*

UNIT-III [15 Lectures]

Role of ethnobotany in modern medicine with special example *Rauvolfia serpentina*, *Trichopus zeylanicus*, *Artemisia*, *Withania*.

Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management).

UNIT-IV [15 Lectures]

Ethnobotany and legal aspects: Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Biopiracy, Intellectual Property Rights and Traditional Knowledge.

Methodology of Ethnobotanical studies: a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places.

Recommended Textbooks and References:

1. S.K. Jain, *Manual of Ethnobotany*, Scientific Publishers, Jodhpur, 1995.
2. S.K. Jain (ed.) *Glimpses of Indian Ethnobotany*, Oxford and I B H, New Delhi – 1981
Lone et al., *Palaeoethnobotany*
3. S.K. Jain (ed.) 1989. *Methods and approaches in ethnobotany*. Society of ethnobotanists, Lucknow, India.
4. S.K. Jain, 1990. *Contributions of Indian ethnobotany*. Scientific publishers, Jodhpur.
5. Colton C.M. 1997. *Ethnobotany – Principles and applications*. John Wiley and sons –Chichester
6. Rama Ro, N and A.N. Henry (1996). *The Ethnobotany of Eastern Ghats in Andhra Pradesh, India*. Botanical Survey of India. Howrah.
7. Rajiv K. Sinha – *Ethnobotany The Renaissance of Traditional Herbal Medicine – INA – SHREE Publishers, Jaipur-1996* 9)

Discipline Specific Course	
BBP614AD BOTANY- VI (ETHNOBOTANY LAB)	CREDITS: 0+2

External Marks	70
Internal Marks	30
Total Marks	100
Time	3 H

LIST OF EXPERIMENTS

1. To document the traditional uses of medicinal plants in a local community.
2. To identify and classify plants used as food sources by indigenous or rural populations.
3. To study and record the cultural significance of plants in local rituals and customs.
4. To analyze the use of plants in traditional handicrafts and material culture.
5. To investigate the role of local plants in natural dyeing and textile production.
6. To collect and document plants used in traditional veterinary medicine.
7. To study the harvesting and sustainable management practices of economically important wild plants.
8. To examine the ethnobotanical uses of plants for household utilities like fuel, fodder, and construction.
9. To analyze the knowledge transfer methods of ethnobotanical information across generations.
10. To evaluate the conservation status and threats to traditionally important plant species.