

Syllabus Department of Botany, CBLU

w.e.f. Session 2025-2026

Chaudhary Bansi Lal University, Bhiwani

(A State University established under Haryana Act No. 25 of 2014)

Department of Botany

Syllabus and Examination Scheme

M.Sc. Botany

In accordance with NEP-2020

w.e.f. 2025-2026



(2025-26)

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SEMESTER III

CREDITS: 28

MARKS: 600

Sr. No.	Paper Code	Subjects	Type of Course	Contact hours per week			Credits			Examination Scheme			Total
				Theory	Practical	Total	Theory	Practical	Total	Theory	Internal Assessments	Practical/ External	
1.	25 BOT301	Plant Physiology	CC-7	04	-	04	04	-	04	70	30	-	100
2.	25 BOT302	Plant Anatomy and Developmental Biology	CC-8	04	-	04	04	-	04	70	30	-	100
3.	25 BOT303	Plant Ecology	CC-9	04	-	04	04	-	04	70	30	-	100
4.	25 BOT304	Microbiology	DEC-5 DEC-6 D.E.C-7	04	-	04	04	-	04	70	30	-	100
5.	25 BOT305	Restoration Ecology	#(Select any one)	04	-	04	04	-	04	70	30	-	100
6.	25 BOT306	Bioinformatics											
7.	25 BOT307	Lab course I	P.C.-5	-	8	8	-	04	04	-	-	50	50
8.	25 BOT308	Lab course II	P.C.-6	-	8	8	-	04	04	-	-	50	50
9.	25 BOT309	Processing of Fruits and Vegetables	##E.E.C	02	-	02	02	-	02	35	15	-	50
10	25 BOT310	*Research Training	**SEC	During 3rd Semester	3rd Semester work in 4th	for			02	----	50	-	50
TOTAL				18	16	34	18	08	28	315	185	100	600

C.C = Core Course, DEC=Discipline Elective Course # Select one out of three or student can also take MOOCs course from SWAYAM portal of equal credit.

Note: Discipline Elective Course paper can be offered depending upon the availability of the Resources and faculties. ** SEC- Skill Enhancement Course, ##EEC- Entrepreneurship Enhancement Course. * A Research Training of 2 Credits of 7-10 days first break of IIIrd semester is to be completed by every student. This programme will help the students for developing the research aptitude and completion of their dissertation work which is to be submitted in the 4th semester. The student will submit a synopsis on the dissertation topic of 4th Semester and will give a brief presentation at the end of third semester before the department research committee constituted for the purpose.

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SEMESTER- IV (Option I)

CREDITS: 24

MARKS: 500

Sr. No.	Paper Code	Subjects	Type of Course	Contact hours per week			Credits			Examination Scheme			Total
				Theory	Practical	Total	Theory	Practical	Total	Theory	Internal Assessments	Practical	
1.	25 BOT401	Cytogenetics and Plant Breeding	CC-10	04	-	04	04	-	04	70	30	-	100
2.	25 BOT402	Biochemical and Biophysical Techniques	CC-11	04	-	04	04	-	04	70	30	-	100
3.	25 BOT403	Evolutionary Biology	CC-12	04	-	04	04	-	04	70	30	-	100
4.	25 BOT404	Seed Science and Technology	DEC-8 DEC-9 DEC-10 DEC-11	04	-	04	04	-	04	70	30	-	100
5.	25 BOT405	Applied Mycology	# (Select any one)										
6.	25 BOT406	Photobiology											
7.	25 BOT407	Phytochemistry & Pharmacognosy											
8.	25 BOT408	Lab course-I	P.C.7	-	8	8	-	4	4	-	-	50	50
9.	25 BOT409	Lab course-II	P.C.8	-	8	8	-	4	4	-	-	50	50
TOTAL				16	16	32	16	8	24	280	120	100	500

DEC=Discipline Elective Course

C.C = Core Course

P.C. = Practical Course

Select one out of one or student can also take MOOCs course from SWAYAM portal of equal credit after discussion with MOOC Coordinator.

Note: Discipline Elective Course paper can be offered depending upon the availability of the Resources and faculties.

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SEMESTER-IV (Option II)

CREDITS: 24

MARKS: 500

Sr. No	Paper Code	Subjects	Type of Course	Contact hours per week			Credits			Examination Scheme			Total
				Theory	Practical	Total	Theory	Practical/ Dissertation	Total	Theory	Internal Assessment	External/ Practical	
1.	25 BOT401	Cytogenetics and plant Breeding											
2.	25 BOT402	Biochemical and Biophysical Techniques	DEC-12 DEC-13 DEC-14 DEC-15										
3.	25 BOT403	Evolutionary Biology	DEC-16 DEC-17 DEC-18	4X3=12	-	4x3=12	4x3=12	-----	4x3=12	70x3=210	30X3=90	-----	100x3=300
4.	25 BOT404	Seed Science and technology											
5.	25 BOT405	Applied Mycology	# (Select any three)										
6.	25 BOT406	Photobiology											
7.	25 BOT407	Phytochemistry Pharmacognosy											
8.	25 BOT408	Dissertation/ Internship		-	8	8	---	12	12	-	100	100	200
TOTAL				12	8	20	12	12	24	210	190	100	500

DEC=Discipline Elective Course * The Core course of semester fourth (option I) will be treated as Discipline Elective Course (DEC) in semester fourth (option II). CC=Core Course # Select one out of three or student can also take MOOCs course from SWAYAM portal of equal.



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SEMESTER - III

Plant Physiology (25 BOT301)

Part A – Introduction Programme and Course

Name of Programme: M.Sc. Botany

Name of the Course: Plant Physiology

Course Code: 25 BOT301

Course Type: CC-7

Course Credits: 04

Teaching Hours per week: 04

Max. Marks: 100

Theory Examination - 70
Internal Assessment - 30

Part B- Course Objectives and Course Learning Outcomes (CLOs):

Course Objectives

This course is designed to provide comprehensive knowledge of plant physiological and biochemical processes with emphasis on water relations, mineral nutrition, photosynthesis, respiration, phytohormones, stress physiology, and signal transduction. The syllabus is structured according to the principles of the National Education Policy (NEP-2020) and aligned with contemporary patterns of UGC-NET/CSIR-NET Life Sciences examinations.

Course Outcomes (COs)

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

1. Explain the mechanisms of water absorption, translocation, mineral uptake, and nutrient utilization in plants.
2. Describe the biochemical and physiological basis of photosynthesis, respiration, and energy metabolism.
3. Interpret the role of phytohormones and secondary metabolites in plant growth, development, and stress adaptation.
4. Analyze plant responses to abiotic and biotic stresses and evaluate physiological adaptation strategies.
5. Photobiology, dormancy, and environmental regulation of plant development.
6. Develop analytical and conceptual skills required for higher studies and competitive examinations such as UGC-NET, CSIR-NET, GATE, and ICAR examinations.

Part C- Instructions for Paper Setter:

The examiner will set 9 questions asking two questions from each UNIT and one compulsory question by taking course learning outcomes (CLOs) into consideration.

The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire

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syllabus. The examinee will be required to attempt 5 questions in all selecting one question from each UNIT and the compulsory question. All questions will carry equal marks.

UNIT-I

Plant water relations and Mineral Nutrition: Concept and components of diffusion, osmosis, DPD and water potential, uptake, transport and translocation of water, ions and solutes from soil, through cells, across membrane and through xylem. Transpiration and factors affecting transpiration, anti-transpirants, Role and mode of action of micro and macronutrients, deficiency disorders.

Photo assimilate Translocation: Mechanism of Phloem loading, Mass Flow through phloem and phloem unloading at sink of photo assimilates.

UNIT-II

Photosynthesis: Light harvesting complex, Photo protective mechanisms, Photo-oxidation of water, cyclic and non-cyclic photophosphorylation, photorespiration and its significance. The sequence of reactions in photosynthesis, carbon Dioxide Fixation- C₃, C₄ cycles and CAM pathways. Factors affecting photosynthesis, Blackman's law of limiting factors.

2. Accumulation and Partitioning of Photosynthates: Formation and mobilization of chloroplast starch, sucrose biosynthesis, transport and signaling.

UNIT-III

Respiration: Mechanism and regulation of glycolysis, Underground metabolism in glycolytic pathway, Krebs cycle (with reference to plant specific reactions), Plant mitochondrial electron Transport and ATP synthesis, alternate oxidase, Photorespiratory Pathway, pentose phosphate pathway (PPP) and glyoxylate Pathway.

2. Nitrogen Metabolism: Biochemistry of nitrogen fixation, symbiotic and free-living nitrogen fixation, formation of root nodule in legumes, Nitrogenase, nitrate reductase, nitrate assimilation, ammonium assimilation (major and alternate route), transamination reactions, amino acid biosynthesis.

UNIT-IV

Plant Hormones and stress Physiology: Biosynthesis, storage, breakdown and transport of plant Growth Regulators (PGRs), Physiological effects, agriculture applications and mechanism of action of plant hormones. Physiological and molecular responses of plants to abiotic (drought, salinity,

heat, cold and oxidative stress) and biotic stresses (Plant-Pathogen interactions and insect resistance mechanisms), innate immunity.

Sensory Photobiology and Secondary Metabolites: Light perception, structure, function and mechanisms of action of phytochromes, cytochromes and phototropins, stomatal movements, Tropic movements, photoperiodism, Dormancy and Vernalization and biological clocks. Biosynthesis of terpenes, phenolics, alkaloids, phenylpropanoids, nitrogenous compounds and their roles, metabolic engineering in plants.

Part D-Learning Resources

Recommended Books/e-resources/LMS:

1. Berg, J. M., Tymoczko, J. L., Gatto, G. J., & Stryer, L. (2019). Biochemistry (9th ed.). W. H. Freeman.
2. Nelson, D. L., & Cox, M. M. (2021). Lehninger Principles of Biochemistry (8th ed.). W. H. Freeman.
3. Voet, D., Voet, J. G., & Pratt, C. W. (2016). Fundamentals of Biochemistry: Life at the Molecular Level (5th ed.). Wiley.
4. Taiz, L., Zeiger, E., Møller, I. M., & Murphy, A. (2018). Plant Physiology and Development (6th ed.). Sinauer Associates.
5. Hopkins, W. G., & Hüner, N. P. A. (2008). Introduction to Plant Physiology (4th ed.). Wiley.

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.

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Plant Anatomy and Developmental Biology (25 BOT302)

Part A: Introduction Programme and Course

Name of Programme M.Sc. Botany

Name of the Course: Plant Anatomy and Developmental Biology

Course Code: 25 BOT302

Course Type: CC-8

Course Credits: 04

Teaching Hours per week: 04

Max. marks: 100

Theory Examination - 70
Internal Assessment - 30

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Part B-- Course Objectives and Course Learning Outcomes (CLOs):

Course Objectives

This course is designed to provide comprehensive knowledge of plant anatomy and Plant developmental Biology with emphasis on plant tissue structure and function, embryogenesis and development of male and female gametophytes in angiosperms. The syllabus is structured according to the principles of the National Education Policy (NEP-2020) and aligned with contemporary patterns of UGC-NET/CSIR-NET Life Sciences examinations.

Course Outcomes (COs)

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

1. explain the structure of various types of plant tissues and their locations and functions.
2. Describe the mechanism of secondary growth and anomalous secondary growth.
3. Explain the process of embryogenesis and roles of phytohormones in embryogenesis.
4. Differentiate between male and female gametophytes.
5. understand the seed and fruit development and seed germination.
6. Develop analytical and conceptual skills required for higher studies and competitive examinations such as UGC-NET, CSIR-NET, GATE, and ICAR examinations.

Part C- Instructions for Paper Setter:

The examiner will set 9 questions asking two questions from each UNIT and one compulsory question by taking course learning outcomes (CLOs) into consideration.

The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions in all selecting one question from each UNIT and the compulsory question. All questions will carry equal marks.

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UNIT-I

Meristem classification, permanent tissues, complex tissues (xylem and Phloem), secretory tissues, epidermal tissue system, types of vascular bundles, anatomy of monocotyledonous and dicotyledonous stems and roots, root-stem transition.

Anatomy of monocotyledonous and dicotyledonous leaves, secondary growth (tissues and mechanism involved), types of wood (storied and non-storied, ray structure, Tyloses, canals), anomalous secondary growth with examples.

UNIT-II

Organization of shoot and root apical meristem, shoot and root development, leaf development and phyllotaxy, transition to flowering, floral meristem, organogenesis and floral development, radial patterning, origin of epidermis, procambial precursors, SAM and RAM differentiation and maintenance, vascular cambium.

UNIT-III

Microsporogenesis and development of male gametophyte in Angiosperms. Megasporogenesis and development of female gametophyte in Angiosperms, pollination and its types, pollen-pistil interaction, Incompatibility.

Embryo sac development and double fertilization in plants, endosperm development and its types, Embryogenesis, polyembryony and apomixis, seed and fruit formation and seed germination.

UNIT-IV

Establishment of symmetry in plants, origins of polarity patterning during embryogenesis, position dependent mechanisms, genetic basis of embryogenesis, mutant analysis, role of phytohormones. Programmed cell death, ageing and senescence in plants.

Recommended Books/e-resources/LMS:

1. Esau, K. (2006). Plant Anatomy (3rd ed.). John Wiley & Sons.
2. Esau, M. (2019). Plant Anatomy. Springer.
3. Esau, M. (2005). Introduction to Plant Anatomy (Rev. ed.). John Wiley & Sons.
4. Went, F. W. (1970). Plant Embryology (2nd ed.). Van Nostrand Reinhold.
5. Gerstel, S. A., & Waller, D. G. (2000). Plant Embryology: A Morphological Approach.
6. Embryology: Bhojwani and Bhatnagar.

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.

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Plant Ecology (25 BOT303)

Part A – Introduction Programme and Course

Name of Programme: M.Sc. Botany

Name of the Course: Plant Ecology

Course Code 25 BOT303

Teaching Hours per week: 04

Max. Marks: 100

Course Type: CC-9

Course Credits: 04

Theory Examination: 70

Internal Assessment: 30

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Part B-- Course Objectives and Course Learning Outcomes (CLOs):

Course Objectives

This course is designed to provide comprehensive knowledge of plant ecology with special emphasis on ecosystem ecology, population ecology, community ecology and biodiversity. The syllabus is structured according to the principles of the National Education Policy (NEP-2020) and aligned with contemporary patterns of UGC-NET/CSIR-NET Life Sciences examinations.

Course Outcomes (COs)

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

1. Understand the ecological levels of organization (population, community, ecosystem and biosphere).
2. Explain the structure of ecosystems, community structure (food chains, food webs, trophic levels), keystone species and species interactions.
3. Explain the population growth models, Life-history strategies and r-and K selection, concept of metapopulation-demes and dispersal, interdemec extinctions, age structured populations.
4. Explain ecological Succession: Types; mechanisms; changes involved in succession; concept of climax.
5. Understand the community structure and various types of interactions in the community.
6. Develop analytical and conceptual skills required for higher studies and competitive examinations such as UGC-NET, CSIR-NET, GATE, and ICAR examinations.

Part C- Instructions for Paper Setter:

The examiner will set 9 questions asking two questions from each UNIT and one compulsory question by taking course learning outcomes (CLOs) into consideration.

The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire

syllabus. The examinee will be required to attempt 5 questions in all selecting one question from each UNIT and the compulsory question. All questions will carry equal marks.

UNIT-I

Introduction to Ecology-History, levels of organization (Individual, population, community, ecosystem, biosphere), approaches to study ecology and scope. The Environment: Solar radiations and temperature, Biotic and abiotic factors, ecological adaptations, ecotype, tolerance range and limiting factors, soil as a reservoir of life.

Ecosystem organization: structure and functions; primary production (Global pattern and controlling factors); energy dynamics, energy flow pathways and ecological efficiencies. Decomposition (mechanism, substrate quality and climatic factors); global biogeochemical cycles of C, N, P, & S, ecosystem stability (resistance and resilience).

UNIT-II

Population ecology- Concept, characteristics, population growth, logistic growth and density dependent and density independent factors, life tables, survivorship curves; population dynamics- Age structure, sex ratio, life history strategies (r-selected vs. K- selected); Metapopulations- Habitat fragmentation, connectivity and extinction risks, age structured populations. Habitat and niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.

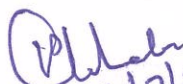
UNIT-III

Community Ecology- Community structure and organization; food chains, food webs, trophic levels, keystone species, species interactions- Mutualism, Competition, predation, parasitism and allelopathy, Nature of communities, community structure and its attributes; species diversity, Edges and ecotones, vegetation characteristics (analytical and synthetic characters, methods of analysis.

Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax/Community stability.

UNIT-IV

Human Impacts and Biodiversity Conservation- Invasion of alien plants: Concept, ecological impact and management. Anthropogenic pressures: Land use and land cover changes, Climate Change, Environmental pollution.


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Threats to biodiversity, IUCN categories of threats, Conservation genetics, Population viability Analysis (PVA), In-situ and Ex-situ conservation strategies, Community based conservation and the role of Indigenous knowledge. International Treaty on Plant Genetic Resources for Food and Agriculture (PGRFA). Protection of Plant Varieties and Farmers' Rights (PPVFR) Act, 2001. Conservation strategies for seed gene banks.

Part-D Recommended Books/e-resources/LMS:

1. Botkin, D.B. and E.A. Keller (2004). Environment Science: Earth as a Living Planet, John Wiley & Sons Inc., New York.
2. Odum, E.P. (1983), Basic Ecology, Sanders, Philadelphia.
3. Mishra & Kumar (2017), Concepts of Environmental Science, Rajesh Publications, New Delhi, India.
4. Smith, R.L. (1996), Ecology and Field Biology, Harper Collins, New York.
5. Steffen, W., A. Sanderson, P. D. Tyson, J. Jager, P. M. Matson, B. Moore, III, F. Oldfield, K. Richardson, H.J. Schellenberg, B. L. Turner, II, and R. J. Wasson. 2004. Global change and the Earth system: A Planet under Pressure. Springer-Verlag, New York, New York, USA Reference books.
6. Townsend, C.R., Begon, M. And Harper, J.L. 2003. Essentials of Ecology. Second Edition. Blackwell Publishing, Oxford.
7. Jakhar, S. (2024). Fundamentals of Ecology. TechSar, New Delhi.

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.

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Microbiology (25 BOT 304)**Part A – Introduction Programme and Course**

Name of Programme M.Sc. Botany

Name of the Course: Microbiology

Course Code 25 BOT 304

Course Type – DEC-5

Course Credits: 04

Teaching Hours per week: 04

Max. Marks: 100
 Theory Examination: 70
 Internal Assessment: 30

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Part B-- Course Objectives and Course Learning Outcomes (CLOs):**Course Objectives**

This course is designed to provide comprehensive knowledge of Microbiology. The syllabus is structured according to the principles of the National Education Policy (NEP-2020) and aligned with contemporary patterns of UGC-NET/CSIR-NET Life Sciences examinations.

Course Outcomes (COs)

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

1. Understand the general features of Prokaryotes.
2. Explain the bacterial genome, Plasmids, bacterial culture and sterilization process.
3. Explain the general features of viruses, bacteriophages, lytic and lysogenic life cycles.
4. Explain horizontal gene transfer (transformation, transduction and conjugation).
5. Describe the agricultural Importance of Microbes-Biological Nitrogen Fixation, Mycorrhizae and Biological control of plant disease and plant pests.
6. Microbial pesticides, Bio transformations: microbial degradation of pesticides and toxic chemicals,
7. Develop analytical and conceptual skills required for higher studies and competitive examinations such as UGC-NET, CSIR-NET, GATE, and ICAR examinations.

Part C- Instructions for Paper Setter:

The examiner will set 9 questions asking two questions from each UNIT and one compulsory question by taking course learning outcomes (CLOs) into consideration.

The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions in all selecting one question from each UNIT and the compulsory question. All questions will carry equal marks.

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UNIT-I

Microbial Taxonomy and Phylogeny. General features and classification of prokaryotes, size and shape, staining, cell wall and membrane system in gram positive and negative bacteria, structure of surface appendages (flagella, pili and fimbriae). Endospore formation, bacterial genome, plasmids, culture media, growth curve and reproduction, sterilization techniques.

UNIT-II

General features and classification of viruses, bacteriophage life-cycle (lytic and lysogenic), plaque assay, important plant viruses (TMV, ToLCV and CaMV), prions, viroid and virusoid.

General features of actinomycetes, mycoplasmas and cyanobacteria, archaebacteria (characteristics, important members, importance and differences from bacteria).

UNIT-III

Microbial Genetics- Bacterial and Viral genomes and derived vectors; Horizontal gene transfer (transformation, transduction and conjugation), Fungal genetics – mating types and genetic exchange, heterokaryosis, parasexual cycle. Recognition and entry processes of different pathogens like bacteria and viruses into animal and plant cells. Alteration of host cell behaviour by pathogens, virus induced cell transformations.

UNIT-IV

Agricultural Importance of Microbes- Biological Nitrogen Fixation, Mycorrhizae, Biological control of plant disease and plant pests. Environmental Microbiology: Microbes and quality of environment; Distribution and implications of microbes in air- bio-aerosols, microbial flora of water, water pollution, drinking water and domestic waste treatment systems; Microbial pesticides, Bio transformations: microbial degradation of pesticides and toxic chemicals, Bio degradation of the agricultural residues, Bioremediation of contaminated soils and water. Microbes in nanotechnology, biosensors; Microbes in extreme environments.

Part D-Learning Resources

Recommended Books/e-resources/LMS:

1. Pelezar, MJ, Chaing, ECS & Krieg, NR (1993). Microbiology, Tata McGraw Hill Publ. New Delhi.
2. Prescott, L.M., Harley, J.P. & Klein, D.A. (1996). Microbiology Wm. C. Brown Publ. USA.
3. Ananthanarayan and Paniker's Textbook of Microbiology (2006) Orient Longman Private Limited, Hyderabad, India

4. Brock Biology of Microorganisms, Global Edition (2018), Pearson Education Limited.
5. Microbiology Question & Answer (2010) S Chand Publications, Delhi, India

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.

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Restoration Ecology (25 BOT-305)

Part A – Introduction Programme and Course

Name of Programme M.Sc. Botany

Course Code: 25 BOT-305

Course Credits: 04

Name of the Course: Restoration Ecology

Course Type: DEC-6

Teaching Hours Per week: 04

Max. marks: 100

Theory Examinations: 70

Internal Assessment: 30

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Part B-- Course Objectives and Course Learning Outcomes (CLOs):

Course Objectives

This course is designed to provide comprehensive knowledge of plant physiological and biochemical processes with emphasis on water relations, mineral nutrition, photosynthesis, respiration, phytohormones, stress physiology, and signal transduction. The syllabus is structured according to the principles of the National Education Policy (NEP-2020) and aligned with contemporary patterns of UGC-NET/CSIR-NET Life Sciences examinations.

Course Outcomes (COs)

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

1. Understand the importance of ecological restoration and strategies of Restoration.
2. Explain restoration plans and rehabilitation measures.
3. Explain various natural and anthropogenic disturbances.
4. Understand prevention and mitigation of invasive species, habitat fragmentation and ecosystem stability.
5. Explain the degradation and restoration of forest and grassland ecosystems.
6. Develop analytical and conceptual skills required for higher studies and competitive examinations such as UGC-NET, CSIR-NET, GATE, and ICAR examinations.

Part C- Instructions for Paper Setter:

The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration.

The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions in all selecting one question from each unit and the compulsory question. All questions will carry equal marks.

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UNIT-I

Restoration-Terms and definitions, Importance of ecological restoration: strategies of Restoration-Natural recovery, active restoration, rehabilitation.

Restoration plan and rehabilitation measures. Natural and anthropogenic disturbances: Characteristics and sources, effects on structural and functioning of terrestrial and aquatic ecosystems.

UNIT-II

Rehabilitation of salt affected soils, Prevention and mitigation of invasive species; Habitat fragmentation. Ecosystem stability: Structural and functional stability, Climate change mitigation and Biological carbon sequestration.

UNIT- III

Sustainable forestry management and agroforestry, Biotechnological Tools of Restoration, Environmental impact and risk assessment.

UNIT-IV

Degradation and Restoration of forest and grassland ecosystems. Degradation and restoration of aquatic resources: River corridors, wetlands and lakes

Adaptive restoration of wetlands; Waste water recycling and waste management. Reclamation of mining sites, Bioremediation and Phytoremediation.

Part D-Learning Resources

Recommended Books/e-resources/LMS:

1. Botkin, D.B. and E.A. Keller (2004). Environment Science: Earth as a Living Planet, John Wiley & Sons Inc., New York.
2. Odum, E.P. (1983), Basic Ecology, Sanders, Philadelphia.
3. Mishra & Kumar (2017), Concepts of Environmental Science, Rajesh Publications, New Delhi, India
4. Smith, R.L. (1996), Ecology and Field Biology, Harper Collins, New York.
5. Steffen, W., A. Sanderson, P. D. Tyson, J. Jager, P. M. Matson, B. Moore, III, F. Oldfield, K. Richardson, H.J. Schnellhuber, B. L. Turner, II, and R. J. Wasson. 2004. Global change and the Earth system: a Planet under Pressure. Springer-Verlag, New York, New York, USA Reference books.
6. Jakhar, S. (2024). Fundamentals of Ecology. TechSar, New Delhi.

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Bioinformatics (25 BOT 306)

Part A – Introduction Programme and Course

Name of Programme: M.Sc. Botany

Name of the Course: Bioinformatics

Course Code: 25 BOT-306

Course Type: DEC-7

Course Credits: 04

Teaching Hours per week: 04

Max. Marks: 100

Theory Examination: 70

Internal Assessment: 30

Part B-- Course Objectives and Course Learning Outcomes (CLOs):

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Course Objectives

This course is designed to provide comprehensive knowledge of plant physiological and biochemical processes with emphasis on water relations, mineral nutrition, photosynthesis, respiration, phytohormones, stress physiology, and signal transduction. The syllabus is structured according to the principles of the National Education Policy (NEP-2020) and aligned with contemporary patterns of UGC-NET/CSIR-NET Life Sciences examinations.

Course Outcomes (COs)

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

1. Explain scope of bioinformatics, biological databases (primary databases, secondary and specialized databases).
2. Know the advantages and disadvantages of biological databases, sequence retrieval from databases (NCBI, Phytozome, SOL Genomics, TAIR and other plant specific databases).
3. Explain the sequence alignment, pairwise sequence alignment, sequence homology, sequence identity, sequence similarity, global and local alignment, alignment algorithms.
4. Explain the gene, promoter and regulatory element prediction programs for prokaryotes and eukaryotes (with reference to plant genomes).
5. Describe phylogenetic trees (concept and programme), protein and RNA structure prediction.
6. Develop analytical and conceptual skills required for higher studies and competitive examinations such as UGC-NET, CSIR-NET, GATE, and ICAR examinations.

Part C- Instructions for Paper Setter:

The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration.

The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions in all selecting one question from each unit and the compulsory question. All questions will carry equal marks.

UNIT-I

Introduction and scope of bioinformatics, biological databases (primary databases, secondary and specialized databases), advantages and disadvantages of biological databases, sequence retrieval from databases (NCBI, Phytozome, SOL Genomics, TAIR and other plant specific databases).

UNIT-II

Sequence alignment, pairwise sequence alignment, sequence homology, sequence identity, sequence similarity, global and local alignment, alignment algorithms (dot matrix method and dynamic programming methods), scoring matrices, statistical significance of sequence alignment.

UNIT-III

Heuristic algorithms for performing database searches, types of BLAST, multiple sequence alignment, Markov and Hidden Markov Models, PSI BLAST, protein motif and domain prediction, motif and domain databases, plant protein family databases.

UNIT-IV

Gene, promoter and regulatory element prediction programs for prokaryotes and eukaryotes (with reference to plant genomes), gene expression databases (data retrieval and processing from SOL Genomics, Phytozome), phylogenetic trees (concept and programme), protein and RNA structure prediction.

Part D-Learning Resources

Recommended Books/e-resources/LMS:

1. Lesk, A. M. (2008). Introduction to Bioinformatics. Oxford University Press.
2. Choudhuri, S. (2014). Bioinformatics for Beginners: Genes, Genomes, Molecular Evolution, Databases and Analytical Tools. Academic Press.
3. Edwards, D. (Ed.). (2016). Plant Bioinformatics: Methods and Protocols. Humana Press.
4. Rashidi, H. H., & Buehler, L. K. (2017). Bioinformatics Basics: Applications in Biological Science and Medicine. CRC Press.
5. Compeau, P., & Pevzner, P. (2014). Bioinformatics Algorithms: An Active Learning Approach. Active Learning Publishers.

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.

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Lab Course-1 (25 BOT-307)

(Practicals Based on 25 BOT-301 and 25 BOT-302)

Maximum Marks: 50**Practical Examination: 50****Time: 6 Hours****Part A – Introduction Programme and Course**

Name of Programme: M.Sc. Botany

Name of the Course: Lab Course-1

Course Code: 25 BOT-307

Course Type: P C-5

Course Credits: 04

Teaching Hours per week: 08

Part B-- Course Objectives and Course Learning Outcomes (CLOs):**Course Objectives**

The practical course is designed to make the students fully acquainted with various tools and procedures for various practicals. The syllabus is structured according to the principles of the National Education Policy (NEP-2020) and aligned with contemporary patterns of UGC-NET/CSIR-NET Life Sciences examinations.

Course Outcomes (COs)

After completion of the course, students will be able to perform practicals related to the course/s. Students will be able to perform practicals and will develop scientific/research abilities. Students will get acquainted with various practicals of Plant Physiology, Plant Anatomy and Plant Embryology.

Part C- Instructions for External Examiner:**Suggested Evaluation Methods**

Evaluation is based on Practical Records, Lab Performance and Viva-voce

Maximum Marks: 50

Practical Performance & Evaluation	Viva-voce	Practical Record/File
35	10	05

List of Practical (Based on 25 BOT-301 Plant Physiology)

1. Compare the rate of Transpiration in different conditions using potometer.
2. Study of stomatal frequency and stomatal index.
3. Determination of nitrate reductase activity.
4. Separation of chlorophyll pigments by paper chromatography/TLC.
5. Estimation of chlorophyll (Arnon's method).

6. Measurement of photosynthetic rate using leaf disc method.
7. Hill reaction using isolated chloroplasts.
8. Measurement of respiration rate using Ganong's respirometer.
9. Effect of gibberellins on seed germination and stem elongation.
10. Assay of amylase activity during seed germination.
11. Determination of electrolyte leakage under stress.
12. Effect of salt stress on seedling growth.
13. Determination of membrane permeability using beetroot tissue.
14. Effect of temperature and solvents on membrane permeability.
15. Estimation of carbohydrate by Anthrone method.

List of practical (Based on 25 BOT-302 Plant Anatomy and Developmental Biology)

1. Double staining of permanent sections (Safranin–Fast Green). and mounting of permanent slides using DPX or Canada balsam.
2. Study of shoot apical meristem/ root apical meristem.
3. Identification of parenchyma, collenchyma, and sclerenchyma.
4. Study the anatomy of Root, Stem and Leaves of dicots and monocot using permanent slides.
5. Study of Secondary growth, annual rings and wood anatomy.
6. Study of stomatal index and stomatal frequency.
7. Identification of fibres and tracheids.
8. To study the structure of young and mature anther.
9. To study Microsporogenesis, stages of Pollen grain development and pollen morphology.
10. To study pollen viability tests.
11. To study pollen germination in vitro.
12. To study various types of ovules with permanent slides
13. To isolate and perform microscopic identification of different stages of embryo development.

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Lab Course-II (25 BOT-308)**(Practical Based on 25 BOT-303 and DEC Course 25 BOT-304,305,306 and 309)****Maximum Marks: 50****Practical Examination:50****Time: 6 Hours****Part A – Introduction Programme and Course**

Name of Programme: M.Sc. Botany

Name of the Course: Lab Course-II

Course Code: 25 BOT-308

Course Type: P C -6

Course Credits: 04

Teaching Hours per week: 08

Part B-- Course Objectives and Course Learning Outcomes (CLOs):

The practical course is designed to make the students fully acquainted with various tools and procedures for various practicals. The syllabus is structured according to the principles of the National Education Policy (NEP-2020) and aligned with contemporary patterns of UGC-NET/CSIR-NET Life Sciences examinations

Course Objectives**Course Outcomes (COs)**

After completion of the course, students will be able to perform practicals related to the course/s and will develop scientific/research abilities. Students will get acquainted with various practicals of Plant Ecology, Microbiology, Bioinformatics and Processing of Fruits and Vegetables.

Part C- Instructions for External Examiner:**Suggested Evaluation Methods**

Evaluation is based on Practical Records, Lab Performance and Viva-voce

Maximum Marks: 50

Practical Performance & Evaluation	Viva-voce	Practical Record/File
35	10	05

List of Practical based on 25 BOT-303, 25 BOT-304, 25 BOT-305,25 BOT-306 and 25 BOT-309)

1. To study the methods of sampling in ecological studies.
2. To determine the minimum size of the quadrat by species area curve method.
3. To study the density and abundance of plants at a given location by quadrat method.

4. To determine the distribution of plants in a given area of vegetation by quadrat method.
5. Compare the anatomical and morphological adaptations of Hydrophytes, Xerophytes and Halophytes.
6. Preparation and sterilization of culture media for Bacteria Culture.
7. Preparation of nutrient agar, potato dextrose agar (PDA), and Czapek-Dox medium.
8. Isolation and culture of microorganisms from soil, water, and air.
9. To study serial dilution technique.
10. Streak plate method for obtaining pure cultures.
11. Gram staining and differential staining of bacteria.
12. Observation of fungi using Lactophenol Cotton Blue.
13. Colony morphology studies.
14. Isolation of nitrogen-fixing bacteria/Isolation of Rhizobium from root nodules.
15. To perform soil texture analysis, Soil pH determination, soil electrical conductivity measurement.
16. Study of Nursery techniques for native plants.
17. Seed collection and storage.
18. Vegetative propagation of native species.
19. Identification of fruits and vegetables suitable for processing.
20. To study preservation Techniques (Solar drying, Tray drying, Osmotic dehydration, refrigerated storage studies, Freezing techniques and preparation of dehydrated vegetables). Preparation of fruit juice.
21. To study the preparation of squash, syrup, nectar, cordial, jam, fruit preserve, candy etc.
22. To study preparation of tomato ketchup, tomato sauce, tomato puree, pickles etc.
23. Preparation of Fermented Products (sauerkraut, pickles, vinegar etc.)

*Other experiments relevant to the course.

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Processing of Fruits and Vegetables (25 BOT-309)

Part A – Introduction Programme and Course

Name of Programme M.Sc. Botany

Name of the Course: Processing of Fruits and Vegetables

Course Code: 25 BOT-309

Course Credits: 02

Max. marks: 50

Theory Exam: 35

Internal Assessment: 15

Course Type: EEC

Teaching Hours per week: 02

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Part B-- Course Objectives and Course Learning Outcomes (CLOs):

Course Objectives

This course is designed to provide comprehensive knowledge of fruit and vegetable processing. The syllabus is structured according to the principles of the National Education Policy (NEP-2020) and aligned with contemporary patterns of UGC-NET/CSIR-NET Life Sciences examinations.

Course Outcomes (COs)

After completion of the course, students will be able to process the fruits and vegetables and will be able to preserve the processed fruits and vegetables.

Part C- Instructions for Paper Setter:

The examiner will set 5 questions asking one questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration.

The compulsory question (Question No. 1) will consist of at least 2 parts covering the entire syllabus. The examinee will be required to attempt 3 questions in all selecting one question from each unit and the compulsory question. All questions will carry equal marks.

UNIT-I

Post-harvest handling (harvesting, sorting, grading and packing and transportation) of fruits, vegetables and flowers, post-harvest treatments (pre-cooling, hot water, hot air and vapour heat, fungicide & biologically safe chemicals, irradiation, curing, pulsing etc.) for quality retention of horticultural crops, fruit ripening and ethylene management.

UNIT-II

On farm storage (evaporative cooled stores, ventilated storage, pit storage etc.), refrigerated storage, controlled / modified atmosphere storage, hypobaric, hyperbaric storage. Contamination and spoilage of fresh fruits, vegetables and processed products.

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UNIT-III

Principles and methods of preservation, processing of fruits and vegetables (canning, drying and dehydration, fruit beverages and juice concentrates, sugar based products, tomato products, fermented products, value added products etc.), food additives, minimal processing, packaging techniques and storage system for processed products.

UNIT-IV

Importance of quality, quality management standards, ISO/BIS, PFA, AGMARK, HACCP, Codex Alimentarius, total quality management (TQM), food standards (FPO, PFA etc.), food laws and regulations.

Part D-Learning Resources

Recommended Books/e-resources/LMS

1. Hui, Y.H. (2008). Handbook of fruit and vegetable processing. Wiley India Pvt. Ltd., New Delhi.
2. Sharma, S.K. (2010). Postharvest management and processing of fruits and vegetables. New India Publishing Agency, New Delhi.
3. Sharma, S.K. and Nautiyal, M.C. (2009). Postharvest technology of horticultural crops. New India Publishing Agency, New Delhi.
4. Wills, R.B.H, McGlasson, W.S, Graham, D. and Joyce, D.C. (2009). Postharvest: An introduction to the physiology and handling of fruits, vegetables and ornamentals. CABI International, Cambridge, USA.

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.

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Research Training (25 BOT-310)

Type of Course: Skill Enhancement Course

Part A – Introduction Programme and Course

Name of Programme: M.Sc. Botany

Name of the Course: Research Training

Course Code: 25 BOT-310

Course Type: SEC

Course Credits: 02

Teaching Hours per week: 04

Maximum Marks: 50 (only internal) *OU*

*A Research Training of 2 Credits of 7-10 days first break of 3rd semester is to be completed by every student. This programme will help the students for developing the research aptitude and completion of their dissertation work which is to be submitted in the 4th semester. The student will submit a synopsis on the dissertation topic of 4th Semester and will give a brief presentation at the end of third semester before the department research committee constituted for the purpose.

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SEMESTER-IV**M.Sc. Botany Syllabus 4th Semester (Batch 2026-28) Option-1
(For students Opting Lab Course I and Lab Course-II)****Cytogenetics and Plant Breeding (25 BOT-401)****Part A – Introduction Programme and Course**

Name of Programme: M.Sc. Botany

Name of the Course: Cytogenetics and Plant Breeding

Course Code: 25 BOT-401

Course Type: CC-10

Course Credits: 04

Teaching Hours per week: 04

Max. Marks: 100

Theory Examination: 70
Internal Assessment: 30

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Part B- Course Objectives and Course Learning Outcomes (CLOs):**Course Objectives**

The purpose of this paper is to acquaint the students about structure and functions of a chromosome in detail. The course also explains the chromosomal variations and their effects on biological system. Further, it aims to draw attention to methods used for crop improvement. The syllabus is structured according to the principles of the National Education Policy (NEP-2020) and aligned with contemporary patterns of UGC-NET/CSIR-NET Life Sciences examinations.

Course Outcomes (COs)

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

1. Know the role of chromosomes and chromosomal rearrangements in generation of variations.
2. They will also be familiar with methods used to change the traits of a plant to create the desired genotype/phenotype.
3. Understand various methods of crop improvement.
4. Methods of breeding in self- and cross-pollinated crops, heterosis and hybrid vigour; utility of hybrids in genetics and plant breeding
5. Methods of breeding of vegetative propagated crops; Non-conventional methods of plant breeding, polyploidy, gene variability.
6. Develop analytical and conceptual skills required for higher studies and competitive examinations such as UGC-NET, CSIR-NET, GATE, and ICAR examinations.

Part C- Instructions for Paper Setter:

The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration.

The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire

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syllabus. The examinee will be required to attempt 5 questions in all selecting one question from each unit and the compulsory question. All questions will carry equal marks.

UNIT-I

Chromatin structure and organization: Molecular organization of chromatin, centromere and telomere; Euchromatin and heterochromatin. Nucleosomes, DNA Packaging.

Karyotype analysis; Chromosome banding technique (Q, G and R Banding and their uses); Flow cytometry and Confocal microscopy in karyotype analysis,

Specialized types of chromosomes: Polytene, Lampbrush, B chromosomes and sex chromosomes.

UNIT-II

Extrachromosomal Inheritance: The Genetics of Plastids, mitochondria and chloroplasts.

Structural alterations in chromosomes—Origin, meiosis and breeding behaviour of duplication, deficiency, inversion and translocation heterozygotes.

Variation in chromosome number: Haploids, aneuploids and euploids- origin, production, effects and uses; polyploidy and crop improvement, Meiotic behaviour and use of trisomics, monosomics and nullisomics in chromosome

UNIT-III

Principles of plant breeding: Principles and objectives; methods of breeding self- and cross-pollinated crops, heterosis and hybrid vigour; utility of hybrids in genetics and plant breeding. Special breeding techniques- Mutation breeding; Breeding for abiotic and biotic stresses,

UNIT-IV

Asexual Breeding Systems: Methods of breeding of vegetative propagated crops; Non-conventional methods; polyploidy; gene variability. **Male Sterility:** Concept, Types, Genetic control and Breeding utility, Self-incompatibility, clonal selection **Multigene families:** Multigene families and their evolution. Centers of Origin of crops, biodiversity and its significance.

Part- D Recommended Books/e-resources/LMS:

1. George Acquaah 2012 Principles of Plant Genetics and Breeding
2. Krebs JE, Goldstein ES and Kalpatrick ST (2010) Lewin's Essential Genes (2nd Ed.), Jones and Barlett Publishers.
3. Lewin B (2010) Gene X, Jones and Barlett Publishers.

4. Pierce BA (2012) Genetics- A Conceptual Approach (4th Ed.), W.H. Freeman and Company, New York, USA.
5. Russell PJ (2006) Genetics (5th Ed.), Addison Wesley Longman, California, USA.
6. Snustad P and Simmons MJ (2011) Principles of Genetics. (6th Ed.), John Wiley, New York.

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.

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Biochemical and Biophysical Techniques (25 BOT-402)

Part A: Introduction Programme and Course

Name of Programme: M.Sc. Botany

Name of the Course: Biochemical and Biophysical Techniques

Course Code: 25 BOT-402

Course Type: CC-11

Course Credits: 04

Teaching Hours per week: 04

Max. Marks : 100

Theory Exam : 70

Internal Assessment : 30

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Part B-- Course Objectives and Course Learning Outcomes (CLOs):

Course Objectives

This paper aims to provide an introduction to various tools and techniques used to gain insight into cell structure and biological processes. The focus is on studying the techniques used for isolation, purification and characterization of bio molecules.

The syllabus is structured according to the principles of the National Education Policy (NEP-2020) and aligned with contemporary patterns of UGC-NET/CSIR-NET Life Sciences examinations.

Course Outcomes (COs)

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

1. This paper is expected for students to gain in-depth knowledge of numerous methods used in characterization the biomolecules.
2. Understand the principles and applications of various types of microscopes.
3. Understand various modern tools and their applications like Chromatography, Electrophoresis, spectroscopy and tracer techniques.
4. Develop analytical and conceptual skills required for higher studies and competitive examinations such as UGC-NET, CSIR-NET, GATE, and ICAR examinations.

Part C- Instructions for Paper Setter:

The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration.

The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions in all selecting one question from each unit and the compulsory question. All questions will carry equal marks.

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UNIT-I

Microscopy: Principles and applications of light, phase contrast, fluorescence microscopes, Confocal microscope, scanning and transmission electron microscopes. Different fixation and staining techniques (Preparation of permanent slides).

Centrifuge technique: Principle, Types of centrifuge, Density gradient centrifuge, differential centrifugation and Ultra centrifugation.

UNIT-II

Chromatography: Principles and Types; Paper chromatography, Thin layer Chromatography, Gel filtration Chromatography, Ion-exchange Chromatography, Affinity Chromatography, Gas chromatography and High-Pressure Liquid Chromatography (HPLC) and FPLC. Application of chromatographic technique in biology.

Electrophoresis: Principles and applications of Agarose, Polyacrylamide gel electrophoresis, 2D Gel Electrophoresis, Differential in-gel Electrophoresis (DIGE), Electrophoretic Mobility Shift Assay (EMSA)

UNIT-III

Spectroscopy: UV, visible, Infra-red, Fluorescence, Atomic absorption spectroscopy, NMR and ESR spectroscopy; Mass spectrometry (LC-MS, GC-MS), X-ray diffraction. Surface Plasmon Resonance (SPR), Flow cytometry

Tracer Biology: Nature and types of radiation, preparation of labeling biological sample, Safety measurement in handling radioisotopes detection and measurement of radiation, GM counter, Scintillation counter Principles and applications of tracer techniques in biology; radioactive isotopes and half-life of isotopes; autoradiography. Application of different spectroscopic technique in biology.

UNIT-IV

Immunotechniques: Detection of molecules using, ELISA, RIA, Western blot and Immuno precipitation, In-situ localization by techniques as Fluorescence In-situ Hybridization (FISH) and Genomic In-situ Hybridization (GISH).

Quantification and quality determination of RNA and DNA, Micro array (DNA and protein)

Part- D Recommended Books/e-resources/LMS:

1. Wilson K and Walker J (2018) Principles and Techniques of Biochemistry and Molecular Biology (8th Ed.), Cambridge University Press, New Delhi.

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2. Sawhney SK and Singh R (2000) Introductory Practical Biochemistry (Ed.), Narosa Publishing House Pvt. Ltd., New Delhi.
3. Devi, P. 2000. Principles and Methods of Plant Molecular Biology, Biochemistry and Genetics. Agrobios, Jodhpur, India.
4. Hegyi G, Kardos J, Kovacs M, Csizmadia AM, Nyitray L, Pal G, Radnai L, Remenyi A Venekei I (2013) Introduction to Practical Biochemistry, EotvosLorand University, Hungary.
5. Plummer DT (1990) An Introduction to Practical Biochemistry, Tata Mc-Graw-Hill Publishing Company Ltd., New Delhi.
6. Ranade R and Deshmukh S (2013) Handbook of Techniques in Biotechnology, Studium Press (India) Pvt. Ltd. New Delhi.

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.

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Evolutionary Biology (25 BOT- 403)**Part A – Introduction Programme and Course**

Name of Programme: M.Sc. Botany

Name of the Course: Evolutionary Biology

Course Code: 25 BOT-403

Course Credits: 04

Max marks : 100

Theory Exam : 70

Internal Assessment : 30

Course Type: CC-12

Teaching Hours per week: 04

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Part B- Course Objectives and Course Learning Outcomes (CLOs):**Course Objectives**

The aim of this course is to provide students with a deeper insight into the evolutionary process including origin and evolution of organisms and also about population genetics. The syllabus is structured according to the principles of the National Education Policy (NEP-2020) and aligned with contemporary patterns of UGC-NET/CSIR-NET Life Sciences examinations.

Course Outcomes (COs)

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

1. Understand the evidences, theories and molecular basis of evolution.
2. Understand the Concepts of neutral evolution, molecular divergence.
3. Know about molecular clocks, molecular tools in phylogeny, protein and nucleotide sequence analysis, origin of new genes and proteins; gene duplication and divergence.
4. Understand various aspects of population genetics and speciation.
5. Understand how evolution helps us to solve biological problems that impact our life.
6. Researchers can also understand evolutionary pattern of hereditary disease in people and by treating them they can improve the quality of human life.
7. Develop analytical and conceptual skills required for higher studies and competitive examinations such as UGC-NET, CSIR-NET, GATE, and ICAR examinations.

Part-C- Instructions for Paper Setter:

The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration.

The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions in all selecting one question from each unit and the compulsory question. All questions will carry equal marks.

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UNIT- I

Emergence of evolutionary thoughts: Lamarckism, Darwinism—concepts of variation, adaptation, struggle, fitness and natural selection, Mendelism, spontaneity of mutations, the evolutionary synthesis. **Origin of cells and unicellular evolution:** Origin of basic biological molecules, abiotic synthesis of organic monomers and polymers, concept of Oparin and Haldane, Experiment of Miller (1953)

UNIT-II

Origin and Evolution of prokaryotic and eukaryotic cells, anaerobic metabolism, photosynthesis and aerobic metabolism.

Molecular Evolution: Concepts of neutral evolution, molecular divergence and molecular clocks, molecular tools in phylogeny, protein and nucleotide sequence analysis, origin of new genes and proteins; gene duplication and divergence.

UNIT-III

Biological diversity: Species and classification, Phylogenetic trees, Geological fundamentals, Phylogeny and the fossil record, Evolutionary trends, Rates of evolution, Major patterns of distribution, phytogeography, Sources of phenotypic variation, Genetic variation in populations, Variation among populations.

UNIT-IV

Population genetics: Populations, gene pool, gene frequency, Hardy-Weinberg law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift, adaptive radiation and modifications; isolating mechanisms, speciation (allopatric and sympatric), convergent evolution, sexual selection, co-evolution.

Part- D Recommended Books/e-resources/LMS:

1. David Briggs, Stuart Max Walters (1997). Plant Variation and Evolution, Cambridge University Press.
2. Douglas J. Futuyma (1998). Evolutionary Biology (3rd Edition), Sinauer Associates.
3. Mark Ridley (2003) Evolution (3rd edition), Blackwell.
4. Roderic D. M. Page, Edward C. Holmes (1998). Molecular Evolution: A Phylogenetic Approach, Blackwell.
5. Scott R, Freeman and Jon C. Herron (2003). Evolutionary Analysis

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.

Seed Science and Technology (25 BOT-404)**Part A – Introduction Programme and Course**

Name of Programme: M.Sc. Botany

Name of the Course: Seed Science and Technology

Course Code: 25 BOT- 404

Course Credits: 04

Max. Marks: 100

Theory Exam: 70

Internal Assessment: 30

Course Type: DEC-8

Teaching Hours per week: 04

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Part B-- Course Objectives and Course Learning Outcomes (CLOs):**Course Objectives**

This course is designed to provide comprehensive knowledge of seeds like seed production, hybrid seeds, seed quality control and seed certification. The syllabus is structured according to the principles of the National Education Policy (NEP-2020) and aligned with contemporary patterns of UGC-NET/CSIR-NET Life Sciences examinations.

Course Outcomes (COs)

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

1. Understand the principles and practices of seed production, including hybrid seed techniques and the role of seed industry stakeholders in India.
2. Learn the objectives and procedures of seed quality control, including seed testing methods and standards, as well as the importance of moisture content and purity standards.
3. Explore the factors affecting seed viability, vigour, and longevity, along with the physiological basis of seed vigour and its impact on crop performance.
4. Gain insights into seed certification regulations, seed processing principles, and the operation of seed processing machinery, essential for maintaining seed quality and standards.

Part C- Instructions for Paper Setter:

The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration.

The compulsory question (Question No.1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions in all selecting one question from each unit and the compulsory question. All questions will carry equal marks.

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UNIT-I

Seed production: seed multiplication ratios, seed replacement rate, demand and supply; suitable areas of seed production and storage, Agro-climatic requirements and their influence on quality seed production, certification standards, use of male sterility and self-incompatibility and CHA in hybrid seed production, seed village concept; seed production agencies, seed industry and custom seed production in India.

UNIT-II

Seed quality: objectives, concept and components and their role in seed quality control, instruments, devices and tools used in seed testing, ISTA and its role in seed testing, procedure of seed sampling, sampling intensity, methods of preparing composite and submitted samples, sub-sampling techniques, dispatch, receipt and registration of submitted sample in the laboratory, prescribed seed purity standards, importance of moisture content, equilibrium moisture content, methods of seed germination testing.

UNIT-III

Seed viability and longevity, pre and post-harvest factors affecting seed viability, seed ageing, physiology of seed deterioration, lipid peroxidation and other viability theories, means to prolong seed viability, mechanism of desiccation sensitivity and recalcitrance with respect to seed longevity, vigour test methods, factors affecting seed vigour, physiological basis of seed vigour in relation to crop performance and yield.

UNIT-IV

Central Seed Certification Board (CSCB), the Seed Act (1966), Seed Rules (1968), New Seed Bill-2004, Indian Minimum Seed Certification Standards (I.M.S.C.S), principles of seed processing, functions of scalper debearder, scarifier, huller, seed cleaner, grader, screen cleaners, specific gravity separator, indented cylinder, velvet-spiral-disc separators, colour sorter, delinting machines; seed blending.

Part- D Recommended Books/e-resources/LMS:

1. ISTA. (2019). ISTA Handbook on Seedling Evaluation (3rd ed.). International Seed Testing Association.
2. Basra, A. S. (2017). Seed Science and Technology (3rd ed.). CRC Press.
3. McDonald, M. B., & Copeland, L. O. (2019). Seed Production: Principles and Practices (2nd ed.). CABL.

4. Smith, R. D., & Dickson, M. H. (2018). Seed Technology and Its Biological Basis (2nd ed.). CRC Press.
5. Vanangamudi, K., & Swaminathan, M. S. (2016). Seed Science and Technology: Theory and Practice (4th ed.). Agrobios Publications.

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.

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Applied Mycology (25 BOT-405)

Part A – Introduction Programme and Course

Name of Programme: M.Sc. Botany

Name of the Course: Applied Mycology

Course Code: 25 BOT-405

Course Credits: 04

Max marks: 100

Theory Exam: 70

Internal Assessment: 30

Course Type- DEC-9

Teaching Hours per week: 04

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Part B-- Course Objectives and Course Learning Outcomes (CLOs):

Course Objectives

This course is designed to provide comprehensive knowledge of Fungi and its various applications in agriculture and industry. The syllabus is structured according to the principles of the National Education Policy (NEP-2020) and aligned with contemporary patterns of UGC-NET/CSIR-NET Life Sciences examinations.

Course Outcomes (COs)

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

1. Know about the production of Valuable microbial products.
2. Understand the role of Fungi as bio fertilizers and biocontrol agents.
3. Become familiar with techniques used for maintenance of fungal cultures.
4. Use the knowledge of mycology for commercial production of mushrooms.

Part C- Instructions for Paper Setter:

The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration.

The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions in all selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit I

Primary metabolites production by fungi: industrial alcohol, organic acid, beer. Secondary metabolites production by fungi: Antibiotics, steroid transformation, enzymes, amino acids, growth regulators, vitamins.

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Unit II

Fungi as biofertilizers: Endomycorrhiza and ectomycorrhiza. Fungi as biocontrol of plant pathogens and weeds. Biodeterioration of materials: Paper, painted surface, wood. Role of fungi in biogeochemical cycle.

Unit III

Food processing by fungi: Bread, cheese, oriental food and baker's yeast. Fungal sources of health food: Single cell protein, edible mushrooms. Spoilage of food and fungal toxicity.

Unit IV

Culturing and preservation of fungi: isolation of fungi, culturing of fungi, establishing a pure culture, aseptic technique, maintenance of culture collection, culture collection and identification centers. Common culture media and sterilization techniques.

Part-B Recommended Books/e-resources/LMS:

1. Deacon, J. W. (2013). Fungal Biology (5th ed.). John Wiley & Sons.
2. Gadd, G. M. (2007). Fungi in Biogeochemical Cycles (2nd ed.). Cambridge University Press.
3. Moore-Landecker, E. (2009). Fundamentals of the Fungi (4th ed.). Prentice
4. Hall, Dighton, J., White, J. F., & Oudemans, P. (2005). The Fungal Community: Its Organization and Role in the Ecosystem (3rd ed.). CRC Press.
5. Sutton, B. C. (2012). The Fungi: An Advanced Treatise (2nd ed., Vol.)
6. Dharendra Kumar, et.al (2025) Mushroom Magic: Biochemistry and Nutritional Value of Fungi", published by CRC Press (Taylor & Francis) United Kingdom

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.





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Photobiology (25 BOT-406)

Max. Marks : 100

Theory Exam : 70

Internal Assessment : 30

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Part A – Introduction Programme and Course

Name of Programme M.Sc. Botany

Course Type- DEC -10

Name of the Course: Photobiology

Course Code: 25 BOT-406

Course Credits: 04

Teaching Hours per week: 04

Part B- Course Objectives and Course Learning Outcomes (CLOs):**Course Objectives**

This course is designed to provide comprehensive knowledge of various aspects of light on the plant life. The syllabus is structured according to the principles of the National Education Policy (NEP-2020) and aligned with contemporary patterns of UGC-NET/CSIR-NET Life Sciences examinations.

Course Learning Outcomes (CLOs)

1. Students will understand light characteristics and plant photoreceptors, including phytochrome and cryptochrome structures and functions.
2. Students will learn about circadian rhythm control by ZEITLUPE and the roles of phototropins and UVR8 in plant responses to light.
3. Students will explore light-hormone interactions in plant growth, development, and stress responses, focusing on phototropism and photomorphogenesis.
4. Students will gain knowledge of key experiments and concepts in photosynthesis, including photosystems, the Z-scheme, and various photosynthetic pathways.

UNIT-I

Characteristics of light, plant photoreceptors and its classification, phytochrome structure and action potential, phytochrome responses (VLFR, LFR, HIR), phytochrome signaling pathways (gene regulation by PIFs; COP regulation), blue light kinetics, cryptochrome structure and action potential, CRY-COP interaction.

UNIT-II

Control of circadian rhythm by ZEITLUPE, phototropins structure and action potential, role of phototropins in chloroplast movement and stomatal opening, UVR8 structure and action potential, responses to UV radiation and molecular mechanism of UVR8 function.

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UNIT-III

Light-hormone interplay in phototropism, photomorphogenesis, chlorophyll biosynthesis, defense and development, molecular mechanism of shade avoidance, role of yellow and green light in growth, development, shade avoidance and stress responses, mechanisms of sensing and responding to light stress in plants.

UNIT-IV

Key experiments in understanding photosynthesis, antenna system, photosystems, Z-scheme, repair and regulation of photosynthetic machinery, genetics, assemble and evolution of photosynthetic systems, C3 cycle, RuBisCO regulation, photorespiration, C4, CAM and SAM photosynthesis.

Part- D Recommended Books/e-resources/LMS:

1. Taiz, L., Zeiger, E., Møller, I. M., & Murphy, A. (2023). Plant physiology and development (7th ed.). Sinauer Associates.
2. Mohr, H., & Schopfer, P. (2020). Plant physiology (2nd ed.). Springer.
3. Kochhar, S. L., & Gujral, S. K. (2020). Plant physiology: Theory and applications (2nd ed.). Cambridge University Press.
4. Nobel, P. S. (2020). Physicochemical and Environmental Plant Physiology (5th ed.). Academic Press.
5. Pessarakli, M. (Ed.). (2024). Handbook of plant and crop physiology (4th ed.). CRC Press (Routledge).

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.



Phytochemistry and Pharmacognosy (25 BOT-407)**Part A – Introduction Programme and Course**

Name of Programme: M.Sc. Botany

Name of the Course: Phytochemistry and Pharmacognosy

Course Code: 25 BOT-407

Course Credits: 04

Max. marks : 100

Theory Exam : 70

Internal Assessment : 30

Course Type: DEC-11

Teaching Hours per week: 04

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Part B-- Course Objectives and Course Learning Outcomes (CLOs):**Course Objectives**

This course is designed to provide comprehensive knowledge of Phytochemistry and Pharmacognosy. The syllabus is structured according to the principles of the National Education Policy (NEP-2020) and aligned with contemporary patterns of UGC-NET/CSIR-NET Life Sciences examinations.

Course Outcomes (COs)

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

1. Understand protein and non-protein amino acids, protein structure and sequencing, special forms of DNA and RNA including isolation and purification techniques.
2. Know about carbohydrates including their classification, structure, properties, types and functions.
3. Understand the roles of water-soluble and fat-soluble vitamins.
4. Explore Pharmacognosy, the classification and evaluation of crude drugs, and the structure and classification of secondary metabolites.
5. Gain knowledge on source plants, parts used, and uses of various bio active compounds, along with commonly used extraction methods.

Part C- Instructions for Paper Setter:

The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration.

The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions in all selecting one question from each unit and the compulsory question. All questions will carry equal marks.

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UNIT-I

Protein and non-protein amino acids, Ramachandran plot, protein (levels of organization), protein sequencing and assays, protein isolation and purification. Special forms of DNA (triplex and G-quadruplex), DNA denaturation and quantification, supercoiling, DNA isolation and purification. RNA world hypothesis, RNA stability and thermodynamics, RNA isolation and purification.

UNIT-II

Carbohydrates (classification, structure and optical properties), reducing and non-reducing sugars, monosaccharide derivatives (sugar alcohols, sugar acids, glycosides and amino sugars), disaccharides (glycosidic bond with examples and sucrose hydrolysis), polysaccharides (homo and hetero), glycoproteins. Water soluble and fat soluble vitamins (biosynthetic precursors and roles).

UNIT-III

Pharmacognosy and its importance in modern medicine, crude drugs, classification of drugs (chemical and pharmacological), drug evaluation (organoleptic, microscopic, chemical, physical and biological), classification and structure of secondary metabolites (terpenes, phenolics and N-containing).

UNIT-IV

Source plant parts used and uses of solasodin, diosgenin, digitoxin, catechin, gingerol, curcuminoids, paclitaxel, quinine, atropine, pilocarpine, strychnine, reserpine, vinblastine, sennoside and capsaicin and the most commonly used methods of their extraction.

Part-D Recommended Books/e-resources/LMS:

1. Berg, J. M., Tymoczko, J. L., & Stryer, L. (2022). Biochemistry (10th ed.). W. H. Freeman.
2. Voet, D., Voet, J. G., & Pratt, C. W. (2020). Fundamentals of biochemistry: Life at the molecular level (6th ed.). Wiley.
3. Lehninger, A. L., Nelson, D. L., & Cox, M. M. (2021). Lehninger principles of biochemistry (8th ed.). W. H. Freeman.
4. Evans, W. C. (2020). Trease and Evans' pharmacognosy (19th ed.). Elsevier.
5. Kokate, C. K., Purohit, A. P., & Gokhale, S. B. (2019). Pharmacognosy (56th ed.). Nirali Prakashan.

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.



Lab Course-I (25 BOT-408)

(Practical Based on 25 BOT-401 and 25 BOT-402)

Maximum Marks: 50

Total Marks: 50

Time: 6 Hours

Part A – Introduction Programme and Course

Name of Programme M.Sc. Botany

Name of the Course: Lab Course-I

Course Code: 25 BOT-408

Course Type: PC-7

Course Credits: 04

Hours per week: 08

Part B- Course Objectives and Course Learning Outcomes (CLOs):

Course Objectives

The practical course is designed to make the students fully acquainted with various tools and procedures for various practical. The syllabus is structured according to the principles of the National Education Policy (NEP-2020) and aligned with contemporary patterns of UGC-NET/CSIR-NET Life Sciences examinations.

Course Outcomes (COs)

After completion of the course, students will be able to perform practical related to the course/s.

Part C- Instructions for Paper Setter:

Maximum Marks: 50

Duration: 6 Hours

Evaluation scheme in Lab Course (Practical) examination:

Practical Performance & Evaluation	Viva-voce	Practical Record/File
35	10	05

List of Practical (from 25 BOT-401,25 BOT-402)

1. Understanding the concept of sampling: Random sampling, sample size, quadrat, transect and point method for the study of community structure.
2. Study the community structure using quadrat method by establishing minimum size and minimum number of quadrates.
3. Study of community structure and assessment of cover and basal area of species present and determine the IVI (Importance Value Index) of the species

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4. Study of community structure and assessing frequency of the species. Prepare a frequency diagram and divide the species into classes based on percentage frequency
5. Study of community structure and assess the density and abundance of the species
6. Understand the concept of community coefficient by comparing the frequency of two communities.
7. Demonstration of Chromatography i.e. TLC, HPLC, GC.
8. To demonstrate the separation of proteins with the help of electrophoresis (SDS-PAGE).
9. To demonstrate the separation of DNA with the help of electrophoresis (AGE)
10. To study various molecular biology techniques i.e. PCR, ELISA, RIA
11. Purification of protein by Column Chromatography.
12. Preparation of plant tissue culture Media

***Other experiments relevant to the course.**

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Lab Course-II (25 BOT-409)

Practical Based on any two courses (25 BOT-403, 25 BOT-404, 25 BOT-405, 25 BOT-406, 25 BOT-407)

Maximum Marks: 50

Total Marks: 50

Time: 6Hours

Part A – Introduction Programme and Course

Name of Programme M.Sc. Botany

Name of the Course: Lab Course-II

Course Code: 25 BOT- 409

Course Type: P C - 8

Course Credits: 04

Teaching Hours per week: 08

Part B-- Course Objectives and Course Learning Outcomes (CLOs):**Course Objectives**

The practical course is designed to make the students fully acquainted with various tools and procedures for various practical. The syllabus is structured according to the principles of the National Education Policy (NEP-2020) and aligned with contemporary patterns of UGC-NET/CSIR-NET Life Sciences examinations.

Course Outcomes (COs)

After completion of the course, students will be able to perform practical related to the course/s.

Part C- Instructions for Paper Setter:

Maximum Marks: 50

Evaluation scheme in Lab Course (Practical) examination:

Practical Performance & Evaluation	Viva-voce	Practical Record/File
35	10	05

List of Practical (25 BOT-403, 25 BOT-404, 25 BOT-405, 25 BOT-406, 25 BOT-407)

1. Surface sterilization of explants
2. Organ culture. Induction of callus, callus propagation, Organogenesis
3. DNA isolation from plant tissues and quantitation
4. Amplification of gene using PCR.
5. Bacterial culture and antibiotic selection medias. Preparation of competent cells.
6. Transformation of bacterial cell.
7. Study of Angiosperm fossil record with the help of chart/model.

8. Study of Phenotypic morphological variation: Intraspecific variation in size and shape of leaves of various angiosperm groups
9. Study of problems on population size fluctuations with respect to migration.
10. Study of phylogenetic tree of Angiosperms with chart.
11. Effect of Light Intensity on Photosynthesis
12. Effect of Light Quality (Color) on Photosynthesis
13. Effect of UV Radiation on Seed Germination
14. Stomatal Opening in Light and Darkness
15. Isolation and quantification of chlorophyll and carotenoids.
16. Measurement of photosynthetic pigments using spectrophotometry.
17. Morphological identification of medicinal plants.
18. Preparation of plant extracts using Cold maceration, Hot extraction, and Soxhlet extraction.
19. Preliminary Phytochemical Screening: Test for alkaloids (Dragendorff's, Wagner's, Mayer's tests), Test for flavonoids, Test for tannins, Test for saponins, Test for glycosides, Test for terpenoids and steroids, Test for phenolics, Test for carbohydrates, Test for proteins and amino acids.
20. Demonstration of Chromatography i.e. TLC, HPLC, GC.
21. Thin Layer Chromatography (TLC) profiling of plant extracts.
22. Paper chromatography of amino acids or sugars.

*Other experiments relevant to the course.

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M.Sc. Botany Syllabus 4th Semester (Batch 2026-28) Option-II (For students who are opting Dissertation Work)

Cytogenetics and Plant Breeding (25 BOT-401)

Part A – Introduction Programme and Course

Name of Programme: M.Sc. Botany

Name of the Course: Cytogenetics and Plant Breeding

Course Code: 25 BOT-401

Course Credits: 04

Max. Marks : 100

Theory Exam : 70

Internal Assessment: 30

Course Type: CC-12

Teaching Hours per week: 04

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Part B- Course Objectives and Course Learning Outcomes (CLOs):

Course Objectives

The purpose of this paper is to acquaint the students about structure and functions of a chromosome in detail. The course also explains the chromosomal variations and their effects on biological system. Further, it aims to draw attention to methods used for crop improvement. The syllabus is structured according to the principles of the National Education Policy (NEP-2020) and aligned with contemporary patterns of UGC-NET/CSIR-NET Life Sciences examinations.

Course Outcomes (COs)

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

6. Know the role of chromosomes and chromosomal rearrangements in generation of variations.
7. They will also be familiar with methods used to change the traits of a plant to create the desired genotype/phenotype.
8. Understand various methods of crop improvement.
9. Methods of breeding in self- and cross-pollinated crops, heterosis and hybrid vigour; utility of hybrids in genetics and plant breeding
10. Methods of breeding of vegetative propagated crops; Non-conventional methods of plant breeding, polyploidy, gene variability.
6. Develop analytical and conceptual skills required for higher studies and competitive examinations such as UGC-NET, CSIR-NET, GATE, and ICAR examinations.

Part C- Instructions for Paper Setter:

The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration.

The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire

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syllabus. The examinee will be required to attempt 5 questions in all selecting one question from each unit and the compulsory question. All questions will carry equal marks.

UNIT-I

Chromatin structure and organization: Molecular organization of chromatin, centromere and telomere; Euchromatin and heterochromatin. Nucleosomes, DNA Packaging.

Karyotype analysis: Chromosome banding technique (Q, G and R Banding and their uses); Flow cytometry and Confocal microscopy in karyotype analysis,

Specialized types of chromosomes: Polytene, Lampbrush, B chromosomes and sex chromosomes.

UNIT-II

Extrachromosomal Inheritance: The Genetics of Plastids, mitochondria and chloroplasts. **Structural alterations in chromosomes**—Origin, meiosis and breeding behaviour of duplication, deficiency, inversion and translocation heterozygotes.

Variation in chromosome number: Haploids, aneuploids and euploids- origin, production, effects and uses; polyploidy and crop improvement, Meiotic behaviour and use of trisomics, monosomics and nullisomics in chromosome

UNIT-III

Principles of plant breeding: Principles and objectives; methods of breeding self- and cross-pollinated crops, heterosis and hybrid vigour; utility of hybrids in genetics and plant breeding. Special breeding techniques- Mutation breeding; Breeding for abiotic and biotic stresses,

UNIT-IV

Asexual Breeding Systems: Methods of breeding of vegetative propagated crops; Non-conventional methods; polyploidy; gene variability. **Male Sterility:** Concept, Types, Genetic control and Breeding utility, Self-incompatibility, clonal selection **Multigene families:** Multigene families and their evolution. Centers of Origin of crops, biodiversity and its significance.

Part- D Recommended Books/e-resources/LMS:

7. George Acquaah 2012 Principles of Plant Genetics and Breeding
8. Krebs JE, Goldstein ES and Kalpatrick ST (2010) Lewin's Essential Genes (2nd Ed.), Jones and Barlett Publishers.
9. Lewin B (2010) Gene X, Jones and Barlett Publishers.

10. Pierce BA (2012) Genetics- A Conceptual Approach (4th Ed.), W.H. Freeman and Company, New York, USA.
11. Russell PJ (2006) Genetics (5th Ed.), Addison Wesley Longman, California, USA.
12. Snustad P and Simmons MJ (2011) Principles of Genetics. (6th Ed.), John Wiley, New York.

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.

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Biochemical and Biophysical Techniques (25 BOT-402)**Part A: Introduction Programme and Course**

Name of Programme: M.Sc. Botany

Name of the Course: Biochemical and Biophysical Techniques

Course Code: 25 BOT-402

Course Type: CC-13

Course Credits: 04

Teaching Hours per week: 04

Max. Marks: 100

Theory Exam: 70

Internal Assessment: 30

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Part B-- Course Objectives and Course Learning Outcomes (CLOs):**Course Objectives**

This paper aims to provide an introduction to various tools and techniques used to gain insight into cell structure and biological processes. The focus is on studying the techniques used for isolation, purification and characterization of bio molecules.

The syllabus is structured according to the principles of the National Education Policy (NEP-2020) and aligned with contemporary patterns of UGC-NET/CSIR-NET Life Sciences examinations.

Course Outcomes (COs)

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

5. This paper is expected for students to gain in-depth knowledge of numerous methods used in characterization the biomolecules.
6. Understand the principles and applications of various types of microscopes.
7. Understand various modern tools and their applications like Chromatography, Electrophoresis, spectroscopy and tracer techniques.
8. Develop analytical and conceptual skills required for higher studies and competitive examinations such as UGC-NET, CSIR-NET, GATE, and ICAR examinations.

Part C- Instructions for Paper Setter:

The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration.

The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions in all selecting one question from each unit and the compulsory question. All questions will carry equal marks.

UNIT-I

Microscopy: Principles and applications of light, phase contrast, fluorescence microscopes, Confocal microscope, scanning and transmission electron microscopes. Different fixation and staining techniques (Preparation of permanent slides).

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Centrifuge technique: Principle, Types of centrifuge, Density gradient centrifuge, differential centrifugation and Ultra centrifugation.

UNIT-II

Chromatography: Principles and Types; Paper chromatography, Thin layer Chromatography, Gel filtration Chromatography, Ion-exchange Chromatography, Affinity Chromatography. Gas chromatography and High-Pressure Liquid Chromatography (HPLC) and FPLC. Application of chromatographic technique in biology.

Electrophoresis: Principles and applications of Agarose, Polyacrylamide gel electrophoresis, 2D Gel Electrophoresis, Differential in-gel Electrophoresis (DIGE), Electrophoretic Mobility Shift Assay (EMSA)

UNIT-III

Spectroscopy: UV, visible, Infra-red, Fluorescence, Atomic absorption spectroscopy, NMR and ESR spectroscopy; Mass spectrometry (LC-MS, GC-MS), X-ray diffraction. Surface Plasmon Resonance (SPR), Flow cytometry

Tracer Biology: Nature and types of radiation, preparation of labeling biological sample, Safety measurement in handling radioisotopes detection and measurement of radiation, GM counter, Scintillation counter Principles and applications of tracer techniques in biology; radioactive isotopes and half-life of isotopes; autoradiography. Application of different spectroscopic technique in biology.

Unit- IV

Immunotechniques: Detection of molecules using, ELISA, RIA, Western blot and immuno precipitation, In-situ localization by techniques as Fluorescence In-situ Hybridization (FISH) and Genomic In-situ Hybridization (GISH).

Quantification and quality determination of RNA and DNA, Micro array (DNA and protein)

Part- D Recommended Books/e-resources/LMS:

1. Wilson K and Walker J (2018) Principles and Techniques of Biochemistry and Molecular Biology (8th Ed.), Cambridge University Press, New Delhi.
2. Sawhney SK and Singh R (2000) Introductory Practical Biochemistry (Ed.), Narosa Publishing House Pvt. Ltd., New Delhi.
3. Devi, P. 2000. Principles and Methods of Plant Molecular Biology, Biochemistry and Genetics. Agrobios, Jodhpur, India.

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4. Hegyi G, Kardos J, Kovacs M, Csizmadia AM, Nyitray L, Pal G, Radnai L, Remenyi A Venekai I (2013) Introduction to Practical Biochemistry, Eotvos Lorand University, Hungary.
5. Plummer DT (1990) An Introduction to Practical Biochemistry, Tata Mc-Graw-Hill Publishing Company Ltd., New Delhi.
6. Ranade R and Deshmukh S (2013) Handbook of Techniques in Biotechnology, Studium Press (India) Pvt. Ltd. New Delhi.

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.

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Seed Science and Technology (25 BOT-404)**Part A – Introduction Programme and Course**

Name of Programme: M.Sc. Botany

Name of the Course: Seed Science and Technology

Course Code: 25 BOT- 404

Course Credits: 04

Max. marks: 100

Theory Exam : 70

Internal Assessment: 30

Course Type: DEC- 15

Teaching Hours per week: 04

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Part B-- Course Objectives and Course Learning Outcomes (CLOs):**Course Objectives**

This course is designed to provide comprehensive knowledge of seeds like seed production, hybrid seeds, seed quality control and seed certification. The syllabus is structured according to the principles of the National Education Policy (NEP-2020) and aligned with contemporary patterns of UGC-NET/CSIR-NET Life Sciences examinations.

Course Outcomes (COs)

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

5. Understand the principles and practices of seed production, including hybrid seed techniques and the role of seed industry stakeholders in India.
6. Learn the objectives and procedures of seed quality control, including seed testing methods and standards, as well as the importance of moisture content and purity standards.
7. Explore the factors affecting seed viability, vigour, and longevity, along with the physiological basis of seed vigour and its impact on crop performance.
8. Gain insights into seed certification regulations, seed processing principles, and the operation of seed processing machinery, essential for maintaining seed quality and standards.

Part C- Instructions for Paper Setter:

The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration.

The compulsory question (Question No.1) will consist of at least 4 parts covering the entire syllabus.

The examinee will be required to attempt 5 questions in all selecting one question from each unit and the compulsory question. All questions will carry equal marks.

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UNIT-I

Seed production: seed multiplication ratios, seed replacement rate, demand and supply; suitable areas of seed production and storage, Agro-climatic requirements and their influence on quality seed production, certification standards, use of male sterility and self-incompatibility and CHA in hybrid seed production, seed village concept; seed production agencies, seed industry and custom seed production in India.

UNIT-II

Seed quality: objectives, concept and components and their role in seed quality control, instruments, devices and tools used in seed testing, ISTA and its role in seed testing, procedure of seed sampling, sampling intensity, methods of preparing composite and submitted samples, sub-sampling techniques, dispatch, receipt and registration of submitted sample in the laboratory, prescribed seed purity standards, importance of moisture content, equilibrium moisture content, methods of seed germination testing.

UNIT-III

Seed viability and longevity, pre and post-harvest factors affecting seed viability, seed ageing, physiology of seed deterioration, lipid peroxidation and other viability theories, means to prolong seed viability, mechanism of desiccation sensitivity and recalcitrance with respect to seed longevity, vigour test methods, factors affecting seed vigour, physiological basis of seed vigour in relation to crop performance and yield.

UNIT-IV

Central Seed Certification Board (CSCB), the Seed Act (1966), Seed Rules (1968), New Seed Bill-2004, Indian Minimum Seed Certification Standards (I.M.S.C.S), principles of seed processing, functions of scalper debearder, scarifier, huller, seed cleaner, grader, screen cleaners, specific gravity separator, indented cylinder, velvet-spiral-disc separators, colour sorter, delinting machines; seed blending.

Part- D Recommended Books/e-resources/LMS:

1. ISTA. (2019). ISTA Handbook on Seedling Evaluation (3rd ed.). International Seed Testing Association.
2. Basra, A. S. (2017). Seed Science and Technology (3rd ed.). CRC Press.



3. McDonald, M. B., & Copeland, L. O. (2019). Seed Production: Principles and Practices (2nd ed.). CABI.
4. Smith, R. D., & Dickson, M. H. (2018). Seed Technology and Its Biological Basis (2nd ed.). CRC Press.
5. Vanangamudi, K., & Swaminathan, M. S. (2016). Seed Science and Technology: Theory and Practice (4th ed.). Agrobios Publications.

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.

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Applied Mycology (25 BOT-405)**Part A – Introduction Programme and Course**

Name of Programme: M.Sc. Botany

Name of the Course: Applied Mycology

Course Code: 25 BOT-405

Course Credits: 04

Max. marks : 100
Theory Exam : 70
Internal Assessment : 30

Course Type- DEC-16

Teaching Hours per week: 04

Part B-- Course Objectives and Course Learning Outcomes (CLOs):**Course Objectives**

This course is designed to provide comprehensive knowledge of Fungi and its various applications in agriculture and industry. The syllabus is structured according to the principles of the National Education Policy (NEP-2020) and aligned with contemporary patterns of UGC-NET/CSIR-NET Life Sciences examinations.

Course Outcomes (COs)

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

5. Know about the production of Valuable microbial products.
6. Understand the role of Fungi as bio fertilizers and biocontrol agents.
7. Become familiar with techniques used for maintenance of fungal cultures.
8. Use the knowledge of mycology for commercial production of mushrooms.

Part C- Instructions for Paper Setter:

The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration.

The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions in all selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit I

Primary metabolites production by fungi: industrial alcohol, organic acid, beer. Secondary metabolites production by fungi: Antibiotics, steroid transformation, enzymes, amino acids, growth regulators, vitamins.

Unit II

Fungi as biofertilizers: Endomycorrhiza and ectomycorrhiza. Fungi as biocontrol of plant pathogens and weeds. Biodeterioration of materials: Paper, painted surface, wood. Role of fungi in biogeochemical cycle.

Unit III

Food processing by fungi: Bread, cheese, oriental food and baker's yeast. Fungal sources of health food: Single cell protein, edible mushrooms. Spoilage of food and fungal toxicity.

Unit IV

Culturing and preservation of fungi: isolation of fungi, culturing of fungi, establishing a pure culture, aseptic technique, maintenance of culture collection, culture collection and identification centers. Common culture media and sterilization techniques.

Part-D Recommended Books/e-resources/LMS:

7. Deacon, J. W. (2013). Fungal Biology (5th ed.). John Wiley & Sons.
8. Gadd, G. M. (2007). Fungi in Biogeochemical Cycles (2nd ed.). Cambridge University Press.
9. Moore-Landecker, E. (2009). Fundamentals of the Fungi (4th ed.). Prentice
10. Hall, Dighton, J., White, J. F., & Oudemans, P. (2005). The Fungal Community: Its Organization and Role in the Ecosystem (3rd ed.). CRC Press.
11. Sutton, B. C. (2012). The Fungi: An Advanced Treatise (2nd ed., Vol.)
12. Dharendra Kumar, et.al (2025) Mushroom Magic: Biochemistry and Nutritional Value of Fungi", published by CRC Press (Taylor & Francis) United Kingdom

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.



Photobiology (25 BOT-406)

Max marks : 100
Theory Exam : 70
Internal Assessment : 30

Part A – Introduction Programme and Course

Name of Programme M.Sc. Botany

Course Type- DEC -17

Name of the Course: Photobiology

Course Code: 25 BOT-406

Course Credits: 04

Teaching Hours per week: 04

Part B- Course Objectives and Course Learning Outcomes (CLOs):**Course Objectives**

This course is designed to provide comprehensive knowledge of various aspects of light on the plant life. The syllabus is structured according to the principles of the National Education Policy (NEP-2020) and aligned with contemporary patterns of UGC-NET/CSIR-NET Life Sciences examinations.

Course Learning Outcomes (CLOs)

1. Students will understand light characteristics and plant photoreceptors, including phytochrome and cryptochrome structures and functions.
2. Students will learn about circadian rhythm control by ZEITLUPE and the roles of phototropins and UVR8 in plant responses to light.
3. Students will explore light-hormone interactions in plant growth, development, and stress responses, focusing on phototropism and photomorphogenesis.
4. Students will gain knowledge of key experiments and concepts in photosynthesis, including photosystems, the Z-scheme, and various photosynthetic pathways.

UNIT-I

Characteristics of light, plant photoreceptors and its classification, phytochrome structure and action potential, phytochrome responses (VLFR, LFR, HIR), phytochrome signaling pathways (gene regulation by PIFs, COP regulation), blue light kinetics, cryptochrome structure and action potential, CRY-COP interaction.

UNIT-II

Control of circadian rhythm by ZEITLUPE, phototropins structure and action potential, role of phototropins in chloroplast movement and stomatal opening, UVR8 structure and action potential, responses to UV radiation and molecular mechanism of UVR8 function.

UNIT-III

Light-hormone interplay in phototropism, photomorphogenesis, chlorophyll biosynthesis, defense and development, molecular mechanism of shade avoidance, role of yellow and green light in

growth, development, shade avoidance and stress responses, mechanisms of sensing and responding to light stress in plants.

UNIT-IV

Key experiments in understanding photosynthesis, antenna system, photosystems, Z-scheme, repair and regulation of photosynthetic machinery, genetics, assemble and evolution of photosynthetic systems, C3 cycle, RuBisCO regulation, photorespiration, C4, CAM and SAM photosynthesis.

Part- D Recommended Books/e-resources/LMS:

1. Taiz, L., Zeiger, E., Møller, I. M., & Murphy, A. (2023). Plant physiology and development (7th ed.). Sinauer Associates.
2. Mohr, H., & Schopfer, P. (2020). Plant physiology (2nd ed.). Springer.
3. Kochhar, S. L., & Gujral, S. K. (2020). Plant physiology: Theory and applications (2nd ed.). Cambridge University Press.
4. Nobel, P. S. (2020). Physicochemical and Environmental Plant Physiology (5th ed.). Academic Press.
5. Pessarakli, M. (Ed.). (2024). Handbook of plant and crop physiology (4th ed.). CRC Press (Routledge).

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.

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Phytochemistry and Pharmacognosy (25 BOT-407)**Part A – Introduction Programme and Course**

Name of Programme: M.Sc. Botany

Name of the Course: Phytochemistry and Pharmacognosy

Course Code: 25 BOT-407

Course Credits: 04

Max. Marks : 100
Theory Exam : 70
Internal Assessment : 30

Course Type: DEC-18

Teaching Hours per week: 04

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Part B-- Course Objectives and Course Learning Outcomes (CLOs):**Course Objectives**

This course is designed to provide comprehensive knowledge of Phytochemistry and Pharmacognosy. The syllabus is structured according to the principles of the National Education Policy (NEP-2020) and aligned with contemporary patterns of UGC-NET/CSIR-NET Life Sciences examinations.

Course Outcomes (COs)

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

6. Understand protein and non-protein amino acids, protein structure and sequencing, special forms of DNA and RNA including isolation and purification techniques.
7. Know about carbohydrates including their classification, structure, properties, types and functions.
8. Understand the roles of water-soluble and fat-soluble vitamins.
9. Explore Pharmacognosy, the classification and evaluation of crude drugs, and the structure and classification of secondary metabolites.
10. Gain knowledge on source plants, parts used, and uses of various bio active compounds, along with commonly used extraction methods.

Part C- Instructions for Paper Setter:

The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration.

The compulsory question (Question No. 1) will consist of at least 4 parts covering the entire syllabus. The examinee will be required to attempt 5 questions in all selecting one question from each unit and the compulsory question. All questions will carry equal marks.

UNIT-I

Protein and non-protein amino acids, Ramachandran plot, protein (levels of organization), protein sequencing and assays, protein isolation and purification. Special forms of DNA (triplex and G-

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quadruplex), DNA denaturation and quantification, supercoiling, DNA isolation and purification. RNA world hypothesis, RNA stability and thermodynamics, RNA isolation and purification.

UNIT-II

Carbohydrates (classification, structure and optical properties), reducing and non-reducing sugars, monosaccharide derivatives (sugar alcohols, sugar acids, glycosides and amino sugars), disaccharides (glycosidic bond with examples and sucrose hydrolysis), polysaccharides (homo and hetero), glycoproteins. Water soluble and fat soluble vitamins (biosynthetic precursors and roles).

UNIT-III

Pharmacognosy and its importance in modern medicine, crude drugs, classification of drugs (chemical and pharmacological), drug evaluation (organoleptic, microscopic, chemical, physical and biological), classification and structure of secondary metabolites (terpenes, phenolics and N-containing).

UNIT-IV

Source plant parts used and uses of solasodin, diosgenin, digitoxin, catechin, gingerol, curcuminoids, paclitaxel, quinine, atropine, pilocarpine, strychnine, reserpine, vinblastine, sennoside and capsaicin and the most commonly used methods of their extraction.

Part-D Recommended Books/e-resources/LMS:

1. Berg, J. M., Tymoczko, J. L., & Stryer, L. (2022). Biochemistry (10th ed.). W. H. Freeman.
2. Voet, D., Voet, J. G., & Pratt, C. W. (2020). Fundamentals of biochemistry: Life at the molecular level (6th ed.). Wiley.
3. Lehninger, A. L., Nelson, D. L., & Cox, M. M. (2021). Lehninger principles of biochemistry (8th ed.). W. H. Freeman.
4. Evans, W. C. (2020). Trease and Evans' pharmacognosy (19th ed.). Elsevier.
5. Kokate, C. K., Purohit, A. P., & Gokhale, S. B. (2019). Pharmacognosy (56th ed.). Nirali Prakashan.

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.

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Dissertation (25 BOT-Disser-400)

Maximum Marks: 200

External Evaluation: 100

Internal Assessment: 100

Part A – Introduction Programme and Course

Name of Programme: M.Sc. Botany

Name of the Course: **Dissertation**

Course Code: **25 BOT-Disser-400**

Course Type- Dissertation

Course Credits: 12

Part B-- Course Objectives and Course Learning Outcomes (CLOs):

Course Objectives

In this paper mentor will assign a minor research topic during IIIrd semester. The student shall work on the allotted topic under the guidance of mentor. The student has to give a pre-presentation on the allotted topic at the end of IIIrd semester (as mentioned in research training course of semester III) before the department research committee in the department. The dissertation work should be original work of the student and free from any sort of plagiarism.

Outcomes expected of Dissertation writing

The following **four** outcomes must be achieved during III Semester:

- i. Research Problem identification
- ii. Review of literature
- iii. Research design formulation
- iv. Commencement of experimentation, fieldwork, or similar tasks

Semester IV

The following **three** outcomes must be achieved by the mid of IV Semester:

1. Completion of experimentation/ fieldwork.
2. Submission of dissertation.
3. Research output shall be publication in a reputed peer reviewed/refereed Journal such as Scopus indexed/web of Science journals or other similar quality journal/ Book or Book chapter in a publication by a reputed publisher.

Dissertation/Project Work:

A student who opts for Dissertation/Project work of 12 credits in 4th / 2nd semester of 2-year / 1-year PG Programme will be required to do the research work based on systematic, scientific and rigorous investigations on the chosen and approved topic utilizing relevant research methods/techniques/innovations.

1. A student, who opts for Dissertation/Project work in 4th semester of 2year PG Programme, shall submit a request for allotment of a supervisor mentioning her/his research areas of interest in order

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of preference to the Chairperson/Principal/Director during 3rd semester. The Department/College/Institute will allot a qualified supervisor to guide the student for doing research for Dissertation/Project work. A full-time teacher/mentor of that Department/College/Institute, will be eligible to guide the students for Dissertation/Project work.

2. The student will submit the synopsis to the supervisor/mentor. In case of University Teaching Department (UTD), the synopsis will be approved by the Departmental Committee after recommendation of the supervisor.

3. In case of affiliated Colleges/Institutes, the Principal/Director shall constitute a committee of at least three members of the concerned subject for this purpose at the College/Institute level. The committee will consist of at least one subject expert from Chaudhary Bansi Lal University, Bhiwani to be nominated by the Chairperson/Director on the request of College/Institute. The request for external expert should reach to the Chairperson/Director before 30th November of the concerned year. The list of students, their approved topics, and names of supervisors along with their synopsis will have to be submitted by the College/Institute to the respective Chairperson/Director latest by 31st January of the concerned year.

4. The student shall be required to submit three hard copies of her/his dissertation or project report along with soft copy as PDF file to the Department/College/Institute by 31st May of the concerned year which will be forwarded to the Controller of Examinations for evaluation within a week.

5. The anti-plagiarism policy of the University will have to be strictly followed by the candidate and the supervisor for dissertation/project report. Similarity report certificate issued by the Librarian as per anti-plagiarism policy of the university is to be annexed with the dissertation/project report.

6. Evaluation of the dissertation/project report shall be done by an external examiner. The panel of examiners for evaluation of dissertations/project reports will be approved by the respective Board of Studies.

7. The schedule as specified above is to be strictly followed by the student and Department/College/Institute and any relaxation will not be allowed. However, in exceptional circumstances, late submission may be allowed with a late fee, as decided by the University authorities from time to time.

 *Deen*


21/7/26