

**DEPARTMENT OF BOTANY
ELECTIVE COURSES OFFERED**

Course No.	Name of the Course	Credit	Remark
	Semester I		
BOT-VC-101	Conservation of Plant Diversity	04	Value added course (Credited)
	Semester II		
BOT-VNC-201	Art of Bonsai	00	Value added course (Non Credited)
	Semester III		
BOT-EL-301A	Applied Botany-I	04	Elective
BOT-EL-301B	Analytical Techniques and Computer Applications		
BOT-EL-302A	Mushroom Cultivation	04	Elective
BOT-EL-302B	Ecotourism		
BOT-IER-301	Plant Resource Utilization	04	Interdepartmental Course
	Semester IV		
BOT-EL-401A	Applied Botany-II	04	Elective
BOT-EL-401B	Biotechnology and Human Welfare		
BOT-EL-402A	Plant Disease Management	04	Elective
BOT-EL-402B	Gardening and Landscaping		
BOT-IRA-401	Natural Resources and their Conservation	04	Intradepartmental Course

BOT = Botany
 BOT-VC = Value added course (Credited)
 BOT-VNC = Value added course (Non Credited)
 BOT-EL = Elective Course
 BOT-IER = Interdepartmental Course
 BOT-IRA = Intradepartmental Course

Department of Botany
Semester I
BOT-VC-101: Conservation of Plant Diversity
4 Credits/40 Hours

Course Outcomes:

After completion of the Course the student will:

- Get an overview of the significance of plant diversity, and an insight into global strategies for developing workable models for its exploration and conservation
- Develop an understanding of the importance of national parks, biosphere reserves and sanctuaries
- Understand the role played by government and non-government organizations in conserving biodiversity

UNIT – I
<ul style="list-style-type: none"> ➤ Plant diversity concepts, its significance and application, Current conservation Status and need for conservation, Conservation Status Assessment of threatened species ➤ Biodiversity in the World: genetic diversity, species diversity, ecosystem diversity
UNIT – II
<ul style="list-style-type: none"> ➤ Biodiversity hotspots in India and the World, their role in conservation, Red list index ➤ Conservation status by IUCN red list category and definition (DD, LC, NT, VU, EN, CR, EW and EX) ➤ Climate change and biodiversity
UNIT – III
<ul style="list-style-type: none"> ➤ Factors affecting biodiversity (biotic and abiotic), Reason for conservation deterioration (degradation of ecosystem, loss of mobility, expansion of vegetation, international trade and artificial conservation site), Types of conservation (preventive, remedial and restoration) ➤ Role of tissue culture in plant diversity and its significance
UNIT – IV
<ul style="list-style-type: none"> ➤ In situ conservation - Protected areas, National parks, Wildlife sanctuaries, Biosphere reserves, Sacred forests ➤ Ex situ conservation- Seed banks, Sacred groves, Botanical gardens ➤ Cryopreservation, Natural reserves, Marine parks, Gene banks
UNIT – V
<ul style="list-style-type: none"> ➤ Global strategy for plant conservation (GSPC), Model for plant development conservation and sustainable use ➤ Conservation programmes –Non-governmental organizations (NGOs), Governmental bodies - UNEP, DST, MoEF, FSI, CPCB, NMPB, AYUSH

Suggested Readings:

1. Plant Conservation and Biodiversity Editors: Hawksworth, David L., Bull, Alan T. (Springer)
2. Biological Diversity and Its Conservation, Sharma Dushyant Kumar, Daya Publishing House
3. A Handbook of Plant Resource Utilization and Conservation, Bijan Bihari Dutta
4. Biodiversity: Concepts and Conservation, B.B. Hosetti, S. Ramkrishna, Aavishkar Publishers, Distributors, Jaipur

Department of Botany
Semester II
BOT-VNC-201: Art of Bonsai

Course Outcomes:

After completion of the Course the student will:

- Get an overview of the art of Bonsai and its applied aspect, at the same time acquire basic skills and aesthetics needed to create a beautiful bonsai
- Develop an understanding of the importance of bonsai

UNIT – I
Introduction of Bonsai, Evolution of Bonsai, Early versions, Classical period, History of Bonsai in China, History of Bonsai in Japan, History of Bonsai in the West, Modern bonsai.
UNIT – II
Bonsai Aesthetics: General aesthetic principles- no trace of the artist, Visual balance, Proportion among elements, Flexibility of the rules, General aesthetic guidelines- Gravitas, Miniaturization, Lignifications, Asymmetry, Leaf Reduction, Nebari, Ramification, Deadwood, Curvature.
UNIT – III
Styles of Bonsai: Special Characteristics of Bonsai, concept of styles, catalogue of styles, common styles: Formal upright, Informal upright, Slant, Cascade, Semi-cascade, other styles.
UNIT – IV
Preparation of Bonsai: Conditions required, Rules for Bonsai making: For trunk, For Branches, Plants suitable for Bonsai making, Cultivation, Agrotechniques for Bonsai: Propagation, Season, Potting and repotting, after care, Containers, Planting media.
UNIT – V
Importance of Bonsai: Scientific Benefits, Spiritual Benefits, Ornamental Value, Economic importance, Bonsai skills.

Suggested Readings

1. Bonsai Basics, Step-by-Step Guide to Growing, Training & General Care by Christian Pessey and Rémy Samson Sterling Pub. (1993).
2. Bonsai; 101 Essential tips by Harry Tomlinson and Carol Watson DK Pub. (2003).
3. The Bonsai Handbook by David Prescott and Colin Lewis New Holland, 2003
4. Indoor Bonsai by Paul Lesniewicz Blandford Press (1986)
5. Bonsai, a beginners guide by Bonsai Empire (2014)

Department of Botany
Semester III
BOT-EL-301A: Applied Botany-I
4 Credits/40 Hours

Course Outcomes:

After completion of the Course the student will:

- Understand the impact of microorganisms on mankind and the innumerable ways in which they serve us
- Learn about the industrial importance of bacteria, fungi, and algae and appreciate their beneficial role in medicine, industry and agriculture
- Learn about the concept of IPM and necessity to reduce usage of chemical pesticides
- Understand the economic importance of Bryophytes, Pteridophytes and Lichens

Unit I
<ul style="list-style-type: none"> ➤ Fermented food products, probiotics ➤ Industrial applications of microbes: organic acids, amino acids, vitamins, enzymes and extremozymes; Immobilized enzyme technology ➤ Biopesticides and biofertilizers ➤ Microbial leaching and bioremediation
Unit-II
<ul style="list-style-type: none"> ➤ Medicinal fungi ➤ SCP and Mushroom cultivation ➤ Mycotoxins ➤ Integrated Pest Management
Unit-III
<ul style="list-style-type: none"> ➤ Algae as food, fodder, aquaculture feed; commercial production of agar-agar, algin and alginate; algal-based fuels ➤ Role of algae in soil fertility, land reclamation, sewage disposal ➤ Medicinal importance of algae; Diatomaceous earth and its uses ➤ Culture of algae
Unit-IV
<ul style="list-style-type: none"> ➤ Lichens as pioneer colonizers ➤ Role of Lichens in monitoring pollution ➤ Lichens as food and fodder ➤ Therapeutic applications of lichens ➤ Lichen synthesis
Unit-V
<ul style="list-style-type: none"> ➤ Use of Bryophytes in pollution studies ➤ Economic importance of Bryophytes in medicine, horticulture, household goods, furnishing and construction ➤ Pteridophytes in ethno-medicine, as food and fodder, and as ornamentals ➤ Role of Pteridophytes in phytoremediation

Suggested Readings:

1. Basic Biotechnology, C. Ratledge and B. Kristiansen (Eds), 3rd edition, 2007, Cambridge University Press.
2. Plant Biotechnology, P.K. Gupta, 2nd edition, Rastogi Publications
3. A Textbook of Biotechnology, R.C. Dubey, 5th revised edition, 2014, S Chand
4. Crueger's Biotechnology-A textbook of Industrial Microbiology, V.B. Rastogi and K.R. Aneja, 3rd edition, 2017, Scientific International Pvt. Ltd.

Department of Botany
Semester III
BOT-EL-301B: Analytical Techniques and Computer Applications
4 Credits/40 Hours

Course Outcomes:

After completion of the Course the student will:

- Understand the principles and applications of several important analytical techniques used in the study of bio-molecules
- Acquire a hands-on knowledge of computers and related programs applicable to various other courses

Unit-I
<ul style="list-style-type: none"> ➤ Sand culture/water culture and controlled soil culture techniques ➤ Tracer techniques: Detection and measurement of isotopes and applications ➤ Microtomy
Unit – II
<ul style="list-style-type: none"> ➤ Centrifugation and ultracentrifugation techniques and their applications. ➤ Chromatography- Paper, TLC, Column, Gel Filtration, Affinity, Ion Exchange, HPLC, GC ➤ Flow cytometry: Principles and Applications
Unit – III
<ul style="list-style-type: none"> ➤ Photometry: Colorimetry and Spectrophotometry (UV-visible). Fluorescence Spectrometry, Chemiluminescence Spectrometry, Atomic Absorption/Emission Spectrometry ➤ Basic features and principles of IR, Raman, Mass, NMR, ESR.
Unit – IV
<ul style="list-style-type: none"> ➤ Electrophoretic techniques and their applications. ➤ Amino acid analysis and protein sequencing. ➤ Applications and detection of proteins and nucleic acids (Western Transfers and Immunoblots and Southern blot), MAB technology. ➤ DNA chip technology and Microarray
Unit – V
<ul style="list-style-type: none"> ➤ Brief introduction to computers and their applications ➤ MS Office (MS Word, MS Excel, MS Power Point, MS Access) ➤ Graphics, Operating System: Windows, dBASE, Coral/Photoshop

Suggested Readings:

1. E.J. Hewitt (1966). Sand and water culture methods used in the study of plant nutrition. Commonwealth Agricultural Bureaux, Farnham Royl. Bucks, England.
2. György Hegyi, József Kardos, Mihály Kovács, András Málnási-Csizmadia, László Nyitray, Gábor Pál, László Radnai, Attila Reményi, István Venekei (2013). Introduction to Practical Biochemistry, ELTE Faculty of Natural Sciences, Institute of Biology
3. K. Wilson, J. Walker (2010). Principles and Techniques of Biochemistry and Molecular Biology, Seventh Edition, Cambridge University Press, New York, USA.
4. Phillip Sheeler and Donald E Bianchi (2006). Cell and Molecular Biology, John Wiley and Sons, Inc. U.K.
5. R. Boyer (2000). Modern Experimental Biochemistry, Pearson Education, Asia
6. S.E. Ruzin (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York
7. S.K. Sawhney, Randhir Singh (2000). Introductory Practical Biochemistry, Narosa Publishing House, New Delhi.

Department of Botany
Semester III
BOT-EL-302A: Mushroom Cultivation
4 Credits/40 Hours

Course Outcomes:

After completion of the Course the student will:

- Get a basic understanding of the cultivation process of mushrooms
- Understand health benefits of consuming mushrooms
- Understand the economic importance of mushrooms

Unit -I
<ul style="list-style-type: none"> ➤ Introduction to mushrooms and historical perspectives ➤ Classification of mushrooms, Nutritional and dietary values of mushrooms as source of proteins, carbohydrates, fibres, vitamins and minerals, therapeutic properties, mushroom collections from field.
Unit-II
<ul style="list-style-type: none"> ➤ Mushroom cultivation techniques: Erections of mushroom culture sheds and maintenance (tools, equipment and prerequisites). ➤ Fungal Isolation techniques, preparation of mother culture- pure culture, selection of stock, spawn production – mother spawn production.
Unit-III
<ul style="list-style-type: none"> ➤ Multiplication of spawn: Precautions, characters, and storage of spawn ➤ Substrate production, culturing of mushrooms, Harvesting, post-harvesting processes, and key machinery and equipment required.
Unit-IV
<ul style="list-style-type: none"> ➤ Cultivation techniques for commercially viable mushrooms - paddy straw mushroom, button mushroom and milky mushroom – spawning, substrate preparation, growth, packing, and maintenance of suitable environmental conditions. ➤ Factors influencing mushroom cultivation and harvesting. Mushroom delights.
Unit-V
<ul style="list-style-type: none"> ➤ Pests management during mushroom cultivation ➤ Diseases and competitor moulds of mushrooms and their management: Dry bubble disease – <i>Verticillium fungicola</i>, wet bubble disease – <i>Mycogoneperniciosa</i>, Cobweb – <i>Cladobotryumdendroides</i>, and Green mould - <i>Trichoderma</i> sp. Flies and mites

Suggested Readings:

1. Mushroom Cultivation : A beginner guide by Nailoke Pauline Kadhila-Muandingi
2nd Edition
2. The Essential Guide to Cultivating Mushrooms by Stephen Russell, Storey Publishing, LLC
3. Mushroom Cultivation Technology by YellaRathaiah
4. Mushroom cultivation in India by V.P. Sharma, Daya Books Publication.
5. Mushroom Cultivation by V. Kumaresan, Saras Publication; 1st edition

Department of Botany
Semester III
BOT-EL-302B: Ecotourism
4 Credits/40 Hours

Course Outcomes:

After completion of the Course the student will acquire:

- Basic knowledge of principles of Ecotourism and its significance.
- Basic understanding of ecological importance of Ecotourism.
- Knowledge about conservation of fragile natural environment.

Unit -I
<ul style="list-style-type: none">➤ Ecotourism: Definition, principles of ecotourism, benefits of ecotourism➤ Role of ecotourism in sustainable development, Economic and livelihood security for locals and forest dwellers
Unit-II
<ul style="list-style-type: none">➤ Sustainable ecotourism, characteristics and principles of sustainable ecotourism➤ Relationship between ecotourism and sustainable tourism
Unit-III
<ul style="list-style-type: none">➤ National and state agencies involved in promotion of ecotourism, concerns of stakeholders in promoting tourism in ecologically sensitive area➤ Ecotourism in India with special reference to ecotourism promoting state in India
Unit-IV
<ul style="list-style-type: none">➤ Destinations for ecotourism in India and ecological importance of these ecotourism destinations in India➤ Role of non-governmental organizations in educating ecotourists about environmental sensitive issues related to ecotourism destinations
Unit-V
<ul style="list-style-type: none">➤ International ecotourism➤ Risks benefits and disadvantages of ecotourism

Suggested Readings:

1. Ralf Buckley-Environmental Impacts of Ecotourism.
2. Seema Bhatt and Syed Liyakhat- Ecotourism Development in India: Communities, Capital and Conservation.
3. Martha Honey-Ecotourism and sustainable development, David Fennell-Ecotourism Third Edition

Department of Botany
Semester III
BOT-IER-301: Plant Resource Utilization
4 Credits/40 Hours

Course Outcomes:

After completion of the Course the student will:

- Learn about the therapeutic applications of plants, and important cash crops and plantation crops
- Understand the benefits of orchards and learn several horticulture and floriculture techniques
- Appreciate the importance of organic farming, vermicomposting, biofertilizers and biopesticides

Unit-I
<ul style="list-style-type: none"> ➤ Plants in Homeopathy (plant parts and uses) ➤ Plants in Ayurveda (plant parts and uses) ➤ Plants in Allopathy (plant parts and active principals, uses) ➤ Ethnomedicine
Unit – II
<ul style="list-style-type: none"> ➤ Vegetative propagation, Gutti, layering, grafting ➤ Micropropagation & its Industry ➤ Seed propagation & its limitation ➤ Plant Quarantine
Unit – III
<ul style="list-style-type: none"> ➤ Commercial floriculture: scope & importance in India. ➤ Techniques of producing ornamental plants like Rose, Marigold, Chrysanthemum , Orchid, Gladiolus etc. ➤ Orchards: Importance, objectives, merits and demerits ➤ Horticultural crops and their nutritive value
Unit – IV
<ul style="list-style-type: none"> ➤ Vermicomposting, green manuring ➤ Biofertilizers and use of biocontrol agents ➤ Biopesticides, pheromones ➤ Organic food and human health
Unit – V
<ul style="list-style-type: none"> ➤ Plantation crops: Scope and importance ➤ Plantation crops: Planting system and methods ➤ Packaging & marketing of some vegetable crops and cash crops (Coffee, Tea, Sugar, Banana) ➤ Export and import potential, uses & Industrial importance of Plantation crops

Suggested Readings:

1. Lyndy J. McGaw *et.al* Medicinal Plants for holistic healing.
2. Bhani Ram, MamtaDail and Anil Sharma. Plantation Crops.
3. Roy A. Larson- Introduction to Floriculture.
4. S.Prashad- Commercial Floriculture.
5. Dr. R. K. Bishwas- Organic farming in India. (N D publication).
6. Bijan Bihari Dutta-A Handbook of Plant Resource Utilization and Conservation

Department of Botany
Semester IV
BOT-EL-401A: Applied Botany-II
4 Credits/40 Hours

Course Outcomes:

After completion of the Course the student will:

- Appreciate the economical aspect of Botany, with the use of plants as a source of food, fibre, timber, oils, beverages and medicines

UNIT – I
<ul style="list-style-type: none">➤ Gymnosperms in forestry➤ Gymnosperms as a source of wood, resins, tannins, fibers, medicines houseplants, essential oils, fatty oils, decoration and others
UNIT – II
<ul style="list-style-type: none">➤ An introduction to plant utilization- Cereals (Wheat, Rice and Maize) and their domestication, Pseudocereals➤ Pulses and their utility, vegetables, fruits (common name, vernacular name and plant parts) and ornamental plants.
UNIT – III
<ul style="list-style-type: none">➤ Timber yielding plants (Sheesham, Teak, Chir and Mango) their seasoning and utility➤ Rubber yielding plants and its processing; gums, resins and dye yielding plants
UNIT – IV
<ul style="list-style-type: none">➤ Extraction and utility of fibers (Cotton, Jute, Coir and Paper making fibers)➤ Oils- their classification, extraction and importance (Mustard, coconut, groundnut, sunflower and essential oils)
UNIT – V
<ul style="list-style-type: none">➤ Beverages: Classification, utility and processing (Tea, coffee and cocoa)➤ Medicinal plants; Petrocrops, Fumatories and Masticatories

Suggested Readings:

1. Economic Botany: Principles and Practices by G.E. Wickens
2. Economic Botany: A Comprehensive Study by S. L. Kochhar.
3. Plants in our World: Economic Botany by Beryl Simpson & Molly Ogorzaly
4. Textbook of Economic Botany by V. Verma
5. Economic Botany by B. C. Pandey
6. Economic Botany by P. C. Das
7. Economic Botany: Useful plants and products by W. W. Robbins

Department of Botany
Semester IV
BOT-EL-401B: Biotechnology and Human Welfare
4 Credits/40 Hours

Course Outcomes:

After completion of the Course the student will:

- Learn about culturing plants through *in vitro* micropropagation techniques
- Acquire knowledge about the techniques in molecular biology for creation of transgenic plants for disease resistance and crop improvement
- Learn about biotechnological approaches in pollution control and improvement of soil fertility

Unit-I
<ul style="list-style-type: none"> ➤ Plant Cell and Tissue culture: Introduction, concept of cellular differentiation, totipotency ➤ Culture media and laboratory requirements ➤ Micropropagation-Organogenesis and embryogenesis, Bioreactors, Embryo rescue ➤ Endosperm culture, nucellus culture ➤ Somaclonal variations: applications and reasons for generation ➤ Protoplast culture, regeneration and somatic hybridization, Cybrids ➤ Production and uses of haploids ➤ Applications of plant tissue culture
Unit – II
<ul style="list-style-type: none"> ➤ Cloning vectors (plasmid and bacteriophage vectors, cosmids BAC and YACs) ➤ Enzymes (restriction endonucleases, polymerases, reverse transcriptase, alkaline phosphatase, polynucleotide kinase, Ligases, terminal transferases) ➤ DNA cloning: Preparation of plasmid DNA, Restriction digestion and electrophoresis, ligation, transformation and analysis of recombinants. ➤ Gene libraries and cDNA libraries, Polymerase chain reaction ➤ Methods of direct and indirect gene transfer in plants, <i>Agrobacterium</i>, Ti and Ri Plasmids.
Unit – III
<ul style="list-style-type: none"> ➤ DNA fingerprinting, DNA Synthesis, DNA Sequencing. ➤ Application of genetic engineering: Transgenic plants for pest and disease resistance, abiotic stress tolerance, production of useful products. ➤ Applications of genetically engineered bacteria in crop production and protection
Unit – IV
<ul style="list-style-type: none"> ➤ Biodegradation of xenobiotics and toxic wastes, production of chemicals and fuels ➤ Biotechnology in pollution control and phytoremediation ➤ Restoration of degraded land, microbes for improving soil fertility ➤ Biopesticides and integrated pest management, Biofertilizers, Organic farming
Unit – V
<ul style="list-style-type: none"> ➤ Introduction to Genomics and Proteomics ➤ Molecular markers ➤ Bioinformatics -general outline ➤ Intellectual Property rights and Protection-brief introduction ➤ Patenting of Biological material and its implications ➤ Ethics in biotechnological research

Suggested Readings:

1. C.A. Cullis (2004) *Plant Genomics and Proteomics*, A John Wiley & Sons, Inc., Publication, Hoboken, New Jersey. USA
2. JH Dodds, L.W. Roberts (1985) *Experiments in Plant tissue Culture*. Cambridge University Press, New York, USA
3. JW Dale, M. von Schanz (2007) *From Genes to Genomes, concepts and applications of DNA technology*. John Wiley and Sons, Ltd. West Sussex, England
4. K. Wilson, J. Walker (2010) *Principles and Techniques of Biochemistry and Molecular Biology*, Seventh Edition, Cambridge University Press, NewYork, USA.
5. K-H Neumann, A. Kumar, J. Imani (2009) *Plant Cell and Tissue Culture - A Tool in Biotechnology, Basics and Application*. Springer-Verlag, Berlin, Germany
6. L. Comai, J.Katz, P.Mallick, (Eds.) *Proteomics Methods and Protocols*, Springer
7. Lodish H, Berk A, Zipursky SL, Matsudaira P, Baltimore D, Darnell JE (2000) *Molecular Cell Biology*, W H Freeman and Company, USA.
8. NL Craig, O Cohen-Fix, R Green, C. Greider, G. Storz, C. Wolberger (2014) *Molecular Biology: principles of genome function*. Oxford University Press, UK.
9. Richard M. Twyman, *Advanced Molecular Biology: A Concise Reference* , BIOS Scientific Publisher Ltd
10. Timothy Palzkill (2002) *PROTEOMICS*, Kluwer Academic Publishers, New York

Department of Botany
Semester IV
BOT-EL-402A: Plant Disease Management
4 Credits/40 Hours

Course Outcomes:

After completion of the Course the student will:

- Develops a basic understanding of the economic and aesthetic damage caused by plant diseases
- Understand and identify diseases and their potential management methods
- Develop significant knowledge of IPM in order to recognize it's the components for an integrated management plan

Unit -I
➤ History of plant pathology and early significant plant diseases, causes of infectious diseases, losses caused by plant disease, host range of pathogens, plant disease epidemiology, effect of pathogens on the host plant, development of epidemics
Unit-II
➤ Principles of plant disease management: Exclusion, quarantines and certifications, avoidance, eradication, host resistance
Unit-III
➤ Plant disease management: Cultural methods, crop rotation, traps and mulches, sanitation, biological methods, chemical methods, integrated pest management (IPM)
Unit-IV
➤ Management of viral diseases: control of vectors, cross protection, pathogen-derived resistance, induced resistance, genetically engineered resistant plants
Unit-V
➤ Management of fungal/bacterial diseases on Rice, Wheat, Potato, Legumes, Mustard

Suggested Readings:

1. Hadidi A, Khetarpal RK, Koganezawa H (Eds), Plant virus disease control, The American Phytopathological Society, 1998, USA
2. Agrios GN, Plant Pathology, 5th edition, Elsevier
3. Ciancio A, Mukerji, KG (Eds), General Concepts in Integrated Pest and Disease Management, 2010, Springer
4. Sharma RC, Sharma JN, Integrated plant disease management, 2005, Scientific Publishers Journal

Department of Botany
Semester IV
BOT-EL-402B: Gardening and Landscaping
4 Credits/40 Hours

Course Outcomes:

After completion of the Course the student will:

- Develop a keen interest in Gardening and Landscaping, an applied aspect of Botany, and acquire the basic skills and aesthetics needed to create a beautiful and green environment
- Assess the role of plants in the well being of the society and appreciate the joy of interacting with the mother earth

Unit -I
<ul style="list-style-type: none"> ➤ Scope and objectives of gardening, style of gardens: Formal, Informal, Types of gardens: English, Mughal and Japanese. ➤ Components of garden, Planning of outdoor gardens: Small, Residential, Larger Home Garden, Roof Garden, Terrace Garden, Children's garden, School and Institutional Garden, Park, Industrial garden, Housing complex, Indoor gardening
Unit-II
<ul style="list-style-type: none"> ➤ Garden Features and Ornamentation: Water, Garden pool, Stream, Waterfall, Fountain, Rocks, Roads, Walks, Pavements and Steps, Walls fences and Gates, Hedges, Edges, Arches, Pergolas, Screens and Bridges ➤ Lawns, Flower beds, Borders, Carpet bedding, Shrubberies, Plant containers & raised beds, Statues, Towers, Plant stands, Green House, Conservatories, Night-lights
Unit-III
<ul style="list-style-type: none"> ➤ Specialized Gardens: Herb garden, Rose garden, Bog garden, Sunken garden ➤ Topiary garden, Kitchen garden, Paved garden, Dish garden, Rock garden, Terrace garden, Water garden & Bottle garden (Terrarium).
Unit-IV
<ul style="list-style-type: none"> ➤ Principles of landscape design, elements, planning and layout ➤ Plant material for landscaping, symbols and tools
Unit-V
<ul style="list-style-type: none"> ➤ Landscape design for specific areas: residence, commercial buildings, educational institutes and hotels ➤ Computer applications in landscape design

Suggested Readings:

1. Peter McHoy- Garden planning & garden design. (Southwater Publication).
2. Deborah L. Martin- Rodale's basic gardening. (Rodale Books Publication).
3. Brian Capon- Botany for Gardeners. (3rd edition)
4. Harry Tomlinson- A complete book of Bonsai.
5. Elizabeth Barlow Rogers- Landscape Design: A cultural and Architectural History.
6. Chris Young- Encyclopedia of Landscape design. (DK Publication).
7. Anupam Tiwari, Anil K. Singh *et.al*- Computer aided designing for Landscape gardening. Global journal of pharmaceutical research 5(5):386-388.
8. Stephen Erwin and Hope Nasdrouck- Landscape Modelling.

Department of Botany
Semester IV
BOT-IRA-401: Natural Resources and their Conservation
4 Credits/40 Hours

Course Outcomes:

After completion of the Course the student will:

- Develop a basic understanding of the limited natural resources and hence the need for their conservation and sustainable use
- Learn about the various types of soils and methods for reclamation of problem soils
- Gather information on various sources of energy and generation of energy from waste

Unit-I
<ul style="list-style-type: none"> ➤ Atmosphere: Characteristics of troposphere, stratosphere, mesosphere, thermosphere and exosphere. ➤ Lithosphere: Basic concepts ➤ Hydrosphere: Structure and physico-chemical properties ➤ Mineral source management: formation, occurrence, exploitation & conservation
Unit – II
<ul style="list-style-type: none"> ➤ Water resources and their integrated management ➤ Watershed development, rainwater harvesting ➤ Agricultural practices in India. Exploitation of agricultural land ➤ Wasteland development- concept, scope and strategies
Unit – III
<ul style="list-style-type: none"> ➤ Energy: Non-renewable (conventional) sources of energy ➤ Thermal power, hydro-energy, atomic, nuclear energy and fossil fuel ➤ Energy : Renewable (non- conventional) ➤ Biogas and power generation from solid waste conservation
Unit – IV
<ul style="list-style-type: none"> ➤ Soils: Origin and development of soil, soils of India ➤ Soil profile ➤ Physical, chemical and biological properties of soils ➤ Characteristics of problem soils
Unit – V
<ul style="list-style-type: none"> ➤ Conservation of rare and endangered animal species, national parks and wildlife sanctuaries of India. ➤ Soil Conservation ➤ Water conservation strategies in India ➤ Energy conservation and storage

Suggested Readings:

1. Nyle Brady and Ray R. Weil- The nature and properties of Soils.
2. P.D. Sharma- Ecology and Environment. (Rastogi Publication).
3. Shankar- Environment (6th edition).
4. Tushar Ghosh, Prelas *et. al.* Energy Resources and systems. (Springer books).