4 Yr. UG Degree Syllabus

According to NEP2023

(For Colleges affiliated to Kazi Nazrul University, Asansol, West Bengal)

Subject: Environmental Science

Semester- I
Course Name: Environment & Ecology
Course Code: BSCENVSCMJ101

Course	Type	Course Code	Course details	L-T-P	Cr	Full Marks	CA Marks		ESE Marks	
							P	T	P	T
Env Sc.	Major	BSCENVSC MJ101	MJC-1	4-1-0	5	100	00	30	00	70

TIME: 3 HOURS
LECTURES: 70
Total MARKS: 100 (30+70)

Marks: 70

Content: Unit wise course content distribution
Theory

Unit-1 Concept of Environment: Concept and types and components of environment; Objectives, nature and scope of the subject; Man-environment relationships; Environmental awareness – Earth Summits, recent Conventions on climate change (15)

Unit-2 Environmental issues and scales: Concepts of micro-, meso-, synoptic and planetary scales; Temporal and special extents of local, regional, and global phenomenon. (10)

Unit-3 Environmental Education: Goals of environmental education; Environmental education at primary, secondary and tertiary level; Green politics; Models for future environmental education; Environmental movements – The Chipko movement, Silent Valley movement, *Narmada Bachao Andolan*, Tehri Dam Conflict. (15)

Unit-4 Concepts of Ecology: Subdivisions and developmental phases of ecology; Ecological classification (hydrophytes, xerophytes, halophytes, mesophytes, lithophytes, chasmophytes, epiphytes) and their anatomical, morphological and physiological adaptation; Ecological factors - climatic, edaphic, physiographic and biotic; Limiting factor & Shelford's Law. (20)

Unit-5 Geology and Ecology: Geological interaction with environment; Concepts of community and keystone species, and relationship with geology; Role of geology in ecological restoration (10)

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:

1. Understanding and knowledge of the environment, man and environment relationships and the role of human beings in shaping the environment
2. Understand various components of the environment and interfaces
3. Understanding the environmental issues, concerns of today
4. Fundamentals of ecology
5. Fundamentals of geological interaction with environment

References/ Suggested Readings

Odum, E.P. and Barrett, G.W., 1971. Fundamentals of ecology (Vol. 3, p. 5). Philadelphia: Saunders
William P. Cunningham, Mary Ann Cunningham, Barbara Woodworth Saigo, Environmental Science: A global concern, McGrawHill 2003
William Cunningham, Mary Cunningham, Principles of Environmental Science: Seventh Edition, McGrawHill 2014
Energy, Ecology and Environment: Richard Wilson and William Jones (Academic Press, Inc)
Rogers PP, Jalal, KF, Boyd JA, An introduction to sustainable development, Earthscan
Roosa SA, Sustainable Development Handbook, CRC Press 2008
Atkinson G., Dietz S., Neumayer E., Agarwala M, Handbook of Sustainable Development, Edward Elger, 2014
Robbins P., Hintz J., Moore S.A., Environment and Society: A critical introduction, Wiley Blackwel 2014

Minor Paper

Semester- I

Course Name: Environment & Ecology
Course Code: BSCENVSCMN101

Course	Type	Course Code	Course details	L-T-P	Cr	Full Marks	CA Marks		ESE Marks	
							P	T	P	T
Env Sc.	Minor	BSCENVSCMNC	MNC-1	4-1-0	5	100	00	30	00	70

TIME: 3 HOURS
LECTURES: 70
Total MARKS: 100 (30+70)

Content: Unit wise course content distribution
Theory

Unit-1 Concept of Environment: Concept and types and components of environment; Objectives, nature and scope of the subject; Man-environment relationships; Environmental awareness – Earth Summits, recent Conventions on climate change. (15)

Unit-2 Environmental issues and scales: Concepts of micro-, meso-, synoptic and planetary scales; Temporal and special extents of local, regional, and global phenomenon. (10)

Unit-3 Environmental Education: Goals of environmental education; Environmental education at primary, secondary and tertiary level; Green politics; Models for future environmental education; Environmental movements – The Chipko movement, Silent Valley movement, *Narmada Bachao Andolan*, Tehri Dam Conflict. (15)

Unit-4 Concepts of Ecology: Subdivisions and developmental phases of ecology; Ecological classification (hydrophytes, xerophytes, halophytes, mesophytes, lithophytes, chasmophytes, epiphytes) and their anatomical, morphological and physiological adaptation; Ecological factors - climatic, edaphic, physiographic and biotic; Limiting factor & Shelford's Law. (20)

Unit-5 Geology and Ecology: Geological interaction with environment; Concepts of community and keystone species, and relationship with geology; Role of geology in ecological restoration (10)

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:

1. Understanding and knowledge of the environment, man and environment relationships and the role of human beings in shaping the environment
2. Understand various components of the environment and interfaces
3. Understanding the environmental issues, concerns of today
4. Fundamentals of ecology
5. Fundamentals of geological interaction with environment

References/ Suggested Readings

Odum, E.P. and Barrett, G.W., 1971. Fundamentals of ecology (Vol. 3, p. 5). Philadelphia: Saunders
William P. Cunningham, Mary Ann Cunningham, Barbara Woodworth Saigo, Environmental Science: A global concern, McGrawHill 2003
William Cunningham, Mary Cunningham, Principles of Environmental Science: Seventh Edition, McGrawHill 2014
Energy, Ecology and Environment: Richard Wilson and William Jones (Academic Press, Inc)
Rogers PP, Jalal, KF, Boyd JA, An introduction to sustainable development, Earthscan
Roosa SA, Sustainable Development Handbook, CRC Press 2008
Atkinson G., Dietz S., Neumayer E., Agarwala M, Handbook of Sustainable Development, Edward Elger, 2014
Robbins P., Hintz J., Moore S.A., Environment and Society: A critical introduction, Wiley Blackwel 2014

SEMESTER- I
PAPER CODE: BSCENVSCSE101 [ENVSC Skill Enhancement: COURSE NO. 1]
ENVIRONMENTAL MONITORING TECHNIQUES
TOTAL CREDITS: 3

Course	Type	Course Code	Course details	L-T-P	Cr	Full Marks	CA Marks		ESE Marks	
							P	T	P	T
Env Sc.	Skill Enhancement Course	BSCENVSC SE101	SEC-1	2-1-0	3	50	00	15	00	35

TIME: 2 Hours
MARKS: 35

Total Lectures: 30

Air quality Monitoring:
Collection of air sample [High volume sampler, particulate matter (PM2.5, PM10)]; Concept of SPM and RSPM. (05)

Water quality monitoring:
Water quality parameters; Water sampling techniques & measurements and instruments (Titrimetric and Gravimetric methods, Portable pH meter, conductivity meter, Spectrophotometer); Standard curve.

(05)

Soil quality Monitoring:
Classification of texture (International pipette and Hygrometer method); Soil sampling and measurement of different soil parameters [pH meter, conductivity meter, Soil organic carbon (Titrimetric method), Nitrogen (modified Kjeldahl's method), & Flame photometer]. (05)

Biological monitoring:
Biological monitoring: Quantification (Sedgwick Rafter counter) & qualification of freshwater plankton (phyto- & zoo-plankton), aquatic macrophytes of importance); Types of plankton net. (05)

Environmental Statistics:
Types of data: Primary and secondary; Methods of collection of environmental data; Measures of central tendency (Mean, median, mode) and variance of a given environmental data set; Frequency distribution; Measures of dispersion; Correlation and Regression, Hypothesis testing, T-test, Chi-square test (10)

Semester- II
Course Name: Biological Environment
Course Code: BSCENVSCMJ201

Course	Type	Course Code	Course details	L-T-P	Cr	Full Marks	CA Marks		ESE Marks	
							P	T	P	T
Env Sc.	Major	BSCENVSC MJ201	MJC-2	2-1-2	5	100	30	15	20	35

TIME: 2 HOURS
LECTURES: 30

Marks: 35

Content: Unit wise course content distribution
Theory

Unit- 1 Taxonomy: Definition of taxonomy, systematic and classification; Morphological and taxonomical studies of flora and fauna. (05)

Unit -2 Cell and Genetics:

Cell: Ultrastructure and functions of plasma membrane, cellular organelles, *e.g.,* Mitochondria, Ribosome, Golgi body, Chloroplast, Endoplasmic reticulum, Nucleus, Chromosome & Cell divisions Fundamentals of genetics: Mendel's Law of inheritance and gene interaction; Darwinism and Modern Synthetic Theory of evolution; Concept on speciation; Hardy Weinberg Equilibrium; Genetic drift. (10)

Unit- 3 Concepts of Ecosystem and Biomes: Structural and functional aspects of major ecosystems; Ecological pyramids, food chain and food.

Biomes: Concept, characteristics of biome types, *viz.*, Grass lands, Tropical Rain Forests and Tundra. (07)

Unit- 4 Biotic Community: Basic ideas on population and community; Elementary idea on biogeochemical cycles (*viz.*, N, C, S, P). (08)

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:

1. Understand the taxonomic importance and cellular morphology
2. Understand the ecology and biotic community
3. Appreciate physiology of plants and animals, and relation with environment
4. Appreciate the environmental factors, role of biogeochemical cycles
5. Fundamental of biological community

References/ Suggested Readings

Energy and Environment: Edited by J Dunderdale (Royal Society of Chemistry)
Kormondy E.J. , 2017. Concepts of Ecology, Pearson
Dash M. C. and Dash S.P.(2009) Fundamentals of Ecology, Mcgraw Hill
Ricklefs, R.E. and Miller, G.L., 2000. Ecology. W. H. Freeman & Co.
Smith, R.L., Smith, T.M., Hickman, G.C. and Hickman, S.M., 1998. Elements of ecology. Pearson Benjamin Cummings, San Francisco, CA.
Krebs C.J. 2016. Ecology: The experimental Analysis of Distribution and Abundance, Pearson
Chew, S.C., 2006. The recurring dark ages: ecological stress, climate changes, and system transformation. Rowman Altamira
Bharucha, E. 2017.Changing Landscapes, The Cultural Ecology of India. Harper Collins Publishers, India
Gaston K.J. and Spicer (2004) Biodiversity – An Introduction, Blackwell Publishing
Krishnamurthy K. V. (2008) An Advanced Textbook on Biodiversity: principles and Practice, Oxford & IBH Pub. Co. Pvt. Ltd.
Schulze Ernst-Detlef, Mooney Harold (Eds.) (1994) Biodiversity and Ecosystem Function. Springer-Verlag, London.

Practical CA:
Marks: 30
1. Practical: 15
2. Viva voce: 10
3. Practical Notebook: 05

TIME: 3 HOURS (ESE)
MARKS: 20
Description of Experiment:
1. One Major Experiment: 10
2. Identification with reasons: 05
3. Viva-voce: 05
Practical Courses
1. Major Experiments
a. Cytological preparation of mitotic stages from onion root tips (*Allium cepa*)
b. Cytological preparation of meiotic stages from *Rheo* sp. flower buds
2. Identification with reasons (at least one from each A & B must be set during examination)
Study on Aquatic organisms (Fauna and Flora)
i) Study on *Brachionus, Keratella, Cyclops, Cypris, Diaptomus,* Nauplius larva, *Bosmina, Moina*
ii) Study of *Spirogyra, Zygnema, Pistia, Eichhornia, Hydrilla, Ceratophyllum, Ipomoea, Azolla, Lemna* (minor and major), *Marselia, Nymphae, Nelumbo*
3. Viva-voce

Minor Paper

Semester- II
Course Name: Biological Environment
Course Code: BSCENVSCMN201

Course	Type	Course Code	Course details	L-T-P	Cr	Full Marks	CA Marks		ESE Marks	
							P	T	P	T
Env Sc.	Minor	BSCENVSCMN201	MNC-2	2-1-2	5	100	30	15	20	35

TIME: 2 HOURS
LECTURES: 30

Content: Unit wise course content distribution
Theory
Unit- 1 Taxonomy: Definition of taxonomy, systematic and classification; Morphological and taxonomical studies of flora and fauna. (05)
Unit -2 Cell and Genetics:
Cell: Ultrastructure and functions of plasma membrane, cellular organelles, *e.g.*, Mitochondria, Ribosome, Golgi body, Chloroplast, Endoplasmic reticulum, Nucleus, Chromosome & Cell divisions Fundamentals of genetics: Mendel's Law of inheritance and gene interaction; Darwinism and Modern Synthetic Theory of evolution; Concept on speciation; Hardy Weinberg Equilibrium; Genetic drift. (10)
Unit- 3 Concepts of Ecosystem and Biomes: Structural and functional aspects of major ecosystems; Ecological pyramids, food chain and food.
Biomes: Concept, characteristics of biome types, *viz*., Grass lands, Tropical Rain Forests and Tundra. (07)
Unit- 4 Biotic Community: Basic ideas on population and community; Elementary idea on biogeochemical cycles (*viz.*, N, C, S, P). (08)

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Understand the taxonomic importance and cellular morphology
2. Understand the ecology and biotic community
3. Appreciate physiology of plants and animals, and relation with environment
4. Appreciate the environmental factors, role of biogeochemical cycles
5. Fundamental of biological community

References/ Suggested Readings
Energy and Environment: Edited by J Dunderdale (Royal Society of Chemistry)
Kormondy E.J. , 2017. Concepts of Ecology, Pearson
Dash M. C. and Dash S.P.(2009) Fundamentals of Ecology, Mcgraw Hill
Ricklefs, R.E. and Miller, G.L., 2000. Ecology. W. H. Freeman & Co.
Smith, R.L., Smith, T.M., Hickman, G.C. and Hickman, S.M., 1998. Elements of ecology. Pearson Benjamin Cummings, San Francisco, CA.
Krebs C.J. 2016. Ecology: The experimental Analysis of Distribution and Abundance, Pearson
Chew, S.C., 2006. The recurring dark ages: ecological stress, climate changes, and system transformation. Rowman Altamira
Bharucha, E. 2017.Changing Landscapes, The Cultural Ecology of India. Harper Collins Publishers, India
Gaston K.J. and Spicer (2004) Biodiversity – An Introduction, Blackwell Publishing
Krishnamurthy K. V. (2008) An Advanced Textbook on Biodiversity: principles and Practice, Oxford & IBH Pub. Co. Pvt. Ltd.
Schulze Ernst-Detlef, Mooney Harold (Eds.) (1994) Biodiversity and Ecosystem Function. Springer-Verlag, London.

Practical CA:
Marks: 30
1. Practical: 15
2. Viva voce: 10
3. Practical Notebook: 05

TIME: 3 HOURS (ESE)
MARKS: 20
Description of Experiment:
1. One Major Experiment: 10
2. Identification with reasons: 05
3. Viva-voce: 05
Practical Courses
1. Major Experiments
a. Cytological preparation of mitotic stages from onion root tips (*Allium cepa*)
b. Cytological preparation of meiotic stages from *Rheo* sp. flower buds
2. Identification with reasons (at least one from each A & B must be set during examination)
Study on Aquatic organisms (Fauna and Flora)
i) Study on *Brachionus, Keratella, Cyclops, Cypris, Diaptomus,* Nauplius larva, *Bosmina, Moina*
ii) Study of *Spirogyra, Zygnema, Pistia, Eichhornia, Hydrilla, Ceratophyllum, Ipomoea, Azolla, Lemna* (minor and major), *Marselia, Nymphae, Nelumbo*
3. Viva-voce

SEMESTER- II
PAPER CODE: BSCENVSCSE201 [ENVSC Skill Enhancement Course: COURSE NO. 2]
HUMAN HEALTH AND CONSERVATION & ECOTOURISM
TOTAL CREDITS: 3

Course	Type	Course Code	Course details	L-T-P	Cr	Full Marks	CA Marks		ESE Marks	
							P	T	P	T
Env Sc.	Skill Enhancement Course	BSCENVSCSE201	SEC-2	2-1-0	3	50	00	15	00	35

TIME: 2 Hours
MARKS: 35

Total Lectures: 30

Human Health:
Concept of health and disease; Principles of epidemiology and epidemiological methods; Health Programs in India; Nutrition and health; Health education. (05)

Diseases:
Concept on air, water, vector borne diseases; some communicable diseases (Viral hepatitis, dengue); non-communicable diseases (cardiovascular, diabetes); Immunology - elementary ideas about antigens and antibody; Immunodeficiency diseases (10)

Conservation:
Concept of Wildlife Conservation - Reserves design, survey techniques of tiger, birds, elephants and insect; Major conservation policies: *in-situ* and *ex-situ* approaches; Major protected areas; National and International instruments for biodiversity conservation; Role of traditional knowledge; Community based conservation; Gender and conservation; Concept of Zoo management (08)

Ecotourism:
Tourism and Leisure; Types of Tourism; Ecotourism – Growth and developments, Impact and management of ecotourism; Home stay tourism; Elementary idea of Rural tourism; Role of ecotourism for addressing Sustainable Development Goals (SDGs) (07)

SEMESTER- II
VALUE ADDED COURSE
PAPER CODE: VAC-201
ENVIRONMENTAL STUDIES
TOTAL CREDITS: 4
[3:1:0:: 35:15:00]

Course	Type	Course Code	Course details	L-T-P	Cr	Full Marks	CA Marks		ESE Marks	
							P	T	P	T
Env Sc.	Value Added Course	VAC-201	VAC	2-1-0	3	50	00	15	00	35

TIME: 2 Hours **MARKS: 50**
Total Lectures: 30

Unit 1: Basics of Environmental Studies: (02)
Definition; Components of environment: Environmental education

Unit 2: Natural Resources: Renewable and Nonrenewable Resources (08)
Nature and natural resources their conservation and associated problems:

- Forest resources: Uses, types and importance, Joint Forest Management
- Water resources: Use, over exploitation of surface and groundwater; Dams: Benefits and problems; Flood and Drought
- Mineral resources: Mineral resources in India; Use and exploitation.
- Food resources: World food problems and food insecurities
- Energy resources: Renewable and Nonrenewable energy sources; Use of alternate energy sources
- Land resources: Land as a resource; Land degradation, landslides, soil erosion, desertification.

Unit 3: Ecology and Ecosystems (05)
Concept of ecology, Population ecology, Community ecology

- Concept of an ecosystem, different types of ecosystems.
- Food chains, food webs
- Energy flow in the ecosystem

Unit 4: Biodiversity and its conservation (05)
Biodiversity: Levels of biological diversity

- Values of biodiversity
- Hot-Spots of biodiversity, Mega-biodiversity countries
- Threat to biodiversity
- Conservation of biodiversity (*In- situ* and *Ex-situ)*

Unit 5: Environmental Pollution and Management (05)
(a) Nature, Causes, Effects and Control measures of – Air pollution, Water pollution, Soil pollution, Noise pollution, Vision pollution
(b) Solid waste management: Causes, effects and disposal methods; Management of wastes

Unit 6: Environmental Policies and Practices (05)
Constitutional Provisions for protecting environment- Article 48(A), 51A(g)

- Environmental Laws: The Environment (Protection) Act, 1986; The Air (Prevention and Control of Pollution) Act, 1981; The Water (Prevention and Control of Pollution) Act 1974
- Climate change, Global warming and Protocols, Acid rain

CA: Field Work Report/Project Report/Plantation Program/Preparation of plant sapling Marks: 15 (10+5) [Report+ *Viva voce*]
[Based on any one of the following topics and to be evaluated by internal teachers only)

- Environmental assets - River/Forest/Grassland/Hill/Mountain *etc*.
- Environmental pollution - Urban/Rural/Industrial/Agricultural
- Study of common Plants/Insect /Birds/Wildlife *etc*.

- Study of simple ecosystems: Pond/River/Hill slope *etc*.
- Participation & Report preparation on Medicinal Plants

Semester- III
Course Name: Physical Environment
Course Code: BSCENVMJ301

Course Type: **MJC-3 (Theoretical)**	Course Details:			L-T-P: **3-0-4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:

1. Understanding the composition and vertical structure of atmosphere
2. Understanding of the clear distinction between adiabatic lapse rate and the environmental lapse rate and be able to work out temperatures at higher altitudes based on the lapse rate
3. Understand the impact of aerosols on climate through processes of scattering and absorption of radiations
4. Knowledge on types of clouds and their structure, geostrophic winds and cyclones
5. Understand the impact of human activity on the energy balance in the earth atmospheric system

Content: Unit wise course content distribution
Theory

Unit- 1 Forces of nature, states of matter-solid, liquid and gas. Structure of earth, origin and composition of atmosphere, atmospheric mass, gaseous constituents, trace gases, vertical profile of atmosphere, scale height, lapse rates-adiabatic and environmental, mixing height, atmospheric stability classes (10)

Unit- 2 Atmospheric aerosols, types and examples, inorganic and organic aerosols, mass transfer, diffusion and transport, particle impaction, sedimentation velocity, relaxation time, stopping distance (08)

Unit- 3 Transfer of heat, conduction, convection, radiative transfer, radiation laws, solar and terrestrial radiations, Stefan Boltzmann law, Wien's law and Planck's law, irradiance, absorption, transmission, reflection, emission and scattering of radiations, Rayleigh and Mie scattering, diffraction (15)

Unit- 4 Atmospheric dynamics, steady and non-steady motion, Geostrophic winds, cyclones, hurricanes and thunderstorms (07)

Unit-5 Dynamic Meteorology: First and second law of thermodynamics, entropy, enthalpy, heat transfer processes; Diffusion and transport of pollutants (10)

Semester- III
Course Name: Physical Environment
Course Code: BSCENVMJ301

Course Type: **MJC-4 (Practical)**	Course Details:			L-T-P:	
Credit:	Full Marks 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	-	**20**	-

Description of Experiment:
1. One Major Experiment: 10
2. Laboratory Notebook: 05
3. Viva-voce: 04

Practical Courses
1. a. Determination of the Value of Stefan's constant; Verification of Stefan's law.
b. Variation of thermo-emf across two junctions of a thermocouple with temperature
c. Verification of Clasius – Clapeyron equation and determination of specific enthalpy
d. To record and analyze the cooling temperature of a hot object as a function of time using a thermocouple and suitable data acquisition system.
e. Construction of wind rose
f. Handling of meteorological data recording equipments; wind speed & direction; relative humidity & temperature
2. Laboratory Notebook containing all practical experiments, Identifications
3. ***Viva-voce***

Semester- III
Course Name: Environmental Chemistry
Course Code: BSCENVMJ302

Course Type: **MJC-4 (Theoretical)**	Course Details:			L-T-P: **3-0-4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Comprehensive understanding of the concept of atom, electronic configuration, periodic properties and bonding
2. Knowledge of the fundamental of thermodynamics, chemical equilibrium and chemical kinetics and a comprehensive understanding of the chemistry of water, air and soil, and influence of human activities pose to alter the chemistry
3. Comprehensive understanding the acid-base concepts, neutralization, and buffer and buffer capacity
4. Functional knowledge on the application on controlling toxic chemicals in the environment, including POPs and emerging pollutants

Content: Unit wise course content distribution
Theory
Unit- 1 Fundamental concepts of general chemistry: Atomic structure, electronic configuration; Molecular weight, equivalent weight, molarity, normality, valency, oxidation state and bonding, oxidation and reduction reactions; Metals and nonmetals; Aromatic and aliphatic organic compounds; Saturated and unsaturated hydrocarbons; Free radicals; Catalytic (15)
Unit- 2 Fundamentals of biochemistry: Elementary ideas on carbohydrates, proteins, lipids and enzymes; Idea on structure of macro-molecules--DNA and RNA, and Chlorophyll; Synthesis of xenobiotic compounds like pesticides, dyes, etc (10)
Unit- 3 Chemical equilibrium and kinetics (Fundamentals): Stoichiometry, chemical equilibrium, chemical potential; Acid-base reactions (acidity, alkalinity, buffers and buffer capacity (10)
Unit- 4 Aquatic chemistry: Principles of sedimentation, coagulation, precipitation; Concept of solubility product; Filtration and adsorption (05)
Unit-5 Atmospheric chemistry: Composition and structure of the atmosphere; Chemistry and sources of atmospheric gases, aerosols, SPM; Photochemical reactions in the atmosphere (photochemical smog (10)

Semester- III
Course Name: Environmental Chemistry
Course Code: BSCENVMJ302
[PRACTICAL]

Course Type: **MJC-4 (Practical)**	Course Details:			L-T-P:	
Credit:	Full Marks 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	-	**20**	-

Description of Experiment:
1. One Major Experiment: 10
2. Laboratory Notebook: 05
3. Viva-voce: 04

Practical Courses
1. a. Estimation of protein, sugar from plant tissues, and acidity, alkalinity of water
b. Estimation of chlorophyll from green leaves
2. Laboratory Notebook containing all practical experiments, Identifications
3. Viva-voce

Minor Paper

Semester- III
Course Name: Environmental Chemistry
Course Code: BSCENVMN302

Course Type: **MNC-4 (Theoretical)**	Course Details:			L-T-P: **3-0-4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Comprehensive understanding of the concept of atom, electronic configuration, periodic properties and bonding
2. Knowledge of the fundamental of thermodynamics, chemical equilibrium and chemical kinetics and a comprehensive understanding of the chemistry of water, air and soil, and influence of human activities pose to alter the chemistry
3. Comprehensive understanding the acid-base concepts, neutralization, and buffer and buffer capacity
4. Functional knowledge on the application on controlling toxic chemicals in the environment, including POPs and emerging pollutants

Content: Unit wise course content distribution
Theory
Unit- 1 Fundamental concepts of general chemistry: Atomic structure, electronic configuration; Molecular weight, equivalent weight, molarity, normality, valency, oxidation state and bonding, oxidation and reduction reactions; Metals and nonmetals; Aromatic and aliphatic organic compounds; Saturated and unsaturated hydrocarbons; Free radicals; Catalytic (15)
Unit- 2 Fundamentals of biochemistry: Elementary ideas on carbohydrates, proteins, lipids and enzymes; Idea on structure of macro-molecules--DNA and RNA, and Chlorophyll; Synthesis of xenobiotic compounds like pesticides, dyes, etc (10)
Unit- 3 Chemical equilibrium and kinetics (Fundamentals): Stoichiometry, chemical equilibrium, chemical potential; Acid-base reactions (acidity, alkalinity, buffers and buffer capacity (10)
Unit- 4 Aquatic chemistry: Principles of sedimentation, coagulation, precipitation; Concept of solubility product; Filtration and adsorption (05)
Unit-5 Atmospheric chemistry: Composition and structure of the atmosphere; Chemistry and sources of atmospheric gases, aerosols, SPM; Photochemical reactions in the atmosphere (photochemical smog. (10)

Semester- IV
Course Name: Natural Resources & Sustainable Development
Course Code: BSCENVMJ401

Course Type: **MJC-5 (Theoretical)**	Course Details:			L-T-P: **3-0-4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Understanding the natural resource use and management
2. Understand the complexity of natural resource and issues, and sustainability
3. Knowledge of sustainable development
4. Understand the significance/importance of use of renewable and non-renewable resources and their environmental consequences

Content: Unit wise course content distribution
Theory

Unit- 1 Natural resources: Current status of Water, Land, Forest, Minerals resources (05)

Unit- 2 Energy resources: Classification, conventional, non-conventional, renewable, non-renewable; Renewable resources: Solar energy (PV cells, PG cells); Geothermal energy (origin, utilization); Ocean energy; Biomass energy; Hydroelectricity (12)

Unit- 3 Fossil fuels: Coal (composition, origin and classification); Petroleum (origin, mining, chemical composition, classification); Natural gas (concept on LNG, CNG, LPG); Oil (origin, utilization) (08)

Unit- 4 Biological wealth: Value of wild species; Sources of agriculture, forestry, aquaculture; Biodiversity – Concept, value; Decline and reasons of consequences of losing biodiversity; Mega-diversity Hotspots, hotspots of biodiversity, Red Data Book; Conservation of biodiversity (International & National) (15)

Unit-5 Sustainable development: Definition and concept; The Brundtland commission and later developments; Determinants of sustainable development; Indicators of sustainable development; International cooperation; Sustainable development goals, Millennium development goals; Role of ESD (Education for Sustainable Development) (10)

Semester- IV
Course Name: Natural Resources & Sustainable Development
Course Code: BSCENVMJ401
[PRACTICAL]

Course Type: **MJC-5 (Practical)**	Course Details:			L-T-P:	
Credit:	Full Marks 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	-	**20**	-

TIME: 3 HOURS
MARKS: 20
Description of Experiment:

1. One Major Experiment: 08
2. Biodiversity registers: 04
3. Laboratory Notebook: 03
4. Viva-voce: 05

Practical Courses
1. Major Experiments
a. Quantitative characters of plant community, density, frequency, dominance
2. Preparation of biodiversity registers
a. Study on local flora and fauna (report)
b. Biodiversity of locality
3. Laboratory Notebook containing all practical experiments
4. Viva-voce

Semester- IV
Course Name: Biodiversity & Conservation
Course Code: BSCENVMJ402

Course Type: **MJC-6 (Theoretical)**	Course Details:			L-T-P: **3-0-4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Systematically understand the biodiversity and its vital role in ecosystem function
2. Knowledge on the need of biodiversity conservation in the context of various developmental pathways and policy framework that the mankind has been undergoing
3. Understand the importance of biodiversity in natural environments
4. Critical understanding on biodiversity and human linkages
5. Understand the importance of species conservation and knowledge on extinction

Content: Unit wise course content distribution
Theory
Unit- 1 Concept and definition; Levels of organization; Dimension of biodiversity, Global biodiversity gradient; List of common flora and fauna of India; Endangered and endemic species, extinction and evolution of species (05)
Unit- 2 Values of Biodiversity and ecosystem services: Importance of biodiversity, Direct and indirect used value (03)
Unit- 3 Biodiversity threats, conservation approaches and management: Decline of biodiversity-causes and consequences, Direct and indirect threats; Reason of conservation and conservation approaches, and threats of invasive species (05)
Unit- 4 National Parks, Wildlife Sanctuary, Conservation reserves, Community Reserves, Protected areas; Conservation and management practices, *In situ* and *ex situ* strategy, Advantages, risks and opportunities; Traditional knowledge on conserved areas in India: Sacred Groves, Rivers, Mountains etc. (12)
Unit-5 Biodiversity and climate changes: Impacts of climate change on biodiversity, Climate change and threats to species and ecosystems; Distribution and adaptation pattern of plants and animals; Vulnerability to climate change; Migration/shifting toward higher latitudes (12)
Unit-6 Biodiversity conservation: Legal aspects: Legal Instruments Relevant to Biological Diversity in India, Endangered Species Act, Federal Role in Wildlife Preservation (03)
Unit-7 Major International Conventions: Convention on Biological Diversity, Convention on Migratory Species, Convention on International Trade in Endangered Species of Wild Fauna and Flora, Ramsar Convention, World Heritage Convention (10)

Semester- IV
Course Name: Biodiversity & Conservation
Course Code: BSCENVMJ402
[PRACTICAL]

Course Type: **MJC-6 (Practical)**	Course Details:			L-T-P:	
Credit:	Full Marks 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	-	**20**	-

TIME: 3 HOURS
MARKS: 20

Description of Experiment:
1. One Major Experiment: 10
2. Laboratory Notebook: 05
3. Viva-voce: 05

Practical Courses
Introduction: Orientation towards field biology and natural history; Study of campus flora and fauna; Types of sampling- quantitative and qualitative for flora/fauna; Study of nearby forests and grasslands; study of habitat specificity in birds or small mammals on campus; Current tools in the wildlife management

1. Major Experiments
Estimation of frequency, density, abundance of species (Nested quadrate analysis and plotless vegetation mapping); Line transect, and belt transect method of community study; Comparison of litter-fall (for at least 2-3 plant species)

2. Laboratory notebook containing all practical experiments
3. Viva-voce

Minor Paper

Semester- IV
Course Name: Natural Resources & Sustainable Development
Course Code: BSCENVMN401

Course Type: **MNC-5 (Theoretical)**	Course Details:			L-T-P: **3-0-4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Understanding the natural resource use and management
2. Understand the complexity of natural resource and issues, and sustainability
3. Knowledge of sustainable development
4. Understand the significance/importance of use of renewable and non-renewable resources and their environmental consequences
Content: Unit wise course content distribution
Theory
Unit- 1 Natural resources: Current status of Water, Land, Forest, Minerals resources (05)
Unit- 2 Energy resources: Classification, conventional, non-conventional, renewable, non-renewable; Renewable resources: Solar energy (PV cells, PG cells); Geothermal energy (origin, utilization); Ocean energy; Biomass energy; Hydroelectricity (12)
Unit- 3 Fossil fuels: Coal (composition, origin and classification); Petroleum (origin, mining, chemical composition, classification); Natural gas (concept on LNG, CNG, LPG); Oil (origin, utilization) (08)
Unit- 4 Biological wealth: Value of wild species; Sources of agriculture, forestry, aquaculture; Biodiversity – Concept, value; Decline and reasons of consequences of losing biodiversity; Mega-diversity Hotspots, hotspots of biodiversity, Red Data Book; Conservation of biodiversity (International & National) (15)
Unit-5 Sustainable development: Definition and concept; The Brundtland commission and later developments; Determinants of sustainable development; Indicators of sustainable development; International cooperation; Sustainable development goals, Millennium development goals; Role of ESD (Education for Sustainable Development) (10)

Semester- IV
Course Name: Wildlife Ecology & Tourism
Course Code: BSCENVSE401

Course Type: **SEC-3 (Theoretical)**	Course Details:			L-T-P: **2-1-0**	
Credit: **3**	Full Marks: **50**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
			15		**35**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Systematically understand the ecological habitat of wildlife and its role in ecosystem function
2. Knowledge on the need of wildlife study and its different aspects of developmental and policy framework for protection
3. Understand the importance of tourism in natural environments
4. Critical understanding on wildlife vs tourism and its linkages
5. Understand the importance of wildlife conservation and knowledge on extinction

Contents

Unit 1: **Wildlife Ecology & Management**

Concept, scope and importance of wildlife; Wildlife values; Concept and importance of population in wildlife studies; Animal-habitat interactions; Effects of intra- and inter-specific competition on wildlife; Prey-predator relationship; Animal movement, concept of home range and territory (10)

Unit 2: **Wildlife Management**

Concept and importance of wildlife management; Construction and importance of lifetables in wildlife management; Habitat manipulation: food, water, shade improvement; Making observations and records: field notes, datasheets; Wildlife photography: types of camera, camera traps; Field equipment: altimeter, pedometer, field compass, binoculars, radio collaring (15)

Unit 3: **Wildlife tourism**

Basic concepts, importance and scope; Sustainable development in wildlife tourism; Negative impact of wildlife tourism: Disruption of breeding behaviour, disruption of parent- offspring bonds, increased mortality, vanity hunts and poaching, increased vulnerability, disruption feeding behaviour; Positive impacts: Habitat restoration by eco-lodges and other tourism operations, conservation breeding, quality interpretation, culling and population maintenance, conservation hunting/harvest, anti-poaching practices and tools (15)

Unit 4: **Ecotourism practices**

Evolution and concept; importance and types of ecotourism; Components and principles of ecotourism; Impacts of ecotourism; Ecotourism criteria; Ecotourists: types and code of ethics; Quebec Declaration on Ecotourism. Ecotourism practices; Community based tourism; Transportation, facilities, service; Examples and case studies of ecotourism in practice (10)

Semester- V
Course Name: RS & GIS and Environmental Modelling
Course Code: BSCENVMJ501

Course Type: **MJC-7 (Theoretical)**	Course Details:			L-T-P: **3-0-4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Understanding Remote Sensing and Geographic Information System (RS-GIS) as a powerful tool for geospatial analysis
2. Understating of cartography, digital image, spatial and non-spatial data and geospatial terminology.
3. Knowledge about data and sources (RS based and other sources, field data collection) and integrate those into GIS environment for analysis
4. Understanding application of RS-GIS techniques to Resource management
5. Skill development skills with functional knowledge of the fundamentals to carry out GIS (RS-GIS) based project

Content: Unit wise course content distribution
Theory
Unit-1 Remote Sensing: Definitions and Principles, properties; Electromagnetic radiation and its interaction with atmosphere; Spectral reflectance of Earth's surface features; Types and characteristics of different data acquisition platforms; Satellite geometry, sensors and resolutions; aerial photography and image interpretation; Data products and their characteristics; Basic principle of visual interpretation; Latest Indian operating satellites and their utilities; Advantages and limitations of remote sensing (20)

Unit- 2 GIS: Definitions and components; spatial and non- spatial data; raster and vector data; database generation; database management system; land use/ land cover mapping; overview of GIS software packages; GPS survey, data import, processing, and mapping (15)

Unit- 3 Applications and case studies of remote sensing and GIS in geosciences, water resource management, land use planning, forest resources, agriculture, marine and atmospheric studies (05)

Unit- 4 Monitoring: General monitoring techniques and methodology; Standards of ambient air, drinking water quality; Monitoring of air, water, soil, and noise pollution (10)

Semester- V
Course Name: RS & GIS and Environmental Modelling
Course Code: BSCENVMJ501

[PRACTICAL]

Course Type: **MJC-6 (Practical)**	Course Details:			L-T-P:	
Credit:	Full Marks 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	-	**20**	-

TIME: 3 HOURS
MARKS: 20

Description of Experiment:
1. One Major Experiment: 10
2. Laboratory Notebook: 05
3. Viva-voce: 05

Practical Courses

i) Georeferencing and mosaicking of images/toposheets

ii) Digital image processing: Image enhancement techniques; histogram equalization techniques; FCC, NDVI; classification of image; Interpretation of Satellite Imagery: Stereoscopic study and visual interpretations of satellite imagery and airborne image; image subset and export; cartographic representation

Semester- V
Course Name: Water Resources
Course Code: BSCENVMJ502

Course Type: **MJC-8 (Theoretical)**	Course Details:			L-T-P: **3-0-4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Knowledge of water sources and processes involved
2. Knowledge on the design parameters of a water resources system using elementary methods
3. Understand the water resource management systems interaction and significance with respect to the environment
4. Application of knowledge on water resource technology
Content: Unit wise course content distribution
Theory
Unit-1 Water Availability around the globe: Forms of water available in earth, Surface, ground and atmospheric water, Salt water and freshwater (07)
Unit- 2 Hydrologic Cycle and Processes: Precipitation – types and forms, Infiltration, Evaporation, Interception, Runoff. Global atmospheric and oceanic circulation and their impact on weather and climate (10)
Unit- 3 Measurement techniques: Use of Rain-gauges, RADAR and satellites for rainfall measurement, Hyetograph and Mass curve of rainfall, Isohyet maps, Mean precipitation over an area, Measurement of Evaporation, Infiltration and River flow (10)
Unit- 4 Ground Water Hydrology: Aquifers and its types, Flow of groundwater in aquifers, Surface and Groundwater interaction (05)
Unit- 5 Statistical Analysis of Hydrological Processes: Frequency and Return period of hydrologic variables, Probability Analysis, Depth-Area-Duration-Frequency relationship of Rainfall (05)
Unit- 6 Water Resources Engineering: Types of Water Resource Projects, Objectives and principles, Irrigation and water supply, Power Generation, Flood Control, Navigation, Recreation, Reservoir projects and their components, Dams, Types of dams, Diversion headworks, Components and their functions, Run of river projects, Multipurpose projects, Advantage and disadvantages of water resource projects (10)
Unit- 7 Water scarcity, Water sensitization and management (03)

Semester- V
Course Name: Water Resources
Course Code: BSCENVMJ502
[PRACTICAL]

Course Type: **MJC-8 (Practical)**	Course Details:			L-T-P:	
Credit:	Full Marks **50**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	-	**20**	-

TIME: 3 HOURS
MARKS: 20

Description of Experiment:
1.One major experiment- 10
2 .Laboratory notebook- 05
3. Viva-voce- 05

Practical Courses
1. Major Experiments
Measurement of rainfall, mean precipitation, humidity & temperature, river velocity (Floating method)
2. Preparation of Report
Field visit: Visit to dams, river projects, multipurpose projects - advantage and disadvantages of water resource projects

Semester- V
Course Name: Environment & Society
Course Code: BSCENVMJ503

Course Type: **MJC-9 (Theoretical)**	Course Details:			L-T-P: **3-0-4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Understand the human surrounding and the role of human being in shaping the surrounding
2. Understand the need to address the current environmental issues
3. Knowledge on environmental movements, environmental legislations
4. Knowledge on forest and environment, agriculture and environment, and institutional initiatives in the field of environment
5. Knowledge on the role of Indian traditions and culture in environment and its priorities

Content: Unit wise course content distribution
Theory
Unit-1 Human beings and environment: Competition within, environmental degradation, conservation; Current environmental issues – Pollution, trans-boundary issues, biodiversity loss, climate change, urbanization, land degradation; Environmental issues of urban areas (10)
Unit- 2 Role of the society – Interest groups, awareness and conservation, rights and duties; Constitutional provisions – Article 48A and Article 51A(g); Environmental legislations, green benches, international cooperation, Indian commitments (10)
Unit- 3 Economy of the environment, environmental good, natural resources, resource use and depletion; Common property resources, the tragedy of commons, sustainable development (08)
Unit- 4 Issues with Indian agriculture – Modern vs. organic agriculture; Crop biodiversity *vs.* monoculture; energy and water availability, agro-marketing, farmers wellbeing and subsistence; The Panchayati raj, participatory development, institutional initiatives for resource development, sanitation and hygiene, social forestry, joint forest management (12)
Unit-5 Environmental issues of Indian villages, biomass mass burning, exposure risk and gender; water availability, water and gender; migration Indian traditions and conservation; Indian environmental priorities (10)

Semester- V
Course Name: Environment & Society
Course Code: BSCENVMJ503
[PRACTICAL]

Course Type: **MJC-9 (Practical)**	Course Details:			L-T-P:	
Credit:	Full Marks 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	-	**20**	-

TIME: 3 HOURS
MARKS: 20

Description of Experiment:
1. One survey report- 15
2. Viva-voce- 05

Practical Courses
1. Preparation of survey report
Preparation of survey report on any one of the following:
a. Visit to rural village to study on agricultural practices, crop pattern and economic benefits
b. Study on biomass mass burning and its consequences
c. Study on water withdrawal for agricultural crop production and ecological footprint

Minor Paper

Semester- V
Course Name: Environment & Society
Course Code: BSCENVMN503

Course Type: **MNC-9 (Theoretical)**	Course Details:			L-T-P: **3-0-4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Understand the human surrounding and the role of human being in shaping the surrounding
2. Understand the need to address the current environmental issues
3. Knowledge on environmental movements, environmental legislations
4. Knowledge on forest and environment, agriculture and environment, and institutional initiatives in the field of environment
5. Knowledge on the role of Indian traditions and culture in environment and its priorities

Content: Unit wise course content distribution
Theory
Unit-1 Human beings and environment: Competition within, environmental degradation, conservation; Current environmental issues – Pollution, trans-boundary issues, biodiversity loss, climate change, urbanization, land degradation; Environmental issues of urban areas (10)
Unit- 2 Role of the society – Interest groups, awareness and conservation, rights and duties; Constitutional provisions – Article 48A and Article 51A(g); Environmental legislations, green benches, international cooperation, Indian commitments (10)
Unit- 3 Economy of the environment, environmental good, natural resources, resource use and depletion; Common property resources, the tragedy of commons, sustainable development (08)
Unit- 4 Issues with Indian agriculture – Modern vs. organic agriculture; Crop biodiversity *vs.* monoculture; energy and water availability, agro-marketing, farmers wellbeing and subsistence; The Panchayati raj, participatory development, institutional initiatives for resource development, sanitation and hygiene, social forestry, joint forest management (12)
Unit-5 Environmental issues of Indian villages, biomass mass burning, exposure risk and gender; water availability, water and gender; migration Indian traditions and conservation; Indian environmental priorities (10)

Semester- VI
Course Name: Basics of Environmental Statistics & Computer Application
Course Code: BSCENVMJ601

Course Type: **MJC-10 (Theoretical)**	Course Details:			L-T-P: **3-0-4**	
Credit**: 5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Knowledge of basic statistical parameters
2. Understand the statistical estimation through R Statistical software
3. Knowledge on data processing and visual presentation using R statistical software
4. Understand the basics of computer

Content: Unit wise course content distribution
Theory
Unit-1 Concept of statistics, population, types of data, data management and Frequency (05)

Unit- 2 Sampling, sampling area, sampling unit, types of sampling, advantages of sampling; Graphical representation of statistical data (15)

Unit- 3 Measurement: Mean, Median, Mode; Mean deviation, Standard deviation, Skewness, Kurtosis, Correlation and Regression; Standard error, parametric and non-parametric tests; curve fitting; Ordination; testing of hypothesis, Null and alternate hypothesis, t – test, chi – square test (15)

Unit- 4 Basic elements of statistical analyses: Probability distribution – normal, binomial, poisson (10)

Unit- 5 Introduction of Computer programs (Microsoft Word, Power point presentation, EXCEL, etc.) (05)

Semester- VI
Course Name: Basics of Environmental Statistics & Computer Application
Course Code: BSCENVMJ601
[PRACTICAL]

Course Type: **MJC-9 (Practical)**	Course Details:			L-T-P:	
Credit:	Full Marks 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	-	**20**	-

TIME: 3 HOURS
MARKS: 20

Description of Experiment:
1. Major experiment- 15
2. Viva-voce- 05

Practical Courses
1. Contents: Lay out of experimental design (RBD; Split-plot etc.); Cluster analysis; sampling techniques and statistical analysis of experimental design
2. Graphical presentation of statistical data; measurement of standard deviation & standard error; t-test, chi-square test, one-way ANOVA, correlation and regression

Semester- VI
Course Name: Solid Waste Management
Course Code: BSCENVMJ602

Course Type: **MJC-11 (Theoretical)**	Course Details:			L-T-P: **3-0-4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Understand the characteristic of wastes and sources of generation, and processes of waste management
2. Understand the pollution potentials of solid wastes
3. Knowledge on solid waste management practices through a cradle-to-grave approach
4. Understanding on generation of recourses from wastes

Content: Unit wise course content distribution
Theory
Unit-1 Definitions, sources, composition; Physico-chemical characterization; and generation of - municipal solid wastes (MSW); biomedical wastes; e-waste; and hazardous wastes at national and global scale (10)
Unit- 2 Effect of Solid Waste Disposal on Environment: Effect of solid waste and industrial effluent discharge on water quality and aquatic life; Mining waste and land degradation; Effect of land fill leachate on soil characteristics and groundwater pollution (10)
Unit- 3 Solid Waste Management: Different techniques used in collection, storage, transportation and disposal of solid waste (municipal, hazardous and biomedical waste); Landfill (traditional and sanitary landfill design); Thermal treatment (pyrolysis and incineration) of waste material (15)
Unit- 4 Concept of Integrated waste management; Methods and importance of Integrated waste management (05)
Unit- 5 Scientific Management**:** Principles of solid management; UN conventions (e.g., Basel Convention); Collection & transportation measures; Segregation techniques (05)
Unit- 6 Environmental regulations**:** Eco-mark & ISO 14000; symbols & color codes; Solid Waste Management Rules, 2016; Plastic Waste Management Rules 2016 (05)

Semester- VI
Course Name: Solid Waste Management
Course Code: BSCENVMJ602
[PRACTICAL]

Course Type: **MJC-11 (Practical)**	Course Details:			L-T-P:	
Credit:	Full Marks 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	-	**20**	-

TIME: 3 HOURS
MARKS: 20

Description of Experiment:
1.One major experiment- 08
2. Identification with reasons- 04
3 .Laboratory notebook- 03
4. Viva-voce- 05

Practical Courses
1. Major Experiments
Proximate analysis; Density & Porosity; pH; Organic C estimation
2. Identification with reasons: Methods of disposal, Eco-marks, Symbols & colour codes
Visit to Landfills & enumeration of waste composition

Semester- VI

Course Name: Environmental Pollution & Human Health
Course Code: BSCENVMJ603

Course Type: **MJC-12 (Theoretical)**	Course Details:			L-T-P: **3-0-4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Knowledge on the types and the science of environmental pollution
2. Understanding of the effect of polluting on human health
3. Knowledge on pollutants and to link cause-and-effects of pollution
4. Knowledge on developing pollution mitigation/abetment strategies

Content: Unit wise course content distribution
Theory
Unit-1 Environmental pollution – Definition, local, regional and global implications (03)

Unit- 2 Air Pollution: Air pollutants, types and sources, air pollution episodes, air pollution and effects on human health [particulate matter, heavy metals (Pb in particular), Sulphur dioxide (SO_2), nitrogen dioxide (NO_2), volatile organics, surface ozone and PAHs]; and some diseases, viz., respiratory diseases, cardiovascular damage, irritation of eyes, nose and throat (15)

Unit- 3 Water pollution: Sources of water pollutants, organic matter, organic micro-pollutants, microbial pollution, Agriculture and Water pollution, Problems of pesticides and chemical fertilizers; Geogenic Contamination: Problems of As and F^- in groundwater and human health, Sewage and wastewater, Pharmaceuticals in wastewater (12)

Unit- 4 Sanitation and Drinking Water: Quality of drinking water; Wastewater treatment and water Reuse; Implications on health – Minamata disease, *itai itai* disease, blue baby syndrome (05)

Unit- 5 Noise pollution: Noise categories; Noise effects - hearing loss, Cardiovascular effects, psychological impacts, Stress, Annoyance, control of noise pollution and regulation (05)

Unit- 6 Land pollution: Characterization and impact of MSW on public health; Emissions from waste dumping sites, leaching, biomagnification, Agriculture and land pollution (05)

Semester- VI
Course Name: Environmental Pollution & Human Health
Course Code: BSCENVMJ603
[PRACTICAL]

Course Type: **MJC-12 (Practical)**	Course Details:			L-T-P:	
Credit:	Full Marks 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	-	**20**	-

TIME: 3 HOURS
MARKS: 20

Description of Experiment:
1. One major experiment- 10
2. Laboratory notebook and Report Preparation- 05
3. Viva-voce- 05

Practical Courses
1. Major Experiments
Measurement of particulate matter in air by grab sampling and gravimetric method; Understanding levels of SOx and NOx in ambient air by HVS
2. Report preparation: Understanding and comparing noise levels of localities by dB Meter
Visit to a local polluted site-Urban/Rural/Industrial/Agricultural, sampling, analysis and reporting, visit to industry having air-pollution control measures and reporting

Semester- VI
Course Name: Environmental Impact Assessment & Laws
Course Code: BSCENVMJ604

Course Type: **MJC-13 (Theoretical)**	Course Details:			L-T-P: **3-0-4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Understand the environment and its natural, and socio-economic and cultural components
2. Knowledge on the origin and development of EIA and its implications
3. Knowledge on the EIA process
4. Understand the Indian EIA process and role of MoEFCC, Green Tribunal, and environmental audit

Content: Unit wise course content distribution
Theory
Unit-1 Environmental Impact Assessment: Concept and definition; Goals of impact assessment; Evolution of impact assessment; Strategic Environmental Assessment; Social Impact Assessment; Ecological impact assessment; Hazard and risk assessment; Technology assessment; Environmental inventory; Environmental Impact Statement (EIS); Public involvement with impact assessment (10)

Unit- 2 EIA Process, scope and methodologies; Rapid EIA; Role of project proponents, project developers and consultants; Terms of Reference; Impact identification and prediction; baseline data collection; Public consultation in EIA (05)

Unit- 3 EIA regulations in India; Status of EIA in India; Case study of hydropower projects/ thermal projects (05)

Unit- 4 Biodiversity Impact Assessment; Cost-Benefit analysis; Life cycle assessment; Environmental management - Principles, problems and strategies; Environmental planning; Environmental Management Plan (EMP); Environmental audit (05)

Unit- 5 Risk assessment: Introduction and scope; hazard identification and assessment; risk characterization; risk communication; environmental monitoring; human and ecological risk assessment (05)

Environmental Laws and Policies: Basic concept on law, rules, act, treaty; Public Policy and PILs; Environmental provisions in the Indian Constitution - Article 48A, 51A(g); Powers and Functions of Govt. Agencies for pollution control (CPCB & SPCB) (10)

Environmental Acts: Objectives & Principles of The Environment Protection Act, 1986; The Air (Prevention and Control of Pollution) Act, 1981; The Water (Prevention and Control of Pollution) Act, 1974; The Noise Pollution (Regulation and Control) Act, 2000; The Wild Life (Protection) Act, 1972; The Forest (Conservation) Act, 1980; The National Green Tribunal Act, 2010; The Biological Diversity Act, 2002; Public Liability Insurance Act, 1991; Green Bench (10)

Students who want to undertake 3-year UG Program will be awarded UG Degree in the relevant Discipline/Subject upon securing 126 credits

Semester- VI
Course Name: Environmental Impact Assessment & Laws
Course Code: BSCENVMJ604
[PRACTICAL]

Course Type: **MJC-12 (Practical)**	Course Details:			L-T-P:	
Credit:	Full Marks 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	-	**20**	-

TIME: 3 HOURS
MARKS: 20

Description of Experiment:
1. One major experiment- 10
2. Laboratory notebook and Report Preparation- 05
3. Viva-voce- 05

Practical Courses
1. Major Experiments: On-Field visit for preparation of report on EIA (based on case studies)
2. Report Preparation: Preparation of report on field visit like industrial effluent treatment plants/water treatment plants/ waste disposal systems/wastewater treatment plants/recycling systems/power generation plants, etc.

Semester- VII
Course Name: Green Chemistry & Environmental Applications
Course Code: BSCENMJ701

Course Type: **MJC-14 (Theoretical)**	Course Details:			L-T-P: **3-0-4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Knowledge on importance and significance of green technology
2. Knowledge on development and application of innovative technologies in conversion natural forms energy to economically and environmentally feasible forms
3. Ability to develop, fabricate and utilize eco-friendly and cost-effective products and green design in building and infrastructure
4. Understand the role of green technology in resource generation, employment and improvement of livelihood standards
5. Knowledge of various environmental monitoring and assessment tools, and industrial safety and hazard analysis
Content: Unit wise course content distribution
Theory
Unit-1 Green Chemistry: Concept, principles, applications of green chemistry, *e. g.*, use of CO_2, H_2O_2, TiO_2; Chitin; Green technology and sustainability (10)

Unit- 2 Green Technology: Development and applications, Green technology in waste management, Supercritical water oxidation (SCWO) of wastes; Rhizosphere in biodegradation of organic wastes; Green techniques in water treatments: Deionization, Desalinizatation, Electrodialysis, Reverse osmosis; Green sources of energy; Green treatments of industrial effluents - Cyanide, Chromate (20)

Unit- 3 Green Synthesis of Chemicals: Production of 3^{rd}& 4^{th} generation pest controller, Integrated Pest Management (IPM), biodiesel, biopolymers, biogas, biofuel, bioethanol, degradable polymers, bioplastics; Alternative Fluorocarbons (AFCs) (10)

Unit- 4 Development and application: Conversion to natural forms of energy such as hydro-energy, solar energy, wind energy, tidal energy, and geo-thermal energy; Green design, building and infrastructure (10)

Semester- VII
Course Name: Green Chemistry & Environmental Applications
Course Code: BSCENVMJ701
[PRACTICAL]

Course Type: **MJC-14 (Practical)**	Course Details:			L-T-P:	
Credit:	Full Marks 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	-	**20**	-

TIME: 3 HOURS
MARKS: 20

Description of Experiment:
1. One major experiment- 08
2. Report Preparation- 04
3. Laboratory notebook- 03
4. Viva-voce- 05

Practical Courses
1. Major Experiments
Characterization of industrial effluents and wastewater MLSS; MLVSS, COD
2. Report preparation: Preparation of Report on Field visit (Industrial effluents treatment plants/water treatment plants/waste disposal systems/wastewater treatment plants/recycling systems/power generation plants etc.
3. Laboratory notebook containing all experiments

Semester- VII
Course Name: Environmental Economics & Management
Course Code: BSCENVMJ702

Course Type: **MJC-15 (Theoretical)**	Course Details:			L-T-P: **3-0-4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Knowledge on market and the economics of the environment
2. Identify economic solutions to environmental problems and the role of environmental market-based instruments
3. Apply of economic theories to analyze environmental problems and solutions
4. Appreciate risk analysis in providing economic solutions to environmental problems
5. Apply economic analysis in environmental decision-making process

Content: Unit wise course content distribution
Theory
Unit-1 Environmental Economics: Concept, scope and interrelation; Concept of supply and demand; Ecological economics; Environmental indicators-sustainable accounting; Introduction to economic theories and economic approach to real world environmental problems; Environmental Kuznets's Curve; Economics of pollution control; Cost: Benefit analysis (15)

Unit- 2 Environmental Accounting and Auditing: Environmental accounting - objectives, financial accounting, social accounting (05)

Unit- 3 Depletion of natural resources, climate change impacts, degradation of environmental quality, solid and toxic wastes, best management practice and sustainable development, pollution charge, subsidy, deposit refund system and pollution permit trading system; national and international agreement; Methods of assessing Natural Capital in economic terms (15)

Unit- 4 Environmental goods, public goods, private goods, common property resources, economic valuation, concept of market, market failure, social costs, private costs, externalities (10)

Unit- 5 Risk analysis: Risk assessment and risk management; Economic issues of ABS (Access Benefit Sharing) as per Biodiversity Act 2002 (05)

Semester- VII
Course Name: Environmental Economics and Management
Course Code: BSCENVMJ702
[PRACTICAL]

Course Type: **MJC-15 (Practical)**	Course Details:			L-T-P:	
Credit:	Full Marks 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	-	**20**	-

TIME: 3 HOURS
MARKS: 20

Description of Experiment:
1. One survey report- 15
2. Viva-voce- 05

Practical Courses
1. Survey report:
Preparation of survey report on market economy, cost-benefit analysis; study on agricultural economics *vs*. ecological footprint

Semester- VII
Course Name: Natural Hazards & Disaster Management and Waste Management
Course Code: BSCENVMJ703

Course Type: **MJC-16 (Theoretical)**	Course Details:			L-T-P: **3-0-4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Understand the different types of natural hazard, their major driving forces/factor, and the causes
2. Understand the relationship/interface between geophysical processes and human activities in causing natural hazard
3. Knowledge on hazards scenario at the global as well as national level
4. Understand the mitigation approaches, their choices and alternatives
5. Knowledge of foundations for hazard, risk and vulnerability assessment

Content: Unit wise course content distribution
Theory
Unit-1 Natural Hazards: Definition, concept and types; Risks & vulnerability; Causes, distribution, consequences and mitigation measures; Hazards and risk assessment (10)

Unit- 2 Disaster Management: Definition and concept, capacity and risk; Disaster management cycle
a. Floods: Floods as physical process (river systems, runoff, river activities); Causes and factors of flooding, effects/hazards associated with flooding; Response to flood hazards; Global and India scenario
b. Earthquake: Origin of earthquakes; Seismic waves; World's seismicity with emphasis on Indo-Burma region; Hazards associated with earthquakes; Response to earthquake hazards
c. Drought: Cause and impact; Types of draughts (meteorological, hydrological, agricultural and socio-economic) response to hazards - mitigation and adaptation; Droughts in India
d. Cyclones: Genesis; Tropical cyclones - formation, frequency and trajectory; impact of cyclones, mitigation and adaptation
e. Landslides: Genesis (slope failure mechanism); Causes of landslides, prevention and correction methods; Global and Indian scenario (25)
Unit- 3 Waste Management: Waste generation & characterization; Integrated Solid Waste Management; Hazardous waste management; Hazardous waste treatment technologies; Municipal Solid Waste Management; Biomedical waste management; Industrial Pollution Management (15)

Semester- VII
Course Name: Natural Hazards & Disaster Management and Waste Management
Course Code: BSCENVMJ703
[PRACTICAL]

Course Type: **MJC-16 (Practical)**	Course Details:			L-T-P:	
Credit:	Full Marks 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	-	**20**	-

TIME: 3 HOURS
MARKS: 20

Description of Experiment:
1. One survey report- 15
2. Viva-voce- 05

Practical Courses
1. Survey report:
a. Preparation of a report based on natural hazards of earlier occurrence after observing/viewing e-resources
b. Report preparation based on perceptions survey of disaster affected areas

Semester- VII
Course Name: Ecotoxicology & Environmental Biotechnology
Course Code: BSCENVMJ704

Course Type: **MJC-17 (Theoretical)**	Course Details:			L-T-P: **3-0-4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Knowledge on scope of biotechnology in environmental applications
2. Knowledge of microbiology and biochemistry
3. Ability to perform various molecular biological applications, and knowledge of equipment used in molecular biological techniques
4. Ability to apply molecular biological techniques in pollution management and industrial applications
5. Knowledge of advanced biotechnological applications, and biosafety in analytical procedures

Content: Unit wise course content distribution
Theory
Unit-1 Ecotoxicology: Definition and Concept; Mechanism of toxicity; Branches of toxicology; Types of interactions in toxicology; Concept of Dose-Response relationship, LD_{50}, LC_{50}, Threshold Limit Value (TLV), Therapeutic index; Ames test, Bio-assay techniques (10)
Unit- 2 Environmental Biotechnology: Concept on Environmental biotechnology, Fermentation techniques, composting, vermicomposting, bioleaching; biofertilizer, biopesticide, biogas, bioethanol and biopolymers; Application of biotechnology in environmental field (10)
Unit- 3 Molecular biology: Cell as a unit of life, cellular components, biomolecules, enzymes, molecular genetics – nuclear material, central dogma, replication, repair and recombination of genetic material, translation, transcription, mutation (10)
Unit- 4 Microbiology and industrial applications: Classification of microorganisms, environment, pathogenic and useful microorganisms, microbial enzymes in industrial applications (05)
Unit- 5 Biotechnological applications in pollution management: Solid waste management and wastewater treatment; role of microorganisms in sewage treatment and degradation of municipal solid waste; degradation of plastics and polymers using microorganisms (10)
Unit- 6 Advanced environmental biotechnology applications: Biofilms, biosensors and genetically engineered microorganisms in environmental applications; Biosafety in analytical procedures (05)

Semester- VII
Course Name: Ecotoxicology & Environmental Biotechnology
Course Code: BSCENVMJ704
PRACTICAL

Course Type: **MJC-17 (Theoretical)**	Course Details:			L-T-P:	
Credit:	Full Marks 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	-	**20**	-

TIME: 2 Hours
MARKS: 20

Description of Experiment:
1. One major experiment- 07
2. Identification- 03
3. Laboratory notebook- 05
4. Viva-voce- 05

Practical Courses
Major Experiments

Different parameters of evaluation of air, water, soil and wastewater
Air: Dust fall/SPM/RSPM/SO_x/NO_x
Water: BOD/COD
Demonstration / Theoretical idea on AAS; Bioassay
Demonstration on Fermentation/ Composting/Vermicomposting

Minor Paper

Semester- VII
Course Name: Environmental Economics & Management
Course Code: BSCENVMN702

Course Type: **MNC-15 (Theoretical)**	Course Details:			L-T-P: **3-0-4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Knowledge on market and the economics of the environment
2. Identify economic solutions to environmental problems and the role of environmental market-based instruments
3. Apply of economic theories to analyze environmental problems and solutions
4. Appreciate risk analysis in providing economic solutions to environmental problems
5. Apply economic analysis in environmental decision-making process

Content: Unit wise course content distribution
Theory
Unit-1 Environmental Economics: Concept, scope and interrelation; Concept of supply and demand; Ecological economics; Environmental indicators-sustainable accounting; Introduction to economic theories and economic approach to real world environmental problems; Environmental Kuznets's Curve; Economics of pollution control; Cost: Benefit analysis (15)

Unit- 2 Environmental Accounting and Auditing: Environmental accounting - objectives, financial accounting, social accounting (05)

Unit- 3 Depletion of natural resources, climate change impacts, degradation of environmental quality, solid and toxic wastes, best management practice and sustainable development, pollution charge, subsidy, deposit refund system and pollution permit trading system; national and international agreement; Methods of assessing Natural Capital in economic terms (15)

Unit- 4 Environmental goods, public goods, private goods, common property resources, economic valuation, concept of market, market failure, social costs, private costs, externalities (10)

Unit- 5 Risk analysis: Risk assessment and risk management; Economic issues of ABS (Access Benefit Sharing) as per Biodiversity Act 2002 (05)

Semester- VIII
Course Name: Wildlife Conservation & Management
Course Code: BSCENVMJ801

Course Type: **MJC-18 (Practical)**	Course Details:			L-T-P: **3-0-4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Understand basic ecological principles and fundamental concepts in wildlife conservation and management.
2. Understanding of cultural, historical, and current perspectives on the human- wildlife relationship to effectively address wildlife issues.
3. Knowledge on the primary international, national, and state agencies and scientific organizations, responsible for conservation and management of wildlife, and understand the role of private citizens in decision-making at all levels.
4. Understanding the wildlife conservation and management by critically evaluating information sources.
5. Know the threats to biodiversity in relation to protected areas and non- protected areas

Content: Unit wise course content distribution
Theory
Unit- 1 **Introduction:** Definition of wildlife; Indian wildlife; Threats to wildlife; Group living; Migration patterns; Predation behavior; Selfishness and altruism; Climate change and wildlife movement; Ecological services of wildlife; Ecotourism and wildlife; Habitat fragmentation and wildlife corridors (10)
Unit- 2 **Conflicts between man and wildlife:** Elephant-man conflict; Rhino-man conflict; River dolphin-man conflict; Tiger-man conflict; Leopard-man conflict; Conflict management and shifting from extraction to preservation; Response system between human-wildlife conflicts (08)
Unit- 3 **Wildlife heath monitoring:** Rescue measures for wounded animals; First aid for animal injuries; Animal health management; Population viability and habitat analysis (PVHA); Zoonotic disease management; National and International organizations involved in wildlife health management (10)
Unit- 4 **Conservation measures:** Man and Biosphere program (MAB); Issue of food and water scarcity; Captive breeding, relocation and rehabilitation of fauna, corridors for protected areas and significance of landscape management, buffer management , fire control, poaching and illegal activities
Wetland management: structure, function, food chains, food webs, threats and conservation; Eco restoration of wetland
Management of coastal and marine ecosystem: coral reefs, distribution, structure, function, threats and conservation (12)
Unit-5 **Laws in India:** Types of protected areas (Wildlife Sanctuaries, National Parks, Biosphere Reserves); IUCN categories of protected areas, Natural World Heritage sites; Concept of core and buffer area in a protected range; Brief introduction to Wildlife Protection Act of 1972; Forest Dwellers Act, 2006; Biodiversity Conservation Act, 2002); Wildlife trade and role of CITES (10)

Semester- VIII
Course Name: Wildlife Conservation & Management
Course Code: BSCENVMJ801
[PRACTICAL]

Course Type: **MJC-18 (Practical)**	Course Details:			L-T-P:	
Credit: **5**	Full Marks 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	-	**20**	-

TIME: 3 HOURS
MARKS: 20

Description of Experiment:
1. One Major Experiment: 08
2. Identification with reasons: 04
3. Laboratory Notebook: 02
4. Field tour report/Assignments/Seminars: 02
5. Viva-voce: 04

Practical Courses
Introduction: Study of campus flora and fauna; Study of nearby forests and grasslands; study of habitat specificity in birds or small mammals on campus; Current tools in the wildlife management; species importance value index (IVI)
One Major Experiment: Ascorbic acid determination of plant; Estimation of frequency, density, abundance of species (Nested quadrate analysis and plotless vegetation mapping); Line transects, and belt transect method of community study; Comparison of litter-fall (for at least 2-3 plant species)
Identification with reasons: Identification of important medicinal and weed species.
Demonstration of Equipment and use tags, collars, radio tracking equipment and bird ringing, GPS

Semester- VIII
Course Name: Energy & Environment
Course Code: BSCENVMJ802

Course Type: **19 (Theoretical)**	Course Details:			L-T-P: **2-0-4**	
Credit: **4**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Understanding of solar radiation's spectrum and the energy available from solar radiations
2. Understand the distinction between conventional and renewable energy sources
3. Understanding of the principles of energy conversion in case of each of the energy sources.
4. Knowledge on consumption of fossil fuels and biomass leads and their subsequent adverse impact on health and climate
5. Understanding of the implications of large-scale production of CO_2 and government's energy policy

Content: Unit wise course content distribution
Theory
Unit-1 Concepts of energy, power, heat and work, potential energy, kinetic energy, conservation of energy; Energy conversion factors, global energy flows, sun's radiations, energy budget of earth atmospheric system; Energy in biosphere, photosynthesis (15)

Unit- 2 History of energy use sectorial consumption of energy, energy consumption with time, population growth and projections for future (10)

Unit- 3 Environmental implications of energy use: Air pollution from fossil fuels and biomass, impacts on climate change and health; Impacts of large scale use of energy from solar, wind, hydro, ocean thermal energy, geothermal sources and nuclear energy; Thermal pollution-cooling towers, cooling by river water, lakes and ocean, radioactive waste, oil spills; CO_2 emission reduction potential from use of renewable energy (20)

Unit- 4 Energy storage devices, efficiency of energy use and energy policy of the country; Current status of installed capacity and potential of renewable energy sources (05)

Semester- VIII
Course Name: Industrial Health & Safety
Course Code: BSCENVMJ803

Course Type: **MJC-20 (Theoretical)**	Course Details:			L-T-P: **2-0-4**	
Credit: **4**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Understand the industrial activity with inputs on health and safety
2. Knowledge on internalize ISO 14001 and its implications for an industry
3. Understand the issues related to occupational health and hazards
4. Development of Protocol for an industry on disaster prevention, health issues, safety measures and environment management.

Content: Unit wise course content distribution
Theory
Unit-1 Introduction to industrial pollutants; TOSCA (Toxic Substances Control Act); Concept on occupational health and health hazards; Drug abuse; Federal Hazardous Substances Act (10)

Unit- 2 Safety measures for workers and sensitization of industry managers; Biological method of monitoring; Clinical studies on workers; Test and monitor to industrial health and safety; Ideas on remedies (10)

Unit- 3 Practical applications: Concept of toxic substance standard; Permissible levels of exposure to airborne industrial chemicals; Legislation for control of toxic substances – OSHA (Occupational Safety and Health Act); Rules of Regulatory toxicology; Preparation for designing and recognition of an industry for IS014001 (15)

Unit- 4 Industrial disaster & degradation of environment; Strategic management and planning and tools for implementing health and safety measures; Management of communicable diseases; Principles of accident prevention; Measures for altering organizational behavior and risk management (15)

Semester- VIII
Course Name: Industrial Health & Safety
Course Code: BSCENVMJ803
PRACTICAL

Course Type: **MJC-20 (Theoretical)**	Course Details:			L-T-P:	
Credit:	Full Marks 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	-	**20**	-

TIME: 2 Hours
MARKS: 20

Description of Experiment:
1. One Major Experiment: 07
2. Identification: 03
3. Laboratory Notebook: 05
4. Viva-voce: 05

Practical Courses
Major Experiments
Risk evaluation, such as the Risk Matrix, Failure Mode and Effects Analysis (FMEA), and the Decision Tree
Guidelines for developing health and safety program; Mental Health Awareness: Stress, anxiety, and depression are just as serious as physical injuries.
Identification
Identification and prevention of workplace injuries, illnesses, and deaths; PPEs are specialized clothing and equipment; Gloves, goggles, and masks: UV and infrared safety helmets for welding, and fall restraint harnesses for working at heights; Hearing Conservation, Blood borne Pathogens.

Semester- VIII
Course Name: Analytical Methods in Environmental Science
Course Code: BSCENVMJ804

Course Type: **MJC-21 (Theoretical)**	Course Details:			L-T-P: **2-0-4**	
Credit: **4**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:

Unit 1: **Separation techniques**
Adsorption, centrifugation, chromatography, crystallization, decantation, distillation, drying, electrophoresis, elutriation, evaporation, leaching, flotation, flocculation, filtration, reverse osmosis, dialysis (biochemistry), fractional distillation, fractional freezing, magnetic separation, precipitation, crystallization, sedimentation, sieving, stripping, sublimation, vapour-liquid separation, winnowing and zone refining's (20)

Unit 2: **Sample Preparation and extraction**
Concept and importance, sample pre-treatment, preparation, post treatment techniques: pressurized liquid and subcritical hot-water extraction, microwave assisted extraction, solid phase extraction, QuEChERS approach of extraction, solid phase micro extraction, single drop micro extraction (SDME), membrane extraction, liquid-liquid extraction (15)

Unit 3: **Chromatography and Mass spectroscopy**
Principle, instrumentation and application of gas, liquid, adsorption, paper, gel, size exclusion, HPLC, TLC, electrophoresis and ion exchange chromatography. Mass spectroscopy: Principle, instrumentation and application of mass spectroscopy, types of mass spectroscopy, fragmentation, ionization and characterization of organic and inorganic materials (15)

Unit 4: **Miscellaneous methods**
Principle, instrumentation and application of classical analytical methods: gravimetric, volumetric and thermal methods); Automatic analytical methods and Hybrid analytical methods (10)

Semester- VIII
Course Name: Analytical Methods in Environmental Science
Course Code: BSCENVMJ804
PRACTICAL

Course Type: **MJC-21 (Theoretical)**	Course Details:			L-T-P:	
Credit:	Full Marks 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	-	**20**	-

TIME: 2 Hours
MARKS: 20

Description of Experiment:
1. One Major Experiment: 07
2. Identification: 03
3. Laboratory Notebook: 05
4. Viva-voce: 05

Practical Courses
Major Experiments
Basic histological and cytological techniques: Fixation & fixatives, Tissue-processing and Microtomy; Staining
Bacteriological examination of water: Standard plate count and coliform test.
Identification
Different types of Microscopes: Different Components of microscope; Types of microscopes – Light, Electron, Phase, Polarized, Fluorescence.
Biological Analysis
Collection and preservation of plankton; Enumeration of net plankton, counting in Sedgwick Rafter cell.
Interpretation of Satellite Imagery
Stereoscopic study and visual interpretations of satellite imagery and airborne image.

Minor Paper

Semester- VIII
Course Name: Wildlife Conservation & Management
Course Code: BSCENVMJ801

Course Type: **MJC-18 (Practical)**	Course Details:			L-T-P: **3-0-4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Understand basic ecological principles and fundamental concepts in wildlife conservation and management.
2. Understanding of cultural, historical, and current perspectives on the human- wildlife relationship to effectively address wildlife issues.
3. Knowledge on the primary international, national, and state agencies and scientific organizations, responsible for conservation and management of wildlife, and understand the role of private citizens in decision-making at all levels.
4. Understanding the wildlife conservation and management by critically evaluating information sources.
5. Know the threats to biodiversity in relation to protected areas and non- protected areas

Content: Unit wise course content distribution
Theory
Unit- 1 **Introduction:** Definition of wildlife; Indian wildlife; Threats to wildlife; Group living; Migration patterns; Predation behavior; Selfishness and altruism; Climate change and wildlife movement; Ecological services of wildlife; Ecotourism and wildlife; Habitat fragmentation and wildlife corridors (10)
Unit- 2 **Conflicts between man and wildlife:** Elephant-man conflict; Rhino-man conflict; River dolphin-man conflict; Tiger-man conflict; Leopard-man conflict; Conflict management and shifting from extraction to preservation; Response system between human-wildlife conflicts (08)
Unit- 3 **Wildlife heath monitoring:** Rescue measures for wounded animals; First aid for animal injuries; Animal health management; Population viability and habitat analysis (PVHA); Zoonotic disease management; National and International organizations involved in wildlife health management (10)
Unit- 4 **Conservation measures:** Man and Biosphere program (MAB); Issue of food and water scarcity; Captive breeding, relocation and rehabilitation of fauna, corridors for protected areas and significance of landscape management, buffer management , fire control, poaching and illegal activities
Wetland management: structure, function, food chains, food webs, threats and conservation; Eco restoration of wetland
Management of coastal and marine ecosystem: coral reefs, distribution, structure, function, threats and conservation (12)
Unit-5 **Laws in India:** Types of protected areas (Wildlife Sanctuaries, National Parks, Biosphere Reserves); IUCN categories of protected areas, Natural World Heritage sites; Concept of core and buffer area in a protected range; Brief introduction to Wildlife Protection Act of 1972; Forest Dwellers Act, 2006; Biodiversity Conservation Act, 2002); Wildlife trade and role of CITES (10)

Students who want to undertake 4-year UG Honours Program will be awarded UG Degree (Honours) in the relevant Discipline/Subject provided they secure 173 credits

Semester- VII
Course Name: Green Chemistry & Environmental Applications
Course Code: BSCENMJ 701

Course Type: **Core (Theoretical)**	Course Details:			L-T-P: **4-0-4**	
Credit: **6**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Knowledge on importance and significance of green technology
2. Knowledge on development and application of innovative technologies in conversion natural forms energy to economically and environmentally feasible forms
3. Ability to develop, fabricate and utilize eco-friendly and cost-effective products and green design in building and infrastructure
4. Understand the role of green technology in resource generation, employment and improvement of livelihood standards
5. Knowledge of various environmental monitoring and assessment tools, and industrial safety and hazard analysis
Content: Unit wise course content distribution
Theory
Unit-1 Green Chemistry: Concept, principles, applications of green chemistry, *e. g.*, use of CO_2, H_2O_2, TiO_2; Chitin; Green technology and sustainability (10)

Unit- 2 Green Technology: Development and applications, Green technology in waste management, Supercritical water oxidation (SCWO) of wastes; Rhizosphere in biodegradation of organic wastes; Green techniques in water treatments: Deionization, Desalinizatation, Electrodialysis, Reverse osmosis; Green sources of energy; Green treatments of industrial effluents - Cyanide, Chromate (20)

Unit- 3 Green Synthesis of Chemicals: Production of 3^{rd}& 4^{th} generation pest controller, Integrated Pest Management (IPM), biodiesel, biopolymers, biogas, biofuel, bioethanol, degradable polymers, bioplastics; Alternative Fluorocarbons (AFCs) (10)

Unit- 4 Development and application: Conversion to natural forms of energy such as hydro-energy, solar energy, wind energy, tidal energy, and geo-thermal energy; Green design, building and infrastructure (10)

Semester- VII
Course Name: Green Chemistry & Environmental Applications
Course Code: BSCENVMJ 701
[PRACTICAL]

Course Type: **Core (Practical)**	Course Details:			L-T-P: **4-0-4**	
Credit: **4**	Full Marks: **50**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**-**	**20**	**-**

Description of Experiment:
1.One major experiment- 08
2. Report Preparation- 04
3. Laboratory notebook- 03
4. Viva-voce- 05

Practical Courses
1. Major Experiments
Characterization of industrial effluents and wastewater MLSS; MLVSS, COD
2. Report preparation: Preparation of Report on Field visit (Industrial effluents treatment plants/water treatment plants/waste disposal systems/wastewater treatment plants/recycling systems/power generation plants etc.
3. Laboratory notebook containing all experiments

Semester- VII
Course Name: Environmental Economics & Management
Course Code: BSCENVMJ 702

Course Type: **Core (Theoretical)**	Course Details:			L-T-P: **4-0-4**	
Credit: **6**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Knowledge on market and the economics of the environment
2. Identify economic solutions to environmental problems and the role of environmental market-based instruments
3. Apply of economic theories to analyze environmental problems and solutions
4. Appreciate risk analysis in providing economic solutions to environmental problems
5. Apply economic analysis in environmental decision-making process

Content: Unit wise course content distribution
Theory
Unit-1 Environmental Economics: Concept, scope and interrelation; Concept of supply and demand; Ecological economics; Environmental indicators-sustainable accounting; Introduction to economic theories and economic approach to real world environmental problems; Environmental Kuznets's Curve; Economics of pollution control; Cost: Benefit analysis (15)

Unit- 2 Environmental Accounting and Auditing: Environmental accounting - objectives, financial accounting, social accounting (05)

Unit- 3 Depletion of natural resources, climate change impacts, degradation of environmental quality, solid and toxic wastes, best management practice and sustainable development, pollution charge, subsidy, deposit refund system and pollution permit trading system; national and international agreement; Methods of assessing Natural Capital in economic terms (15)

Unit- 4 Environmental goods, public goods, private goods, common property resources, economic valuation, concept of market, market failure, social costs, private costs, externalities (05)

Unit- 5 Risk analysis: Risk assessment and risk management; Economic issues of ABS (Access Benefit Sharing) as per Biodiversity Act 2002 (05)

Semester- VII
Course Name: Environmental Economics and Management
Course Code: BSCENVMJ 702
[PRACTICAL]

Course Type: **Core (Practical)**	Course Details:			L-T-P: **4-0-4**	
Credit: **4**	Full Marks: **50**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**-**	**20**	**-**

TIME: 3 HOURS
MARKS: 20

Description of Experiment:
1.One survey report- 15
2. Viva-voce- 05

Practical Courses
1. Survey report:
Preparation of survey report on market economy, cost-benefit analysis; study on agricultural economics vs. ecological footprint

Semester- VII
Course Name: Natural Hazards & Disaster Management and Waste Management
Course Code: BSCENVMJ 703

Course Type: **Core (Theoretical)**	Course Details: **CC-14**			L-T-P: **4-0-4**	
Credit: **6**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Understand the different types of natural hazard, their major driving forces/factor, and the causes
2. Understand the relationship/interface between geophysical processes and human activities in causing natural hazard
3. Knowledge on hazards scenario at the global as well as national level
4. Understand the mitigation approaches, their choices and alternatives
5. Knowledge of foundations for hazard, risk and vulnerability assessment
Content: Unit wise course content distribution
Theory
Unit-1 Natural Hazards: Definition, concept and types; Risks & vulnerability; Causes, distribution, consequences and mitigation measures; Hazards and risk assessment (10)

Unit- 2 Disaster Management: Definition and concept, capacity and risk; Disaster management cycle
a. Floods: Floods as physical process (river systems, runoff, river activities); Causes and factors of flooding, effects/hazards associated with flooding; Response to flood hazards; Global and India scenario
b. Earthquake: Origin of earthquakes; Seismic waves; World's seismicity with emphasis on Indo-Burma region; Hazards associated with earthquakes; Response to earthquake hazards
c. Drought: Cause and impact; Types of draughts (meteorological, hydrological, agricultural and socio-economic) response to hazards - mitigation and adaptation; Droughts in India
d. Cyclones: Genesis; Tropical cyclones - formation, frequency and trajectory; impact of cyclones, mitigation and adaptation
e. Landslides: Genesis (slope failure mechanism); Causes of landslides, prevention and correction methods; Global and Indian scenario (25)

Unit- 3 Waste Management: Waste generation & characterization; Integrated Solid Waste Management; Hazardous waste management; Hazardous waste treatment technologies; Municipal Solid Waste Management; Biomedical waste management; Industrial Pollution Management (15)

Semester- VII
Course Name: Natural Hazards & Disaster Management and Waste Management
Course Code: BSCENVMJ 703 [PRACTICAL]
PRACTICAL

Course Type: **Core (Practical)**	Course Details:			L-T-P: **4-0-4**	
Credit: **4**	Full Marks: **50**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**-**	**20**	**-**

TIME: 3 HOURS
MARKS: 20

Description of Experiment:
1.One survey report- 15
2. Viva-voce- 05

Practical Courses
1. Survey report:
a. Preparation of a report based on natural hazards of earlier occurrence after observing/viewing E-resources
b. Report preparation based on perceptions survey of disaster affected areas

Semester- VII
Course Name: Ecotoxicology & Environmental Biotechnology
Course Code: BSCENVMJ 704

Course Type: **Core (Theoretical)**	Course Details:			L-T-P: **5-1-0**	
Credit: **6**	Full Marks: **50**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		-	**10**	**-**	**40**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Knowledge on scope of biotechnology in environmental applications
2. Knowledge of microbiology and biochemistry
3. Ability to perform various molecular biological applications, and knowledge of equipment used in molecular biological techniques
4. Ability to apply molecular biological techniques in pollution management and industrial applications
5. Knowledge of advanced biotechnological applications, and biosafety in analytical procedures

Content: Unit wise course content distribution
Theory
Unit-1 Ecotoxicology: Definition and Concept; Mechanism of toxicity; Branches of toxicology; Types of interactions in toxicology; Concept of Dose-Response relationship, LD_{50}, LC_{50}, Threshold Limit Value (TLV), Therapeutic index; Ames test, Bio-assay techniques (10)

Unit- 2 Environmental Biotechnology: Concept on Environmental biotechnology, Fermentation techniques, composting, vermicomposting, bioleaching; biofertilizer, biopesticide, biogas, bioethanol and biopolymers; Application of biotechnology in environmental field (10)

Unit- 3 Molecular biology: Cell as a unit of life, cellular components, biomolecules, enzymes, molecular genetics – nuclear material, central dogma, replication, repair and recombination of genetic material, translation, transcription, mutation (10)

Unit- 4 Microbiology and industrial applications: Classification of microorganisms, environment, pathogenic and useful microorganisms, microbial enzymes in industrial applications (05)

Unit- 5 Biotechnological applications in pollution management: Solid waste management and wastewater treatment; role of microorganisms in sewage treatment and degradation of municipal solid waste; degradation of plastics and polymers using microorganisms (10)

Unit- 6 Advanced environmental biotechnology applications: Biofilms, biosensors and genetically engineered microorganisms in environmental applications; Biosafety in analytical procedures (05)

Semester- VII
Course Name: Ecotoxicology & Environmental Biotechnology
Course Code: BSCENVMJ 704
PRACTICAL

Course Type: **Core (Theoretical)**	Course Details:			L-T-P: **5-1-0**	
Credit: **6**	Full Marks: **50**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		-	**10**	**-**	**40**

TIME: 2 Hours
MARKS: 20

Description of Experiment:
1.One major experiment- 07
2. Identification- 03
3. Laboratory notebook- 05
4. Viva-voce- 05

Practical Courses
1. Major Experiments
Different parameters of evaluation of air, water, soil and wastewater
Air: Dust fall/SPM/RSPM/SO_x/NO_x
Water: BOD/COD
Demonstration / Theoretical idea on AAS; Bioassay
Demonstration on Fermentation/ Composting/Vermicomposting

Minor Paper

Semester- VII
Course Name: Environmental Economics & Management
Course Code: BSCENVMN 702

Course Type: **Core (Theoretical)**	Course Details:			L-T-P: **4-0-4**	
Credit: **6**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Knowledge on market and the economics of the environment
2. Identify economic solutions to environmental problems and the role of environmental market-based instruments
3. Apply of economic theories to analyze environmental problems and solutions
4. Appreciate risk analysis in providing economic solutions to environmental problems
5. Apply economic analysis in environmental decision-making process

Content: Unit wise course content distribution
Theory
Unit-1 Environmental Economics: Concept, scope and interrelation; Concept of supply and demand; Ecological economics; Environmental indicators-sustainable accounting; Introduction to economic theories and economic approach to real world environmental problems; Environmental Kuznets's Curve; Economics of pollution control; Cost: Benefit analysis (15)

Unit- 2 Environmental Accounting and Auditing: Environmental accounting - objectives, financial accounting, social accounting (05)

Unit- 3 Depletion of natural resources, climate change impacts, degradation of environmental quality, solid and toxic wastes, best management practice and sustainable development, pollution charge, subsidy, deposit refund system and pollution permit trading system; national and international agreement; Methods of assessing Natural Capital in economic terms (15)

Unit- 4 Environmental goods, public goods, private goods, common property resources, economic valuation, concept of market, market failure, social costs, private costs, externalities (05)

Unit- 5 Risk analysis: Risk assessment and risk management; Economic issues of ABS (Access Benefit Sharing) as per Biodiversity Act 2002 (05)

Semester- VIII

Course Name: Tools & Techniques in Environmental Science
Course Code: BSCENVMJ 801

Course Type: **Core (Theoretical)**	Course Details:			L-T-P: **5-1-0**	
Credit: **6**	Full Marks: **50**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		-	**10**	**-**	**40**

Content: Unit wise course content distribution

Theory

Unit 1: **Statistics**

Types of data: Primary and secondary; Methods of collection of environmental data; Mean, median, mode and variance of a given environmental data set; Frequency distribution; Measures of central tendency; Measures of dispersion; Correlation and Regression, Hypothesis testing, T-test, Chi-square test (15)

Unit 2: **Air quality Monitoring**

Ambient air quality monitoring; Measurement of suspended particulate matter (PM2.5, PM10), carbon monoxide; Oxides of nitrogen; Oxides of sulfur; Determination of RSPM in atmosphere (roadside and classroom) (10)

Unit 3: **Water quality monitoring**

Water quality parameters; Water sampling techniques; Principles and procedures for measurement of pH, conductivity, total solids, hardness, chloride, dissolved oxygen, combined CO_2, phosphate, nitrate, heavy metals (Atomic Absorption Spectrophotometry method); and Total coliform count (10)

Unit 4: **Meteorological parameters**

Light intensity, ambient temperature and relative humidity (05)

Unit 5: **Noise monitoring**

Monitoring of noise level in public area (campus and roadside) (05)

Unit 6: **Remote Sensing and GIS**

Basics of Remote Sensing and GIS; Use of remote sensing and GIS in resource survey and land use mapping (05)

Minor Paper

Semester- VIII
Course Name: Wildlife Conservation & Management
Course Code: BSCENVMN801

Course Type: **MNC-18 (Practical)**	Course Details:			L-T-P: **3-0-4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes:
(After the completion of course, the students will have the ability to):
Course outcomes:
1. Understand basic ecological principles and fundamental concepts in wildlife conservation and management.
2. Understanding of cultural, historical, and current perspectives on the human- wildlife relationship to effectively address wildlife issues.
3. Knowledge on the primary international, national, and state agencies and scientific organizations, responsible for conservation and management of wildlife, and understand the role of private citizens in decision-making at all levels.
4. Understanding the wildlife conservation and management by critically evaluating information sources.
5. Know the threats to biodiversity in relation to protected areas and non- protected areas

Content: Unit wise course content distribution
Theory
Unit- 1 **Introduction:** Definition of wildlife; Indian wildlife; Threats to wildlife; Group living; Migration patterns; Predation behavior; Selfishness and altruism; Climate change and wildlife movement; Ecological services of wildlife; Ecotourism and wildlife; Habitat fragmentation and wildlife corridors (10)
Unit- 2 **Conflicts between man and wildlife:** Elephant-man conflict; Rhino-man conflict; River dolphin-man conflict; Tiger-man conflict; Leopard-man conflict; Conflict management and shifting from extraction to preservation; Response system between human-wildlife conflicts (08)
Unit- 3 **Wildlife heath monitoring:** Rescue measures for wounded animals; First aid for animal injuries; Animal health management; Population viability and habitat analysis (PVHA); Zoonotic disease management; National and International organizations involved in wildlife health management (10)
Unit- 4 **Conservation measures:** Man and Biosphere program (MAB); Issue of food and water scarcity; Captive breeding, relocation and rehabilitation of fauna, corridors for protected areas and significance of landscape management, buffer management , fire control, poaching and illegal activities
Wetland management: structure, function, food chains, food webs, threats and conservation; Eco restoration of wetland
Management of coastal and marine ecosystem: coral reefs, distribution, structure, function, threats and conservation (12)
Unit-5 **Laws in India:** Types of protected areas (Wildlife Sanctuaries, National Parks, Biosphere Reserves); IUCN categories of protected areas, Natural World Heritage sites; Concept of core and buffer area in a protected range; Brief introduction to Wildlife Protection Act of 1972; Forest Dwellers Act, 2006; Biodiversity Conservation Act, 2002); Wildlife trade and role of CITES (10)