

# **S.S.JAIN SUBODH P.G. (AUTONOMOUS) COLLEGE JAIPUR**

(Affiliated to University of Rajasthan)



## **SYLLABUS**

### **SCHEME OF EXAMINATION AND COURSES OF STUDY**

#### **FACULTY OF SCIENCE**

#### **DEPARTMENT OF ENVIRONMENTAL SCIENCE**

- **M.Sc. Environmental Science ( I, II, III and IV Semester-2013-16)**
- **Foundation Environmental Studies for B.A./B.Com./B.Sc. (Compulsory in Semester IV)**

**As per New Education Policy -2020**

# **Contents:**

## **1. OBJECTIVES**

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## **STRUCTURE\_**

### **Objectives:**

M.Sc. Environmental Science is an interdisciplinary program with an emphasis on environmental analyses, pollution control, climate changes, and impact assessment. The main objectives of the course are:

- To impart knowledge of environmental problems of regional and global scale;
- To train the students for scientific analysis of environmental components for critical understanding, efficient environmental decision-making and management.
- To prepare them for global competence for career options in education, research, industries, consultancy, environmental journalism etc.
- To train the students for Environmental Impact Assessment and for management systems
- To understand the impacts of climate change to develop mitigation strategies
- To prepare students for designing, conducting independent research in the area of their interest.
- To sensitize students towards developing the earth as a green planet for a clean habitat for all living forms.

### **Eligibility:**

A candidate who has secured more than 55% or CGPA of 3.5 in the UGC Seven Point scale [36% or Pass marks for SC/ST/Non-creamy layer OBC/SBC] or equivalent in the Bachelor degree in Science or Engineering or Technology or Medicine or Pharmaceutical Science or Paramedical or Agriculture or Dairy Technology shall be eligible for admission to First Semester of a Master of Environmental Science course. For candidates from outside state of Rajasthan 60% or CGPA of 4.0 in the UGC Seven Point Scale will be applicable irrespective of the category

## **Scheme of Examination:**

1. Each theory paper carries 100 marks. The internal assessment will be 30 marks and EoSE shall carry 70 marks. The EoSE will be of 3 hours duration. There will be a practical examination of 200 marks in all Semester
2. There will be two parts in EoSE theory paper. Part „A“ of theory paper shall contain 10 Short Answer Questions of 14 marks, based on knowledge, understanding and applications of the topics/texts covered in the syllabus. Candidate has to attempt seven questions out of 10 and each question will carry two marks for correct answer.
3. Parts “B” of EoSE theory paper will consist of four questions from each unit with internal choice of 14 marks each. The limit of answer will be five pages.
4. Each Laboratory EoSE will be of four hour durations and involve laboratory experiments/exercises/ Seminar presentation / Synopsis presentation/Project work or field study / Industrial Training/ consultancy training and viva-voce examination consist of 200 Marks.
5. The aim of Project work or field study / Industrial Training/ consultancy training is to introduce students to research methodology in the subject and prepare them for pursuing research in theoretical or experimental or computational areas of the subject. The project work or Field Study is to be undertaken under guidance jointly by Head of the Department and a senior faculty or a Scientist or any other suitable person with proven research excellence in the concerned field of study. Project work or field study / Industrial Training/ consultancy training can also be taken up in an outside institution of repute Department. The guide will make continuous internal assessment of the Project work or field study / Industrial Training/ Consultancy training. EoSE for Project work or field study / Industrial Training/ consultancy training and seminar will be held at department of the college by a board of three examiners consist of HoD, two senior faculty of the department or expert from interdisciplinary department of the institution.
6. Supplementary/ due paper/ special examinations will be resolute as per the institutions autonomous rules
7. Grade/CGPA/percentage/division will be decided as per the autonomous guidelines of the institution.

## M. Sc. I Semester

Max. Marks (Theory): 400

Nomenclature			External/ Theories	Internal / Theories	Total Max Marks	Total Mini. Marks
MES 101	Paper I	Ecology and Ecosystems	70	30	100	40
MES 102	Paper II	Biodiversity and Conservation	70	30	100	40
MES 103	Paper III	Environmental Pollution and Health	70	30	100	40
MES 104	Paper IV	Environmental Issues: Regional and Global	70	30	100	40
<b>Practical: Based on Theory Paper</b>						
MES 111A	Practical PR-I		60	40	100	40
MES 111B	Practical PR-II		60	40	100	40

## M.Sc. II Semester

Nomenclature			External/ Theories	Internal / Theories	Total Max Marks	Total Mini. Marks
MES 201	Paper I	Waste Management	70	30	100	40
MES 202	Paper II	Environmental Policies, Legislation and Ethics	70	30	100	40
MES 203	Paper III	Environmental Chemistry	70	30	100	40
MES 204	Paper IV	Environmental Disasters and Management	70	30	100	40
<b>Practical: Based on Theory Paper</b>						
MES 211 A	Practical PR-I		60	40	100	40
MES 211 B	Practical PR-II		60	40	100	40

## M.Sc. III Semester

### Max. Marks Theory Papers: 400

S. No.	Subject Code	Course Title	External / Theories	Internal / Theories	Total Max. Marks	Total Mini. Marks
1.	MES 301	Instrumentation for Environmental Monitoring and Analysis	70	30	100	40
2.	MES 302	Environmental Bioremediation Process and Technology	70	30	100	40
Elective I ( <i>Any one of the following</i> )						
3.	MES 303A	Pollution Control Technology	70	30	100	40
4.	MES 303B	Environmental Geosciences	70	30	100	40
5.	MES 303C	ISO Certification and Environmental Management System	70	30	100	40
Elective II ( <i>Any one of the following</i> )						
6.	MES 304A	Statistics, Environmental Modelling and Research Methodology	70	30	100	40
7.	MES 304 B	Green Eco-technologies	70	30	100	40
8.	MES 304C	MOOCs and Internship based skill Enhancement	70	30	100	40
9.	MES 311A	Elective Practical Lab Work Internal and External ( <b>PRI</b> )	60	40	100	40
10.	MES 311B	Synopsis Preparation and Project work, / Presentation(External) & Seminar (Internal) ( <b>PRII</b> )	60	40	100	40

## M.Sc. IV Semester

### Max. Marks Theory Papers: 400

S. No	Subject Code	Course Title	External / Theories	Internal / Theories	Total Max. Marks	Total Mini. Marks
1.	MES 401	Environmental Impact Assessment	70	30	100	40
2.	MES 402	Environmental Clearance and Environmental Audit	70	30	100	40
Elective I ( <i>Any one of the following</i> )						
3.	MES 403A	Remote sensing & GIS for Environmental Science	70	30	100	40
4.	MES 403B	Integrated Watershed Conservation and Harvesting Techniques	70	30	100	40
5.	MES 403C	Sustainable Development and its Application	70	30	100	40
Elective II ( <i>Any one of the following</i> )						
6.	MES 404A	Energy and Environment	70	30	100	40
7.	MES 404B	Industrial Safety, Health and Environmental Management	70	30	100	40
8.	MES 404 C	Human-Wildlife Conflict And Management	70	30	100	40
9.	MES 411A	Elective Practical Lab Work Internal and External <b>(PRI)</b>	60	40	100	40
10.	MES 411B	Research Dissertation work Presentation (External) and Dissertation work Submission (Internal) <b>(PRII)</b>	60	40	100	40

**Semester Structure:** The details of the courses with code, title assign are as given below.  
M.Sc. Environmental Science Duration: 4 Semesters (2 Years)

### Semester–I

MES101-Paper-I: Ecology and Ecosystems

MES102-Paper-II: Biodiversity and Conservation

MES103-Paper III: Environmental Pollution and Health

MES104-Paper IV: Environmental Issues: Regional and Global

Practical: Based on Theory Papers

MES111A-Practical PR-I

MES111B-Practical PR-II

### Semester–II

MES201-Paper-I: Waste Management

MES202-Paper-II: Environmental Policies, Legislation and Ethics

MES203Paper III: Environmental Chemistry

MES204-Paper IV: Environmental Disasters and Management

Practical: Based on Theory Papers

MES211A-Practical PR-I

MES211B-Practical PR-II

### Semester–III

MES301-Paper-I: Instrumentation for Environmental Monitoring and Analysis

MES302- Paper-II: Environmental Bioremediation Process and Technology

MES303A-Paper III: Pollution Control Technology

MES 303B- Paper-III: Environmental Geosciences

MES 303C- Paper-III: ISO Certification and Environmental Management System

MES304 A-Paper IV: Statistics, Environmental Modelling and Research Methodology

MES 304B- Paper IV: Green Eco-Technologies

MES 304C- Paper IV: MOOCs and Internship based on skill Enhancement

MES311 A- (PRI)-Elective Practical Lab Work Internal and External

MES 311B- (PRII) - Project work and Synopsis Preparation / Presentation (External) & Seminar (Internal)

### Semester–IV

MES401-Paper-I: Environmental Impact Assessment

MES402-Paper-II: Environmental Clearance and Environmental Audit

MES403 A-Paper III: Remote sensing & GIS for Environmental Science

MES403 B -Paper III: Integrated watershed conservation and Harvesting Techniques

MES403C -Paper III: Sustainable development and its application

MES404 A Paper IV: Energy and Environment

MES404 B Paper IV: Industrial Safety, Health and Environmental Management

MES404 C Paper IV: Human-Wildlife Conflict and Management

MES411A (PRI) - Elective Practical Lab Work Internal and External

MES411B (PRII) - Dissertation work Presentation (External) and Dissertation work Submission (Internal)

## Abbreviations Used:

### Course Category

DSC: Discipline Specific Core  
 DSCP: Discipline Specific Core Practical  
 DSE: Discipline Specific Elective  
 DSEP: Discipline Specific Elective Practical  
 GE : General Elective  
 AEC: Ability Enhancement Course  
 AECC: Ability Enhancement Compulsory Course  
 SEC: Skill Enhancement Course  
 SEM: Seminar  
 PRJ: Project Work  
 RP: Research Publication

### Contact Hours

L: Lecture  
 T: Tutorial  
 P: Practical or Other S:  
 Self Study

### Relative Weights

CIA: Class Internal Assessment ( Test/Attendance/Classroom Participation/Quiz/Home Assignment etc.)  
 EoSE: End of Semester Examination

**The medium of instruction and examination shall be English only.**

### First Semester

S. No.	Subject Code	Course Title	Course Category	Credit	Contact Hours Per week		EoSE Duration (Hrs.)	
					L	P	Thy	P
1.	MES 101	Ecology and Ecosystems	DSC	4	4	0	3	0
2.	MES 102	Biodiversity and Conservation	DSC	4	4	0	3	0
3.	MES 103	Environmental Pollution and Health	DSC	4	4	0	3	0
4.	MES 104	Environmental Issues: Regional and Global	DSC	4	4	0	3	0
5.	MES 111A	P/SEM/PRJ - <b>Practical PR-I</b>	DSC	6	0	12	0	4
6.	MES 111B	<b>Practical PR-II</b>	DSC	6	0	12	0	4

### Second Semester

S. No.	Subject Code	Course Title	Course Category	Credit	Contact Hours Per week		EoSE Duration (Hrs.)	
					L	P	Thy	P
1.	MES 201	Waste Management	DSC	4	4	0	3	0
2.	MES 202	Environmental Policies, Legislation and Ethics	DSC	4	4	0	3	0
3.	MES 203	Environmental Chemistry	DSC	4	4	0	3	0
4.	MES 204	Environmental Disasters and Management	DSC	4	4	0	3	0
5.	MES 211A	P/SEM/PRJ <b>Practical PR-I</b>	DSC	6	0	12	0	4
6.	MES 211B	<b>Practical PR-II</b>	DSC	6	0	12	0	4



## Third Semester

S. No.	Subject Code	Course Title	Course Category	Credit	Contact Hours Per week		EoSE Duration (Hrs.)	
					L	P	Thy	P
1.	MES 301	Instrumentation for Environmental Monitoring and Analysis	DSC	4	4	0	3	0
2.	MES 302	Environmental Bioremediation Process and Technology	DSC	4	4	0	3	0
Elective I ( <i>Any one of the following</i> )								
3.	MES 303 A	Pollution Control Technology	DSE	4	4	0	3	0
4.	MES 303B	Environmental Geosciences	DSE	4	4	0	3	0
5.	MES 303C	ISO Certification and Environmental Management System	DSE	4	4	0	3	0
Elective II ( <i>Any one of the following</i> )								
6.	MES 304A	Statistics, Environmental Modelling and Research Methodology	DSE	4	4	0	3	0
7.	MES 304 B	Green Eco-Technologies	DSE	4	4	0	3	0
8.	MES 304C	MOOCs and Internship based Skill Enhancement	DSE	4	4	0	3	0
9.	MES 311A	Elective Practical Lab Work Internal and External ( <b>PRI</b> )	DSC	6	0	12	0	4
10.	MES 311B	Seminar Presentation (Internal) and Synopsis Preparation for Project work(External) ( <b>PRII</b> )	DSE	6	0	12	0	4

## Fourth Semester

S. No.	Subject Code	Course Title	Course Category	Credit	Contact Hours Per week		EoSE Duration (Hrs.)	
					L	P	Thy	P
1.	MES 401	Environmental Impact Assessment	DSC	4	4	0	3	0
2.	MES 402	Environmental Clearance and Environmental Audit	DSC	4	4	0	3	0
Elective I ( <i>Any one of the following</i> )								
3.	MES 403A	Remote sensing & GIS for Environmental Science	DSE	4	4	0	3	0
4.	MES 403B	Integrated Watershed Conservation and Harvesting Techniques	DSE	4	4	0	3	0
5.	MES 403C	Sustainable Development and its Application	DSE	4	4	0	3	0
Elective II ( <i>Any one of the following</i> )								
6.	MES 404A	Energy and Environment	DSE	4	4	0	3	0
7.	MES 404B	Industrial Safety, Health and Environmental Management	DSE	4	4	0	3	0
8.	MES 404 C	Human-Wildlife Conflict and Management	DSE	4	4	0	3	0
9.	MES 411A	Elective Practical Lab Work Internal and External ( <b>PR I</b> )	DSC	6	0	12	0	4
10.	MES 411B	Research Dissertation work Submission (Internal) and Presentation (External) ( <b>PR II</b> )	DSE	6	0	12	0	4

Departments will offer minimum three and maximum five theory elective courses for the semester based on options submitted by students and availability of Faculty to teach the course.

### **Credit Numbers:**

SEMI

**28**

SEM II

**28**

SEM III

**28**

SEM IV

**28**

## **COURSE DETAILS:**

### **Semester I**

#### **PAPER I(101): ECOLOGY AND ECOSYSTEMS**

**Duration :3 hrs.**

**Max. Marks : 70**

**Note: There will be two parts in end semester theory paper.**

**Part A of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.**

**Part B of the paper will consist of four questions one question from each unit with internal choice. Each question will carry 14 marks.**

**Objective:** The study of Ecology and Ecosystem provides interactions among living things and their environment. It also provides new understanding of these vital systems as they are now, and how they may change in the future. It also helps to understand the ecosystem, population and community ecology, its relevance for the environmental segments and factors and how to apply the fundamentals of ecology for forming the foundation of ecological theories.

#### **UNIT -I**

**Ecosystem** – Concept of Ecosystem, Levels of Organization, Structure and functions of ecosystem - abiotic and biotic components, food chain, food web; The Energy flow in Ecosystems - Laws of thermodynamics, biogeochemical cycles of nitrogen, carbon, phosphorus, sulphur. Primary and secondary productivity. Ecological pyramids, Ecotypes, Ecospecies, Niche, Keystone species, invasive species, Ecotone, Edge effect.

#### **UNIT -II**

**Ecology and Ecological factors:** Ecology as an interdisciplinary subject, Types of ecology, Structure and Composition of atmosphere, hydrosphere, lithosphere and biosphere. Climatic and edaphic factors, Laws of limiting factors – Liebig's law of minimum, Shelford's law of tolerance.

#### **UNIT -III**

**Population and Community:** Population characteristics, population regulation– biotic potential and environmental resistances (r and k selections); Factors of population regulation – density dependent and density independent; and carrying capacity; genecology, Community Characteristics. Interactions- Co-evolution, Neutralism, symbiosis, commensalism, mutualism, antagonism, antibiosis, parasitism, predation; competition- inter and intra specific.

#### **UNIT -IV**

**Introduction of Types of Ecosystem:** Structure, types and characteristics of Terrestrial and aquatic ecosystem (Marine, freshwater, grassland, desert). Concept of Artificial or Man Made Ecosystem.

#### ***Reference Books***

1. Concepts of Ecology; Kormondy Edward J; Pearson Education;4<sup>th</sup> Edition 2017
2. Fundamental Processes in Ecology: An earth Systems Approach; David M. Wilkinson; OUP Oxford. 2007
3. Principles of Terrestrial Ecosystem Ecology; F. Stuart Chapin, III; et.al.; Springer: 2012 edition
4. Fundamentals of Ecology; Eugene Odum; Cengage: 5 edn. 2017
5. Ecology and Environment; PD Sharma; Rastogi Publications: 13 edn. 2017

# Semester I

## PAPER II (102): BIODIVERSITY AND CONSERVATION

Duration :3 hrs.

Max. Marks :70

**Note:** There will be two parts in end semester theory paper.

**Part A of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.**

**Part B of the paper will consist of four questions one question from each unit with internal choice. Each question will carry 14 marks.**

**Objective:** It helps to understand about the variety of life on Earth at all its levels, from genes to ecosystems, and can encompass the evolutionary, ecological, and cultural processes that sustain life. Generate a skilled postgraduate who can research in the field of Biodiversity, Wildlife biology, and nature conservation. Develop critical and analytical thinking for decision-making in biodiversity and wildlife management.

### UNIT-I

**Forest:** Forest ecosystem goods and services, Global distribution of forests and forest types in India, Succession, Bio-geographic regions of India, Forestry - Social forestry - farm forestry, urban forestry, community forestry, Commercial Forestry.

### UNIT-II

**Biodiversity:** Definition, Types of diversity and significance, criteria and measurement of biodiversity, factors affecting biodiversity, IUCN Criteria of endangerment, Red Data Books. Endemism.- Mega biodiversity nations, Hotspots of biodiversity.

### UNIT-III

**Biodiversity Conservation Strategies:** in-situ conservation through participatory conservation, Protected Area network - National Parks, sanctuaries, biosphere reserves, sacred groves; ex-situ conservation – Zoological Parks, Botanical Gardens, gene pools, Role of biotechnology, IN-vitro, Gene banks, cryopreservation and institutions(NBPGR). Wildlife of India Valuation of Biodiversity.

### UNIT-IV

**Biodiversity Conservation Efforts:** Intellectual Property Rights, Bioprospecting, Biopiracy. Convention on Biological Diversity, Biosafety protocols, CITES, World Heritage sites, National Biodiversity strategy and Action Plan.

### *Reference Books*

1. Biodiversity Conservation and Phylogenetic Systematics: Roseli Pellens & Philippe Grandcolas: Springer: 1 edn. 2016
2. An Advanced Textbook on Biodiversity: Principles and Practice: KV Krishnamurthy; Oxford and IBH Publishing Co Pvt Ltd.: 2018
3. Biodiversity: MN William; CBS 2019
4. Textbook of Biodiversity; KV Krishnamurthy; CRC Press; 1 edn. 2003

# Semester I

## PAPER III(103): ENVIRONMENTAL POLLUTION AND HEALTH

Duration :3 hrs.

Max. Marks :70

**Note:** There will be two parts in end semester theory paper.

**Part A** of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.

**Part B** of the paper will consist of four questions one question from each unit with internal choice. Each question will carry 14 marks.

**Objective:** It provides a good approach to individuals to explore environmental issues related to climate changes, mass pollution of water, air and soil, and engage them in problem solving, and take action to improve the environment. Students can also understand present environmental pollution and their impact at national and international conventions. In addition, knowledge of various control measures adopted for the abatement of pollution.

### UNIT-I

**Air Pollution:** Atmospheric composition and stratification. Sources of pollutants, classification – criteria and specific pollutants. Effects of air pollution on plants, human health, materials and ecosystems. Air quality Index and air quality standards, Air pollutant dispersion, Plume behavior, Temperature inversion, Lapse Rate and Stability, Wind Rose.

### UNIT-II

**Water Pollution:** Sources, species and water quality parameters, Organic and inorganic pollutants, Eutrophication, heavy metals, Bioaccumulation, Biomagnifications, Bio-indicators, Transport of pollutants in aquatic ecosystems. Characteristics of domestic, industrial and agricultural effluents, their effects, Waterborne diseases. **Thermal Pollution:** Sources, Effects of pollution on human and animals.

### UNIT-III

**Soil Pollution:** Sources of Soil pollution - industrial effluents, fertilizers, pesticides, heavy metals, waste disposal, Detrimental effects of soil pollutants on flora, fauna and ground water.

### UNIT-IV

**Noise and Radiation Pollution:** Sources, sound pressure level, noise-spectra-octave bands, noise-monitoring-sound level meter, frequency weighting net-works, equivalent continuous noise level and other noise indices, Effects of noise pollution on human and animals, Permissible standards, **Radiation Pollution :** Sources and Effects on human and animals.

### ***Reference Books***

1. Environmental Chemistry; Air Pollution: O. Hutzinger; Springer; 2013
2. Environmental Pollution Control Engineering; C.S. Rao; New Age International: 2018
3. Water Pollution: Concerns, Concepts and Analysis: Sheryl McMillan; Callisto Reference; 2015
4. Soil Pollution: From Monitoring to Remediation; Armando C. Duarte et. al.; Academic Press, 1 edn. 2017
5. Noise Pollution and Its control: KJ Polak; CBS Publishers: 2020

# Semester I

## PAPER IV (104): ENVIRONMENTAL ISSUES: REGIONAL AND GLOBAL

Duration :3hrs.

Max. Marks :70

**Note:** There will be two parts in end semester theory paper.

**Part A** of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.

**Part B** of the paper will consist of four questions one question from each unit with internal choice. Each question will carry 14 marks.

**Objective:** It helps scholars to develop a deeper understanding of environmental issues and have the skills to make informed and responsible decisions. Provide an alternate avenue for students to specialize as “environmental entrepreneurs” in areas such as environmental audits, Environmental Education etc.

### UNIT-I

**Global Issues:** Acid rain and its effects on ecosystems (flora, fauna and human beings). Ozone layer depletion, causes and consequences of Ozone depletion, CFCs. Heat Budget of the Earth, Green House Effect, global warming- causes and impact of global warming, Climate change, Carbon Sequestration.

### UNIT-II

**Population:** Population explosion, Malthusian theory, population un-sustainability, population growth, population pyramids, pattern of India population, scale of urbanization, migration trends- rural and urban, Population displacement due to developmental projects. International initiatives on population related issues.

### UNIT-III

**Environment and Human Health:** Hazardous chemicals, pesticides and their impact, polychlorinated biphenyls (PCBs), Lead, mercury, arsenic, cadmium, asbestos, dioxins. Environment and development, Social consequences of development and environmental changes.

### UNIT- IV

**Occupational Health and Industrial Hygiene:** Occupational hazards in industries and other sectors, Safety requirements and Measures, Industrial hygiene and Occupational health- Indian Scenario. Occupational diseases- Pneumoconiosis, Silicosis, Anthracosis, Byssinosis, Bagasosis, Asbestosis, Farmer’s lung, Metal poisoning, Occupational cancer, Occupational dermatitis, Radiation Hazards.

### *Reference Books:*

1. Global Environment; Rosemary Charles; Syrawood Publishing House: 2016
2. Introduction to Population Biology; Dick Neal; Cambridge University Press: 2018
3. Environment and Human Health; Claudio Bini, JaumeBech; Springer: 2014
4. Fundamentals of Industrial Hygiene; Barbara A. Plog; Natl Safety Council: 5 edn. 2001

**SEMESTER-I**  
**PRACTICAL**

**Duration : 4 hrs.**

**(3 hrs per day)**  
**Max. Marks :200**

**Part A**

- Determination of pH in water
- Determination of pH in soil
- Determination of conductivity of water
- Determination of conductivity of soil
- Determination of bulk density
- Estimation of TDS in the water sample
- Estimation of Acidity in the water sample
- Estimation of Alkalinity in the water sample
- Estimation of Chloride in the water sample
- Estimation of Chloride in the soil sample
- Estimation of Free CO<sub>2</sub> in the water sample
- Determination of turbidity of given water sample
- Measurement of noise in silence, industrial, residential and commercial zones.
- Determine the Minimum Size of the Quadrat by Species Area Curve Method and Calculate the Species Frequency, Density and Abundance.
- Calculate Importance Value Index (IVI) of species.
- Analysis of soil microflora by dilution plate method, study of rhizospheric and rhizoplane microbes.

**Part B**

Preparation of a Ecology File Comprising of the Following Topics

- Major biomes of the World
- Hotspots of Biodiversity in the World
- Important Environmental Organizations (National and International)
- National Parks, Sanctuaries and Biosphere Reserves of India
- Preparation of Green File
- Preparation of Seminar report on different topics

# Semester II

## PAPER I (201): WASTE MANAGEMENT

Duration:3 hrs.

Max. Marks: 70

**Note:** There will be two parts in end semester theory paper.

**Part A** of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.

**Part B** of the paper will consist of four questions one question from each unit with internal choice. Each question will carry 14 marks.

**Objective:** It provides an understanding about the direct consequence of human activity, shortage of natural resources, and use of technology in waste management.

### UNIT-I

**Solid Wastes:** Types of wastes – Municipal and industrial wastes, domestic waste; agricultural waste. Solid waste characterization: Integrated Solid waste Management; Waste reduction at source, volume reduction, Collection techniques/Methods and Transport of solid waste. Recycling, treatment and disposal techniques. Landfill –land-filling methods and operation. composting, vermi-composting.

### UNIT-II

**Hazardous Waste:** Classification, nature and characteristics of hazardous waste, techniques of hazardous waste treatment, disposal of hazardous waste.

### UNIT-III

**Nuclear Waste** –Classification of nuclear waste. Concentration and Containment at Storage Site including at deep underground facilities, Delay for Decay of short lived radio nuclides, Dilution & Dispersion of residual waste;

### UNIT-IV

**Biomedical Wastes:** Types of solids, liquids, sharps, blood and blood tissue, nuclear medicinal wastes; segregation and designated storage of biomedical wastes. Transport of medical waste: Authorization and accidental spilling reporting; biomedical waste treatment and disposal methods: Incineration.

### Reference Books

1. Integrated Solid Waste Management: George Tchobanoglous et. al., Mac Graw Hill Education: 2014
2. Biomedical waste Management: R. Radhakrishnan; Sumit Enterprises: 2007
3. Hazardous waste Management; JM Dewan, KN Sudarshan: Discovery Publishing Pvt. Ltd. 2008
4. Nuclear and Hazardous Waste Management; N K Malhotra; Sumit Enterprises; 2007
5. Nuclear Waste Management; Er L K Thakur; Indian Books and Periodicals; 2019



## Semester II

### PAPER II (202): ENVIRONMENTAL POLICIES, LEGISLATIONS AND ETHICS

Duration: 3 hrs.

Max. Marks: 70

**Note:** There will be two parts in end semester theory paper.

**Part A of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.**

**Part B of the paper will consist of four questions one question from each unit with internal choice. Each question will carry 14 marks.**

**Objective:** It helps to learn laws related to protect land, air, water, and soil. Advocate a particular viewpoint to protect the environment and prevent environmental degradation.

#### UNIT-I

**Environmental Policy:** National Environmental Policy, National Policy on EIA and Regulatory framework, Rajasthan State Environmental issues and policy framework. Constitutional Provisions (Article 21, 48A, 51A), Role of Ministry of Environment & Forests.

#### UNIT-II

**Acts, Rules and Regulations:** Acts, rules and amendments thereof - Wildlife (Protection) Act 1972, Water (Prevention and Control of Pollution) Act 1974, Central and State Pollution Control Boards; Forest Conservation Act 1980, Environment (Protection) Act 1986. Air (Prevention and Control of Pollution) Act 1981; Bio-Medical Waste (Management & Handling) Rules, 1998 and its amendments; Transboundary Movement Rules, 2008.

#### UNIT-III

**Environmental Treaties and Conventions:** Evolution and development of International Environmental laws with reference to Stockholm Conference on Human Environment, 1972, Montreal Protocol, 1987, Basel Convention (1989, 1992), Earth Summit at Rio de Janeiro, 1992, UNEP, GEF, UNFCCC, Kyoto Protocol, Copenhagen Summit 2009. UNCCD, Rio +10, Ramsar Convention.

#### UNIT-IV

**Environmental Ethics:** Value education, individual, community, corporate social responsibility. Movements related to Environment –Bishnoi tradition, Chipko movement, Tehri dam, Sardar Sarovar, Narmada dam, Almatti dam, Silent Valley. Role of NGOs. Environmentally Significant Days.

### *Reference Books*

1. Environmental economics and Policy: Lynne Lewis and Tom Titenberg: Routledge: 7 edn. 2019
2. Environmental policy, Implementation and Enforcement: Neil Hawke; Routledge: 1 edn. 2019
3. International Conventions on Protection of Humanity and Environment: Gunter Hoog; DE Gruyter: Reprint 2020 edn.
4. The Oxford Handbook of Environmental Ethics; Stephen M. Gardiner; Allen Thompson; Oxford University Press: 2016

# Semester II

## PAPER III (203): ENVIRONMENTAL CHEMISTRY

Duration :3 hrs.

Max. Marks :70

**Note:** There will be two parts in end semester theory paper.

**Part A** of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.

**Part B** of the paper will consist of four questions one question from each unit with internal choice. Each question will carry 14 marks.

**Objective:** It involves the study of the effects that chemicals have on the air, water and soil and how they impact the environment and human health. Students gain knowledge about the theoretical basis and observational methods for the study of chemical species present in the environment and understand the interactions of varied spheres of environment

### UNIT-I

**Fundamentals of Environmental Chemistry:** Elements and organics and radio nuclides in nature, Stoichiometry, Gibbs' energy; chemical potential; chemical equilibria, chemical kinetics, oxidation- reduction potentials (ORP). Solubility of gases in water, carbonate system, Absorption, adsorption- isotherms, Vanderwaals forces, ion bonding.

### UNIT-II

**Atmospheric Chemistry:** Major and Trace gases in the atmosphere; Natural and manmade sources. Chemical process of formation of inorganic and organic particulate matter Thermo-chemical and photochemical reactions in the atmosphere. Role of hydrocarbons, oxides of sulphur and nitrogen, halogens in the atmosphere; Chemical speciation.

### UNIT-III

**Chemistry of Aquatic Environment:** Physical and chemical properties of water and their environmental significance, concept of oxygen demand -DO, BOD, COD; TDS, pH, conductivity, Colloids, Salinity, Chemical speciation in aquatic environment.

### UNIT-IV

**Soil Chemistry:** Physico-chemical characteristics of Soil, soil clays, organic carbon, soil humus and mineralization, cation exchange capacity, soil water solution, Nitrogen pathways, C/N ratio, NPK in soil, soil acidity, soil salinity.

### *Reference Books*

1. Chemistry for Environmental Engineering and Science: Clair N. Sawyer et. al., MC. Graw Hill Education: 2017
2. Environmental Chemistry: Stanley Manahan: CRC Press: 10 edn. 2017
3. Chemistry of Atmosphere; Richard P. Wayne; OUP Oxford: 3 edn. 2000
4. Soil Chemistry: Daniel G. Strawn et.al. , Wiley-Blackwell: 5 edn. 2020

# Semester II

## PAPER IV (204): ENVIRONMENTAL DISASTERS AND MANAGEMENT

Duration :3 hrs.

Max. Marks: 70

**Note:** There will be two parts in end semester theory paper.

**Part A of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.**

**Part B of the paper will consist of four questions one question from each unit with internal choice. Each question will carry 14 marks.**

Objective: It helps the students to understand how to anticipate, absorb and adapt to such events. This paper introduces the connections between the state of the environment and disaster risk, and identifies areas of action.

### UNIT- I

**Disaster-** Concept, definition, and classification of disasters, Rapid onset and slow onset disasters, Hydrology. Changes in Coastal zone, coastal erosion, beach protection. Coastal erosion due to natural and manmade structures.

### UNIT- II

**Floods and Cyclones:** Trends in climatology and meteorology, causes, nature and frequency of flooding, Hazards associated with flooding. Flood forecasting. Flood management, Integrated Flood Management and Information System (IFMIS), Flood control. Types of wind forces, Coriolis Effect, Structure and nature of tropical cyclone. Droughts: Causes, impacts and mitigation.

### UNIT- III

**Earthquakes:** Nature and responses to geo-hazards, Causes and characteristics of ground-motion, Seismic activities ,earthquake scales, magnitude and intensity, earthquake hazards and risks, Tsunamis – causes and physical characteristics.Volcanic land forms, eruptions, early warning from satellites, risk mitigation and training, Landslides and avalanches.

### UNIT- IV

**Mitigation Efforts:** UN draft resolution on Strengthening of Coordination of Humanitarian Emergency Assistance, International Decade for Natural Disaster Reduction (IDNDR), Policy for disaster reduction, problems of financing and insurance.

### *Reference Books:*

1. Environmental Disasters, Natural Recovery and Human Responses; Roger del Moral et.al., Cambridge University Press: 2007
2. Environmental Disasters (Let's Explore Science); Shirley Duke; Rourke Educational media: 2018
3. Earthquakes: Seymour Simon: Harper Collis: 2006
4. Improving Disaster Resilience and Mitigation- IT Means and Tools; Horia- Nicolai Teodorescu et. al., Springer: 2014

## **Semester II PRACTICAL**

**(3 hrs per day)**

**Max. Marks: 200**

**Duration: 4 hrs.**

### **Part A**

- To study principle, components and working operation of Fine Dust Sampler for sampling & assessment of TSPM level in the ambient air.
- Sampling and Analysis of SO<sub>2</sub>, NO<sub>2</sub>
- Plot Wind Rose diagram to summarize meteorological condition.
- Study of plume behavior in relation with wind velocity in your surrounding area.
- Estimation of Total Hardness in the water sample
- Estimation of Calcium, Magnesium Hardness in the water sample
- Determination of Dissolve Oxygen & Biological Oxygen Demand (BOD) – (3 Day 28<sup>0</sup>C or 5 day 20<sup>0</sup>C)
- Determination of Chemical Oxygen Demand (COD)
- To determine moisture content, pH and conductivity of solid wastes sample.
- Determination of water holding capacity of soil
- Study of soil texture.
- To determine the ash content and organic carbon content of given material.
- Determination of Dust Retaining Capacity of plants (APT index)

### **Part B**

- Data on the various methods of handling and transport of hospital wastes in the city.
- A visit to normal and secured landfill site, biological composting/vermi-composting
- Preparation of Green File
- Preparation of Seminar report on different topics

# Semester III

## PAPER I (301): INSTRUMENTATION FOR ENVIRONMENTAL MONITORING AND ANALYSIS

Duration:3 hrs.

Max. Marks :70

**Note:** There will be two parts in end semester theory paper.

**Part A of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.**

**Part B of the paper will consist of four questions one question from each unit with internal choice. Each question will carry 14 marks.**

**Objective:** It helps to learn measure of air, soil, noise, dust, vibration and water, establishing environmental parameters and determining whether the levels comply with those outlined in relevant legislation and guidance. Students learn the fundamental instrumental techniques and evaluation of data quality that are part of their environmental projects.

### UNIT-I

**Sampling Methods:** Sampling methodologies for Air, Water, Soil Noise. Sampling protocols- Selection of sites, Time and frequency for sampling. Preservation, Storage and Handling of samples.

### UNIT-II

**Analytical Instruments:** Principles, working and applications of High volume sampler, Respirable Sampler, Cyclones, Particle Size Analyser, Gas Analysers, Spectrophotometer (UV-Visible), Flame Photometer, Atomic Absorption spectrophotometer (AAS).

### UNIT-III

Chromatography: Principles, working and applications of Gas Chromatography (GC), HPLC, Ion chromatography and Size – exclusion Chromatography

### UNIT-IV

**Radiation Detectors and Monitors:** Principles and working of radiation detectors- gas filled, scintillation(inorganic and organic) and semiconductor. Principles and working of Alpha Counter, Beta Counter, Gamma-ray Spectrometer, Liquid scintillation Counter, Beta-Gamma survey meters, Alpha, Beta and Gamma contamination Monitors.

#### ***Reference Books***

1. Environmental Instrumentation and Analysis Handbook Hardcover – Illustrated, by Randy D. Down, Jay H. Lehr, Wiley-Interscience; 1st edition, 2004
2. Instrumental Methods of Chemical Analysis. Atwal,G.R.,and Anand,S.K. Himalaya Publishing House, Delhi: 2007.
3. Environmental Chemistry, De, A.K. New Age International, New Delhi: 2000.
4. Introduction to the environmental monitoring instruments, Jian-Feng Wang, Jian-Feng Tian, Xian-Qun Zeng, Res. Astron. Astrophys, 2020
5. Environmental Impact Assessment: Theory and Practice, M. Anji Reddy, BS Publications/BSP Books: 2019

## Semester III

### PAPER II (302) : ENVIRONMENTAL BIOREMEDIATION PROCESS AND TECHNOLOGY

Duration :3 hrs.

Max. Marks :70

**Note:** There will be two parts in end semester theory paper.

**Part A** of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.

**Part B** of the paper will consist of four questions one question from each unit with internal choice. Each question will carry 14 marks.

**Objective:** It provides the knowledge about the use of living micro organisms and technology to degrade the environmental contaminants into less toxic forms.

#### UNIT-I

Basic Concept of bacteria, fungi, algae, Protozoa and viruses. Use of microorganisms in bioremediation of soil and oil spills. Bio - fertilizers, Rhizobium, Azotobactor, Nitrogen fixation, vermin-technology and vermin-composting. Xeno-biotics, biodegradation of harmful (toxic) organic pollutants-pesticides, chloroaromatic compounds and benzene.

#### UNIT-II

PCB and its degradation, Integrated treatment system for biodegradation of Polychlorinated biphenyls (PCBs) Enzymes contributing to industrial sustainable development. Starch processing, detergents, textile, leather, pulp and paper manufacture, Industrial ecology

#### UNIT – III

Biodegradation of halogenated hydrocarbons; polycyclic aromatic hydrogen; Pesticides and Detergents. Applications of microbes in removal of heavy metals and other contaminants from water and soil.

#### UNIT-IV

**Biotechnology for Management of Resources:** Role of environmental biotechnology in management of resources; Reclamation of wasteland; Biomass production; Biogas and biofuel production, Microorganisms in mineral and energy recovery, Nanotechnology for control of pollution.

#### *Reference Books*

1. Environmental Bioremediation Technologies, S.N. Singh, R. D. Tripathi Springer Science & Business Media: 2007.
2. Applied Bioremediation and Phytoremediation, Ajay Singh, Owen P. Ward, Springer Science & Business Media: 2004
3. Environmental Biotechnology: Concepts and Applications, Hans-Joachim Jördening, Josef Winter, Wiley Publication: 2006
4. Pepper, I.L. and Gerba, C.P. Environmental Microbiology - Laboratory Manual. Elsevier, USA: 2005
5. Basic Biotechnology Ratledge, C. and Kristiansen, B.. 2nd ed. Cambridge University Press, Cambridge: UK. 2002.

# Semester III

## PAPER III: ELECTIVE PAPER (MES 303A)

### POLLUTION CONTROL TECHNOLOGY

**Duration : 3 hrs.**

**Max. Marks :70**

**Note: There will be two parts in end semester theory paper.**

**Part A of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.**

**Part B of the paper will consist of four questions one question from each unit with internal choice. Each question will carry 14 marks.**

**Objective:** It provides knowledge on specific methodology of the traditional sciences and their technological applications in order to describe and solve specific environmental problems.

#### UNIT-I

**Air Pollution Control:** Air quality. Stack emission monitoring. Air Quality Monitoring Programme. Preliminary information required for planning an air quality survey; Control of air pollutants: General methods of control of Gaseous pollutants- scrubbers, condensers, control equipment for particulate matter-gravity settling chambers, cyclone, fabric filters, electrostatic precipitators, Hybrid Filter (Combination of ESP and Bag House).

#### UNIT-II

**Control Technology for Drinking Water:** Water quality standards. Treatment for Clean Water: Water Treatment Plant Procedures- Pre-treatment, Primary- flocculation, settling, filtration, reverse sand filter, cleaning, secondary biological methods of treatment Tricking filters, rotatory biological contactors, oxidation ponds.

#### UNIT-III

**Physico-Chemical Treatment:** Tertiary treatment methods; chlorination, chemical oxidation, Membrane filtration processes (RO, Microfiltration, Ultrafiltration, nanofiltration) and adsorption using various materials, UV treatment. Sludge treatment and process.

#### UNIT-IV

**Soil Treatment Technologies:** Methodologies for soil conservation, conservation of arable land, techniques of reclamation and restoration of soil, wasteland reclamation, soil salinity management, Biochar for soil remediation.

#### ***Reference Books***

1. Practical Methods for Water and Air Pollution Monitoring, Bhargava, S. K. New Age International Pub., New Delhi: 2008.
2. Textbook of Air Pollution and Its Control. Bhatia, S.C. Atlantic Pub., New Delhi. 2007.
3. Industrial Air Pollution Monitoring, Gaseous and Particulate Emissions, Clarke, Andrew G.Springer. 2008.
4. Municipal Water and Wastewater Treatment. Kumar, R and Singh, R.N. Capitol Pub. Co., New Delhi. 2006.

# Semester III

## PAPER III - ELECTIVE PAPER (MES 303B)

### ENVIRONMENTAL GEOSCIENCES

**Duration : 3 hrs.**

**Max. Marks :70**

**Note: There will be two parts in end semester theory paper.**

**Part A of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.**

**Part B of the paper will consist of four questions one question from each unit with internal choice. Each question will carry 14 marks.**

#### **Objectives**

- Understand fundamentals of geosciences and the evolution of earth and its interiors
- Understand the geological processes and related hazards, geological division, physical geology of India
- Understand primary mineralogy and mining processes
- Understand the impacts of mining on the environment and human health

#### **UNIT I**

**Introduction of Earth:** and its position in the solar system, the evolution of the earth through ages, Earth's Interiors with the details of layers (core, mantle, and crust); Earth systems, Physical features of the earth, Rocks types and classification

#### **UNIT II**

**Geological division of India:** Northern mountains and northern plains, Peninsular plateau, coastal plains and islands, Principles of geomorphology and landforms related to aeolian, fluvial, glacial, and lacustrine processes.

#### **UNIT III**

**Volcanoes:** Plate Tectonics, Earthquake, Tsunami, Landslide, Mass wasting, Mudflow, Avalanches, Glacier outburst Flood (GLOF)

#### **UNIT IV**

**Water Cycle and Terminology:** Classification of aquifers and confining layers, hydraulic properties & Hydraulic conductivity, water table and piezometric surface, Mining, Tunnelling, Exploration and Exploitation; Mining related environmental concerns

#### **Reference Books:**

1. An Introduction to Geology. Salt Lake Community College. Johnson, C., Matthew, D., Affolter, P.I., & Mosher, C. 2017
2. Fundamentals of Geophysics. William L. Cambridge university Press: William L. 2012
3. A Textbook of Geology; Mahapatra G. B. 2019
4. Physical Geology, Monroe, J.S. & R. Wicander; 4th edition. Brooks/Cole Pacific Grove CA, 2001
5. Introduction to Environmental Geology, Keller, E.A. 4th Edition. Prentice Hall of India. 2007



**Semester III**  
**PAPER III -ELECTIVE PAPER (MES 303C)**  
**ISO CERTIFICATION AND ENVIRONMENTAL MANAGEMENT SYSTEM**

**Duration: 3 hrs.**

**Max. Marks: 70**

**Note: There will be two parts in end semester theory paper.**

**Part A of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.**

**Part B of the paper will contain four questions one question from each unit with internal choice. Each question will carry 14 marks.**

**Objective:** identifying and controlling the environmental impact of its activities, products and services. Continually improving its environmental performance.

To enhancement of environmental performance, fulfilment of compliance obligations and achievement of environmental objectives.

**UNIT I:**

Environmental Management and Standardization Environmental management standards: a common framework for environmental management in business. Historical links between environmental management, International Organization for Standardization (ISO).

**UNIT II:**

Introduction and Implementation of ISO 14001 The introduction and implementation of ISO 14001: planning, implementation and operation, checking, management review, etc.

**UNIT III:**

ISO 14000 and ISO 14001 Environmental Policy, Planning, Implementation and Operation, Checking, Management Review, advantages and disadvantages of ISO 14000 certification, product-oriented standards and process oriented standards.

**UNIT IV:**

OHSAS 18001 Structure and responsibility, training, awareness, competence, communication  
Environmental management system documentation, operational control, monitoring and management

**Reference books:**

- 1.Environmental Impact Assessment. Canter, L. McGraw hill Book Company, New York. 2nd Edition. 1996.
- 2.Environmental Risks and Hazards. Cutter, S. L.; Prentice Hall of India, New Delhi. 1999.
- 3.Introduction to Environmental Impact Assessment. Glasson, J.Therivel, R.and Chadwick, A. Routledge, London: 2006.
- 4.Environmental Management. Kulkarni, V. and Ramachandra, T.V. Capitol Pub. Co. New Delhi. 2006.
- 5.Methods of Environmental Impact Assessment. Morris, P. and Therive 2ndEdition, SponPress London: 2001.

# Semester III

## PAPER IV- ELECTIVE PAPER (MES 304A)

### STATISTICS, ENVIRONMENTAL MODELLING AND RESEARCH METHODOLOGY

Duration :3 hrs.

Max. Marks :70

**Note:** There will be two parts in end semester theory paper.

**Part A** of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.

**Part B** of the paper will consist of four questions one question from each unit with internal choice. Each question will carry 14 marks.

**Objective:** It focuses on the application of statistics to the analysis and solution of environmental problems, and the development of technical designs for research studies.

To deliver top-notch statistical information that enhances our understanding of the environment, aids evidence- based policy- and decision-making, and provides pertinent information to the general public and specific user groups.

#### UNIT-I

**Statistical Analysis:** Sampling, Data collection and recording. Central tendency – concept; arithmetic mean, mode, median for ungrouped and grouped data. Measures of dispersion: absolute and relative measures; range, standard deviation (grouped and ungrouped data), variance, quartile deviation, coefficient of variability. Skewness, Kurtosis;

#### UNIT-II

**Probability and Tests of Significance:** Probability - normal, poisson and binomial, Statistical Methods: Hypothesis testing, significance and correlation. Correlation. Linear models and regressions. Pearson and other correlation coefficients. Distribution- Normal, t and chi square test.

#### UNIT-III

**Environmental Model Approaches:** Approaches to development of models; linear simple and multiple regression models; models of population growth and interactions: Lotka-Volterra model, Leslie matrix model, Point source stream pollution model, Box model, Gaussian plume model.

#### UNIT-IV

**Research Methodology:** Basic principles of research design, execution and reporting; Concept of research articles, research papers, reviews, scientific popular articles, Preparation of synopsis and research report writing, Concept of Research Ethics and its Basic Principles.

#### *Reference Books*

1. Basics of Biostatistics, Kulkarni, A.P. CBS Publishers: 2ndEdition 2019
2. Introduction To Biostatistics And Research Methods Rao, P.S& S.S. PHI Learning Pvt. Ltd.; 5th edition 2012
3. Introduction to Environmental Modeling, William G. Gray, Genetha A. Gray; Cambridge University Press: 2016
4. Research Methodology: Methods and Techniques, Kothari C. R. & Garg G. NEW AGE Publication: 4<sup>th</sup> Edition, 2019

**Semester III**  
**PAPER- ELECTIVE PAPER (MES 304B)**  
**Green Eco-Technologies**

Duration :3 hrs.

Max. Marks :70

**Note: There will be two parts in end semester theory paper.**

**Part A of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.**

**Part B of the paper will consist of four questions one question from each unit with internal choice. Each question will carry 14 marks.**

Objective: This paper introduces students to the concept of green technology, its goals and advantages. It also highlights potential role of green technologies in realizing the goal of sustainable development and focuses on community participation to tap the economic benefits associated with switching to green technologies.

### **Unit-I**

Definition, concept and perspective, Eco-designing, green technology, green energy, green economy, and green chemistry; sustainable consumption of resources for social welfare and sustainable development, Agrochemicals, Microorganism presence, Energy metabolism versus co metabolism; paradigm shift from 'cradle to grave' approach. Agenda of green development; reduction of ecological footprint;

### **Unit-2**

Eco-farming: Perspectives, Food sovereignty regarding rural livelihood, smarter food production and yield, Eco engineering technology, Bio composting, Green Building, Biosensitizer Eco-technology, Odourless self-flushing bio toilets. ; LEED certified building; Bio-fuel production - Urban waste to energy conversion - Biomass energy programme in India

### **Unit-3**

Ecomark certification, Green planning: role of governmental bodies, land use planning, concept of green cities, waste reduction and recycling in cities, public transportation for sustainable development, green belts, Green Inhibitor: Environmental green inhibitor

### **Unit-4**

Applications of green technologies Increase in energy efficiency: cogeneration, motor system optimization, oxy-fuel firing, isothermal melting process, energy efficient fume hoods, Eco system dynamics: Restoration of degraded eco system using ecological approach; waste land, mining area, building resilience, role of advancement in science in developing environmental friendly technologies.

### **Reference Books**

1. Green Building Handbook; Woolley, T. & Kimmins, S. (Volume 1 and 2). Spon Press. 2002
2. Green Technologies: For a Better Future. Arceivala, S.L. Mc-Graw Hill Publications: 2014
3. Essential of Ecology and Environmental Sciences, S.V. Rana Prentice Hall of India, New Delhi: 2005
4. Green and Ecological Technologies for Urban Planning: Creating Smart Cities (Advances in Environmental Engineering and Green Technologies) ; Ozge Yalciner Ercoskun; Business Science Reference; 1st edition; 2011

**Semester III**  
**PAPER-ELECTIVE PAPER (MES 304C)**  
**MOOCs and Internship based Skill Enhancement**

**Duration :3 hrs.**

**Max. Marks :70**

**Note: There will be two parts in end semester theory paper.**

**Part A of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.**

**Part B of the paper will consist of four questions one question from each unit with internal choice. Each question will carry 14 marks.**

**Objective:** Learn about environmental initiatives and activities and development of skills required for environmental analysis and monitoring.

Exposure to real environmental problems and assess interests and abilities in their field of studies and Explore career alternatives.

Visit to research laboratories/ academic institutions/industries/NGOs etc. during summer vacations (3-4 weeks). Evaluation will include report submission and presentation based on their visit and work respective laboratories/institutions/industry

**Instructions to the students regarding MOOCs**

1. The courses are circulated on the website <https://swayam.gov.in> in the month of June and November every year for the forthcoming semester.
2. Every student has to pass a selected MOOC course within the stipulated time period. The passing of a MOOC course is mandatory for the fulfillment of the award of the degree.
3. A student has to register for the course for which he/she is interested and eligible which is approved by the department with the help of course coordinator.
4. The student must read all the instructions for the selected course on the website, get updated with all key dates of the concerned course and must inform his/her progress to their course coordinator.
5. The students should note that there will be a weight age of Assessment/quiz etc. and final examination appropriately as mentioned in the instructions for a particular course.
6. A student must claim the credits earned in the MOOC course in his/her mark sheet in the examination branch by forwarding his/her application through the Head of the Department.
7. The student may contact the MOOCs coordinator of the department for any further clarification.

**Semester III  
PRACTICAL  
(3 hrs per day)**

**Duration :4 hrs.**

**Max. Marks :200**

**Part A**

- Determination of Sulphate content in the water sample by Spectrophotometric method.
- Estimation of Nitrate in water sample by Spectrophotometric method.
- Estimation of Phosphorus in water sample by Spectrophotometric method.
- Determination of cations (Na, K, Ca and Mg) in a given water sample by using a Flame photometer.
- Determination of cations (Na, K, Ca and Mg) in a given soil sample by using a Flame photometer.
- Determination of Cation Exchange Capacity of soil.
- Determination of Total Kjeldahl Nitrogen (TKN) in soil samples.
- Determination of Total Organic Carbon of a soil samples.
- Determination of Heavy metals in soil samples.
- Calculation of mean, mode, median, standard error, standard deviation.
- Regression analysis and application of statistical tests in environmental problems.
- Use of Chi-square, F-test and t-test.
- Calculation of Coefficient of Correlation.

**Part B**

- Preparation of Synopsis on different project/dissertation work
- Visit to a national park/any-natural habitat/sanctuary and report preparation for the same.
- Study of rainwater harvesting structure.
- Survey of market for environmental sound products(eco-labeling)
- Visit to a Cement Industry to know about CDM it has followed.

# Semester IV

## PAPER I (401): ENVIRONMENTAL IMPACT ASSESSMENT

Duration :3 hrs.

Max. Marks :70

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.

Part B of the paper will consist of four questions one question from each unit with internal choice.

Each question will carry 14 marks.

**Objective:** It helps to enhance student's problem-solving and decision-making skills for the betterment of environment.

Discuss the implications of current jurisdictional and institutional arrangements in relation to environmental impact assessment. Understand how to liaise with and the importance of stakeholders in the EIA process

### UNIT-I

**Overview of EIA;** Objectives and development of EIA. Benefits of EIA, Indian directions of EIA. Rapid and comprehensive EIA perspectives. Sources and collection of data for EIA.

### UNIT-II

**EIA Methodology:** Outline of EIA process, Screening, Scoping, Purpose of scoping, impact implications, Baseline studies and superimposition of projected plant emission impacts, EIA methodology: checklist, matrices, Overlays and Geographical Information System, Impact analysis and Predictions, Environmental Impact Statement [EIS], cost benefits analysis (CBA), Public hearing as part of EIA.

### UNIT-III

**Environmental Management and ISO Certification:** Environmental Management Systems (EMS), ISO 14000 (EMS). Components of Environmental Management System-Objectives, Policies, Implementation and Review. Life Cycle Analysis –LCA Defining goal and scope, preparation of life cycle inventory.

### UNIT-IV

**Public Participation:** Social impact assessment (SIA), Strategic Environmental Assessment (SEA), Public involvement, Public Hearing compulsion, restoration and rehabilitation methodologies, Mitigation criteria, Project modification, Post project analysis, Overview of CSR, ISO 26000

### *Reference Books*

1. Environmental Impact Assessment Methodologies 3Rd Edition by Anjaneyulu Ceramal Valli Manickam, BS Publications: 2020
2. Methods of Environmental and Social Impact Assessment Peter Morris, Riki Therivel and Graham Wood , Routledge 4Th Edition; 2018
3. Environmental Management, Ajith Sankar, Oxford University Press; Illustrated edition: 2015
4. ISO 14001: 2015 – Environmental Management System (EMS) ‘Beginners Guide’, Mohamed Nazeer Ali, Notion Press; 1st edition 2021

# Semester IV

## PAPER II (402): ENVIRONMENTAL CLEARANCE AND ENVIRONMENTAL AUDIT

Duration : 3 hrs.

Max. Marks: 70

**Note:** There will be two parts in end semester theory paper.

**Part A of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.**

**Part B of the paper will consist of four questions one question from each unit with internal choice. Each question will carry 14 marks.**

**Objective:** Identification of Potential Environmental Impacts: EIA helps to identify potential environmental impacts of a project, such as air and water pollution, soil erosion, deforestation, and biodiversity loss. The main purpose is to assess impact of the planned project on the environment and people and to try to abate/minimise the same.

The purpose of an environmental audit is to: assess the nature and extent of the risk of harm to human health or the environment.

### UNIT-I

**EIA Notification:** EIA in Indian context, EIA Notification 2006, Prior environmental clearance requirements, EIA authority - State and Central government, Committees for Environmental Clearance, Application for EC, Form 1- contents. Categorization of projects, list of projects, activity, financial overlays, conditions and specifications.

### UNIT-II

**Project types:** General idea, categorization criteria important considerations/features developmental projects – river valley project, mining, cement industry, thermal power, pulp and paper industry, Road /highway construction.

### UNIT-III

**Reports for Environmental Clearance:** Generic structure of environmental impact assessment document – Executive summary of Project, Introduction, Project description, Project benefits, Policy legal and administrative framework, Description of Environment, prediction of environmental impacts, evaluation of impacts, Impact evaluation, Environmental Management Plan(EMP),

### UNIT-IV

**Environmental Audit-** objectives, frequency and criteria audit team, Environmental appraisal, accounting and environmental audit. Environmental guidelines for siting of industry, Green Marketing, Global Reporting Initiative Guideline G-3, Green Accounting, Environmental GRI reports

### ***Reference Books***

1. Environmental Impact Assessment, R.R. Barthwal, New Age International Private Limited; 2nd edition; 2012
2. Environmental Impact Assessment, A. K. Shrivastava, APH 2003
3. Environmental Auditing, Neil Humphrey, Mark Hadley EMIS Professional Publishing, 2000
4. Environmental Impact Assessment: Practical Solutions to Recurrent Problems, David P. Lawrence, John Wiley & Sons, Inc. 2003

# Semester IV

## PAPER III ELECTIVE PAPER (MES 403A)

### REMOTE SENSING AND GIS FOR ENVIRONMENTAL SCIENCE

Duration:3 hrs.

Max. Marks:70

**Note:** There will be two parts in end semester theory paper.

**Part A** of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.

**Part B** of the paper will consist of four questions one question from each unit with internal choice. Each question will carry 14 marks.

#### **Objective:**

It Exposing the knowledge of satellite data utilization via GIS and image processing software in environmental studies. Train the students in practical and executable solutions to the challenges of the emergent field of Remote Sensing and GIS.

Apply the fundamental principles for a successful profession and/or for higher technical education based on mathematical, scientific and engineering principles, to solve realistic and field problems that arise in engineering and non-engineering sectors. Students will be installed with ethical feeling, encouraged to make decisions that are safe and environmentally-responsible and also innovative for societal improvement.

#### **UNIT-I**

**Fundamentals of Remote Sensing:** Principles of remote sensing (Optical/Microwave) - principles of Aerial photography, Imaging systems, satellites, sensors, data generation. History of remote sensing. Hyper spectral remote sensing.

#### **UNIT-II**

**Image Interpretation:** Principles of image interpretation, visual image interpretation. Digital image processing- Image enhancement, image rectification, image classification techniques and Accuracy assessment.

#### **UNIT-III**

**Applications of Remote Sensing:** Remote sensing based land use/land cover mapping, remote sensing of vegetation-spectral characters of vegetation, remote sensing of biodiversity applications, remote sensing for climate change studies, remote sensing for flood mapping,

#### **UNIT – IV**

**GIS System:** GIS concepts. Basic concepts of cartography. Data structures - vector and raster data. Data inputting, Data storage, Data editing.

### ***Reference Books***

1. Remote Sensing and GIS, Basudeb Bhatta, OUP India; 3rd edition; 2021
2. Basics Of Remote Sensing And GIS, S. Kumar, Laxmi Publications; First edition; 2016
3. Remote Sensing and GIS for Ecologists, Martin Wegmann, Benjamin Leutner, Stefan Dech, Pelagic Publishing Ltd; 2016
4. Textbook of Remote Sensing and Geographical Information Systems, Kali Charan Sahu Atlantic Publishers & Dist; 2007



# Semester IV

## PAPER ELECTIVE PAPER (MES 403B)

### INTEGRATED WATERSHED CONSERVATION AND HARVESTING TECHNIQUES

**Duration: 3 hrs**

**Max. Marks: 70**

**Note:** There will be two parts in end semester theory paper.

**Part A** of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.

**Part B** of the paper will consist four questions one question from each unit with internal choice. Each question will carry 14 marks.

**Objective:** prevention of soil erosion, regeneration of natural vegetation, rain water harvesting and recharging of the ground water table.

To increase infiltration into soil, to control damaging excess runoff and to manage and utilise runoff for useful purposes”

#### **Unit-I:**

Watershed delineation, Objectives of planning watershed projects, guidelines for project preparation. Gully control, terracing, building check dams, reclamation of soils, Water harvesting- rainwater harvesting and roof water harvesting, Water Harvesting Techniques, Micro-Catchments, Design of Small Water Harvesting Structures.

#### **Unit-II:**

**Watershed Management:** Project Proposal Formulation, Watershed Development Plan, Entry Point Activities, Estimation, Watershed Economics, Watershed Approach in Government Programmes, Evaluation of Watershed Management.

#### **Unit III:**

**Watershed Standard Modeling:** approaches and classification, system concept for watershed modeling, overall description of different hydrologic processes, modeling of rainfall runoff process, Introduction to integrated approach.

#### **Unit-IV**

Quality criteria for groundwater supplies- Drinking and Domestic, Irrigation, and Industrial use, water quality monitoring and preventive measures, Trilinear Plots, Piper, Logrithmic diagram-Schoeller, Mixing diagrams.

#### **Books:**

1. Mainstreaming Gender in Water Management, Resource Guide, Version2 2006.  
<http://www.genderandwaterresourceguide>.
2. Watershed Management; J.V.S. Murthy; New Age International Publication 2nd Edition 2013
3. Managing Water Resources, Policies, Institutions, and Technologies, Ratna V. Reddy and S. Mahendra Dev. Oxford University Press (Ed.), 2006,
- 4.. Global Perspectives on Integrated Water Resources Management: A Resource Kit, Vasudha Pangare, et. al Academic Foundation. 2006
5. Standard methods for examination of water and waste water analysis-APHA-AWWA-WEF.

**Semester IV**  
**PAPER ELECTIVE PAPER (MES 403C)**  
**SUSTAINABLE DEVELOPMENT AND ITS APPLICATION**

**Duration: 3 hrs.**

**Max. Marks: 70**

**Note:** There will be two parts in end semester theory paper.

**Part A of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.**

**Part B of the paper will contain four questions one question from each unit with internal choice. Each question will carry 14 marks.**

**Objective:** The outcomes include conservation of biodiversity, reduced pollution and waste, improved air and water quality, preservation of natural resources, and the promotion of sustainable land use practices.

**UNIT I: Principles of Sustainable Development and Environmental Economics:** History and emergence of the concept of Sustainable Development: Introduction to WTO and International Trade, Environmental Trade Barriers, Green GDP, Natural Resource Accounting, Green Accounting, Environmental GRI reports

**UNIT II:**

**Indian Environmental Scenario:** State of Environment in India: State of India's Environment Report by CSE and MOEF, State Government Environmental Status Reports, social insecurity, Industrialization. Environmental Compliance Status of Industries, State of the Environment in major cities, Quality Standards of CPCB, State Governments and WHO, Globalization and Environment.

**UNIT III: Environmental Organizations, Conferences and Socio-Economic Sustainable Development Systems:** Green Peace Movement, WWF, UNEP, NFCCC, UNCED – 1992 (Stockholm Conference, Earth Summit, world earth summit), Montreal Protocol, World Business Council For Sustainable Development (WBCSD), WRI, GRI, World Bank, Socio-economic policies for sustainable development, Cost Benefit Analysis.

**UNIT IV: Corporate Social Responsibility (CSR)**

Definition of CSR, History & evolution of CSR, The Triple Bottom-line Approach, Philanthropy – Conventional and Strategic Concept of Charity, Corporate philanthropy, Corporate Citizenship, Ethical and Governance issues, Human Rights – UN Charter, Dow Jones Sustainability Index / FTSE4GOOD Index

**Reference Books:**

1. Sustainable Development- Issues and Perspectives; R.N Pati and Odile Schwarz-Herion; D. K. Print world Pvt. Ltd.; 2007
2. Concepts of Environmental Management for Sustainable Development; M.C. Dash; Dreamtech Press; 2019
3. Economics Of Sustainable Development; Sabanna Talwar; Global Research Publications; 2012
4. Environmental Issues & Sustainable Development; Arjun Gope, Abhijit Sarkar ,Prasamita Sarkar, and Santanu Majumder; Notion Press; 2019

**Semester IV**  
**PAPER IV ELECTIVE PAPER (MES 404A)**  
**Energy and Environment**

**Duration: 3 hrs.**

**Max. Marks :70**

**Note: There will be two parts in end semester theory paper.**

**Part A of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.**

**Part B of the paper will consist of four questions one question from each unit with internal choice. Each question will carry 14 marks.**

**Objective:** It helps to create public awareness and knowledge about renewable energy resources and their benefits.

Understand the effect of the implementation of environmental technologies and policies on sustainable energy usage. Learn related global and national issues and to recognize suitable energy resources.

**UNIT-I**

**Non-renewable Sources of Energy:** Fossil fuels-classification, composition, physico-chemical characteristic and energy content of coal, petroleum and natural gas. Gross-calorific value and Net-calorific value. Mining and uses of coal, oil and natural gas. Environmental impact of extraction, processing and smelting of minerals, recycling and recovery of resources.

**UNIT-II**

**Renewable Sources of Energy:** Solar energy- Sun as a source of energy; solar radiation and its spectral characteristics, Harnessing of solar energy, Solar collectors, solar heaters, dryers, photovoltaic, solar ponds: Wind energy- harnessing of wind energy, wind mill; Generation of hydropower, tidal energy, ocean thermal energy conversion; Geothermal energy, Magneto-hydrodynamic power;

**UNIT-III**

**Alternate Energy Resources:** Fission and fusion, Nuclear fuels – mining and processing of Uranium, concentration, Nuclear reactors, Bioaccumulation, Impact on environment. Bio-energy- energy from biomass and biogas, anaerobic digestion. Hydrogen as fuel.

**UNIT-IV**

**Environmental Implications:** Environmental implications of energy use; energy use pattern in India and the world, Renewable energy potential in India, emissions of CO<sub>2</sub> in developed and developing countries including India, Impact of large scale exploitation of solar, wind, hydro and other renewable energy sources.

***Reference Books***

1. Energy and Environment, V K Ahluwalia The Energy and Resources Institute (TERI); 2019
2. Energy, the Environment, and Sustainability, Efstathios E. Michaelides, CRC Press; 2018
3. Sustainable Energy and Environment: An Earth System Approach, Sandeep Narayan Kundu, Muhammad Nawaz, CRC Press; 2020
4. Fundamentals And Applications Of Renewable Energy; Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala; McGraw Hill; 2020

**Semester IV**  
**PAPER- ELECTIVE PAPER (MES 404B)**  
**Industrial Safety, Health and Environmental Management**

**Duration: 3 hrs.**

**Max. Marks : 70**

**Note:.** There will be two parts in theory paper.

**Part A of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.**

**Part B of the paper will consist four questions one question from each unit with internal choice.**

**Each question will carry 14 marks.**

**Objective:** Maintaining a focus on occupational health and health surveillance where required. Provide an effective system of work related injury and illness rehabilitation.

The objective of Environmental Management Plan (EMP) is to formulate measures, which will:

1. Mitigate adverse impacts on various environmental components, 2. Protect environmental resources where possible, 3. Enhance the value of environmental components where possible.

### **UNIT- I**

**Occupational Safety, Health and Environmental Safety, Management** – Principles & practices, Role of Management in Industrial Safety, Organization Behavior Human factors contributing to accident. Planning for Safety: Planning: Definition, purpose, nature, scope and procedure. Management by objectives and its role in Safety, Health and Management (SHE)

### **UNIT-II**

**Monitoring for Safety, Health & Environment:** Occupational Safety, Health and Environment Management System, Bureau of Indian Standards on Safety and Health: 14489 – 1998 and 15001 – 2000, ILO and EPA Standards. Principles of Accident Prevention: Definition: Incident, accident, injury, dangerous, occurrences, unsafe acts, unsafe conditions, hazards, oversight, mistakes etc.

### **UNIT-III**

**Education, Training and Employee Participation in Safety:** Element of training cycle, Assessment of needs. Training methods and strategies types of training. Competence Building Techniques (CBT), Concept for training, safety as a on-line function. Employee Participation: Purpose, areas of participation, methods, Role of trade union in Safety, Health and Environment Protection.

### **UNIT-IV**

**Management Information System:** Sources of information on Safety, Health and Environment Protection. Compilation and collation of information, Analysis & use of modern methods of programming, storing and retrieval of MIS for Safety, Health and Environment. QCC HS Computer Software Application and Limitations.

### **References:**

1. Lees' Loss Prevention in the Process Industries: Hazard Identification, Assessment and Control, Frank Lees, Butterworth-Heinemann Publisher, 4 Edition, 2012
2. Safety and Health for Engineers, Roger L. Brauer, Wiley Publisher, 3 Edition 2016.
3. Industrial Safety, Health and Environment Management Systems, R.K. Jain and Prof. Sunil S. Rao; 2000.
4. Safety, Occupational Health and Environmental Management in Construction, S.C.Sharma and Vinit Kumar, Khanna Publishers, 2013

**Semester IV**  
**PAPER ELECTIVE PAPER (MES 404C)**  
**Human-Wildlife Conflict and Management**

**Duration: 3 hrs.**

**Max. Marks: 70**

**Note: There will be two parts in end semester theory paper.**

**Part A of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.**

**Part B of the paper will contain four questions one question from each unit with internal choice. Each question will carry 14 marks.**

**Object:** This paper deals with the conflicts that have arisen as a result of shrinkage of wildlife habitats and the same being shared by human communities. It raises questions about the moral obligations of humans, need for conservation, and social impacts of conflicts. The paper aims at introducing the students to the scientific and social perspective of conservation.

**Unit 1:** Evolution of the concept of wildlife management Journey of mankind from predator to conservator; prehistoric association between wildlife and humans: excerpts from rock edicts; Bishnoi community; understanding wildlife management, conservation and policies regarding protected areas, The role of government, wildlife biologists and social scientists, concept of deep and shallow ecology.

**Unit 2:** Wildlife conservation laws in India Need of environmental management; philosophy of wildlife management; Types of protected areas, 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 act 1927, Environmental Protection Act 1986, and Forest conservation Act 1920; introduction of Tiger task force.

**Unit 3:** Socio-economic and legal basis of conflicts Concepts of development and encroachment, Impact of conflict on humans and wildlife, impact of habitat fragmentation, introduction to tribal rights in India, demographic profile of tribes in India, importance of forest produce to tribal populations, Forest dwellers (Recognition of forest right) Act, 2006: Keoladeo National park conflict of Bharatpur, Human and elephant conflicts of Kerala, Fisherman and tiger conflict of Sundarbans forest.

**Unit 4:** Human wildlife coexistence Symbiotic relationship between tribals and forest, forest and development, focus on the inclusive growth of tribes: community participation in forest management, case study of Chipko movement, sacred groves forests, India's Bishnoi community and their conservation practices; ecological economic welfare and development: conservation of indigenous culture and traditions, role of international organizations:

**Reference Books:**

1. People and Wildlife: Conflict and Coexistence. Woodroffe, R. Cambridge; 2005
2. Complexities of conflict: the importance of considering social factors for effectively resolving human-wildlife conflict. Animal Conservation Dickman, A. J. 13: 458-466. 2010.
3. Forest Government and Tribe. Paty, C. Concept Publishing Company. 2007.
4. Textbook Of Wildlife Management; SINGH S. K.; CBS Publisher 3ed. 2020
5. Human conflict and wildlife conservation; Kadambari Sharma; Jnanada Prakashan; 2011

**Semester IV  
PRACTICAL  
(3 hrs per day)**

**Duration :4 hrs.**

**Max. Marks : 200**

**Part A**

- To estimate carbohydrate content in given plant sample.
- To estimate protein content in the given sample.
- Study of morphological changes in plants to detect effect of pollution.
- Estimation of total coliform bacteria in water sample.
- Estimation of heavy metals and Dyes in wastewater sample.
- Estimation of phytoplankton species in given water sample.
- Determination of Total Kjeldahl Nitrogen (TKN) in plant samples.
- Study of biochemical & morphological parameters during pre, peak & post stages of plants.

**Part B**

- Report writing Cost – benefit analysis.
- Environment auditing procedures and report writing.
- EIA of: dam / Industry / Mining exploration/ Housing/ Thermal Power plant/Bridge/ railway tract/ urban city (Visits for EIA preparation) categorized by MOEF and VivaVoce.
- A Project work / Dissertation topic may be allotted by the department

**Dissertation Report Submission Guidelines:**

The dissertation report should contain the followings:

1. Dissertation report will contain a cover page, certificate signed by student and supervisor, table of contents, introduction, Objective, Literature review, methodology, results and discussions conclusion, and references.
  - Paper size to be used should be A-4 size.
  - Font size should be 12 with Times New Roman.
  - Text of the dissertation may be typed in 1.5 (one and a half) space.
  - Print out of the dissertation shall be done on both sides of the paper (instead of single side printing)
  - Total no. of written pages in dissertation report should be 40 to 60.
2. The candidate shall be required to submit three hard bound copies of dissertation along with a soft copy emailed to the department as per the date announced.
3. The candidate will defend her/his dissertation/project work through presentation before the External examiner at the end of semester and will be awarded marks.