

# **ENVIRONMENTAL SCIENCE**

## **SYLLABUS**

**M.Sc.**

**(2020-2022)**

**&**

**M. Phil**

**(2020-2021)**



**SOS IN ENVIRONMENTAL SCIENCE (IGAEERE)**

**JIWAJI UNIVERSITY  
GWALIOR M.P. 474011**

**SESSION: 2020-2022****M.Sc. Environmental Sciences****Choice Based Credit System**

Four Semester Course

Course Structure and Scheme of Examination

**SEMESTER I**

Code (MSES)	Course	C/E/S	L	T	P	Credit	Marks		Total
							IA	EA	
101	Fundamentals of Environmental, Climatic and Soil Science	Core	3	0	0	3	40	60	100
102	Ecology, Biodiversity, Forestry, Wildlife and Their Conservation	Core	3	0	0	3	40	60	100
103	Earth Processes, Hazards and Risk assessment	Core	3	0	0	3	40	60	100
104	Energy and Environment	Core	3	0	0	3	40	60	100
105	Practical I	Core	0	0	3	3	100	-	100
106	Practical II	Core	0	0	3	3	100	-	100
107	Seminar	Core	0	1	0	1	100	-	100
108	Assignment	Core	0	1	0	1	100	-	100
109	Comprehensive Viva-voce (virtual credit)	Core	0	0	4	4	100	-	100

**Total Credit Value: #20+4 (virtual credit)****SEMESTER II**

Code (MSES)	Course	C/E/S	L	T	P	Credit	Marks		Total
							IA	EA	
201	Air, Noise Pollution and Control	Core	3	0	0	3	40	60	100
202	Water, Thermal and Radioactive Pollution	Core	3	0	0	3	40	60	100
203	Hazardous Waste Treatment and Solid Waste Management and Occupational Health	Core	3	0	0	3	40	60	100
204	EIA, EMS and EA	Core	3	0	0	3	40	60	100
205	Practical I	Core	0	0	3	3	100	-	100
206	Practical II	Core	0	0	3	3	100	-	100
207	Seminar	Core	0	1	0	1	100	-	100
208	Assignment	Core	0	1	0	1	100	-	100
209	Comprehensive Viva-voce (virtual credit)	Core	0	0	4	4	100	-	100

**Total Credit Value: #20+4 (virtual credit)**


### SEMESTER III

Code (MSES)	Course	C/E/S	L	T	P	Credit	Marks		Total IA
							IA	EA	
301	Biotechnology , Toxicology and Environmental Management	Core	3	0	0	3	40	60	100
302	Environmental Administration, Law and Judicial Attitude	Core	3	0	0	3			
303	Remote Sensing in Geoenvironmental Science	Generic Elective/ Centric Elective	3	0	0	3	40	60	100
304	Environmental Economics	Generic Elective/ Centric Elective	3	0	0	3	40	60	100
305	Practical I	Core	0	0	3	3	100	-	100
306	Practical II	Core	0	0	3	3	100	-	100
307	Seminar	Core	0	1	0	1	100	-	100
308	Assignment	Core	0	1	0	1	100	-	100
309	Comprehensive Viva-voce (virtual credit)	Core	0	0	4	4	100	-	100

**Total Credit Value: #20+4 (virtual credit)**

**SEMESTER IV**

Code (MSES)	Course	C/E/S	L	T	P	Credit	Marks		Total
							IA	EA	
401	Global Prospects Towards Environmental Ethics and Sustainable Development	Generic Elective/ Centric Elective	3	0	0	3	40	60	100
402	Statistics, Biometry and Research Methodology	Generic Elective/ Centric Elective	3	0	0	3	40	60	100
403	Minor Project/Practical I	Core	3	0	0	3	100	-	100
404	Field work/ Project Work/ Dissertation	Core	0	0	9	9	300		300
405	Seminar	Core	0	1		1	100	-	100
406	Assignment	Core	0	1		1	100	-	100
407	Comprehensive Viva-voce (virtual credit)	Core	0	0	4	4	100		100

**Total Credit Value: #20+4 (virtual credit)****NOTE: Lecture (L): 1 hr = 1 Credit****Tutorial (T): 2 hr = 1 Credit****Practical (P): 2 hr = 1 Credit****Total Core Course: 68 credits****Total Elective: 12 credits****Total Virtual Credits: 16**

## **I SEMESTER**

### **PAPER 101: FUNDAMENTALS OF ENVIRONMENTAL, CLIMATIC AND SOIL SCIENCE**

**Credits – 3, Theory Lectures**

#### **Unit I**

1. Introduction to Environmental Science: definition, objective, scope.
2. Structure and composition of atmosphere.
3. Development and evaluation of the atmosphere; Milutin Milankovitch and Milankovitch cycle;
4. Brief account of Hydrosphere, Lithosphere, Biosphere and Bio-Geo Chemical Cycles
5. James E. Lovelock and Gaia Hypothesis

#### **Unit II**

1. Scale of meteorology: Meteorological parameters pressure, temperature, precipitation, humidity, radiation and wind.
2. Atmospheric stability, inversion and wind roses.
3. Climate of India, Monsoons. El Nino and La Nina and southern Oscillation
4. Weather and folklores on weather forecast.
5. Climate change and corresponding issues.

#### **Unit III**

1. Types of media and their role in environmental communication and education.
2. Different environmental laws and limiting factors.
3. Role of people, Professionals and NGO's in environmental education and Protection.
4. Environmental movements in India.
5. Environment protection faith and religious beliefs.

#### **Unit IV**

1. Soil and Methods of soil formation.
2. Organic and Inorganic constituents of Soil.
3. Physical and Electrochemical properties of soil.
4. Gas and liquid phases in soil.
5. Soil fertility, analysis and economic importance of soil microbes.

#### **Unit V**

1. Soil types of India.
2. Soil erosion and conservation.
3. Green Revolution and adverse effects on Soil.
4. Organic farming, microbes and agriculture.
5. Soil pollution and remedial measures.

#### **Suggested Readings:**

- Miller Raymond W., Gardiner Duane T. 1998: Soil in our Environment.(eight edition).  
Sahai V.N. 1990: Fundamental of Soil.  
Ambasht R.S. & Ambasht P.K. 1992: Environment & Pollution an ecological approach (second edition).  
Santra S.C. January 2016: Environment Science. New Central Book agency Pvt. Ltd. London.  
Keller Edward & Botkin Daniel 1995: Environmental Science Earth as a living planete.

**PAPER-102: ECOLOGY, BIODIVERSITY, FORESTRY, WILDLIFE AND THEIR  
CONSERVATION**

**Credits – 3, Theory Lectures**

**Unit I**

1. Introduction to Ecology, Structure and function of ecosystem.
2. Productivity in Ecosystem, Energy flow and Laws of Thermodynamics.
3. Gibbs Free Energy(concept and application in ecology).
4. Energy models and energy relations in ecosystems.
5. Different environmental laws (Liebig's law of minimum, Shelford's law of Tolerance)

**Unit II**

1. Characteristics of populations.
2. Population: Growth, Interactions and Regulation
3. Limiting factors (Combined concept of limiting Factors and Gause's Principle.)
4. Concept and Characteristics of communities.
5. Community Development.

**UNIT III**

1. Concept of Biodiversity.
2. Global and Indian scenario of Biodiversity.
3. Principles of biodiversity conservation and Agenda-21.
4. Hot spots of biodiversity and Key stone species.
5. Concept of bioprospecting and biodiversity informatics

**UNIT IV**

1. Forest Mensuration.
2. Forest policies, Protection, Regeneration and community participation in forest management.
3. Ecotourism, Green people and Green organizations of the world.
4. Natural range lands-savanna, steppes and other grasslands, wetlands and wood lands with reference to India
5. Forest Protection Laws of India (Pre-Independence and Post-Independence)

**UNIT V**

1. Wildlife habitat and their management, National parks and other prohibited habitats
2. Red data book and endangered species, CITES.
3. Wildlife studies and Research Techniques.
4. Exploitation, Trade and sustainable utilization of wildlife.
5. Biopiracy and Patent protection.

**Suggested Readings:**

- Sharma P.D. 2011: Ecology and Environment.  
Odum E.P. 2009: Fundamentals of Ecology (fifth edition).  
Majupuria T.C. 1989: Wildlife wealth of India (resource & management).  
Maniknandan K. & Prabhu S. 2016: Indian Forestry.  
Khan T.I., DhariN.AI-Ajmi 1999: global biodiversity conservation measures., pointer publishers jaipurindia.

**PAPER 103: EARTH PROCESSES, HAZARDS AND RISK ASSESSMENT**  
**Credits – 3, Theory Lectures**

**UNIT-I**

1. Fundamental Concepts of earth
2. Weathering including weathering reactions,
3. Resources from the earth.
4. Land use pattern in India.
5. Land use management and practices.

**UNIT-II**

1. Hazards in the environment Dimension of Disaster.
2. Tectonic hazards
3. Atmospheric hazards.
4. Hydrological hazards.
5. Biophysical hazards.

**Unit III**

1. Introduction to risk assessment.
2. The elements of human health and risk assessment.
3. Risk Characterization
4. Applications of risk assessment
5. Future directions in risk assessment.

**Unit IV**

1. The concept of disaster as a product of hazard and vulnerability.
2. Disaster risk management concept areas for action and components.
3. Risk analysis concepts goals and products.
4. Bhopal gas tragedy and disaster analysis.
5. Nuclear power plant disaster and its safety management.

**Unit V**

1. The chemistry of hazardous material.
2. Safety management practices for laboratory.
3. RCRA act and waste analysis plan.
4. Hazard communication.
5. Process technology and hazard analysis.

**Suggested Readings:**

Santra S.C. January 2016: Environment Science. New Central Book agency Pvt. Ltd. London.

Killer Edward & Botkin Daniel 1995: Environmental Science Earth as a living planet.

OHSAS 18001 and 18000: Occupational Health and safety.

Murthy D.B.N.2008:Disaster management text and case studies.

Deep and deep publications pvt.ltd.new delhi.

Daniel A. Cowl and Joseph F. Louvar, Chemical Process safety- Fundamentals with Applications (Publisher Prentice Hall)

**PAPER-104: ENERGY AND ENVIRONMENT**  
**Credits – 3, Theory Lectures**

**UNIT I**

1. Energy Fundamentals and Units. Definitions of Energy, Work and Power; Energy Source, Resource and Reserves.
2. Energy cycle and environmental effects.
3. Global and Indian Energy Scenario (Conventional and Non- Conventional)
4. Grass root solutions in energy conservation.
5. Sustainable energy development in India.

**UNIT II**

1. Fossil fuel : oil ,coal , natural gas ,shale ,tar sands sources, Exploration ,exploitation ,environmental consequences
2. Fuels use in Urban and Rural Society.
3. Modern Energy Sources and Challenges.
4. Physic-Chemical Characteristics and Energy Content of Coal, Petroleum and Natural Gas.
5. Flow of Energy.

**UNIT III**

1. Solar energy and insulation, active and passive solar system, photo voltaic cells.
2. Solar and its spectral characteristics.
3. Solar energy collection.
4. Solar photo applications.
5. Green buildings and their applicability.

**UNIT IV**

1. Wind energy, conversion, collectors and applications.
2. Hydraulic source of energy-hydroelectricity, ocean energy, ocean thermal electric conversion.
3. Geothermal energy-source applications, advantages and disadvantages.
4. Nuclear energy: Nuclear fission nuclear fusion and nuclear minerals nuclear fuel cycle ,nuclear fuel production
5. Energy audit, Energy accounting & analysis.

**UNIT V**

1. Energy plantations.
2. Energy from biomass, biomass conversion technology.
3. Biomass gasification.
4. Anaerobic digestion.
5. Biogas technology (Methanogenesis)

**Suggested Readings:**

Rai G.D. 2015: Non Conventional Energy Resources.

Santra S.C. January 2016: Environment Science. New Central Book agency Pvt. Ltd. London.

Reddy Sudhakara B.1998:Urban energy systems .,concept publishing company, new Delhi.





**PRACTICAL PAPER: 105**  
**Credit 3**

**Atmosphere**

1. Study of Meteorological Parameters: Temperature, Precipitation, Relative Humidity, Wind Velocity, Wind Direction, Atmospheric Pressure, Light Intensity

**Energy**

1. Field work on Urban Energy usage
2. Field work on Rural Energy use pattern
3. Electricity generation through Photovoltaic Cell (Solar Educational Kit)
4. Installation and working of Solar module
5. Practical implications of solar energy
6. Practical applications of wind energy
7. Biomass conversion technologies
8. Energy auditing and preparation of Audit report

**Soil**

1. Soil sample collection and sample preparation
2. Study of soil profile, colour, temperature, pH and EC
3. Determination of mechanical composition of soil (Soil Texture) by simple wetting technique
4. Determination of soil density and porosity
5. Estimation of soil moisture content and water holding capacity (WHC)
6. Determination of presence of Carbonate, Bicarbonate and Nitrate
7. Determination of Organic Carbon
8. Determination of Nitrogen, Phosphorus and Potassium level in the soil

**Examination Pattern**

**S.O.S. in Environmental Science, Jiwaji University, Gwalior**

M.Sc. 1<sup>st</sup> Semester

Paper 105  
Credit 3

Time 4 hrs.

S. No.	Topics	Marks	
		Final	internal
1	Experiment related to Meteorological data	12	8
2	Experiment related to Energy	12	8
3	Determination of physical and chemical composition of given sample(s) <ul style="list-style-type: none"><li>• Physical Parameter (1)</li><li>• Chemical Parameter (1)</li></ul>	12	8
4	Identify and Comment upon the spots 1 to 5	6	4
5	Practical Record	12	8
6	Viva-voice	6	4
	<b>Total</b>	<b>60</b>	<b>40</b>

**NOTE:** At least 60% of the practical listed to be performed during the semester.



**PRACTICAL PAPER: 105**  
**Credit 3**

**Atmosphere**

1. Study of Meteorological Parameters: Temperature, Precipitation, Relative Humidity, Wind Velocity, Wind Direction, Atmospheric Pressure, Light Intensity

**Energy**

1. Field work on Urban Energy usage
2. Field work on Rural Energy use pattern
3. Electricity generation through Photovoltaic Cell (Solar Educational Kit)
4. Installation and working of Solar module
5. Practical implications of solar energy
6. Practical applications of wind energy
7. Biomass conversion technologies
8. Energy auditing and preparation of Audit report

**Soil**

1. Soil sample collection and sample preparation
2. Study of soil profile, colour, temperature, pH and EC
3. Determination of mechanical composition of soil (Soil Texture) by simple wetting technique
4. Determination of soil density and porosity
5. Estimation of soil moisture content and water holding capacity (WHC)
6. Determination of presence of Carbonate, Bicarbonate and Nitrate
7. Determination of Organic Carbon
8. Determination of Nitrogen, Phosphorus and Potassium level in the soil

**Examination Pattern**

**S.O.S. in Environmental Science, Jiwaji University, Gwalior**

M.Sc. 1<sup>st</sup> Semester

Paper 105  
Credit 3

Time 4 hrs.

S. No.	Topics	Marks	
		Final	internal
1	Experiment related to Meteorological data	12	8
2	Experiment related to Energy	12	8
3	Determination of physical and chemical composition of given sample(s) <ul style="list-style-type: none"><li>• Physical Parameter (1)</li><li>• Chemical Parameter (1)</li></ul>	12	8
4	Identify and Comment upon the spots 1 to 5	6	4
5	Practical Record	12	8
6	Viva-voice	6	4
	<b>Total</b>	<b>60</b>	<b>40</b>

**NOTE:** At least 60% of the practical listed to be performed during the semester.



**PRACTICAL PAPER: 106**

**Credit 3**

**Forestry and Ecology**

1. Quadrates
  - a. Determination of frequency
  - b. Determination of Dominance
  - c. Determination of Density
  - d. Determination of Basal Area
  - e. Determination of Abundance
  - f. Determination of IVI
  - g. Calculation of Biodiversity Index
2. Canopy Cover
3. Tree Height
4. Profile Diagram
5. Phenology
6. To study the Biotic components of Pond Ecosystem
7. Estimation of Benthos population density

**Wildlife**

1. Wildlife census through direct evidence by Line Transect, Point Count, Capture-recapture techniques
2. Population estimation through indirect evidences
3. Preparation of pug marks
4. Identification of wild animals and description of their habitats, putting photos, slides or stuffed animals

**Examination Pattern**

**S.O.S. in Environmental Science, Jiwaji University, Gwalior**

M.Sc. 1<sup>st</sup> Semester

Paper 106

**Credit 3**

**Time 4 hrs.**

S. No.	Topics	Marks	
		Final	Internal
1	Experiments related to Forestry	12	8
2	Experiments related to Ecology	12	8
3	Experiments related to Wildlife	12	8
4	Identify and Comment upon the spots 1 to 5	6	4
5	Practical Record	12	8
6	Viva-voice	6	4
	<b>Total</b>	<b>60</b>	<b>40</b>

**NOTE :** At least 60% of the practical listed to be performed during the semester.

## II SEMESTER

### PAPER-201: AIR, NOISE POLLUTION AND CONTROL

Credits – 3, Theory Lectures

#### Unit I

1. Air pollution, sources and types.
2. Pollution dispersion models.
3. Pollutant behavior in the atmosphere.
4. Smog, Acid rain, cause consequences and control.
5. Greenhouse effect and ozone depletion.

#### Unit II

1. Indoor air pollution.
2. Effects of air pollutants on ecosystem.
3. Importance of maintaining air quality for environment.
4. Air quality standards (CPCB and WHO) and management.
5. Control of air pollution.

#### Unit III

1. Introduction to automobile pollution.
2. Exhaust emission and their measurement, Emission control technology (Novel Metals and Catalytic Converters)
3. Emission legislation.
4. Environmental effects of automobile pollution.
5. Compressed Natural Gas and other upcoming technology.

#### Unit IV

1. Noise pollution Definition and classification
2. Noise exposure level standards.
3. Measurement of noise and sound pressure level
4. Impact of noise on human health
5. Noise control and abatement measures

#### Unit V.

1. Atmospheric reactions and secondary pollutants.
2. Effects of meteorological parameters on transport and diffusion of air pollutants.
3. Wind effects (planar wind motion, synoptic wind motions, land sea breeze, Micro scale wind motions)
4. Atmospheric stability (temperature lapse rates, inversion plume types).
5. Air quality impact assessment.

#### Suggested Readings:

Dey A.K. 1980: Environmental Chemistry.  
Sharma B.K. 2014: Environmental Chemistry.  
Deshwal S. & Deshwal A.: Environmental Study.  
Santra S.C. January 2016: Environment Science. New Central Book agency Pvt. Ltd. London.  
Mido Y., Satake M., Iqbal S.A., Sethi M.S. 2010: Environmental Chemistry.  
B. D. Sharma Air Pollution

## PAPER-202: WATER, THERMAL AND RADIOACTIVE POLLUTION

Credits – 3, Theory Lectures

### Unit I

1. Sources and types of water pollution.
2. Water pollutants: types, sources, heavy metals, metalloids and organics
3. Chemistry and Biology of water contaminants.
4. Water quality parameters; criteria and standards.
5. Various method of Water Sampling for Surface and Ground Water

### Unit II

1. Types of wastewater and their characteristics
2. Physical and Chemical treatment of water
3. Biological Wastewater Treatment
4. Membrane filtration processes.
5. Nanotechnology in water treatment.

### Unit III

1. Principle of ground water flow.
2. Ground water contamination and Control
3. Water shed management and Rain water harvesting.
4. Lake optics, thermal stratification
5. Wet land, conservation and RAMSAR.

### Unit IV

1. Water borne diseases.
2. Clean Water and Sanitation as Human Rights
3. Land treatment system
4. Advance waste water treatment system.
5. Role of aquatic plants in pollution abatement.

### Unit V

1. Thermal pollution, causes control and consequences (Problems and Case Study of Thermal Power Plants)
2. Radioactive pollution, causes control and consequences
3. Marine pollution, causes, control and consequences
4. E-waste, causes and consequences.
5. Desertification causes and control.

### Suggested Readings:

Khan M.A. 2002: Watershed management for sustainable Agriculture.

Drinking water health effects Task Force 1989: Health effects of drinking water treatment technology.

Santra S.C. January 2016: Environment Science. New Central Book agency Pvt. Ltd. London.

Hammer JR., Hammer perez, chadik, 2015: Water supply and pollution control, eighth edition., Indian edition published by person Indian education services pvt. Ltd.

Master M. Gilbert and Wendell P. Ela, Introduction to Environmental Engg. and Science (III Edition) 2007 Pearson, India Pvt. Ltd

**PAPER-203:HAZARDOUS WASTE TREATMENT AND SOLID WASTE MANAGEMENT AND OCCUPATIONAL HEALTH**

**Credits – 3, Theory Lectures**

**UNIT I**

1. Major industrial wastes.
2. The apparel industries (Textiles, Tannery, and Laundry) and material industries (wood, metals, etc.)
3. Food industries: Cannery waste, Dairy, Poultry and Distillery wastes.
4. Sludge: types and techniques
5. Chemical Industries.

**UNIT II**

1. Introduction: Handling & storage to Hazardous materials.
2. Hazardous waste: sources, effects, characterization, sampling and analysis.
3. Risk assessment and hazardous waste management, treatment, storage and disposal.
4. Guidelines for owner/operator/transporter of hazardous waste, storage, treatment and disposal.
5. Responsibilities of the occupiers, generators of hazardous waste and its management.

**UNIT III**

1. Engg. Methods of Solid Waste Management in Sanitary Land Fills.
2. Waste separation, storage and disposal and Waste minimization.
3. Waste Reduction, Recycling and Recovery of materials.
4. Integrated municipal solid waste management.
5. Biomedical waste management.

**UNIT IV**

1. Wealth from wastes.
2. Municipal waste water treatment and energy recovery.
3. Integrated solid waste management
4. Environmental and health impact assessment of waste management
5. Plastic waste management

**UNIT V**

1. The people issue in construction, safety and health.
2. Construction, safety and health programme of UN with special reference to India.
3. Industrial hygiene activations in construction.
4. Personal protections equipment.
5. Safety Management.

**Suggested Readings:**

Gilbert M. Masters 2007: Environmental Engineering & Science, Third Edition.

George Tchobanoglous, , Frank Kreith 2002: Handbook of solid waste management. Second edition. Publisher Mcgrow hill New York.

Versar, Inc. Camp Dresser & Mc Kee, Inc.1990: Hazardous waste management facilities Directory treatment, storage, Disposal & Recycling, Published by No Yes & Andrews, Inc.



**PAPER-204: ENVIRONMENTAL IMPACT ASSESSMENT (EIA), ENVIRONMENTAL  
MANAGEMENT SYSTEM (EMS) AND ENVIRONMENTAL AUDIT (EA).**

**Credits – 3, Theory Lectures**

**UNIT I**

1. EIA: Introduction, Aims and Objectives
2. NEPA'S concept and Legislative frame work of EIA
3. Guidelines for conducting EIA
4. EIA Methodologies.
5. Procedure for reviewing EIA of developmental projects

**UNIT II**

1. Introduction and legal basis for EIS.
2. Process for preparing EIS and role of public participation
3. Draw backs of EIA
4. EIA notification 2006 with time to time amendments
5. Environmental Audit: definition, objectives, procedure and guidelines.

**UNIT III**

1. Environmental management: problems, reaction and legislation.
2. Environmental Management System (EMS) and Environmental Management Plan (EMP)
3. The integrated approach to Environmental Management. 12 steps to heaven.
4. EMS Audit, Management reviews and preparing environmental operational procedures.
5. Documentation assistance, manual, folders and assistance.

**UNIT IV**

1. ISO 9000: A step towards TQM and Safety Management.
2. ISO 14000: Introduction, Certification and standards.
3. Eco-labeling schemes.
4. Life-cycle analysis, and cost benefit analysis.
5. OHSAS 18000 health and safety.

**UNIT V**

1. Guidelines for Sitting of Industries – Introduction, Site selection, Environmental site clearance, EIA  
Case study of River Valley Development, Coal and Thermal Power Projects
2. Resource Analysis and Baseline information.
3. Classification of Industries
4. Industrial Scenario-Locational Policies.
5. Industrial Policy of Indian and fiscal incentives for environmental protection.

**Suggested Readings:**

- Gilpin A. 1994: Environmental impact assessment. Publisher Cambridge University Press.  
Morgan Richard K. 1999: Environmental impact assessment: A Methodological approach. Publisher Springer  
Science & Business media.  
Adems Edward E. 1995: Total Quality safety management: an introduction American Society of safety engineers.  
Weinstein Michal B. 1997: Total Quality safety management and Auditing Lewis Publishers New York.  
L.W. Canter EIA Latest Edition

**PRACTICAL PAPER: 205**  
**Credit 3**

**Water and Waste Water analysis**

1. Water sampling for Chemical, Bacteriological and Benthos analysis.
2. Study of Physical characteristics of water: Colour, Odour, Turbidity and Temperature
3. Determination of solids: Total Solids, Total Suspended Solid, Total Dissolved Solid, Total Settleable Solid
4. Determination of pH, Conductivity
5. Determination of Dissolve Oxygen
6. Determination of Acidity, Alkalinity, Hardness, Free CO<sub>2</sub>
7. Determination of Chloride, Sulphate
8. Determination of Nitrate, Ammonical Nitrogen, Phosphate
9. Determination of Fluoride
10. Determination of Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand

**Solid Waste, Hazardous Waste Management, and Risk Assessment**

1. Solid waste characterization and segregation techniques
2. Survey of solid waste dumping sites
3. Hazardous waste characterization
4. Techniques of hazardous waste treatment
5. Occupational Safety Assessment
6. Risk assessment study of the following Commercial sites:  
Shopping malls, Petrol Pumps, Offices, Welding shops, Cracker shop
7. Risk assessment study of the following Industrial sites:  
Heavy Industries, Chemical Industries, Mining area, Stone Crusher, Construction sites.
8. Risk assessment study of Hospitals/Nursing homes.
9. Safety practices in Laboratories.
10. Pulmonary function test.

**Examination Pattern**

**S.O.S. in Environmental Science, Jiwaji University, Gwalior**

M.Sc. 2<sup>nd</sup> Semester

Paper 205  
Credit 3

Time 4 hrs.

S. No.	Topics	Marks	
		Final	Internal
1	Determination of physico-chemical composition of given sample(s) <ul style="list-style-type: none"><li>• Physical Parameter (2)</li><li>• Chemical Parameter (2)</li></ul>	16	10
2	Experiments related to solid waste management	10	6
3	Experiments related to hazardous waste management	10	6
4	Identify and Comment upon the spots 1 to 5	6	5
5	Practical Record	12	8
6	Viva-voice	6	5
	<b>Total</b>	<b>60</b>	<b>40</b>

**NOTE :** At least 60% of the practical listed to be performed during the semester.





## PRACTICAL PAPER: 206

Credit 3

### EIA/EMS/EA and Sitting of Industries

Case studies/Field works

1. Preparation of Environmental Impact Assessment report of a given area/scenario
2. Preparation of Environmental Impact Statement report of a given area/scenario
3. Preparation of Environmental Management System for a given institution/industry
4. Preparation of Environmental Audit report of a given institution/industry /scenario
5. Implementation of ISO 9000 (Total Quality Management) for a given institution/industry /scenario
6. Implementation of ISO 14000 and 14001 (Environmental Management System) for a given institution/industry /scenario
7. Plan for how to site an Industry
8. Ecoplanning of an urban area
9. Ecoplanning of rural area

### Air

1. Air sampling for gaseous pollutants and Suspended Particulate Matter (SPM)
2. Analysis of SO<sub>2</sub> in ambient air
3. Analysis of H<sub>2</sub>S
4. Analysis of NO<sub>x</sub>
  - a. In ambient air
  - b. In petrol vehicle exhaust
5. Analysis of CO-CO<sub>2</sub>
  - a. In ambient air
  - b. In petrol vehicle exhaust
6. Determination of Smoke level from diesel vehicle exhaust
7. Analysis of Aerosols

### Noise

1. Noise measurement
2. Noise pollution during festivals

### Examination Pattern

## S.O.S. in Environmental Science, Jiwaji University, Gwalior

M.Sc. 2<sup>nd</sup> Semester

Paper 206  
Credit 3

Time 4 hrs.

S. No.	Topics	Marks	
		Final	internal
1	Report writing of EIA /EMS/EA according to a given scenario	10	6
2	Experiments related to EMS	10	6
3	Determination of physical and chemical composition of given sample(s) <ul style="list-style-type: none"><li>• Particulate and smoke (1)</li><li>• Chemical Parameter of ambient air or vehicular pollutant (2)</li></ul>	16	10
4	Identify and Comment upon the spots 1 to 5	6	5
5	Practical Record	12	8
6	Viva-voice	6	5
	<b>Total</b>	<b>60</b>	<b>40</b>

**NOTE :** At least 60% of the practical listed to be performed during the semester.

### III SEMESTER

#### PAPER-301: BIOTECHNOLOGY, TOXICOLOGY AND ENVIRONMENTAL MANAGEMENT

Credits – 3, Theory Lectures

##### UNIT I

1. Role of Biotechnology in environmental protection.
2. Plant Tissue culture: Principals, methods and its application.
3. Genetic engineering and Genetically Modified Microbes
4. Fermentation, Vermiculture, Mushroom Culture Technology
5. Hydroponics and their role in waste water management.

##### UNIT II

1. Bacterial Metabolism in Wastewater Treatment Systems
2. Aerobic Wastewater Treatment
3. Anaerobic Wastewater Treatment
4. Bioreactors
5. Soil Remediation and Disposal

##### UNIT III

1. Bioabsorption of metals.
2. Biopolymers and Bioplastics.
3. Biofuels and Biodiesel.
4. Biofertilizers and Biopesticides.
5. Bioremediation.

##### UNIT IV

1. Definition, scope, goals and divisions of environmental toxicology.
2. Factors affecting environmental concentration of toxicants.
3. Toxicity of chemical mixtures in environment.
4. Dose, effect, response and dose response relationship.
5. Environmental impact of nanotechnology.

##### UNIT V

1. Membrane permeability & mechanism of chemical transfer .
2. Xenobiotic compounds in the Environment.
3. Degradation of Xenobiotic compounds.
4. Toxicity testing methods ( single and multi - species, acute, sub-acute and chronic toxicity tests).
5. Teratogenicity, Mutagenicity, Carcinogenicity and Environmental Diseases.

##### Suggested Readings:

Kaiser Klaus L.E. 1984: QSAR in environmental toxicology. D. Reidel publishing company.

Landis wayneG., Yuming-Ho 1998: Introduction to environmental toxicology impacts of chemical up on ecological systems, second edition. Levis publishers London new York Washington D.C. .

Thakur Indu Shekhar. 2011: Environmental Biotechnology. (Second edition).

Jördening, H.J. and Winter, J. eds., 2005. Environmental biotechnology: concepts and applications. John Wiley & Sons.

**PAPER-302: ENVIRONMENTAL ADMINISTRATION, LAW AND JUDICIAL ATTITUDE**  
**Credits – 3, Theory Lectures**

**UNIT I**

1. Environmental protection: issues and problems.
2. International and National efforts for environmental protection.
3. Judiciary and Protection of environment.
4. Public policies strategies in Pollution control
5. Environmental legislation

**UNIT II**

1. The water (Prevention and Control of Pollution) Act, 1974 as amended up to 1988.
2. The merchant shipping (amendment) act, 1970.
3. Marine pollution act 1974 (MARPOL 73/78)
4. Judiciary approach and water pollution.
5. Case studies: M.C. Mehta v. Union of India, The Ganga Pollution case, AIR 1988 SC 1115.

**UNIT III**

1. The Air (Prevention and Control of Pollution) Act, 1981 as amended upto, 1987.
2. Motor vehicle Act, 1988.
3. Kolahal Adhiniy 1985.
4. Sanitary Environment: the constitutional and judiciary approach.
5. The e-waste (Management) Rules 2016,

**UNIT IV**

1. Constitutional provisions in India (Article 48A and 51A).
2. Wildlife Protection Act, 1972 with recent amendments.
3. Forest Conservation Act, 1980 – Amended upto 1988.
4. Biological diversity Act 2002 with recent amendments.
5. The Plastic Waste Management Rules, 2016,

**UNIT V**

1. Hazardous waste management and handling rules 1989. Amendments there of 2000.
2. Municipal Solid Waste management and Rules 2000.
3. Environmental law and Public Interest Litigation.
4. Environmental law in the curriculum of legal education.
5. Intellectual Property Right issue.

**Suggested Readings:**

Paras diwan and peeyushidiwan 1997: Environmental administration, law and judicial attitude.  
Deep and deep publication, new delhi.  
Rosedar S.R.A. 2014: Environmental Law, publisher Laxis Nexis; First Edition.  
Shyam Diwan, Arwin Rosencranz New Edition: Environmental law and policy in India: cases, material & statutes;  
publisher Oxford.

## PAPER-303: REMOTE SENSING IN GEOENVIRONMENTAL SCIENCE

### Credits – 3, Theory Lectures

#### Unit - I

1. Basic concepts and fundamental principles of remote sensing, its advantages and limitations
2. EM Spectrum - Nature, Principles and sources
3. Interaction of EMR with atmosphere
4. Interaction of EMR with Earth's surface
5. Spectral response and spectral signature

#### Unit - II

1. Introduction and principles of aerial photography
2. Geometry of aerial photographs
3. Scale of Aerial photographs
4. Types of aerial photographs
5. Elements of Photo interpretation. Obscuring factors in photointerpretation.

#### Unit - III

1. Platforms – Types and their characteristics.
2. Satellites and their characteristics – Geo-stationary and sun-synchronous.
3. Earth Resources Satellites -LANDSAT, SPOT, IRS, IKONOS satellite series.
4. Meteorological satellites – INSAT, NOAA, GOES.
5. Sensors - Introduction and elementary idea about imaging, non-imaging, active and passive sensors.

#### Unit - IV

1. Concept of Resolution – Spatial, Spectral, Temporal, Radiometric.
2. Basic concept and principles of Thermal, microwave and hyperspectral sensing.
3. Basic principles, types, steps and Techniques of visual interpretation and interpretation keys.
4. Multispectral, multispectral and multidisciplinary concepts.
5. Introduction to digital image processing- steps in DIP-Image enhancement Techniques and Image Classification.

#### Unit – V

1. Introduction to GIS (Geographic Information System) – Fundamental concepts.
2. Introduction to Global Positioning System (GPS) – Fundamental concepts.
3. Overview of Application of remote sensing in various branches of geosciences.
4. Application of Remote Sensing in Water resources and Natural Hazards studies.
5. Application of Remote Sensing in solid waste management.

#### Suggested Readings:

- Anji Reddy, M. 2004 : Geoinformatics for environmental management. B.S. Publications  
Campbell, J.B. 2002: Introduction to Remote sensing. Taylor Publications  
Chang, T.K. 2002 : Geographic Information Systems. Tata McGrawHill  
Jensen, J.R. 2000 : Remote Sensing of the Environment: An Earth resource Perspective. Prentice Hall.  
Joseph George, 2003 : Fundamentals of remote sensing. Universities Press  
Lillesand, T.M., and Kieffer, R.M., 1987: Remote Sensing and Image Interpretation, John Wiley.  
Pandey, S.N., 1987: Principles and Applications of Photogeology. Wiley Eastern  
Pratt, W.K. 2004: Digital Image processing. John Wiley  
Sabbins, F.F., 1985: Remote sensing Principles and interpretation. W.H. Freeman and company  
Tar Bernhardsen. Geographical Information Systems. John Wiley.  
Wise S. 2002: GIS Basics. Taylor Publications

**PAPER-304: ENVIRONMENTAL ECONOMICS**  
**Credits – 3, Theory Lectures**

**UNIT-I**

1. Meaning of Environmental Economics.
2. Inter linkages between economics – environment and ecology.
3. Environment quality as a public good.
4. National Income Accounting and Environment.
5. Environmental Problems on Economy.

**UNIT – II**

1. Economic causes of environmental and ecosystem degeneration,
2. Policies for controlling pollution - economical and persuasive.
3. Sustainable industrialization.
4. Sustainable development.
5. Social Cost Benefit Analysis- Methods. Application and Limitations.

**UNIT – III**

1. Environment Impact Analysis (EIA).
2. Environment Impact Statement (EIS).
3. Environment Auditing (E.A.).
4. Salient features of National Environmental Policy 2006
5. The Environment (Protection) Act 1986

**UNIT – IV**

1. Global Environmental Problems- Global Warming, Acid Rains, Deforestation.
2. Impact of Climate Change on Economy.
3. Earth Summits.
4. Constitutional rights and duties regarding environment.
5. Role of State in Environmental preservation.

**UNIT – V**

1. Mineral Resources and Environment (Processing and smelting of minerals)
2. Economies of energy resources.
3. Relation between development and Environmental stress.
4. Trade & Environment.
5. Tragedy of commons and its implications on current environmental issues

**Suggested Readings:**

Perman Yue ma and Mc Gilvray james,1996 natural Recourses and environmental economics,longman London and new York  
M.Karpagam,2004:Environmental economics,Sterling publishers pvt ltd.  
Santra S.C. January 2016: Environment Science. New Central Book agency Pvt. Ltd. London.  
Environmental Economics by Tom Titenberg Latest Edition  
Env. and Resource Economics By Roger Permonn et al. Latest Edition



## PRACTICAL PAPER: 305

### Credit 3

#### Environmental Biotechnology and Toxicology

1. Tissue Culture technologies, effect of environmental agents on tissue culture.
2. Hydroponics.
3. Vermiculture Technology and analysis of the following parameters
  - a. pH
  - b. Electrical Conductivity
  - c. Humus
  - d. Total Phosphorus
  - e. Total Nitrogen
  - f. Organic Carbon
4. Study of microbes in the Water, Air and Soil.
5. LD<sub>50</sub> and LC<sub>50</sub> values of toxicants.
6. Determination of Heavy metals in water.

#### Environmental Laws and Judicial Attitude

1. M.C. Mehta V. Union of India, AIR 1992 SC 382.
2. M/S Narula Dyeing and Printing works V. Union of India, AIR 1995 Guj 185.
3. Rural Legislation and entitlement Kendra-Dehradun V/S State of Uttar Pradesh (1987) Supp. Sec 487 AIR 1987 SC 359, 1986 Supp Sec 517.
4. The Bhopal Gas Disaster case UCC vs UOI MPLJ (1988)540, AIR 1992 SC 248 (1991) 4 SCC 38.
5. Ganga water Pollution M.C. Mehta V/S Union of India Sec 47, April 1988 SC AIR SC 273 (1989)2S CC 540 115. Date of Decision 22.09.1987.
6. Tarun Bhagat Singh V/S Union of India, 1992 Supp (2) SCC 448 at 457, AIR 1992 SC 519.
7. U.P. Pollution Control Board V.M.P. Modi Distillery and other, AIR 1988 Sc 1128.
8. Mandu Distillery Pvt. Ltd. V.M.P. Pradushan Niwaran Mandal, Bhopal, AIR 1995 M.P. 57.
9. Mahavir Soap and Godakhu factory V. Union of India AIR 1995 Ori 218.
10. Satyavan V. AP Pollution Board, AIR 1993 AP 257.

#### Examination Pattern

### S.O.S. in Environmental Science, Jiwaji University, Gwalior

M.Sc. 3<sup>rd</sup> Semester

Paper 305  
Credit 3

Time 4 hrs.

S. No.	Topics	Marks	
		Final	internal
1	Report writing of Risk Assessment study for a given location	8	6
2	Experiments related to Tissue Culture/Hydroponics/Determination of physical and chemical composition of given vermicompost sample(s) <ul style="list-style-type: none"><li>• Physical parameter (1)</li><li>• Chemical Parameter (2)</li></ul>	14	8
3	Experiment related to Microbial Study/ Lethal values/Heavy metals	14	8
4	Identify and Comment upon the spots 1 to 5	6	5
5	Practical Record	12	8
6	Viva-voice	6	5
	<b>Total</b>	<b>60</b>	<b>40</b>

**NOTE :** At least 60% of the practical listed to be performed during the semester.

**PRACTICAL PAPER: 306**

**Credit 3**

**Surveying and Remote Sensing**

1. Calculation of SOI Map lay out number
2. Interpretation of SOI Topographic sheet
3. Map Reading
4. Study of the border information of Aerial photograph
5. Determination of Scale
6. Stereo-test and orientation of Aerial photographs
7. Identification of features from single vertical aerial photograph
8. Study of Topography through stereographs and aerial photographs
9. Preparation of land use map
10. Visual Interpretation of stereo-pair for environmental studies

**Environmental Economics**

1. Economical study and management of following:-
  - a. Biological resources
  - b. Ocean resources
  - c. Water resources
  - d. Mining resources
  - e. Forest resources
2. Origin and composition of sea water, ice sheets and fluctuations of sea levels.
3. Socio. economic and environmental impact of mining.
4. World food supply – agriculture, ecosystem and food production.

**Examination Pattern**

**S.O.S. in Environmental Science, Jiwaji University, Gwalior**

M.Sc. 3<sup>rd</sup> Semester

Paper 306

**Credit 3**

**Time 4 hrs.**

S. No.	Topics	Marks	
		Final	inter nal
1	Experiment related to Survey procedures/Map reading/Aerial photography	12	8
2	Experiments related to Base map preparation/Interpretation of Remote Sensing data	12	8
3	Comment upon a given Environmental Case Study	12	8
4	Identify and Comment upon the spots 1 to 5	6	4
5	Practical Record	12	8
6	Viva-voice	6	4
	<b>Total</b>	<b>60</b>	<b>40</b>

**NOTE:** At least 60% of the practical listed to be performed during the semester.

## V SEMESTER

### PAPER-401: GLOBAL PROSPECTS TOWARDS ENVIRONMENTAL ETHICS AND SUSTAINABLE DEVELOPMENT Credits – 3, Theory Lectures

#### UNIT I

1. Ethics in Environmental management.
2. Totality of environment-Holistic view and ecology to environmental Science
3. Environmental Science on the move.
4. From Stockholm to Rio and Beyond.
5. Nanotechnology: Boon or Threat

#### UNIT II

1. Human Impact on Natural Environment.
2. Terrorism and its impact on human ecosystem.
3. Effects of Nuclear Explosions and Threat of Nuclear Terrorism.
4. Genesis of Biological warfare and current threat.
5. Chemical warfare and chemical weapons convention.

#### UNIT III

1. Water Crisis
2. Food Crisis
3. Biosafety
4. Microplastics and its Issues
5. Global trends in human infectious disease

#### UNIT IV

1. World Trade and environment.
2. Managing global commons.
3. Poverty, Trade, DEBT, and Environment.
4. Intellectual Property Rights (IPR).
5. Economics and ethics: Foundation of a Sustainable future.

#### UNIT V

1. The global environment debate: Global issues and strategies
2. Sustainable Development: brief history and interpretation.
3. Sustainable development in India.
4. Strategies and appropriate Technologies for Sustainable Development.
5. Environmental Accounting.

#### Suggested Readings:

Okour Nawal 2014: Environmental Ethics and sustainable Development; Environmental values & Ethics among Yarmouk University students; Publisher: Lap Lambert  
Engel J. Ronald 1991: Ethics of Environment & Development. Global Challenge, International Response.



**PAPER-402: STATISTICS, BIOMETRY AND RESEARCH METHODOLOGY**  
**Credits – 3, Theory Lectures**

**UNIT I**

1. Introduction.
2. Collection, Tabulation and classification of Statistical Data.
3. Measure of Central Tendencies, Mean, Mode and Median.
4. Geometric mean and Harmonic mean.
5. Measure of dispersion – Standard deviation.

**UNIT II**

1. Calculation of coefficient of correlation in simple series.
2. Linear and Multiple regression.
3. Curve fitting up to second order.
4. Probability and theoretical distribution-addition theorem, multiplication theorem.
5. Binomial, poisson and normal distribution.

**UNIT III**

1. Large samples: relating to attributes, relating to variable differences of means.
2. Small samples: 'f' and 't' test..
3. ANOVA – 1 way classification.
4. ANOVA – 2 way classification.
5. Chi Square test.

**UNIT IV**

1. Concept and method of Research
2. Sources of information on research and relation of research topic.
3. Measurement of Research problem.
4. Use of Sampling and Questionnaires construction for Research.
5. Processing of Research data and preparation of research report.

**UNIT V**

1. Approaches to development of models.
2. Linear, simple and multiple regression models.
3. Lotka-volterra Model and Leslie's matrix model.
4. Point source stream pollution model.
5. Box model and Gaussian plume model.

(Note: Mathematical aspects of statistics and derivations are not included in this syllabus.)

**Suggested Readings:**

Shrivastava N.2009-10: Introductory Biometry: Statistic & Research Methodology; Publisher: Pointer publisher  
Rao Radhakrishna C. : 1974: Advanced Statistical Methods in Biometric Research Collier – Macmillan publisher  
London.



**PRACTICAL PAPER: 403**  
**Credit 3**

Practical / Field Work / Case Studies:

**Global Prospects towards Environmental Ethics and Sustainable Development.**

1. Impact of terrorism on the natural environment - Case study
2. Impact of terrorism on the human ecosystem – Case Study
3. Impact of the human activities on the natural environment – Case Study
4. Environment accounting in different areas
5. Study of level of industrialization
6. Study of physical setting of an area
7. Study of social setting of an area
8. Study of technologies for sustainable development adopted in your area
9. Study of impact of industrialization on local environment
10. Local issues calling for immediate attention

**Statistics, Biometry and Research Process as applied to Environment**

1. Methods and techniques of research
2. Level of research project
3. Problem, selection and research design
4. Questionnaires construction for research
5. Study of collection of data and tabulation
6. Application of standard deviation and standard error
7. Application of Test of Significant
8. Application of ANOVA
9. Application of Chi Square Test

**Examination Pattern**

**S.O.S. in Environmental Science, Jiwaji University, Gwalior**

M.Sc. 4<sup>th</sup> Semester

Paper 403  
Credit 3

Time 4 hrs.

S. No.	Topics	Marks	
		Final	Internal
1	Write comment upon environmental and social impact of Anthropogenic activities/Industrialization/terrorism of a given case study	12	8
2	Experiments related to data interpretation	12	8
3	Experiments related to Standard deviation/Chi square/ANOVA	12	8
4	Experimental design on a given scenario	6	4
5	Practical Record	12	8
6	Viva-voice	6	4
	<b>Total</b>	<b>60</b>	<b>40</b>

**NOTE :** At least 60% for the practical listed to be performed during the semester.



**M. Phil. ENVIRONMENTAL SCIENCE**  
**I SEMESTER**  
**PAPER 101: RESEARCH METHODOLOGY**

**UNIT: I**

1. Basic and applied research.
2. Objective formations.
3. Research design.
4. Literature collection for research.

**UNIT: II**

1. Devices for data collection.
2. Meta analysis, content analysis and historical methods of data collection.
3. Pilot study and pretest of tools.
4. Choice of data collection methods.

**UNIT: III**

1. Bibliography, indexing and literature citation.
2. Publication of paper in journal, proceeding, chapters in book.
3. Preparation of research reports.
4. Publication of research work in online journals.

**UNIT: -IV**

1. Statistical analysis and applications in biology Mean, Mode, Median.
2. Variability: Standard deviation and standard error.
3. Correlation techniques.
4. Analysis of variance (ANOVA), chi square test.

**UNIT: V**

1. Techniques for photography, diagram and graphic presentation.
2. IPR issues, terminology of IPR issues.
3. Status of IPR with reference to India.
4. Copy right issues.

**Suggested Readings:**

Kothari C.R.: Research Methodology (latest edition)  
Mahajan B. K.: Methods in Biostatistics (latest edition)  
Norton P. 2006. Peter Norton's Introduction to Computers, McGraw-Hill  
Goel D., Parashar S.: IPR, Biosafety and Bioethics (latest edition)



**M. Phil. ENVIRONMENTAL SCIENCE**  
**I SEMESTER**  
**PAPER 102: COMPUTER APPLICATIONS**

**UNIT :I**

1. Basics of Computer and its terminology.
2. Input device and output devices.
3. Computer generation and its classification.
4. Basics of operating system (OS), types of OS, some basic terms related to windows OS some basic terms related to windows OS,
5. Computer memory: primary and secondary.

**UNIT:-II**

1. Research publishing Tool-MS WORD,, some basic terms-toolbar, format bar, status bar.
2. Creating, editing and saving a word document, creating a research paper.
3. Use of Auto-text, autocorrect, spelling and grammar tool.
4. Crating a cover letter, table and related operation.
5. Adding graphics with MS Word.

**UNIT-III**

1. MS-Excel introduction to excel, features and functions of spreadsheet in research.
2. Creating spreadsheet and enter data storing.
3. Format worksheet-inserting, removing resizing a column and rows, column freezing, labels, hiding splitting etc.
4. Use formulas and function.

**UNIT-IV**

1. MS Power Point presentation tools.
2. Functions and features of a power Point presentation.
3. Creating presentation, master page, putting animations, showing presentation.
4. Insert-Image, second, video, chart, table, seminar presentation.

**UNIT- V**

1. Introduction to internet and Word Wide Web.
2. Searching on the internet.
3. Literature survey suing web, websites, handling search engines.
4. Virus and its types.
5. Anti-plagiarism software.

**Suggested Readings:**

Norton P. 2006. Peter Norton's Introduction to Computers, McGraw-Hill  
Priti Sinha, Pradeep K., Sinha P.K., Sinha P. Computer Fundamentals (latest edition)  
Kumar B. Mastering MS Office (latest edition)



**M. Phil. ENVIRONMENTAL SCIENCE**  
**I SEMESTER**  
**PAPER 103: GENERAL INSTRUMENTATION**

**UNIT-I**

1. Definition, scope and techniques of instrumentation.
2. Spectroscopy and its types with reference to atomic absorption spectrophotometer.
3. Advance characterization techniques: TEM, SEM-EDX, XRD and BET.

**UNIT-II**

1. General principle, applications and types of chromatography.
2. Advance chromatography techniques: GC, GCMS and its principle, application.
3. General idea about IR and UV-Visible, its application.

**UNIT- III**

1. Principles, types and applications of centrifugation.
2. Flame photometry. Its application in environment.
3. Environmental impact assessment and environmental auditing.

**UNIT-IV**

1. Air samplers: Handy air sample and High-volume air sampler.
2. Environmental pollution act and its regulations.
3. Biomass conversion technology.

**UNIT-V**

1. Remote sensing and its applications.
2. Introduction to geographic information system (GIS).
3. Introduction to geographical positioning system (GPS) and its applications.

**Suggested Readings:**

Sharma B. K.: Instrumental Methods of Chemical Analysis (latest edition)  
Joseph George, 2003 : Fundamentals of remote sensing. Universitit Pre

