

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 BA/B.Com./B.Sc. (Compulsory in Semester III and IV)**

Contents:

1. OBJECTIVES

2. ELIGIBILITY

3. SCHEME OF EXAMINATION

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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 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 mark 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 consisting 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 consisting 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 Ecosystem	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
MES 111 Practical: Based on Theory Paper Max Marks 200						
Experimental work			80	60	200	80
Seminar				60		

M.Sc. II Semester

Nomenclature			External/ Theories	Internal / Theories	Total Max. Marks	Total Mini. Marks
MES 201	Paper I	Occupational Health Safety and 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
MES 211 Practical: Based on Theory Paper Max Marks 200						
Experimental work			80	60	200	80
Seminar				60		

M.Sc. III Semester

Max. Marks Theory Papers: 400

Nomenclature			External/ Theories	Internal / Theories	Total Max. Marks	Total Mini. Marks
MES 301	Paper I	Instrumentation for Environmental Monitoring and Analysis	70	30	100	40
MES 302	Paper II	Environmental Bioremediation Process and Technology	70	30	100	40
MES 303	Paper III	Pollution Control Technology	70	30	100	40
MES 304	Paper IV	Statistics, Environmental Modeling and Research Methodology	70	30	100	40
MES 311 Practical: Based on Theory Paper Max Marks 200						
Experimental work			80	60	200	80
Synopsis Preparation of Minor/ Major Research work				60		

M.Sc. IV Semester

Max. Marks Theory Papers: 400

Nomenclature			External/ Theories	Internal /Theories	Total Max. Marks	Total Mini. Marks
MES 401	Paper I	Environmental Impact Assessment and Sustainable Development	70	30	100	40
MES 402	Paper II	Environmental Clearance and Environmental Audit	70	30	100	40
MES 403	Paper III	Remote sensing & GIS FOR Environmental Science	70	30	100	40
MES 404	Paper IV	Energy and Environment	70	30	100	40
MES 411 Practical: Based on Theory Paper , Max Marks :200						
Experimental work			80	60	200	80
Industrial Training / Minor Research work				60		

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 Ecosystem
MES102-Paper-II: Biodiversity and Conservation
MES103-Paper III: Environmental Pollution and Health
MES104-Paper IV: Environmental Issues: Regional and Global
MES111-Practical: Based on Theory Papers
- **Semester –II**
MES201-Paper-I: Occupational Health Safety and Waste Management
MES202-Paper-II: Environmental Policies, Legislation and Ethics
MES203Paper III: Environmental Chemistry
MES204-Paper IV: Environmental Disasters and Management
MES211-Practical: Based on Theory Papers
- **Semester –III**
MES301-Paper-I: Instrumentation for Environmental Monitoring and Analysis
MES302-Paper-II: Environmental Bioremediation Process and Technology
MES303-Paper III: Pollution Control Technology
MES304-Paper IV: Statistics, Environmental Modeling and Research Methodology
MES311-Practical: Based on Theory Papers
Practical: Synopsis Preparation + Design of r Project work and Its Power point presentation
- **Semester –IV**
MES401-Paper-I: Environmental Impact Assessment and Sustainable Development
MES402-Paper-II: Environmental Clearance and Environmental Audit
MES403-Paper III: Remote sensing & GIS for Environmental Science
MES404Paper IV: Energy and Environment
MES411-Practical: Based on Theory Papers/ Based on Industrial Tanning/ Survey work/Lab work/ Minor Research Work/Project work

Abbreviations Used:

Course Category

CCC: Compulsory Core Course
SEM: Seminar
PRJ: Project Work

Contact Hours

L: Lecture
T: Tutorial
P: Practical or Other
S: Self Study¹²

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.

S. No.	Subject Code	Course Title	Course Category	Contact Hours Per week			EoSE Duration (Hrs.)	
1.	MES 101	Ecology and Ecosystem	CCC	4	2	-	3	0
2.	MES 102	Biodiversity and Conservation	CCC	4	2	-	3	0
3.	MES 103	Environmental Pollution and Health	CCC	4	2	-	3	0
4.	MES 104	Environmental Issues: Regional and Global	CCC	4	2	-	3	0
5.	MES 111	P/SEM/PRJ	CCC	0	0	18	0	4

Second Semester

S. No.	Subject Code	Course Title	Course Category	Contact Hours Per week			EoSE Duration (Hrs.)	
1.	MES 201	Occupational Health Safety and Waste Management	CCC	4	2	-	3	0
2.	MES 202	Environmental Policies, Legislation and Ethics	CCC	4	2	-	3	0
3.	MES 203	Environmental Chemistry	CCC	4	2	-	3	0
4.	MES 204	Environmental Disasters and Management	CCC	4	2	-	3	0
5.	MES 211	P/SEM/PRJ	CCC	0	0	18	0	4

Third Semester

S. No.	Subject Code	Course Title	Course Category	Contact Hours Per week			EoSE Duration (Hrs.)	
1.	MES 301	Instrumentation for Environmental Monitoring and Analysis	CCC	4	2	-	3	0
2.	MES 302	Environmental Bioremediation Process and Technology	CCC	4	2	-	3	0
3.	MES 303	Pollution Control Technology	CCC	4	2	-	3	0
4.	MES 304	Statistics, Environmental Modeling and Research Methodology	CCC	4	2	-	3	0
5.	MES 311	P/SEM/PRJ	CCC	0	0	18	0	4

Fourth Semester

S. No.	Subject Code	Course Title	Course Category	Contact Hours Per week			EoSE Duration (Hrs.)	
1.	MES 401	Environmental Impact Assessment and Sustainable Development	CCC	4	2	-	3	0
2.	MES 402	Environmental Clearance and Environmental Audit	CCC	4	2	-	3	0
3.	MES 403	Remote sensing & GIS FOR Environmental Science	CCC	4	2	-	3	0
4.	MES 404	Energy and Environment	CCC	4	2	-	3	0
5.	MES 411	P/SEM/PRJ	CCC	0	0	18	0	4

COURSE DETAILS:

Semester I

PAPER I(101): ECOLOGY AND ECOSYSTEM

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.

UNIT -I

Ecosystem – concept and function - abiotic and biotic components, food chain, food web; Ecological pyramids Ecological energetics - The Energy flow in Biosphere and in Ecosystems. Laws of thermodynamics, Energy Flow, biogeochemical cycles of nitrogen, carbon, phosphorus, sulphur . Primary and secondary productivity.

UNIT -II

Ecology and Ecological factors: Ecology as an interdisciplinary subject, Structure and Composition of atmosphere, hydrosphere, lithosphere and biosphere. Climatic and soil factors, Laws of limiting factors – Liebig’s law of minimum, Shelford’s law of tolerance. Abiotic and Biotic factors and interactions- Co-evolution, Neutralism, symbiosis, commensalism, mutualism, antagonism, antibiosis, parasitism, predation; competition- inter and intra specific.

UNIT -III

Population and Community: Levels of Organization, 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, Ecotypes, Ecospecies, Niche, Keystone species, invasive species. Community – analytical and synthetic characters; Ecotone, Edge effect.

UNIT -IV

Ecosystem Diversity: Structure, types and characteristics of Terrestrial and aquatic ecosystem (lotic, lentic, grassland, desert,).

Reference Books

Begon, M., Townsend, C. R., and Harper, J. L. *Ecology from Individuals to Ecosystems*. Wiley-lackwell, USA. 2005.

Botkin, Daniel B. and Keller, Edward A. *Environmental Science: Earth as a Living Planet*. 6th ed. John Wiley & Sons, USA, 2007.

Chapman, J. L. and Reiss, M. J. *Ecology: Principles and Applications*. Cambridge University Press, UK., 1998.

Cunningham, W. P. and Cunningham, M. A. *Principles of Environment Science. Enquiry and Applications*. 2nd ed. Tata McGraw Hill, New Delhi, India, 2004.

Kemp, M. J. *Environmental Science*. The McGraw-Hill Companies. 1997.

Nebel, B. J. and Wright, R. T. *Environmental Science*. Prentice Hall.1981.

Odum, E.P. *Fundamentals of Ecology*. W.B. Saunders, USA. Indian Reprint 1996, Natraj Publishers, Dehradun, India, 1991. 7

Odum, E.P. *Ecology: A Bridge between Science and Society*. Sinauer Associates, Inc., USA, 1997.

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 four questions one question from each unit with internal choice. Each question will carry 14 marks.

UNIT-I

Forest: Forest ecosystem goods and services, forest types, succession, forest resources of India, forestry programmes – social forestry, farm forestry, urban forestry, community forestry. Forest fragmentation. Plantations.

UNIT-II

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

UNIT-III

Biodiversity conservation strategies: in-situ conservation through participatory conservation, Protected Area network, biosphere reserves, National Parks, sanctuaries, sacred groves; ex-situ conservation, gene pools, germplasm banks, cryopreservation and institutions(NBPGR). Wildlife of India, Preservation of Breeding Stock; Artificial stocking and Habitat Improvement, Game Farming. Valuation of Biodiversity, Bioprospecting. Biopiracy.

UNIT-IV

Biodiversity Conservation Efforts: Convention on Biological Diversity, Rio Summit +5, Biosafety protocols, World Heritage sites, National Biodiversity strategy and Action Plan for different biogeographic regions, Role of biotechnology, IN-vitro, IPR.

Reference Books

Botkin, Daniel B. and Keller, Edward A. *Environmental Science: Earth as a Living Planet*. 6th ed. John Wiley & Sons, USA. 2007.

Enger, E.D. and Smith, B. F. *Environmental Science: A Study of Interrelationships*. 11th ed. McGraw Hill Inc., USA. 2006.

Frankel, O.H., Brown A.H.D. and Burdon, J.J. *Conservation of Plant Biodiversity*. Cambridge University Press, UK. 1995.

Gadgil, Madhav and Rao, P.R.S. *Nurturing Biodiversity: An Indian Agenda*. Centre for Environment Education, Ahmadabad, India. 1999.

Heywood, V.H. and Watson, R. T. *Global biodiversity Assessment*. UNEP-Cambridge, 1995.

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 four questions one question from each unit with internal choice. Each question will carry 14 marks.

UNIT-I

Air Pollution: Atmospheric composition and stratification Sources, Species of pollutants, classification – criteria and specific pollutants. Effects of air pollution on plants, human health, materials and ecosystems. Synergistic effects of air pollutants. 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, sewage, leachates, eutrophication, heavy metals. Transport of pollutants in aquatic ecosystems. Bioaccumulation, Biomagnification. Bioindicators. Characteristics of domestic, industrial and agricultural wastes, their effects on receiving water bodies, 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 Pollution: Sources, sound pressure level, decibels, intensity, duration, pitch, 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.

Thermal, Radiation and Space Pollution : Sources, Effects of pollution on human and animals.

Reference Books

Baird, C. and Cann, M. *Environmental Chemistry*. W.H. Freeman and Company 2008.

Botkin, Daniel B. and Keller, Edward A. *Environmental Science: Earth as a Living Planet*. 6th ed. John Wiley & Sons, USA. 2007.

Cunningham, W. P. and Cunningham, M. A. *Principles of Environment Science. Enquiry and Applications*. 2nd ed. Tata McGraw Hill, New Delhi. 2004.

Davis, M.L. and Cornwell, D.A. *Introduction to Environmental Engineering*. WCB/McGraw-Hill Publications, ISBN-0-07-115234-2. 1998.

De, A.K., *Environmental Chemistry*. New Age International (P) Ltd. Publishers,

Enger, E.D. and Smith, B. F. *Environmental Science: A Study of Interrelationships*. 11th ed. McGraw Hill Inc., USA. 2006.

Hammer, M.J. & Hammer, M.J. Jr., *Water & Waste Water Technology*. Prentice Hall. 2000.

Kemp, M. J. *Environmental Science*. The McGraw-Hill Companies 1997. Liptak. Environmental engineering. Vol.1,2,3.

McEldowney, S. *Pollution: Ecology and Biotreatment*. Longman Grup. 1995.

Sharma, B.K. *Environmental Chemistry*; Goel Publishing House, Meerut. 2000.

Semester I

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

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.

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. Climate change, global warming- causes and impact of global warming, International initiatives to control global warming.

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-II

Environment and human health: Hazardous chemicals, pesticides and their impact, polychlorinated biphenyls (PCBs), Lead, mercury, arsenic, cadmium, asbestos, dioxins. Environment and development, poverty and environmental degradation, water requirement, Community participation in water conservation, Water harvesting, role of NGOs in environmental protection. Social consequences of development and environmental changes.

UNIT- IV

Natural Resources: Depletion and regeneration of natural resources, Renewable and non-renewable resources, Biotic Resources- fisheries, livestock, Abiotic Resources- Surface and ground water, Energy, non-energy mineral resources, land resources, soil erosion, ecosystem services.

Reference Books:

Botkin, Daniel B. and Keller, Edward A. *Environmental Science: Earth as a Living Planet*. 6th ed. John Wiley & Sons, USA. 2007.

Cunningham, W. P. and Cunningham, M. A. *Principles of Environment Science. Enquiry and Applications*. 2nd ed. Tata McGraw Hill, New Delhi. 2004.

Rajagopalan, R. *Environmental Studies: From crisis to cure*, Oxford University Press, New Delhi

Richards, I. S. *Principles and Practice of Toxicology in Public Health*. Jones and Bartlett Publishers, London. 2008.

Singh, J.S., Singh, S.P. and Gupta, S.R. *Ecology, Environment and Resource Conservation*. Anamaya Publishers, New Delhi, India. 2006.

UNEP. *Global Environment Outlook 3*. Geneva: UNEP, Global Resource Information Division. 2003.

World Commission on Environment and Development (WCED): *Our Common Future*, Oxford University Press, London. 1987.

SEMESTER –I

PRACTICAL

Duration : 4 hrs.

(3 hrs per day)

Max. Marks : 200

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 and Sanctuaries of India
- Biosphere reserves of India
- Study of fauna of local area
- To find out minimum size and number of the quadrat for vegetation study

Estimation of Soil quality and Preparation of Record

- Determination of pH in soil
- Determination of conductivity of soil
- Determination of bulk density
- Estimation of Chloride in the Soil sample

Estimation of Water quality and Preparation of Record

- Estimation of pH in the water sample
- Estimation of Conductivity in the water sample
- 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 Free CO₂ in the water sample
- Measurement of noise in silence, industrial, residential and commercial zones.
- Preparation of Green File
- Preparation of Seminar report on different topics

Semester II

PAPER I (201): OCCUPATIONAL HEALTH, SAFETY AND 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 four questions one question from each unit with internal choice. Each question will carry 14 marks.

UNIT-I

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.

UNIT-II

Solid Wastes and their management : Types of wastes – Municipal and industrial wastes, domestic waste; sewage and sludge; 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 -landfilling methods and operation. composting, vermi-composting, biofertilizers

UNIT-III

Industrial Effluents and their Management:

Wastes from Industries- Oil Refineries, pulp and paper, mining. Collection, segregation, transport, treatment and disposal of effluents. Standards for disposal of treated effluents; Re-cycling and re-use of treated effluents-technologies.

UNIT-IV

Biomedical Wastes and their Management: 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

- Acharya, D.B. and Singh, M. *Hospital Waste Management*. Minerva Press, Delhi. 2003.
Alleman, J. E. and Karanagh, J. T. *Industrial Waste*. Ann Arbor Science.1982.
Bhatia, S.C. *Solid and Hazardous Waste Management*. Atlantic Publishers.2007.
Blackman, W.C. *Basic Hazardous Waste Management*. CRC Press, USA. 2001.
Evans, G. *Biowaste and Biological Waste Treatment*. James and James (Science Publishers) Ltd, U.K. 2005.
Hasan Syed E. *Geology and Hazardous Waste Management*, Prentice Hall, USA, 1996.
Kreith, F. *Handbook of Solid Waste Management*. McGraw Hill Publishers, USA. 22 1999.
LaGrega M.D., Buckingham, P.L. and Evans J.C., *Hazardous Waste Management*, McGraw Hill International Publications, Singapore, 1994 – Revised Edition Available – ISBN 0-07-113454-9.
Moore, J. W. *The changing Environment*. Springer-Verlag. 1986.
Pichtel, J. *Waste Management Practices: Municipal, Hazardous, and Industrial*. CRC Press, USA. 2005.
Shah, K. L. *Basics of Solid and Hazardous Waste Management Technology*. McGraw Hill, USA. 1999

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 four questions one question from each unit with internal choice. Each question will carry 14 marks.

UNIT-I

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

UNIT-II

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

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 and UNFCCC, Kyoto Protocol, 2000, Copenhagen Summit 2009.

UNIT-IV

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

Reference Books

Constitution of India [Referred articles from Part-III, Part-IV and Part-IV-A].

CPCB, 2010, [Revised], *Pollution Control Acts, Rules and Notifications* Issued there under.

Declaration of: The Stockholm Conference, Rio, Rio+5 and Rio+10.

Jaswal, P.S. and Jaswal, N. *Environmental Law*. Pioneer Publications, Delhi. 2003.

Leelakrishnan, P. *Environmental Law in India*. LexisNexis Butterworths Wadhwa, Nagpur. 2005.

Shastri, S.C. *Environmental law in India*. Eastern Book Co, Lucknow. 2008.

The Wildlife [Protection] Act, 1972 [as amended up to 1991, Natraj Publishers, Dehradun, India, 1994.

Tiwari, R. K. *Global Environmental Policies*. A B D Publishers.2007.

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 four questions one question from each unit with internal choice. Each question will carry 14 marks.

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. Chemistry of air pollutants- Thermo-chemical and photochemical reactions in the atmosphere.; Tropospheric oxidation- reduction processes, smog formation; stratospheric and surface ozone. Role of hydrocarbons, oxides of sulphur and nitrogen, halogens in the atmosphere; Chemical speciation.

UNIT-III

Chemistry of Aquatic Environment: Chemistry of water and chemical reactions in aquatic environment; 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, soil acidity, soil salinity.

Reference Books

Baird, C. and Cann, M. *Environmental Chemistry*. W.H. Freeman and Company 2008.

Banerji, S. K. *Environmental Chemistry*. 2nd ed. Prentice-Hall, New Delhi, India.

1999.

De, A. K. *Environmental Chemistry*. 4th ed. New Age International (P) Ltd., New Delhi 2001

Neill, P. O. *Environmental Chemistry*. Chapman & Hall.1985.

Plunkett, E. R. *Industrial Toxicology*. 3rd ed. Edward Arnold (Australia) Pty. Ltd., Australia. 1987.

Richards, I. S. *Principles and Practice of Toxicology in Public Health*. Jones and Bartlett Publishers, London. 2008.

Sawyer, C.N. and McCarty, P.L. G.F. Parkin (Eds). *Chemistry for Environmental Science and Engineering*, Tata-McGraw-Hill Edition, 2003.

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 four questions one question from each unit with internal choice. Each question will carry 14 marks.

UNIT- I

Disaster- Causes and phases of disaster, Rapid onset and slow onset disasters. Nature and responses to geo-hazards, trends in climatology, meteorology and hydrology. Seismic activities. Changes in Coastal zone, coastal erosion, beach protection. Coastal erosion due to natural and manmade structures.

UNIT- II

Floods and Cyclones: causes of flooding, Hazards associated with flooding. Flood forecasting. Flood management, Integrated Flood Management and Information System (IFMIS), Flood control. Water related hazards- Structure and nature of tropical cyclone, Tsunamis – causes and physical characteristics, mitigation of risks.

UNIT- III

Earthquakes: Causes and characteristics of ground-motion, earthquake scales, magnitude and intensity, earthquake hazards and risks, Volcanic land forms, eruptions, early warning from satellites, risk mitigation and training, Landslides.

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:

Bolt, B.A. *Earthquakes*, W. H. Freeman and Company, New York. 1988

Carter, N,W. *Disaster Management: A Disaster Manager's Hand Book*, Asian Development Bank, Manila. 1992

Gautam Ashutosh. *Earthquake: A Natural Disaster*, Ashok Publishing House, New Delhi. 1994

Sahni, P.and Malagola M. (Eds.).*Disaster Risk Reduction in South Asia*, Prentice-Hall of India, New Delhi. 2003.

Sharma, V.K. (Ed.). *Disaster Management*, IIPA, New Delhi. 1995.

Singh T. *Disaster management Approaches and Strategies*, Akansha Publishing House, New Delhi. 2006

Sinha, D. K. *Towards Basics of Natural Disaster Reduction*, Research Book Centre, New Delhi. 2006

Smith, K. *Environmental Health, Assessing Risk and Reduction Disaster*, 3rd Edition, Routledge, London. 2001 21

Thomas Babu. *Disaster Response: A Handbook for Emergencies*, CASA, New Delhi.1993.

Ward, R. *Floods- A Geographical Perspective*, MacMillan Press Ltd. New Delhi. 1978.

Semester II PRACTICAL

Duration : 4 hrs.

(3 hrs per day)

Max. Marks : 200

Estimation of Air quality and Preparation of Air record

- Determination of SPM in ambient air by high volume sampler
- Determination of RSPM
- Sampling and Analysis of SO₂, NO₂

Estimation of Water quality and Preparation of Record

- Estimation of Total Hardness in the water sample
- Estimation of Calcium Hardness in the water sample
- Determination of Biological Oxygen Demand (BOD) – (3 Day 28°C or 5 day 20°C)
- Determination of Chemical Oxygen Demand (COD)
- Determination of Dissolve Oxygen

Estimation of Solid waste

- To determine moisture content, pH and conductivity of solid wastes sample.
- Determination of water holding capacity of soil
- Study of soil texture
- Determination of Organic matter in Pollute Soil Sample
- Determination of Dust Retaining Capacity of plants (APT index)
- 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/vermin-composting
- 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 four questions one question from each unit with internal choice. Each question will carry 14 marks.

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, Impactors, Cyclones, Particle Size Analyser, Gas Analysers, Spectrophotometer (UV-Visible), Flame Photometer, Atomic Absorption spectrophotometer (AAS).

UNIT-III

Chromatographs: Principles, working and applications of Gas Chromatograph (GC), HPLC, Ion chromatograph.

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

Baird, C. and Cann, M. Environmental Chemistry. W.H. Freeman and Company 2008.

Chatwal, G. R., and Anand, S. K. Instrumental Methods of Chemical Analysis.

Himalaya Publishing House, Delhi. 2007.

De, A.K. Environmental Chemistry, New Age International, New Delhi. 2000.

Keith, L. H. Principles of Environmental Sampling. American Chemical Society.1988.

Murphy, W.J. Analytical Chemistry, American Chemical Society, USA. 1977

Reeve, R. Introduction to Environmental Analysis. John Willey & Sns.2002.

Shukla, S. K. and Srivastava, P. R. Methodology of Environmental monitoring and Assessment. Commonwealth Publishers.1992.

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 four questions one question from each unit with internal choice. Each question will carry 14 marks.

UNIT-I

Basic Concept of bacteria, fungi, algae, Protozoa and viruses. Use of microorganisms in bioremediation of soil and oil spills.

Bio - fertilizers, Rhizobium, Azotobacter, Nitrogen fixation, vermitechnology and vermicomposting. Xenobiotics, biodegradation of harmful (toxic) organic pollutants-pesticides, herbicides, chloroaromatic and benzene.

UNIT-II

Xenobiotics, Integrated treatment system for biodegradation of Polychlorinated biphenyls (PCBs) PCB treatment process and design, 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

Evano, G.H. and Furlong, J.C. *Environmental Biotechnology – Theory and Application*. John Wiley and Sons, USA. 2004.

Jjemba, P.K. *Environmental Microbiology – Theory and Application*. Science Pub. Inc., USA. 2004.

Olguin, C. J., Sanchez, G., Hernandez, E. *Environmental Biotechnology and Cleaner Bioprocesses*. Taylor & Francis.2000.

Pepper, I.L. and Gerba, C.P. *Environmental Microbiology - Laboratory Manual*. Elsevier, USA. 2005.

Ratledge, C. and Kristiansen, B. *Basic Biotechnology*. 2nd ed. Cambridge University Press, Cambridge, UK. 2002.

Rittman, B. and McCarty, P. L. *Environmental Biotechnology: Principles and Applications*. 2nd edition. Tata McGraw-Hill, USA. 2000.

Rittmann, B.E. and McCarty, P.L. *Environmental Biotechnology – Theory and Application*. McGraw Hill, USA. 2001.

Semester III

PAPER III (303): 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 four questions one question from each unit with internal choice. Each question will carry 14 marks.

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: Treatment for Clean Water: Water Treatment Plant Procedures, flocculation, settling, filtration, reverse sand filter, cleaning, chlorination, chemical oxidation, Reverse osmosis, Ultra filtration; Water quality standards.

UNIT-III

Industrial Effluent Treatment: Pre-treatment, Primary- secondary and tertiary treatment methods; physical, chemical and biological methods of treatment Trickling filters, rotatory biological contactors.

UNIT-IV

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

Reference Books

Air Pollution Control Engineering, Ed. Noel De Nevers, McGraw-Hill International Editions, 2000, ISBN 0-07-116207-0.

Air Quality Management, Issues in Environmental Science & Technology –Pub-8, Eds. K.E. Hester and R.M. Harrison, The Royal Society of Chemistry, UK, 1997. 18

APHA, Standard Methods of Analysis for Water and Waste Water, American Public Health Association Publication, 2004.

Bhargava, S. K. *Practical Methods for Water and Air Pollution Monitoring*, New Age International Pub., New Delhi. 2008.

Bhatia, S.C. *Textbook of Air Pollution and Its Control*. Atlantic Pub., New Delhi. 2007.

Clarke, Andrew G. *Industrial Air Pollution Monitoring, Gaseous and Particulate Emissions*, Springer. 2008.

Evans, G. *Biowaste and Biological Waste Treatment*. James and James (Science Publishers) Ltd, U.K. 2005.

Gurnham, C. F. *Principle of Industrial Waste Treatment*. John Wiley & Sons Inc, New York. 2004.

Hammer, M.J. and Hammer Jr, M.J. *Water and Wastewater Technology*. 3rd ed. Prentice Hall of India. 2000.

Kumar, R and Singh, R.N. *Municipal Water and Wastewater Treatment*. Capitol Pub. Co., New Delhi. 2006.

Ray, T.K. *Air Pollution Control in Industries*. Tech Books International, New Delhi (2 volumes). 2006.

Semester III

PAPER IV(304): STATISTICS, ENVIRONMENTAL MODELING 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 four questions one question from each unit with internal choice. Each question will carry 14 marks.

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; Probability - normal, poisson and binomial

UNIT-II

Probability and Tests of Significance: 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, 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

Reference Books

Bailey, N.T.J. *Statistical Methods in Biology*. 3rd ed. Cambridge University Press, Cambridge, UK. 1994.

Banerjee, P.K.. *Introduction to Biostatistics*. S. Chand and Co., New Delhi. 2004.

Central Statistical Organization. *Compendium of Environmental Statistics India 2003*. Ministry of Statistics & Programme implementation. GOI, New Delhi

Gardiner, W. P. *Statistics for biosciences*. Prentice hall, Hamel Hempstead.1997.

Gerstman, B.B. *Basic Biostatistics – Statistics for Public Health Practice*. Janes and Bartlett Pub., U.K. 2008

Semester III

PRACTICAL

(3 hrs per day)

Duration : 4 hrs.

Max. Marks : 200

Statistics and Research Methodology

- 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.
- 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.
- Preparation of Synopsis on different topics
- Visit to a national park/any-natural habitat/sanctuary and report preparation for the same

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 four questions one question from each unit with internal choice. Each question will carry 14 marks.

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, checklist, matrices, Overlays and Geographical Information System, Impact analysis and Predictions, Environmental Impact Statement [EIS]; 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.

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.

Reference Books

Anjaneyulu, Y. and Manickam, V. *Environmental Impact Assessment Methodologies*. B.S. Publications.2002.

Boland, R.G.A. (Ed) *Environmental Management Training*. Sterling Publishers Pvt. Ltd. New Delhi, 1993.

Canter, L. *Environmental Impact Assessment.2nd Edition*. McGraw-hill Book Company, New York.1996.

Cutter, S.L.. *Environmental Risks and Hazards*. Prentice Hall of India, New Delhi. 1999.

Glasson, J. Therivel, R. and Chadwick, A.. *Introduction to Environmental Impact Assessment*. Routledge, London. 2006.

Kulkarni, V. and Ramachandra, T.V.. *Environmental Management*. Capitol Pub. Co., New Delhi. 2006.

Morris, P. and Therivel R. (Eds) *Methods of Environmental Impact Assessment*. 2nd Edition, Spon Press London. 2001.

Paliwal, U.L. *Environment Audit*. Indus Valley Publications. Jaipur2002

Petts, J. *Handbook of Environmental Impact Assessment- Volume 1 and 2*. Blackwell 28 Publishers, UK 2005.

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 four questions one question from each unit with internal choice. Each question will carry 14 marks.

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 - 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, EIA methodology, Description of Environment, prediction of environmental impacts, evaluation of impacts, Environmental impact statement (EIS), 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

Reference Books

Bose, S. and Parekh, A. *The Environment Audit-Holy Grail or Essential Management Tool*. The Management Accountant.1994.

Corello, V. T., Mumpower, J. L., Stallen, P. J. M., Uppuluri, V. R. R. *Environmental Impact Assessment, Technology assessment and Risk Analysis*. Springer-Verlag Berlin Heidelberg.1985.

Glasson, J. Therivel, R. and Chadwick, A.. *Introduction to Environmental Impact Assessment*. Routledge, London. 2006

GOI – Ministry of MoEF Gazette Notification under sub-rule (3) of Rule 5 of Environment (Protection) Rules. 2006.

Morris, P. and Therivel R. (Eds) *Methods of Environmental Impact Assessment*. 2nd Edition, Spon Press London. 2001.

Petts, J. *Handbook of Environmental Impact Assessment- Volume 1 and 2*. Blackwell Publishers, UK 2005.

Rajaraman, N. *Environment Audit*. The Management Accountant.1997. 29

Semester IV

PAPER III (403): 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 four questions one question from each unit with internal choice. Each question will carry 14 marks.

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

George Joseph, *Fundamentals of remote sensing*, Universities press (India) Pvt Ltd., Hyderabad, 2003

Jenson, J.R. *Introductory Digital Image Processing*: Prentice Hall Series, 1996.

Jensen, J.R., *Remote Sensing of the Environment – An Earth Resources Perspectiv*, Pearson Education, Inc. (Singapore) Pvt. Ltd., Indian edition, Delhi, 2000.

Lillesand, Thomas M. and Kiefer, Ralph, W., *Remote Sensing and Image Interpretation*, John Wiley and Sons, New York, 2000.

Michael N. Demers. *Fundamentals of Geographical Information Systems*. John Wiley & Sons, Inc. 2008.

Semester IV

PAPER IV (404): 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 four questions one question from each unit with internal choice. Each question will carry 14 marks.

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; Bio-energy-energy from biomass and biogas, anaerobic digestion.

UNIT-III

Nuclear energy: Fission and fusion, Nuclear fuels – mining and processing of Uranium, concentration, Nuclear reactors, Radioactive Waste Disposal -Concentration and Containment at Storage Site including at deep underground facilities , Delay for Decay of short lived radio nuclides, Dilution & Dispersion of residual waste; Bioaccumulation, Impact on environment.

UNIT-IV

Environmental implications: Environmental implications of energy use; energy use pattern in India and the world, Renewable energy potential in India, emissions of CO₂ in developed and developing countries including India, Impact of large scale exploitation of solar, wind, hydro and other renewable energy sources.

Reference Books

Andrew R.W., Jackson & Julie M. Jackson, *Environmental Science – The Natural Environment and Human Impact*, Addison Wesley Longman Limited, 1996. 12

Carless, Jennifer, *Renewable Energy: A Concise Guide to Green Alternative*, Walker, New York, 1993

Ebbing, D.D., *General Chemistry*, (International 4th Edition) MA : Houghton Mifflin, Boston, 1993.

Eisenbud, M. , *Environmental Radioactivity*, Academic Press, Orlando, USA,1987.

Flowler, John M., *Energy and the Environment*, 2nd Edition, McGraw Hill, New York, 1984.

Santra, S.C. *Environmental Science*, 2nd Edition, New Central Book Agency (P) Ltd, Kolkata, India, 2005.

United Nations Scientific Committee on *Effects of Atomic Radiation Report 2000*, New York, USA, 2000.

Weast R.C., *Handbook of Chemistry and Physics*, CRC Press, 1994.

Rao, P. S. and Rao, P. M. *Environmental Management and Audit*. Deep and Deep Publications.2000.

Raymond, A. B. and Fenn, D. H. *The Corporate Social Audit*. Russell Sage Foundation New York.1992.

Semester IV PRACTICAL

Duration : 4 hrs.

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

A Project work / Dissertation topic may be allotted by the department

Projects may be related to any topic of environment/ecology. However, an emphasis should be given to:

- Energy and water issues in Rajasthan/India
- Desertification
- Environmental aspects of Infrastructural development in Rajasthan.
- Ground water depletion
- Habitat modification - Canal irrigation and environment
- Ground water Pollution
- Mining and environment including Marbles and minerals
- Inventories of elements like Sulphur, Calcium, Nitrogen, in different components of an ecosystem and preparation of Biochemical Cycle therein
- Listing of data required for EIA of a project (Thermal Power Plant/Cement Industry/ mineral mining/ Group Housing/ Biomass Energy/Highways.
- List of Impacts at the stage of construction, operation and production.
- EIA of: dam / Industry / Mining exploration/ Housing/ Thermal Power plant/Bridge / railway tract/ urban city (Visits for EIA preparation).
- Study of biotic and a biotic stresses Radiation exposure
- Remote sensing and GIS for resource measurement and management Evaluation and Viva Voce