MAHARSHI DAYANAND SARASWATI UNIVERSITY

AJMER

SYLLABUS

SCHEME OF EXAMINATION AND COURSES OF STUDY

FACULTY OF SCIENCE

M. Sc. ENVIRONMENTAL SCIENCE

M. Sc. I & II Semester w.e.f. 2015-16

M. Sc. III & IV Semester w.e.f. 2016-17

Name of the Program of Study: M.Sc. Environmental Science

1. **Programme Duration:**

a. Minimum 1 semester for Certificate in Basics of Environmental Science
b. Minimum 2 semesters for PG Diploma in Environmental Science
c. Minimum 3 semesters for Advanced PG Diploma in Environmental Science
d. Minimum 4 Semesters for M.Sc. in Environmental Science

2. **Minimum Eligibility Conditions:**

3. **Relaxation in Minimum Qualifying Marks for** the SC, ST and Persons with Disabilities Categories: 5%

4. **Criteria for Selection of Students for Admission:** Merit list as per the rules in Prospectus

5. **Credit Requirements:**

a. A minimum of 80 credits are to be completed by the student, 30% (24 credits) of which will be elective including a minimum of 12 credits (15%) from other programs of studies (Minimum 9 form a single program of study other than M.Sc. Environmental Science) and 70% (56 credits) being core courses. Core courses include 4 L credits of Foundation courses (Compulsory and elective). Of the remaining 52 core credits, one short term project (3P) will have to be done in each of the first three semesters, and one long term project work/dissertation (10 credits) in the fourth semester.
b. The maximum number of credits that a student may earn in a Semester shall not exceed 36 hours of teaching, and he/she shall be required to register for such number of courses accordingly.

6. **Conditions for the Award of Degree / Diploma / Certificate:**

6.1 In case a student admitted to the Programme opts out of the Programme after successful completion of minimum

20 credits of Semester I, he/she will be awarded Certificate in Basics of Environmental Science
40 credits of Semesters I and II he/she will be awarded PG Diploma in Environmental Science
60 credits of Semesters I, II and III, he/she will be awarded Advanced PG Diploma in Environmental Science
80 credits of Semesters I, II, III and IV, he/she will be awarded M.Sc. in Environmental Science

6.2 Students opting out with the Certificate/PG Diploma/Advanced PG Diploma may be permitted to get lateral entry into the Programme within a period of maximum two years to complete their Master's Degree.

6.3 There is a provision of Certificate of specialization or skills learnt which would be given away to a student by the Dean PG Studies for the University teaching departments (UTDs) on the recommendation of the Council of the Department of Environmental Science , if a minimum of 9 credits have been completed by the student in a specific skill or field of specialization.

Foundation Courses

The Course Committee does not have the required capability to set the course for the foundation courses, moreover teaching these courses would require different specializations which the faculty of environmental Science does not possess. Yet we propose that following types of foundation courses may be useful for the personality development of the students:

S. No.	Course	Lecture Credits	Practical Credits	Required faculty
Compulsory				
FOC 401	Language skills	1		English
FOC 402	Presentation skills	1		Management
FOC 403	Information, sources, retrieval & usage	1		Library science
Elective				
FOO 401	History of Ajmer	1		History
FOO 402	Brief History of Rajasthan	1		
FOO 403	Social work	1	1	Sociology
FOO 404	Environmental Journalism	1	1	Journalism

Courses offered in M.Sc. Environmental Science

SEM I			SEM II			SEM III			SEM IV		
Title	Credit	Contact Hours	Title	Credit	Contact Hours	Title	Credit	Contact Hours	Title	Credit	Contact Hours
Core Courses											
FC (Foundation Course)	2 L	2 hr	FC (Foundation Course)	1 L	1 hr	FC (Foundation Course)	1 L	1 hr	FC (Foundation Course)	1 L	1 hr
ENV -401 Concepts of Ecology	2 L	2 hr	ENV – 407 Ecosystem Science	4 L	4 hrs	ENV – 412 Environmental Biotechnology	3 L	3 hr	ENV 500 L Long Term Project	10 P	30 hrs
ENV -402 Components of Environment	2 L	2 hr	ENV-408 Environmental Pollution & Control -II	4 L	4 hrs	ENV – 413 Environmental Geo Science	4 L	4 hr			
ENV – 403 Natural Resources & Eco modelling	3 L	3 hr	ENV-409 Biodiversity, Wild Life and Environmental Ethics	4 L	4 hrs	ENV – 414 Ecotourism	3 L	3 hr			
ENV – 404 Environmental Management and Legislation	4 L	4 hr	ENV – 410 Occupational Health	3 L	3hrs	ENV – 415 Geo-Chemistry	4 L	4 hr			
ENV – 405 Environmental Pollution & Control - I	4 L	4 hr									

ENV – 406 Practical	3P	9 hrs	ENV 411 Practical	3P	9 hrs	ENV – 416 Practical	3P	9 hrs			
	18+1	**25 hrs**		**18+1**	**25 hrs**		**17+1**	**24**		11	31
Elective Courses											
ENV – 421 (Practical)	3P	9 hrs	ENV – 424 (Practical)	3P	9 hrs	ENV-429 (Practical)	3P	9 hrs	ENV- 432 Research Methodology & Statistics	4 L	4 hr
ENV -422 EIA –I	4L	4 hrs	ENV – 425 Eco-Toxicology	1L	1 hr	ENV – 430 EIA in Practice	4 L	4 hr			
ENV – 423 Disaster Management	4L	4 hrs	ENV – 426/ MIC 433 Energy & Alternatives of Energy	1L	1 hr	ENV – 431 Natural Disaster Management	4 L	4 hr			
			ENV – 427 EIA – II	4 L	4 hrs						
			ENV – 428 Geological Disasters	4 L	4 hrs						

1 L = 15 Lectures/Month

Semester I

Core Courses:

ENV 401. Concepts of Ecology (2L) (2h/week)
ENV 402. Components of Environment (2L) (2h/week)
ENV 403. Natural Resources & Ecomodelling (3L) (3h/week)
ENV 404. Environmental Management & Legislation (4L) (4h/week)
ENV 405 Environmental Pollution & Control- I (4L) (4h/week)
ENV 406 Techniques in Environmental Science-I (3P) (9h/week)

Elective Courses for Sem I & III

ENV 421 Techniques in Environmental Science-II (3P) (9h/week)
ENV 422. Environmental Impact Assessment –I (4L) (4h/week)
ENV 423 Disaster Management (4L) (4h/week)
If a student opts to drop after successful completion of minimum 20 credits in 1st semester s/he will be awarded Certificate in Basics of Environmental Science

Elective Courses Sem I & III

ENV 429 Practical (3P) (9h/week)
ENV 430 EIA in Practice (4L) (4h/week)
ENV 431 Natural Disaster Management (4L) (4h/week)
If a student opts to drop after successful completion of minimum 60 credits s/he will be awarded Advanced PG Diploma in Environmental Science.

Semester II

Core Courses:

ENV 407 Ecosystem Science (4L) (4h/week)
ENV 408 Environmental Pollution & Control- II (4L) (4h/week)
ENV 409 Biodiversity, Wildlife and Environmental Ethics (4L) (4h/week)
ENV 410 Occupational Health (3L) (3h/week)
ENV 411 Practical (3P) (9h/week)

Elective Courses for II & IV

ENV 424 Practical (3P) (9h/week)
ENV 425 Eco toxicology (3L) (3h/week)
ENV 426/ MIC -433 Energy and Alternative Energy (1L) (1h/week)
ENV 427 Environmental Impact Assessment – II (4L) (4h/week)
ENV 428 Geological Disasters (4L) (4h/week)

If a student opts to drop after successful completion of minimum 40 credits, s/he will be awarded PG Diploma in Environmental Science.

Elective Courses for II & IV

ENV 432 Research Methodology and Statistics (4L= 4h/week)

In addition to the Project work in this semester, a student may pick courses up to 4L in addition to foundation course (1-2L).

Semester III

Core Courses

ENV 412 Environmental Biotechnology (3L) (3h/week)
ENV 413 Environmental Geo Science (4L) (4h/week)
ENV 414 / Ecotourism (3L) (3h/week)
ENV 415 Environmental Geochemistry (4L) (4h/week)
ENV 416 Practical (3P) (9h/week)

Elective Courses for Sem I & III

ENV 421 Techniques in Environmental Science-II (3P) (9h/week)
ENV 422. Environmental Impact Assessment –I (4L) (4h/week)
ENV 423 Disaster Management (4L) (4h/week)
If a student opts to drop after successful completion of minimum 20 credits in 1st semester s/he will be awarded Certificate in Basics of Environmental Science

Elective Courses Sem I & III

ENV 429 Practical (3P) (9h/week)
ENV 430 EIA in Practice (4L) (4h/week)
ENV 431 Natural Disaster Management (4L) (4h/week)
If a student opts to drop after successful completion of minimum 60 credits s/he will be awarded Advanced PG Diploma in Environmental Science.

Semester IV
Core Course:
ENV 500L Long Term Project /Dissertation (10 P= 30h per week)

Elective Courses for II & IV

ENV 424 Practical (3P) (9h/week)
ENV 425 Eco toxicology (3L) (3h/week)
ENV 426/ MIC -433 Energy and Alternative Energy (1L) (1h/week)
ENV 427 Environmental Impact Assessment – II (4L) (4h/week)
ENV 428 Geological Disasters (4L) (4h/week)

If a student opts to drop after successful completion of minimum 40 credits, s/he will be awarded PG Diploma in Environmental Science.

Elective Courses for II & IV

ENV 432 Research Methodology and Statistics (4L= 4h/week)

In addition to the Project work in this semester, a student may pick courses up to 4L in addition to foundation course (1-2L).

Successful completion of minimum 80 credits along with all core courses will earn a student degree of Mater of Science in Environmental Science.

CORE COURSE (FOC 401) 2L

Basic English Grammar

Teaching scheme	Examination scheme
Theory: 2 hrs per wk.	University: 40 marks
Duration of Univ. Exam. 2hrs	Internal: 10 marks

Objectives:

The course focuses on equipping students with structural and functional abilities. At the end of the semester students will acquire language skills that will enhance their overall language proficiency.

Course Content

Unit I

Common errors, modality- some important uses, Reported speech, Active- Passive Voice, Conjunctions and sentence linkers, use of Adverbials, Articles, Determiners and Quantifiers.

Unit II

Word formation- prefix/ suffix, Collective nouns, Synonyms- antonyms, One word substitution, Word used to describe- Colour, shape, size, length, height, distance, texture, sounds etc., Phrasal Verbs and Idioms.

Unit III

Comprehension & non- fiction unseen passages drawn from varied fields- Travelogue, history, scientific writing, environmental studies, geography etc.

Unit IV

Structural and functional ability to express regret, make requests, express opinion, show preference, give advice, make suggestions, frame questions, (Yes/ No and information Questions), describe processes and procedures, describe objects.

Unit V

Writing and composition- Job application, Resume writing, writing notices, Reports, writing project proposals.

Books Recommended

1. Krishnaswamy, N. and Sriraman, T. Creative English for communication, Macmillan.
2. Corder, S Pit. An intermediate Practice Book.
3. Smith-Pearse, T.L.H. The English errors of Indian students. OUP.
4. Murphy, Raymond. Intermediate English grammar.
5. Hewings, martin. Advanced English grammar. CUP
6. Murphy, Raymond. English grammar in use (With answers and CD Rom)

Detailed course outline of Courses offered in M.Sc. Environmental Science

SEMESTER I

CORE COURSES

PAPER: ENV 401 CONCEPTS OF ECOLOGY (2L) (2h/week)

Note: The question paper will be divided into three parts- ABC

Part A- This part is of 8 Marks. Eight questions are to be set, at least 2 from each unit. **All questions are compulsory**. The answer for each question should not exceed twenty words. All question carry equal marks, each question is of one mark.

Part B- This part is of 8 Marks. Four questions are to be set, at least one from each unit. All questions are compulsory. The answer for each question should not exceed fifty words. All questions carry equal marks, each question is of two marks.

Part C- This part is of 24 Marks. Six questions are to be set, that is two from each Unit. The candidates have to answer any three questions choosing at least one question from each Unit. The answer for each question should not exceed four hundred words. All questions carry equal marks, each question is of 8 Marks.

Unit: I

Definition, principles and scope of Ecology, Origin of life and speciation. Ecosystem-Concepts, structure and function, Abiotic and Biotic components, Ecosystem as a dissipative structure, Food chain: grazing and detritus food chains and food webs, Ecological pyramids-number, biomass, energy. Interrelationships between organisms: Positive, Negative and Neutral.

Unit: II

Population characteristics - density, natality, age distribution, biotic potential, growth rate. Ecads, Ecotypes: Types of ecotypes. Ecological Adaptations – Ecological groups of plants and ecological adaptations (i) Hydrophytes (ii) Mesophytes (iii) Xerophytes (iv) Halophytes. Ecological adaptations in animals.

Unit: III

Genetic model for range extensions: Population change - k and r selections. Concept of community, methods of study of plant communities. Characters of communities - Analytical (quantitative and qualitative) and synthetic characters. Raunkiaer's life forms and biological spectrum diversity indices.

PAPER ENV 402 COMPONENTS OF ENVIRONMENT (2L) (2h/Week)

Unit-I

Defination, principle and scope of environment. Interrelationship between environment and its components – atmosphere hydrosphere, lithosphere and biosphere.

Atmosphere – Composition and Structure heat balance, chemical composition of air (classification of elements, chemical speciation, particles, ions and radicals in atmosphere),

chemical processes for formation of inorganic and organic particulate matter, thermo chemical reaction, oxygen and ozone chemistry.

Unit-II

Lithosphere- formation of the earth, zonal structure of the earth and its composition, composition of the earth as a whole, differentiation of elements. Soil and agricultural, nature and composition of soil, acid-base and ion-exchange reaction in soil, macronutrients in soil, micronutrients in soil.

Unit-III

Hydrosphere- characteristic, characteristic and structure of the ocean, snow and ice, fresh water system. Properties of water and their significance, characteristic of water bodies, alkalinity, acidity, calcium and other metals in water, sedimentation, coagulation, organic pollutants in sewage, soaps, oil and detergents, pesticides in water, their classification, radio-nuclide in water.

PAPER: ENV 403 NATURAL RESOURCES & ECOMODELLING (3L) (3h/Week)

Note: the question paper will be divided into three parts- ABC

Part A- This part is of 8 Marks. Eight questions are to be set, at least 2 from each unit. **All questions are compulsory**. The answer for each question should not exceed twenty words. All question carry equal marks, each question is of one mark.

Part B- This part is of 8 Marks. Four questions are to be set, at least one from each unit. All questions are compulsory. The answer for each question should not exceed fifty words. All questions carry equal marks, each question is of two marks.

Part C- This part is of 24 Marks. Six questions are to be set, that is two from each Unit. The candidates have to answer any three questions choosing at least one question from each Unit. The answer for each question should not exceed four hundred words. All questions carry equal marks, each question is of 8 Marks.

Unit: I

Renewable and Non-renewable energy sources. Fossil fuels-classification, composition, physico-chemical characteristics and energy content of coal, crude oil, natural gas, hydroelectric power. Forest resources of India, Causes of forest degradation, Forest conservation measures-social forestry (farm forestry, agroforestry), Ethnobotanical aspects of forest flora with special reference to Rajasthan.

Unit: II

Land classification and use, causes of soil degradation, soil erosion, soil conservation methods, formation and reclamation of Usar and Saline soil. Impact of canal irrigation on characteristics of land and soil, soil fertility problems, salinity problems with special reference to Rajasthan. Wasteland and their reclamation.

Unit: III

Complexity of systems. Objectives of system ecology, analysis of system processes and conditions, Model for steady state conditions, Lotka voltara, leslics matrix model, box model, microcosm model, Gaussian plume model, models for population growth and interactions, Point source Stream Pollution Model

PAPER: ENV 404 ENVIRONMENTAL MANAGEMENT AND LEGISLATION (4L) (4h/Week)

Note: The question paper will be divided into three parts- ABC

Part A- This part is of 8 Marks. Eight questions are to be set, at least 2 from each unit. **All questions are compulsory**. The answer for each question should not exceed twenty words. All question carry equal marks, each question is of one mark.

Part B- This part is of 8 Marks. Four questions are to be set, at least one from each unit. All questions are compulsory. The answer for each question should not exceed fifty words. All questions carry equal marks, each question is of two marks.

Part C- This part is of 24 Marks. Six questions are to be set, that is two from each Unit. The candidates have to answer any three questions choosing at least one question from each Unit. The answer for each question should not exceed four hundred words. All questions carry equal marks, each question is of 8 Marks.

Unit: I

Overview of the ISO 14000 family: Key aspects of the International Standard ISO 14001. Environmental Management Systems: Benefits, Principles and elements of successful environmental Management. Auditing of EMS. Occupational Health and Safety Management System (OHSMS), OHSAS 18001, Environmental Labelling, Life Cycle Assessment, Ecological Foot-printing, Ecotourism- its components and principles, Environmental education. Clean Development Mechanism- Process, Validation & Case Studies.

Unit: II

Environmental Impact Assessment (EIA): Definition, benefits & general structure of the EIA, Procedure of EIA. Overview of the variety of impact identification methodologies and their strengths and weaknesses as tools for identifying different impacts and their sources/causes. Definition, functions, benefits and costs of Environmental Auditing. Basic principles of Environmental auditing. Comprehensive Environmental Pollution Index (CEPI), Cost -benefit Analysis, Concept and strategies of sustainable development.

Unit: III

Forest (Conservation Act), 1980, Air(Prevention and Control of Pollution)Act - 1981, Water (Prevention and Control of Pollution) Act - 1974, Wildlife Protection Act 1972, , Environmental (Protection) Act - 1986, Bio- Medical Waste (Management and Handling rules - 1998, Hazardous Waste Management and Handling rules - 1989, Plastic Waste (Management and Handling) Rules 2011. Provision in the Constitution of India regarding Environment (Article 48A and 51G). Motor Vehicle Act 1988, Public liability Insurance Act 1991 and Rules 1991.

PAPER: ENV 405 ENVIRONMENTAL POLLUTION & CONTROL- I (4L) (4h/Week)

Note: The question paper will be divided into three parts- ABC

Part A- This part is of 8 Marks. Eight questions are to be set, at least 2 from each unit. **All questions are compulsory**. The answer for each question should not exceed twenty words. All question carry equal marks, each question is of one mark.

Part B- This part is of 8 Marks. Four questions are to be set, at least one from each unit. All questions are compulsory. The answer for each question should not exceed fifty words. All questions carry equal marks, each question is of two marks.

Part C- This part is of 24 Marks. Six questions are to be set, that is two from each Unit. The candidates have to answer any three questions choosing at least one question from each Unit. The answer for each question should not exceed four hundred words. All questions carry equal marks, each question is of 8 Marks.

Unit: I

Air Pollution: Sources of pollution, Nature, Effects and Classification of air pollutants, Gas laws governing the behaviour of pollutants in the atmosphere. Meteorological measurements, plume behaviour and wind rose. Fly ash utilization, Vehicular air pollution. Photochemical reactions in the atmosphere. Smog (Case Study) Measurement and Control (SOx, NOx, SPM) of air pollution. History and episodes of air pollution. Indoor Air Pollution: Sources and effects on human health. Allerogens

Unit: II

Chemistry of Air, Global consequences of air pollution (acid rain, global warming and ozone depletion), Air quality Index, Air quality standards.Air sampling techniques. Biochemical Aspects of Arsenic, Cadmium, Lead, Mercury, Carbon Monoxide, O3 and PAN Pesticides, Insecticide, MIC, Carcinogens in the air.

Unit: III

Chemistry of Water, Redox Potential, Water Pollution: Types, sources and consequence, types of water pollutants, physico-chemical and bacteriological sampling and analysis of water quality. Sewage and Effluent Treatment : STP and ETP and recycling, Drinking water purification, indices of pollution, water quality standards. Marine Pollution. Eutrophication.

PAPER: ENV 406 TECHNIQUES IN ENVIRONMENTAL SCIENCE – I (3P) (9h/Week)

Climate

1. Wind Monitor- Temperature, Relative Humidity, Wind Direction and Wind Speed.

Water Analysis

1. Dissolved Oxygen by Azide modification and by Oximeter.
2. pH
3. Chloride by titration.
4. Total residual Chlorine

5. TDS using Conductivity meter
6. Conductivity using Conductivity meter.

Soil Analysis

1. pH of Soil using pH Meter
2. Soil Texture.
3. Soil moisture, WHC
4. Percentage Organic Carbon of Soil

Ecology

1. Floristic survey of area and ecological adaptations
2. Least size of quadrate for community study.
3. Determine frequency, density and abundance of various plant species in a community.

Principles of Advanced Instrumental Analysis

1. Flame Photometry
2. Ozone generator
3. Trtrimetry,
4. Gravimetry
5 Colourimetry
6. Spectrophotometry
7. Chromatography

SEMESTER –II

CORE COURSES

PAPER: ENV 407 ECOSYSTEM SCIENCE (4L) (4H/Week)

Note: The question paper will be divided into three parts- ABC

Part A- This part is of 8 Marks. Eight questions are to be set, at least 2 from each unit, **All questions are compulsory**. The answer for each question should not exceed twenty words. All question carry equal marks, each question is of one mark.

Part B- This part is of 8 Marks. Four questions are to be set, at least one from each unit. All questions are compulsory. The answer for each question should not exceed fifty words. All questions carry equal marks, each question is of two marks.

Part C- This part is of 24 Marks. Six questions are to be set, that is two from each Unit. The candidates have to answer any three questions choosing at least one question from each Unit. The answer for each question should not exceed four hundred words. All questions carry equal marks, each question is of 8 Marks.

Unit: I

Holistic concept, Liebig's Law of Minimum, Shelford's Law of Tolerances, Ecological Amplitute, Limiting and Inhibiting effects. Ecological Energetics and cybernetics : principles of thermodynamics. Energy flow: Lindemann's and Odum's energy flow models. Concept of productivity: estimates of primary production, relation between GPP and NPP, Energy budget, efficiency of energy. Ecological Niche and Types.

Unit: II

Biogeochemical cycles, pools and flexes, basic types of cycles, hydrological, carbon, oxygen, nitrogen, phosphorus and sulphur, Nutrient cycling in forests ecosystem and in nutrient-poor soils. Integrated principles of ecosystem structure and function. Homeostasis self organization : Biodemographic regulation, Mcarthur's hypothesis, stability index; Biogeochemical regulation. Ecosystem and development.

Succession and Models of ecosystem development: microcosm and Tubular (Macro versus Microevolution). Concept of Exotics and invasives; natural spread versus man induced invasion.

Unit: III

Ecosystem type - Aquatic (fresh water, marine) and terrestrial (grassland, forest) ecosystem. Desert ecosystem with reference to flora and fauna of Rajasthan desert. Modified ecosystem with reference to the Impact of canal irrigation. Aravalli ecosystem characteristics-community and biological spectrum of aravallis. Waterbodies and their management strategies. Ecotone and its Types.

PAPER: ENV 408 ENVIRONMENTAL POLLUTION & CONTROL- II (4L) (4h/Week)

Note: the question paper will be divided into three parts- ABC

Part A- This part is of 8 Marks. Eight questions are to be set, at least 2 from each unit, **All questions are compulsory**. The answer for each question should not exceed twenty words. All question carry equal marks, each question is of one mark.

Part B- This part is of 8 Marks. Four questions are to be set, at least one from each unit. All questions are compulsory. The answer for each question should not exceed fifty words. All questions carry equal marks, each question is of two marks.

Part C- This part is of 24 Marks. Six questions are to be set, that is two from each Unit. The candidates have to answer any three questions choosing at least one question from each Unit. The answer for each question should not exceed four hundred words. All questions carry equal marks, each question is of 8 Marks.

Unit: I

Chemical nature and composition of soil and rocks, Soil Pollution- sources, chemical and metallic soil pollutants, control. Physico-chemical and bacteriological sampling and analysis of soil quality. Degradation of different insecticides, fungicide, and weedicides in soil. Different kinds of synthetic fertilizers (N, P and K) and their interaction with different components of soil.

Unit: II

Basic concept and definition, sources of noise pollution, RMS sound pressure, intensity level, power levels and sound pressure levels, decibels, measurements of noise-sound level meters, noise exposure levels and standards. Impacts of noise on human health, control of noise.

Unit: III

Radioactive pollution - sources, types, effects of radiation, major episodes of radioactive pollution, management and disposal of radioactive wastes. Thermal pollution- Sources, types, effects of thermal pollution, measurement of radioactive pollution and control of radioactive pollution.

PAPER: ENV 409 BIODIVERSITY AND WILDLIFE AND ENVIRONMENTAL ETHICS (4L) (4h/week)

Note: The question paper will be divided into three parts- ABC

Part A- This part is of 8 Marks. Eight question are to be set, at least 2 from each unit, **All questions are compulsory**. The answer for each question should not exceed twenty words. All question carry equal marks, each question is of one mark.

Part B- This part is of 8 Marks. Four questions are to be set, at least one from each unit. All questions are compulsory. The answer for each question should not exceed fifty words. All questions carry equal marks, each question is of two marks.

Part C- This part is of 24 Marks. Six questions are to be set, that is two from each Unit. The candidates have to answer any three questions choosing at least one question from each Unit. The answer for each question should not exceed four hundred words. All questions carry equal marks, each question is of 8 Marks.

Unit: I

Definition and importance of Biodiversity conservation and Agenda 21, Causes of biodiversity reduction and strategies for biodiversity conservation. Hotspots of Biodiversity. Endangered, Endemic and Extinct Species of India: Threatened species categories of IUCN, threatened species of plants and animals in India. Red data books. Biomes and Habitat Diversity: Classification of biomes, major biotic elements of each biome and their characteristics.

Unit: II

Critical issues related to biodiversity conservation, Endemic species, Wildlife-causes of depletion, Biosphere reserve, National parks and Sanctuaries in India. Gene pool. UN role in Biodiversity conservation: conventions and policies. Human and Conflicts. Biodiversity conservation: Global agreements and national concerns. RAMSAR sites (Wetland Conservation), CBD, Quarantine Regulations, National Forest Policy, Biodiversity Act., Wildlife Protection Ac

Unit: III

Defination and scope of Environmental Ethics. Environmental Values, Value education. Deep Ecology, Environmental Thinkers. Contribution from Religious books and authors. Role and need of Environmental Ethics in present scenario. Movements related to Environment. Conservation efforts by communities.

PAPER: ENV 410 OCCUPATIONAL HEALTH (3L) (3h/Week)

Note: The question paper will be divided into three parts- ABC

Part A- This part is of 8 Marks. Eight questions are to be set, at least 2 from each unit, **All questions are compulsory**. The answer for each question should not exceed twenty words. All question carry equal marks, each question is of one mark.

Part B- This part is of 8 Marks. Four questions are to be set, at least one from each unit. All questions are compulsory. The answer for each question should not exceed fifty words. All questions carry equal marks, each question is of two marks.

Part C- This part is of 24 Marks. Six questions are to be set, that is two from each Unit. The candidates have to answer any three questions choosing at least one question from each Unit. The answer for each question should not exceed four hundred words. All questions carry equal marks, each question is of 8 Marks.

Unit: I

Definition of Occupational Health, Health of a worker and interactions in a working environment, Occupational Hazards, Occupational diseases, Pneumoconiosis: Silicosis, Anthracosis, Byssinosis, Bagassosis, Asbestosis, Farmers's Lung. Lead poisoning, Occupational Cancer, Occupational Dermatitis, Radiation Hazards.

Unit: II

Levels of prevention, History of occupational health, Essentials of occupational health service, personal protective equipments (respiratory and non-respiratory) Occupational Hazards of agriculture workers, Accidents in Industry, Health problems due to Industrialisation, Measures for Health protection of workers, Prevention of Occupational diseases.

Unit: III

Role of World Health Organisation (WHO) in Occupational Health., WHO Declaration on occupational health for all (1994), Stresa Declaration on Workers Health (2006) , Global Occupational Health Network (GOHNET), Occupational Health in India.

PAPER: ENV 411 Techniques in Environmental Science –III (3P) (9h/week)

Water Analysis

1. Chemical Oxygen Demand (COD)
2. Biochemical Oxygen Demand (BOD)
3. Total Hardness
4. Flame photometery
5. Carbonate and Bicarbonate Alkalinity by Titrimetry

Soil Analysis

1. Sodium, potassium by flame photometer
2. Calcium, Magnesium by titrimetric method

Air Quality

1. Respirable dust using High Volume Sampler, Fine Particulate Sampler APM 550
2. Working knowledge of Cyclone collectors, fabric or bag filters, Electrostatic precipitators, Scrubbers.
3. Determination of noise levels using noise level meter and comparing with ambient standards

Ecology

1. Study of diversity indices of plant/organisms
2. Determination of IVI of various plant species.
3. Frequency classes in a community compared with Raunkiers normal values

Principles of Advanced Instrumental Analysis

1.Atomic Absorption Spectrophotometry

2.HPLC
3.Electrophoresis
4.X-ray fluorescence
5. X- ray Diffraction
6. Gas Chromatography

SEMESTER -III

CORE COURSES

PAPER: ENV 412 ENVIRONMENTAL BIOTECHNOLOGY (3L) (3h/Week)

Note: The question paper will be divided into three parts- ABC

Part A- This part is of 8 Marks. Eight question are to be set, at least 2 from each unit, **All questions are compulsory**. The answer for each question should not exceed twenty words. All question carry equal marks, each question is of one mark.

Part B- This part is of 8 Marks. Four questions are to be set, at least one from each unit. All questions are compulsory. The answer for each question should not exceed fifty words. All questions carry equal marks, each question is of two marks.

Part C- This part is of 24 Marks. Six questions are to be set, that is two from each Unit. The candidates have to answer any three questions choosing at least one question from each Unit. The answer for each question should not exceed four hundred words. All questions carry equal marks, each question is of 8 Marks.

Unit: I

A brief idea of genetic engineering - Restriction endonucleases, properties of restriction engineering, plasmids, isolation of plasmid.Cloning of DNA fragments, Shuttle Vectors and their environmental applications, Recombinant DNA Technology and Development of Genetically Engineered Microorganisms (GEMs), Polymerse Chain Reaction (PCR) and development of Gene Probes for environmental remediation,

Unit II

Emerging technologies for environmental bioremediation - Microelectromechanical systems (MEMs) Genosensor technology, Gene Probes - nah operon. Integrated Treatment System with special reference to biodegradation of Polychlorinated biphenyls (PCBs), PCB treatment process and Design. Enzymes contributing to sustainable industrial development - Starch processing, detergents. Textile, leather, pulp and paper manufacturing, baking. Biochemical measures of stress and Mixed Function Oxidise enzyme (MFOs), protein induction and SFG. Fermentation technology.

Unit III

Bioremediation of metal contaminated soils, spilled oil and grease deposits and synthetic pesticides. Biosensors to detect environmental pollutants.Microorganisms and organic pollutants; Extremophiles. Fermentation technology (Bioreactors). Biotechnology strategies in forestry and wasteland management. Biotechnology in biodiversity conservation: gene banks, germplasm conservation and DNA Banks. Genetically modified organisms and Biosafety- a general account.

PAPER: ENV 413 ENVIRONMENTAL GEO SCIENCE (4L) (4h/week)

Note: The question paper will be divided into three parts- ABC

Part A- This part is of 8 Marks. Eight questions are to be set, at least 2 from each unit, **All questions are compulsory**. The answer for each question should not exceed twenty words. All question carry equal marks, each question is of one mark.

Part B- This part is of 8 Marks. Four questions are to be set, at least one from each unit. All questions are compulsory. The answer for each question should not exceed fifty words. All questions carry equal marks, each question is of two marks.

Part C- This part is of 24 Marks. Six question are to be set, that is two from each Unit. The candidate have to answer any three questions choosing at least one question from each Unit. The answer for each question should not exceed four hundred words. All questions carry equal marks, each question is of 8 Marks.

Unit 1

Environmental Geoscience; fundamental concept.The earth system and biosphere conversion of matter in various geospheres-lithosphere, hydrosphere, atmosphere and biosphere. Earth processes: cycle in the earth system, Concept of residence, time and rates of Natural cycles.

Unit II

Water as a natural source, Types of water. Hydrological cycle. Water balance, porosity, permeability, runoff processes. Global water balance. Ground water pollution. Ice sheets and fluctuations in sea levels. Geochemical cycles. Biogechemical factors in environmental health. Human use, trace elements and health. Possible effect of imbalance of some trace elements. Diseases induced by human use of land. Land use planning. Soil survey in relation to landuse planning.

Unit III

Mineral resources-distribution major steps of extraction of common metals and their recycling. Concept of major, trace and Rare Earth Elements (REE). Environmental impact of exploitation of minerals and mining activities with reference to Rajasthan. Minerals and population. Ocean as new areas for exploitation of mineral resources.

PAPER : ES 414/ECOTOURISM (3L) (3h/week)

Note: The question paper will be divided into three parts- ABC

Part A- This part is of 8 Marks. Eight questions are to be set, at least 2 from each unit. **All questions are compulsory**. The answer for each question should not exceed twenty words. All question carry equal marks, each question is of one mark.

Part B- This part is of 8 Marks. Four questions are to be set, at least one from each unit. All questions are compulsory. The answer for each question should not exceed fifty words. All questions carry equal marks, each question is of two marks.

Part C- This part is of 24 Marks. Six question are to be set, that is two from each Unit. The candidates have to answer any three questions choosing at least one question from each Unit. The answer for each question should not exceed four hundred words. All questions carry equal marks, each question is of 8 Marks.

Unit I

Introduction

Need and importance of ecotourism; social and ecological impacts of tourism; definition of ecotourism. Concept of ecotourism- Ecotourism and related sub-sectors of the tourism industry; Ecotourism criteria; Quebec declaration on ecotourism

Ecotourism practices

Transportation; Facilities (reduce, replace, reuse, recycle); Services (types, activities, and code of ethics); The eco-tourists (types, and code of ethics). Ecotourism Practices- Eco-labelling and green-washing (Examples and case studies of ecotourism in practice); Best practice guidance, Certification, Identify existing examples and case studies of eco-friendly practices in the tourism industry.

Unit: II

Resources and products

Ecotourism Resources: Identifying, listing, and understanding ecotourism resource categories (natural, built, and events); Protected areas- definition, categories and roles.Identifying and describing ecotourism products; Components of ecotourism- Ecotourism and the environment; Ecotourism and conservation; Ecotourism and protected areas; Ecotourism and economic benefits; Ecotourism and social benefits; Ecotourism and local community; Ecotourism and education. Community-based tourism- Community-based tourism management; Monitoring the success and impacts of community-based tourism

Unit: III

Ecotourism in the national/global context

Convention on Biological Diversity; Millennium Development Goals; Approaches in sustainable tourism: Global initiative under Quebec City and Oslo conventions- Responsible Tourism; Concept and Global responses. Ecotourism-based/related employment- Scope and areas of employment. Student presentations on important eco-tourism circuits in India.

Developing an ecotourism product

Identifying products, developing partnerships, tapping local knowledge, incorporating research, zoning, developing policies and guidelines, educating & marketing; Knowledge, skills, attitude and commitment of ecotourism service providers; Ecotourism products in Rajasthan.

PAPER: ENV -415 ENVIRONMENTAL GEOCHEMISTRY (4L) (4h/Week)

Note: The question paper will be divided into three parts- ABC

Part A- This part is of 8 Marks. Eight questions are to be set, at least 2 from each unit, **All questions are compulsory**. The answer for each question should not exceed twenty words. All question carry equal marks, each question is of one mark.

Part B- This part is of 8 Marks. Four questions are to be set, at least one from each unit. All questions are compulsory. The answer for each question should not exceed fifty words. All questions carry equal marks, each question is of two marks.

Part C- This part is of 24 Marks. Six questions are to be set, that is two from each Unit. The candidates have to answer any three questions choosing at least one question from each Unit. The answer for each question should not exceed four hundred words. All questions carry equal marks, each question is of 8 Marks.

Unit: I

Biogeographical classification of India, General relationship between landscape, biomes and climate. Energy budget of the earth. Climate of India. Indian Monsoon. El-Nino. Drought, Tropical cyclones and Western disturbances.

Unit: II

Catastrophic geological hazards : Study of floods, landslides, earthquakes, volcanoes and avalanche. Prediction and perception of the hazards and adjustment to hazardous activities. Origin and composition of sea water. Resources of oceans. Ocean pollution by toxic wastes. Water crisis as current environmental issue, conservation of water. OTEC (Ocean Thermal Energy Conversion) and GTEC (Geo-thermal Energy Conversion).

Unit: III

Method of site-selection and evaluation. Application of GIS and remote sensing in Environmental Sciences. Environmental impact of exploitation of minerals and mining activities with reference to Rajasthan. Aravallis mining lands types of mine reclamation practices. Revegetation of mine spoils through plants fertilization and related practice.

PAPER: ENV 416 Practical (3P) (9h/week)

Air Quality Monitoring Techniques for defined Parameters :

1. Sulphur dioxide by Colorimetric method.
2. Nitrogen Dioxide by Colorimetric method.

2. Respirable Suspended Particulate Matter (RSPM) by Respirable suspended particulate matter sampler (RDS APM 460).
4. Dust retaining capacity of plants.

Water Quality Monitoring : Advanced Instrumental Analysis

1. Working Knowledge of UV-Visible Spectrophotometer.
2. Working Knowledge of Atomic Absorption Spectroscopy for heavy metal analysis.

Solid Waste Analysis

1. Physical composition (by weight)
2. Calorific value by calculation
3. Moisture content
4. pH and Conductivity
5 Total Organic Carbon
6. Nitrogen, Phosphorus and Potassium (NPK)
7. Carbon – Nitrogen ratio (C:N ratio)

Data handling and Management

1. Knowledge of Statistical software which processes numerical data and performs statistical tests and analysis
2. Different modes of graphical representation of data
3. Working knowledge of Internet
4. Model for steady-state conditions of hypothetical system.

SEMESTER IV

CORE COURSE:

ENV 500 Long Term Project /Dissertation (10 P)

ELECTIVE COURSES FOR I & III

ENV 421 Techniques in Environmental Science-II

Climate

1. Peterson week indices for climatic Study.

Soil Analysis

1 Wilting coefficient, hygroscopic coefficient, colloidal matter of soil samples.
2 Na and K- Flame photometery

Ecophysiological

1. Determination of water relation indices of plant- moisture content, water saturation deficit and relative water content.

PAPER: ENV 422 ENVIRONMENTAL IMPACT ASSESSMENT –I (4L) (4h/Week)

Note: The question paper will be divided into three parts- ABC

Part A- This part is of 8 Marks. Eight questions are to be set, at least 2 from each unit, **All questions are compulsory**. The answer for each question should not exceed twenty words. All question carry equal marks, each question is of one mark.

Part B- This part is of 8 Marks. Four questions are to be set, at least one from each unit. All questions are compulsory. The answer for each question should not exceed fifty words. All questions carry equal marks, each question is of two marks.

Part C- This part is of 24 Marks. Six questions are to be set, that is two from each Unit. The candidates have to answer any three questions choosing at least one question from each Unit. The answer for each question should not exceed four hundred words. All questions carry equal marks, each question is of 8 Marks.

Unit- I

Introduction & Overview of EIA: - The concept of EIA, History & evolution of EIA, Purpose Principle and Process of EIA, Generalized EIA Process Flowchart. Cost and Benefits of Using EIA Process. Law policy and Institutional Arrangements for EIA system.
Public Involvement:- Objectives and purpose of public involvements, levels & forms of public involvement, Role and contribution of public involvement in EIA, Principles, Public involvement in Keys stages of EIA process. Factors affecting the effectiveness of Public Involvement. Benefits of Effective Participation.

Unit- II

Screening:- Purpose, Screening Method, Scoping:- Role and Purpose of Scoping in EIA, Guiding principle and objectives of scoping, steps involved in scoping, outline of Terms of

References, Identification and consideration of alternatives. Impact Identification Methods: - Checklists, Matrices, Networks, Overlays and Geographic information system (GIS), Professional Experience etc. Main Advantages and Disadvantages of Impact Identification Methods.

Unit- III

Impact Analysis & Prediction: - Importance of impacts in prediction and decision making, Methods of Impact Prediction, types of Uncertainty in Impact Prediction. Evaluation of Impact Significance: - Importance of determining impact significance, Principles, Impact Significance criteria. Mitigation: - objectives & principles, elements of mitigation, proponents responsibility for implementing mitigation. A framework for Impact Management, Objectives of Impact Management & components of EMP.

PAPER: ENV 423 DISASTER MANAGEMENT (4L) (4h/week)

Note: The question paper will be divided into three parts- ABC

Part A- This part is of 8 Marks. Eight questions are to be set, at least 2 from each unit, **All questions are compulsory**. The answer for each question should not exceed twenty words. All question carry equal marks, each question is of one mark.

Part B- This part is of 8 Marks. Four questions are to be set, at least one from each unit. All questions are compulsory. The answer for each question should not exceed fifty words. All questions carry equal marks, each question is of two marks.

Part C- This part is of 24 Marks. Six questions are to be set, that is two from each Unit. The candidates have to answer any three questions choosing at least one question from each Unit. The answer for each question should not exceed four hundred words. All questions carry equal marks, each question is of 8 Marks.

UNIT I

Fundamentals of Disasters, Causal Factors of Disasters, and Phases of Disaster: Rapid Onset Disasters, Slow Onset Disasters Nature of Responses to Geo- hazards, Trends in Climatology, Meteorology and Hydrology, Trends in Seismic Activity, Problems Related to Insurance, UN Draft Resolution on Strengthening of Coordination of Humanitarian Emergency Assistance.

UNIT II

Flood Management Model, Integrated Flood Management Information System (IPMIS). Flood Control in India. Structure of Tropical Cyclone, Nature of Tropical Cyclones, Water Related Hazards, Tsunamis: Physical Characteristics, Causes, Mitigation of Risk and Hazards.

UNIT III

Changes in the Coastal Zone, Coastal Erosion and Beach Protection, Wave Erosion, Erosion due to near shore Currents, Coastal Erosion Caused by Natural Features, and Coastal Erosion Caused by Man-Made Structures.

ELECTIVE COURSES FOR I & III

ENV 429 Practical (3P) (9h/week)

Air Quality Monitoring Techniques for defined Parameters :

1. Formaldehyde (HCHO) by Colorimetric method.

Water Quality Monitoring : Advanced Instrumental Analysis

1. NPK in water sample
2. Total, organic and inorganic carbon.

Biological Monitoring

1. Fish
2. Macrophytes.
3. Phytoplankton, Zooplankton.
4. Benthic Macroinvertebrates
5. Periphyton
6. Diversity indices – Shanon Index
7. Measurement of Pigments

Ecomodeling

1. Compartment/Box model of forest ecosystem.
2. Detemine steady state conditions(ecosystem analysis).
3. Detemine transfer rates between various trophic level.

Microbiological Analysis

1. IMViC tests
2. Heterotrophic plate Count
3. Multiple fermentation tube technique - MPN index for polluted and unpolluted waters.

Data handling and Management

1. Knowledge of EIA related software
2. Computer aided assessment for Environmental Impact study.

Case Study:

1. Study of a given Case and to determine the key facts and issues. List the impacts for each of the three phases of the project: construction, operations and expansion. Then prepare an Activity/Impact Matrix.
2. Study of Data collection methods including, plot sampling (using quadrats), Plotless sampling (using transects)

PAPER ENV 430 EIA IN PRACTICE (4L) (4h/week)

Note: the question paper will be divided into three parts- ABC

Part A- This part is of 8 Marks. Eight question are to be set, at least 2 from each unit, **All questions are compulsory**. The answer for each question should not exceed twenty words. All question carry equal marks, each question is of one mark.

Part B- This part is of 8 Marks. Four questions are to be set, at least one from each unit. All questions are compulsory. The answer for each question should not exceed fifty words. All questions carry equal marks, each question is of two marks.

Part C- This part is of 24 Marks. Six questions are to be set, that is two from each Unit. The candidates have to answer any three questions choosing at least one question from each Unit. The answer for each question should not exceed four hundred words. All questions carry equal marks, each question is of 8 Marks.

Unit: I

Capacity Building, Quality and Quality Control in EIA, The Convention of Environmental Impact Assessment in a Trans-boundary Context. Status of EIA in India, Prediction and Assessment of Impact on the Air Environment, Surface-Water Environment, Soil and Groundwater Environments, Noise Environment, Biological Environment. Cultural (Architectural, Historical, and Archaeological) Environment, Prediction and Assessment of Visual Impacts. Prediction and Assessment of Impacts on the Socio-economic Environment, Health Impact assessment.

Unit II

Strategic Environmental Assessment:- Concept of SEA, Comparison between EIA & SEA, Aims & Objectives of SEA, Institutional benefits from the use of SEA, Guiding principles, Scope of application of SEA to different level of decision making. Generic forms of SEA. Origin, definition, function. National Accreditation Board for Education and Training (NABET) Criteria for Registration of EIA Consultant Organizations including Need, Eligibility, Skills and Knowledge of Experts. EIA Coordinators, Functional Experts, Work Experience of Functional Area Experts and procedure of Registration.

Unit III

EIA for Mining Projects, EIA for Building Construction and townships, EIA for Highways, EIA for Nuclear Power, EIA for Thermal power. EIA for Water Projects, EIA of Cement Plant. EIA for Pulp and Paper, EIA for Oil refineries, EIA for man made fibre. EIA for

common hazardous waste disposal, storage and treatment facilities. Knowledge of EIA related organizations including International Association of Impact Assessment (IAIA), Established EIA Centers of India and abroad. Important Consultants and NGOs working in the field of EIA. Case Studies: Tehri Hydro-Electric Project, Almetti Dam, Narmada Dam and Indira Gandhi Canal Project

ENV 431 NATURAL DISASTER MANAGEMENT (4L) (4h/week)

1

Note: The question paper will be divided into three parts- ABC

Part A- This part is of 8 Marks. Eight questions are to be set, at least 2 from each unit, **All questions are compulsory**. The answer for each question should not exceed twenty words. All question carry equal marks, each question is of one mark.

Part B- This part is of 8 Marks. Four questions are to be set, at least one from each unit. All questions are compulsory. The answer for each question should not exceed fifty words. All questions carry equal marks, each question is of two marks.

Part C- This part is of 24 Marks. Six questions are to be set, that is two from each Unit. The candidates have to answer any three questions choosing at least one question from each Unit. The answer for each question should not exceed four hundred words. All questions carry equal marks, each question is of 8 Marks.

Unit I

Characteristics of Particular Hazards and Disasters: Earthquakes, Tsunamis, Tropical cyclones, Floods. The UN International Decade for Natural Disaster Reduction (IDNDR) , Policy for the Reduction of Disaster Consequences, Problems of Financing and Insurance, Role of the civil defence during disasters, Training of emergency Management Personnel,

Unit II

Causes of Floods, River systems, River Flooding, Hazard associated with Flooding, Flood Forecasting, Methods of Flood Forecasting, Disaster Management and Mitigation Measures, Cyclonic Storms in Bay of Bengal, Tropical Cyclone Warning Strategy in India.

Unit III

Oil Spills: Sources and Nature of Oil, Behaviour of Oils Spills, Countermeasures, Effects, Measures to Prevent Accidental Spills, Accidental Discharges.

ELECTIVE COURSES FOR II & IV

ENV 424 Practical (3P) (9h/week)

Climate

1. Calculation of water balance indices: heat index potential, evapotranspiration, ecoclimate formula
2. Relative humidity, precipitation, temperature (ombrothermic representative)

Water Analysis:

1. Phosphate by Spectrophotometer

Soil Analysis

1. Salinity of Soil using WTW instrument

Ecophysiological

1. Productivity by harvest and chlorophyll method of terrestrial community
2. Energy content of given biomass by Bombs calorimeter

Statistics

1. Calculation of standard deviation, correlation, regression
2. T-test, Chi-test, ANOVA,
3. Basic elements & tools of statistical analysis: Probability, sampling, measurement and distribution of attributes; Distribution- Normal, t and x2, Arithemetic, Geometric and Harmonic means; tests of hypothesis and significance.
4. Study of different Ecological sampling methods: - Data collection methods, Species abundance measures, sampling pattern (in space and time) and sample size.

PAPER ENV 425 ECO TOXICOLOGY (3L) (3h/Week)

Unit - I

History and scope of toxicology. Principles of ecotoxicology. Role of Environmental Chemistry in Ecotoxicology. Spectrum of Toxic dose: Approximate acute LD50 of some representative chemical agents. The use of biomarkers in assessing the impact of environmental contaminants. Aquatic toxicology: Requirements for ecotoxicological measures in the aquatic Environment. Terrestrial Toxicology: Acute and Chronic. Toxicity testing, field testing, Enclosure studies. Trophic level transfer of contaminants. Role of modelling and GIS in ecotoxicology. Ecological risk assessment.

Unit- II

Toxic chemicals in the environment - air, water & their effects, Pesticides in water, Biochemicals aspects of arsenic, cadmium, lead mercury, carbon monoxide, ozone and PAN

pesticide. Insecticides, MIC effects. Concept of major, trace and Rare Earth Element (REE) - possible effects of imbalance of some trace elements

Unit- III

Mode of entry of toxic substance, biotransformation of xenobiotics detoxification, Carcinogens in air, chemical carcinogenicity, mechanism of carcinogenicity, Environmental carcinogenicity testing.Biogeochemical factors in environmental health. Epidemiological issues goiter, fluorosis, arsenic poisoning

ENV 426/ MIC -433 ENERGY AND ALTERNATIVE ENERGY (1L) (1H/WEEK)

Unit- I

Energy and Fuel. Sources of energy. Current Energy scenario: Demand, supply and prospects. Transport energy and fuels. Pros and cons of each fuel/energy source. Problems arising with current sources of energy and fuels. Alternative sources of energy (Nuclear, solar, wind, tidal and others).

Unit-II

Solid fuel. Clean Energy. Clean coal. Magnetic hydrodynamic Power, Improving energy efficiency. Co-generation and other strategies.
Fossil fuels: Coal, Natural Gas and Petroleum. Petroleum refineries and petro bye products. Pollution and Global warming.

Unit-III

Bioenergy and Biofuels: Biomass for steam and power. Biofuel crops in the world. Oil crops, Starch crops, Sugar crops. Extraction of oil, starch and sugar. Wastelands available in India and candidate biofuel crops for these regions. Life cycle analysis of biofuels.

ENV 427 ENVIRONMENTAL IMPACT ASSESSMENT – II (4L) (4h/Week)

Note: The question paper will be divided into three parts- ABC

Part A- This part is of 8 Marks. Eight question are to be set, at least 2 from each unit, **All questions are compulsory**. The answer for each question should not exceed twenty words. All question carry equal marks, each question is of one mark.

Part B- This part is of 8 Marks. Four questions are to be set, at least one from each unit. All questions are compulsory. The answer for each question should not exceed fifty words. All questions carry equal marks, each question is of two marks.

Part C- This part is of 24 Marks. Six questions are to be set, that is two from each Unit. The candidates have to answer any three questions choosing at least one question from each Unit. The answer for each question should not exceed four hundred words. All questions carry equal marks, each question is of 8 Marks.

Unit I

Reporting: - Features & purpose of EIA Reports, Main elements of EIA Report, Shortcoming encountered in preparing EIA reports. Review of EIA Quality:- Role & purpose of the

Review process, Aspects for consideration, EIA Review- Types of Procedures, Steps involved in EIA Review, EIA review criteria, EIA review methods, Four steps approaches for EIA review. Environmental Management plan Or Impact management Plan.

Unit II

Decision Making: - concepts and its importance, responsibilities f decision makers in EIA process, Decision Making Process. Implementation & Follow up:- Need & purpose, Its components, Guiding Principles and elements, Aspects and Issues needs to be considered in EIA implementation & follow up.

Unit III

EIA Project Management: - its concepts, Role of Project Manager, Characteristics & Attributes of an interdisciplinary of EIA team, Project Managers Responsibilities. Social Impact Assessment:- concept, role & purpose of SIA, Benefits of SIA, Steps & principles of SIA, Methods used for predicting Social Impacts.

Paper ENV 428 GEOLOGICAL DISASTERS (4L) (4h/week)

Note: the question paper will be divided into three parts- ABC

Part A- This part is of 8 Marks. Eight questions are to be set, at least 2 from each unit, **All questions are compulsory**. The answer for each question should not exceed twenty words. All question carry equal marks, each question is of one mark.

Part B- This part is of 8 Marks. Four questions are to be set, at least one from each unit. All questions are compulsory. The answer for each question should not exceed fifty words. All questions carry equal marks, each question is of two marks.

Part C- This part is of 24 Marks. Six question are to be set, that is two from each Unit. The candidate have to answer any three questions choosing at least one question from each Unit. The answer for each question should not exceed four hundred words. All questions carry equal marks, each question is of 8 Marks.

UNIT I

Causes, Characterization of Ground-Motion, Earthquakes Scales: Magnitude and Intensity, Earthquake Hazards and Risks, Perception and Prediction of Earthquake, Earthquake Disaster Mitigation Programme Components, and Disaster Mitigation Programme in India. Monitoring and Warning, Volcano Monitoring using Satellite Images, Detection and Monitoring of Eruption Plumes,

Description of Phenomenon,Volcanic Landforms, Eruption Early Warning from Satellites, Volcanic Hazards, Reducing Structural Vulnerability, Risk Mitigation and Training.

UNIT II

Types of Mass wasting process, Factors influencing the Slope Stability, Landslides, Rock falls, Avalanches, Mudflows and Glaciers, Landslide Information, Snow Avalanches, Event Modification Surface subsidence and Collapse, Removal of Solids and Mine-Related Collapse, Subsidence Caused by Fluid Withdrawal, Other Causes of Subsidence vulnerability Modification. Types of Glacier Hazard. Landslide Hazard Potential Map (LHPM), Landslide

Hazard Grading (LHG). Carbonate Dissolution, Karst Topography, Predicting and Mitigating Subsidence Hazards.

UNIT III

Mining and Environment, Environmental Impacts of Mining in India, Disasters Due to Mine Subsidence Open-Cast Mining: Environmental Impacts, Land Degradation, Hydrology and Water Pollution, Air Pollution, Noise Pollution. Land Degradation and Reclamation, , Calamities of Fire and Explosion in Coal Mines, Hazards of Fire in Mines, Disasters of Mine Fire and Its Diagnostics, Case Study of some Major Open Cast Mining Activity in Rajasthan.

ELECTIVE COURSES FOR II & IV

ENV 432 Research Methodology and Statistics (4L=4h/week)

Unit-I

Concept of research; purpose, types, significance, objectives. Selection of research problem, Authenticity of Research topic.

Unit-II

Research Design; Exploratory, descriptive, experimental. Sampling techniques; sampling theory, types of sampling, sampling error, selection of sample, sample size. Probability.

Unit-III

Data collection; types of data, primary & secondary data, process of data collection. Measurement of research, data collection measurement & analysis. Arithmetic, Geometric and Harmonic Mean, Median and mode, Distribution- Normal, t and x2, poisson and binomial, Concept of central tendency, standard deviation, standard error, test of significance, correlation, Regression, Non-parametric & Parametric techniques, T-test, Chi- Test, ANOVA, preparation of synopsis & Research Report Writing.

- Ten credits (30 hour/week each) of workload such as independent individual/group work; obligatory / optional work placement; field work; project work/ dissertation, which will be equivalent to 10 L credits (10h/week) workload for the advisor teacher. Details are as below:

S. No.	Course	Credits (batch limit 10 students)	Student workload (h/week)
1	Ground work (Review of literature)	1	1.5
2	Plan of work	1	1.5
3	Conduction of Experiments		14
4	Presentation of data	1	1.5
5	Analysis of data	2	2
6	Presenting weekly reports (20 min seminars+5min discussion)	1	1
7	Report Writing	1	1.5
8	Presentation as Seminar (8 min+2 min discussion) and Presentation as Poster Paper	1	1

9	Popular writing on social/scientific issues/awareness/presenting on public platform	2	1
	Total (1-9)	10	25

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Books recommended for M.Sc. Previous:

Practicals

- APHA , Standard Methods for the Examination of Water and Wastewater, 18th edition, American Public Health Association (APHA). 1992
- Water Quality Monitoring/edited by Jamie Bartram and Richard Balance a book published by E & FN SPON Press London on behalf of UNEP and WHO. 1996
- Guidelines for drinking- water Quality Vol1-3. WHO 1985
- Essential Environmental Science- Methods and Techniques/ edited by Simon Watts and Lyndsay Halliwell , Routledge Press, London.1996
- Environmental Management Training/edited by R.G.A.Boland Sterling Publishers (P) Ltd., New Delhi.1993
- Practical Methods in Ecology and Environment – R.K. Trivedi and P.K.Goel, EnviroMedia publications, Karad.
- Handbook of Methods in Environmental Studies Vol – I Water and Waste Water Analysis S.K. Maiti A.B.D. Publications Jaipur.

Books recommended for M.Sc. Final

- Methods of Environmental Impact Assessment /edited by Peter Morris and Riki Therivel - 2nd edition Spon Press, London. 2001.
- APHA , Standard Methods for the Examination of Water and Wastewater, 18th edition, American Public Health Association (APHA). 1992
- Water Quality Monitoring/edited by Jamie Bartram and Richard Balance a book published by E & FN SPON Press London on behalf of UNEP and WHO. 1996
- Guidelines for drinking- water Quality Vol.3. WHO 1985
- Essential Environmental Science- Methods and Techniques/ edited by Simon Watts and Lyndsay Halliwell , Routledge Press, London.1996
- Environmental Management Training/edited by R.G.A.Boland Sterling Publishers (P) Ltd., New Delhi.1993
- Bureau of Indian Standards IS: 9235-1979 Method for Physical analysis and determination of moisture in solid wastes (excluding industrial solid wastes)
- Bureau of Indian Standards IS: 9234-1979. Method for preparation of solid waste sample for chemical and microbiological analysis
- Bureau of Indian Standards IS:10158-1982 Methods of analysis of solid wastes (excluding industrial solid wastes)
- Bureau of Indian Standards IS:1350 (Part II) – 1970. Calorific value

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MIC 414 S Sk Short term Project (1P)

Students will be given basic experimental work to achieve specific goal so as to acquaint him/her with the handling of microorganisms.

In addition to the Project work in this semester (Semester IV), a student may pick courses upto 4L only in addition to foundation course (1-2L).

17. Course List

17.1. All courses as specified and approved by the Boards of Studies shall be listed in the Course List for each Program of Study and the lists shall be continuously reviewed and updated.

17.2. The Course List will provide a comprehensive listing and a brief outline of all courses offered across all Departments /Centres of the University/Departments of Colleges.

17.3. Each course of the Course List shall indicate its level, pre-requisite(s) and co-requisite(s), expectations in terms of time commitments on the part of students registering for that course and requirements for successful completion of the course.

17.4. Listed courses of a department may be offered or not in a particular semester, depending on the availability of faculty and infrastructure.

17.5 Each Head of the Department must provide the list of courses being offered by the concerned Department in the upcoming semester along with name of the respective course leader 30 days before the commencement of the semester in Proforma III. This information must be available at the Notice Board of the Department as well as the University/College website and also must be sent to the Dean PG Studies/Principal.

Proforma III

List of Courses to be provided to the Dean PG Studies/Principal of the College by the Head of the Department

Department of Environmental Science

List of Courses being offered in Semester I/II/III/IV Session 20... -20....

Course Code	Core Course Title and credits	Course Leader	Course Code	Elective Course Title and credits	Course Leader

Signature of the Head

17.6. A comprehensive list of courses and course leaders for all departments as well as for the Foundation Courses shall be sent by the Dean PG Studies/Principal to each Head of the Department in the prescribed Proforma (IV), who in turn shall make it available to the Student advisors.

Proforma IV Compiled List of all courses being offered in a Semester by the University or the College (to be prepared by the Dean, PG Studies/Principal of the College and sent to the Heads of the Departments)

List of Courses being offered in Semester I/II/III/IV Session 20... -20....

Foundation Courses

Course Code	Core Course Title and credits	Course Leader	Course Code	Elective Course Title and credits	Course Leader

Department of.....

Course Code	Core Course Title and credits	Course Leader	Course Code	Elective Course Title and credits	Course Leader

Department of .....

Course Code	Core Course Title and credits	Course Leader	Course Code	Elective Course Title and credits	Course Leader

Department of .....

Course Code	Core Course Title and credits	Course Leader	Course Code	Elective Course Title and credits	Course Leader

(Signature)

Dean, PG Studies/Principal of the College

18. Course Registration

18.1 The program of admission in each semester including date for Course Registration, orientation, counseling and course registration and reporting to the course leader must be announced by the Dean PG 15 days before any semester has to begin.

18.2 Each department under CBCS shall provide the list of courses being offered in the semester to begin to the Dean PG in both hard and the soft copy, 7 days before the course registrations are to be done.

18.3 The Dean PG Office will consolidate the list of courses being offered by all departments under CBCS in the semester to begin and send them to all Heads of the Departments and also get them uploaded on the website of the university.

18.4 The information on list of all the courses offered in every department specifying the credits, the prerequisites, a brief description of syllabus or list of topics, the instructor who is offering the course and the time slot shall be made available by the Heads of the Departments concerned for uploading on the University website.

18.5 The Heads of Departments must make available this list to the faculty members of their departments.

18.6 All admitted students must be present on the days of Orientation, counseling, registration of courses and the day of reporting to the course leader.

18.7 Orientation day: The students must be introduced to the procedures of registration of courses, evaluation) at the concerned department/institute/centre on the Orientation day (i.e., the first day of the semester) and provide them the list of Course leaders and the Head of the Department would inform the students the names of their Faculty Advisors.

18.8 Faculty Advisors must guide students about the academic programs and counsel on the choice of courses keeping in view the student's academic background and career objectives. They would inform and discuss what choices a student may take on the basis of list of courses being offered by all departments in the concerned semester following which the student must register the courses online in the department. Alternatively at a single point (for example in the library) department wise all course leaders must be given a desk where each student willing to register may enroll with the concerned course leader.

18.9 The student has to seek consent of each teacher offering the courses and sign in a Course Registration Card (Proforma V). The student should meet the criteria for prerequisites to become eligible to register for that course. Two copies of the Registration Card shall be provided by the Course Leader to the Head of the Department, who in turn must send one copy of all course registration cards for the courses finally being offered by the department in the concerned semester to the Controller of Examinations.

Proforma V

Course Registration Card

Department of Environmental Science Semester I/II/III/IV **Session 20... -20....**

Code and the Title of the Course: Credits.....

S. No.	Name of the Student	Department	Program of study registered	Year of Admission	Signature of the student with date	Signature of the student with date if dropping the course*

*A registered student may drop the course before the end of the 3rd week of the semester, after which two copies are to be forwarded to the Head of the Department.

The course shall run/not run since there are/are not minimum 3 registrations (for PG course)/minimum 10 registrations (for UG course).

Name of the Course Leader:

(Signature of the Course Leader with Date)

Since 3 weeks of semester have completed, the Course Registration Card is forwarded for necessary action.

(Signature of the Course Leader with Date of completion of 3 weeks)

(To be forwarded in three copies to the Head of the Department before the end of the 4th week of the semester)

(Signature of the Head of the Department)

(One copy to be sent back to the Course Leader, one retained in office and the third copy to be forwarded to the Controller of Examinations, only when the course has registrations of minimum number of students)

18.10 For a PG degree program, the student will have to register for a minimum of 18 credits in a department other than the parent department and a minimum of 4 credits of the Foundation Courses during the entire period of a Program of Study.

18.11 A student, to retain his status, should register for at least 12 credits in a semester. However, no student shall be permitted to register for courses exceeding 36 hours of actual teaching. Registration for Repeat courses shall be allowed in excess of this limit.

18.12 If a student finds that he/she has registered for more courses than possible to study in a semester, he/she can drop one or more of courses before the end of 3rd week of the semester.

18.13 Students shall have to register for the courses for the semester within the first week of admission.

18.14 The maximum number of students to be registered in each course shall depend upon the physical facilities available.

18.15 In any department preference for registration shall be given to those students of that department for whom the course is a Core course.

18.16 The registration for the elective course shall be on first come first served basis, provided the student fulfils prerequisites for that course, if any.

18.17 Normally, every Lecture-based course shall be offered by one teacher.

18.18 No course shall be offered unless a minimum of 3 students for PG and 10 for UG are registered.

18.19 Essential Foundation courses shall be registered by all students as per the recommendation of the Program of Study.

18.20 Students admitted late will have to contact the concerned Head of the department, who in turn must introduce and guide him/her to the process of registration.

19. Auditing a Course

Subject to the permission of the teacher handling the course, a student may be permitted to audit a maximum of two courses without assigning any credits. The student will be assessed the same way as other students who credited the course but will be awarded either 'satisfactory' or 'unsatisfactory' grade based on his/her performance.

20 Class schedule

20.1 Tentative time table of each department shall be displayed on its Notice Board on the 1st day of the semester and a copy should be made available to the Dean PG Studies/ Principal and the Course leaders of the Department, a day before the beginning of the semester.

20.2 Practical classes must be arranged in the afternoon sessions.

20.3 In general, it is understood that course leaders would adjust the conflicting time slots on the basis of mutual understanding. Yet in case of any dispute, the Dean PG would give slot in the time table on priority to a course leader having more variety of students (i.e., having registrations of students from maximum number of departments).

20.4 If all classes cannot be accommodated to the usual period, then teaching hours may be extended. Teachers having classes starting early or in the late hours shall be free to leave/come to the campus compensating this time. Total stay in the campus shall be as per the UGC norms.

20.5 In no case, however a teacher must be given a time slot of both early and late hours.

21 Assessment and Evaluation

21.1 Breakup of Internal/External End Semester Examinations

21.1.1 All subjects in a PG programme shall carry an Internal Assessment component to the extent of 40% marks and End Semester for 60% marks. For UG programs it should be 30% marks internal and 70% marks for external.

21.1.2 In case of Laboratory/Field/Project work based subjects, appropriate distribution of marks for Practical Record/Project Report, Practical end-Semester exam, Viva, etc., if any shall be made by the respective Committee of Courses/Board of Studies.

21.1.3 A student shall not be permitted to repeat any course only for the purpose of improving the grade.

21.2 **Breakup of Internal Assessment Marks**

21.2.1 Each teacher shall organize a continuous assessment of each of the courses assigned to him/her. The internal assessment shall be as per the following breakup:

S. No.	Item	Max Marks
1	Internal Assessment Tests/Term Papers/Quizzes (two) 1 x 30 or 2 x15	30
2	Seminars/Assignments/Case Demos/Presentations/Write ups/ Viva, etc.	10
	Total	40

21.2.2 It is mandatory for all students to participate in all the Internal Assessment tests and in various course-work related activities for award of the above marks. Therefore a schedule of Internal Assessment tests shall be prepared by the Course Leader and informed to the students at the very beginning of the semester.

21.2.3 Internal Assessment marks shall be displayed within a week from the date of conduct of examination and all corrected answer papers shall be given back to students with comments, if any.

21.3 End-semester examinations

21.3.1 An End Semester examination shall be conducted for all courses offered in the department. The duration of the end semester examination shall be for 3 hours.

21.3.2 A schedule of End Semester examinations be prepared by the Examination Section and displayed at the departments at least one-month ahead of the conduct of the examination.

21.3.3 No student who has less than 75% attendance in any course shall be permitted to attend the end-semester examination and s/he shall be given grade of FA-failure due to lack of attendance. S/He shall be asked to repeat that course the next time it is offered.

21.4 Conduct of End-Semester Exams and Evaluation

21.4.1 End-Semester Examination shall be conducted by the University by inviting Question Papers from the External Examiners.

21.4.2 An alternative Question paper should also be made available for any contingency.

21.4.3 The scheme of the paper must be as is being practiced currently at the University

21.4.4 The answers papers of end-semester examination (theory) should be evaluated by the External Examiner.

21.4.5 For practical examinations, there will be a panel of examiners consisting of one external and one internal examiner.

Following shall be the distribution of marks in practical courses or the Board of Studies/Committee of Courses may modify it as per their requirements:

S. No.	Item	Maximum marks
1	Experimental work assigned during examination	60
2	Record	20
3	Viva voce	20

21.4.6 A panel of examiners consisting of one external (a faculty from the departments of MDS University, other than department of Environmental Science/faculty from local institutions/institutions from other cities) and one internal examiner (faculty from the department of Environment) must evaluate short/medium term projects, Following shall be the distribution of marks for the short term projects or the Board of Studies/Committee of Courses may modify it as per their requirements:

S. No.	Item	Maximum marks
1	Project report	70
2	Viva voce	30

21.4.7 Evaluation of long term projects/dissertation/research work shall also be done by the panel of examiners consisting of one external and one internal expert. Distribution of Marks for the evaluation of Long term projects may be as below or the Board of Studies/Committee of Courses may modify it as per their requirements:

S. No.	Item	Max Marks
1	Ground work/Review of literature	5
2	Plan of work	5
3	Conduction of Experiments	5
4	Presentation of data	5
5	Analysis of data	10
6	Presenting weekly reports (20 min seminars+5min discussion)	20
7	Report Writing	5

8	Presentation as Seminar (8 min+2 min discussion) and Presentation as Poster Paper	10
9	Popular writing on social/scientific issues/awareness/presenting on public platform	5
10	Presentation of seminar (10 min) in front of examination panel (One external, one internal)	10
11	Viva Voce	20
	Total (1-9)	100

22 Consolidation of Marks

22.1 The Head of the Department must send the award list of the internal assessment to the examination section. The examination section shall consolidate the Internal Assessment marks and End-Semester marks (average of both Internal and External Evaluation) and prepare a consolidated Statement of Marks.

22.2 In order to declare the pass, a Student should get a minimum of 40% marks in aggregate of Internal Assessment and End-Semester marks.

23 Supplementary Examination

23.1 A failed student who meets the attendance requirement and has a minimum of 40% in internal assessment marks may be permitted to register for the next end-semester examination in the semester in which the course is offered next.

23.2 Students who have failed due to insufficient attendance and/or less than 40% in Internal Assessment marks should repeat the course as and when it is offered.

24 GRADING AND GRADE CARD

The Examination Section shall prepare two copies of the results, one with marks to be sent to the Department and another for the University Office, not later than 15 days after the last day of semester examinations.

24.1 Letter Grades

24.1.1 Performances of students in each paper are expressed in terms of marks as well as in Letter Grades. In case of fractions the marks shall be rounded off to nearest integer. The class interval for the purpose of awarding the grades can be arrived at by dividing the difference between the highest mark secured and the minimum pass mark by 7 as there are seven passing grades. The formula is given below:

$K = (X-40)/7$

Where, K = class interval, X= the highest mark in the subject.

24.1.2 The grades may be awarded as given in the following table:

Range of Marks in %	Letter Grade	Points for Calculation of GPA/ CGPA
X to (X-K)+1	O	10
(X-K) to (X-2K)+1	A+	9
(X-2K) to (X-3K)+1	A	8
(X-3K) to (X-4K)+1	B+	7
(X-4K) to (X-5K)+1	B	6
(X-5K) to (X-6K)+1	C	5
(X-6K) to 40	P	4
Below 40	F	0
Failure due to lack of attendance	FA	0

24.1.3 K should not be rounded off to less than two decimal places. The numbers given in Range of Marks column, (X-K), (X-2K), (X-3K), etc., can be rounded off to the nearest whole number.

24.1.4 In courses where the number of students who have secured 40 marks and above is less than 10 then grading may be given based on the Table

Range of Marks in %	**Letter Grades**	Points for Calculation of GPA/ CGPA
81-100	O	10
71-80	A+	9
66-70	A	8
61-65	B+	7
56-60	B	6
50-55	C	5
40-50	P	4
<40	F	0

24.1.5 The GPA and CGPA will be calculated as weighted average of points secured by the student in all the papers registered by him/her. The weights are the number of credits for each paper. For example, a student getting an A+ grade in 4 credit course, A grade in 2 credit course, O grade in a 3 credit course and F grade in a 3 credit course will have a GPA as (9x4 + 8x2 +10x3 + 0x3)/(4+2+3+3) = (36+16+30+0)/12=82/12 = 6.83 out of 10.0; GPA = 6.83. The CGPA shall also be calculated in similar lines taking all subjects taken by the students in all semesters.

24.1.6 Student with a CGPA of 9.0 and above and who did not fail in any of the courses taken by him/her shall be awarded Distinction.

24.1.7 A CGPA of 6.0 and above shall be placed in First class.

24.1.8 Student who has secured less than 40% marks in any paper gets F Grade and he is treated as failed in that paper.

25. Grade Card

25.1 The University Office shall issue a Grade card for the students containing the marks and grades obtained by the student in the previous semester and Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA) (Proforma VI).

25.2 The grade card shall list:

The title of the courses taken by the student.
The credits associated with the course.
The marks and grade secured by the student.
The total credits earned by the student in that semester
The GPA of the student.
The total credits earned by the students till that semester.
The CGPA of the student.

26. Conditions for the Award of the Degree/Diploma/Certificate

26.1 In case a student admitted to the Programme opts out of the Programme after successful completion of

- Semester I, he/she will be awarded PG Certificate in
- Semester II he/she will be awarded PG Diploma in
- Semester III, he/she will be awarded Advanced PG Diploma in
- Semester IV, M.Sc. in

26.2 Students opting out with the PG Certificate/PG Diploma/Advanced PG Diploma may be permitted to get lateral entry into the Programme within a maximum period of two years to complete their Master's Degree.

26.3 There will be a provision of Certificate of specialization or skills learnt which would be given away to a student by the Dean PG Studies for the University teaching departments (UTDs) on the recommendation of the Departmental Council of the UTDs, if a minimum of 9 credits have been completed by the student in a specific skill or field of specialization.