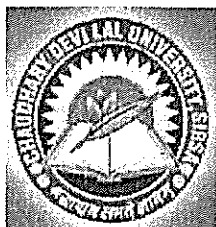


# COURSE CURRICULUM AND SCHEME OF EXAMINATION

M. Sc. Environmental Science  
Choice Based Credit System (CBCS)  
w.e.f Academic Session 2017-18



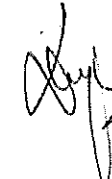


SEMESTER	CORE COURSE (CC)	ELECTIVE (CEC)	TOTAL	TOTAL MARKS
I	20	4	24	600
II	20	4	24	600
III	16	10	26	650
IV	16	8	24	600
<b>TOTAL</b>	<b>72</b>	<b>26</b>	<b>98</b>	<b>2450</b>

The student have to earn 10% of the programme credit from open elective courses

DEPARMENT OF ENERGY AND ENVIRONMENTAL SCIENCES

CHAUDHARY DEVI LAL UNIVERSITY

SIRSA, (HARYANA)-125055  
(Established by State Legislature Act 9 of 2003)

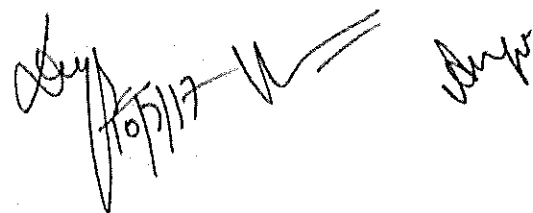
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### M. Sc. Environmental Science (First Semester)

S. No.	Course	Nomenclature	Type (Credit)	Contact hours		Examination schedule marks		Duration of Exam (Hour)
				L	PR	TH	Int. Assess	
1	EES-101	Earth Processes	NCC	4		70	30	3
2.	EES-102	Ecology	CC (4)	4		70	30	3
3.	EES-103	Environmental Chemistry	CC (4)	4		70	30	3
4	EES-104	Physical Environment	CC (4)	4		70	30	3
5	EES-105 (A)	Natural Resources	CEC (4)	4		70	30	3
	EES 105 (B)	Environmental Awareness and Planning	CEC (4)	4		70	30	3
6	EES-106	Lab-I: Ecology	CC (4)		(4+4) (In two days & Two groups)	100		6
7	EES-107	Lab-II: Environmental Monitoring- Soil	CC (4)		(4+4) (In two days & Two Groups)	100		6
		Total	(CC-20)(CEC-4)=24	24	8x2=16x2= 32	600		

### M.Sc. Environmental Science (Second Semester)

S.N o.	Course	Nomenclature	Type (Credit)	Contact hours		Examination schedule marks		Duration of Exam (Hour)
				L	PR	TH	Int. Assess	
1	EES-201	Environmental Impact Assessment	CC (4)	4		70	30	3
2	EES-202	Analytical Techniques	CC (4)	4		70	30	3
3.	EES-203	Biodiversity and Conservation	CC (4)	4		70	30	3
4.	EES-204	Environmental Pollution	NCC	4		70	30	3
5.	EES-205 (A)	Biostatistics and Computer Applications	CEC (4)	4		70	30	3
	EES-205 (B)	IPR and Biosafety	CEC (4)	4		70	30	3
6.	EES-206	Lab-III: Environmental Monitoring-Water	CC (4)		(4+4) (In two days & Two Groups)	100		6
7.	EES-207	Lab-IV: Environmental Monitoring -Air & Noise	CC (4)		(4+4) (In two days & Two Groups)	100		6
		Total	(CC- 20, CEC-4) 24	24	8x2=16 X 2= 32	600		


  
 10/7/17

### M.Sc. Environmental Science (Third Semester)

S.No.	Course	Nomenclature	Type (Credit)	Contact hours		Examination schedule marks		Duration of Exam (Hour)
				L	PR	TH	Int. Assess	
1	EES-301	Environmental Microbiology	CC (4)	4		70	30	3
2	EES-302	Pollution Control & Management	CC (4)	4		70	30	3
3.	EES-303	Environmental Biotechnology	CC (4)	4		70	30	3
4	EES-304(A)	Environmental Issues	CEC (4)	4		70	30	3
	EES-304(B)	Environmental Law	CEC (4)	4		70	30	3
5.	EES-305	Lab-V: Environmental Microbiology	CC (4)		(4+4) (In two days & Two Groups)	100		6
6.	EES-306(A)	Lab-VI: Biostatistics & Computer Applications	CEC (4)		(4+4) (In two days & Two Groups)	100		6
	EES-306(B)	Lab-VII: Solid Waste	CEC (4)		(4+4) (In two days & Two Groups)	100		6
7.	EES-307	Credit Seminar	CEC (2)		2X N (N- No of faculty Members)	50		To be evaluated by all faculty members
8.	EES-308	Major Project	CC (4)		One hour /student/week			To be evaluated in fourth semester by external Examiner
		Total	(CC-16, CEC-10) 26	18	8x3=24x2= 48	650		

### M.Sc. Environmental Science (Fourth Semester)

S.No.	Course	Nomenclature	Type (Credit)	Contact hours		Examination schedule marks		Duration of Exam (Hour)
				L	PR	TH	Int. Assess	
1	EES-401	Energy Resources	CC (4)	4		70	30	3
2	EES-402	Environmental Health and Toxicology	CC (4)	4		70	30	3
3	EES-403	Remote Sensing and Modelling	CC (4)	4		70	30	3
4.	EES-404 (A)	Natural Resource Management	CEC (4)	4		70	30	3
	EES-404 (B)	Environmental Hazards and Disasters	CEC (4)	4		70	30	3
5.	EES 405(A)	Lab-VIII: Environmental Biochemistry	CEC (4)		(4+4) (In two days & Two Groups)	100		6
	EES 405(B)	Lab-IX: Energy	CEC (4)		(4+4) (In two days & Two Groups)	100		6
6.	EES- 308	Major Project	CC (4)		One hour /student/week	100		To be evaluated in fourth semester by external Examiner
		Total	(CC-16) (CEC-8) (24)	20	8x2=16 x2=32	600		

### Open Elective Courses for the Students of M.Sc. Environmental Science

The student will earn minimum ten percent of the programme credits by choosing open elective courses offered by different departments of the university other than the Department of Energy and Environmental Sciences.

### Departmental Compulsory (Non-Credit Courses)

The department of Energy and Environmental Sciences will offer the following Compulsory Non-Credit courses (NCC) for the student of M.Sc. Environmental Sciences. The grades of Compulsory Non-Credit courses will not be counted for the computation of SGPA/CGPA. The student will have to obtain at least P Grade in Compulsory Non-Credit courses.

S. No.	Course	Nomenclature	Type (Credit)	Contact hours	Examination schedule marks	Duration of Exam (Hour)
				L PR	TH Int. Assess	
1	EES-101	Earth Processes	NCC	4	70 30	3
4.	EES-204	Environmental Pollution	NCC	4	70 30	3

NCC\*- Non Credit Compulsory course

### Open Elective Courses for the Students of other departments of the university

The department of Energy & Environmental Sciences will offer the following open elective course for the student of other departments of the university in both the odd and even semesters.

### Open Elective Courses

S. NO.	COURSE CODE	TITLE	TEACHING HOURS	CREDIT	EXAMINATION SCHEDULE			DURATION OF EXAM
					TH	Int.	Assess	
1	EES- OEC-001	Environmental Awareness	OE (4)	4	70	30	3	
2	EES- OEC- 002	Disaster Management	OE (4)	4	70	30	3	
3	EES- OEC-003	Environment and Society	OE (4)	4	70	30	3	

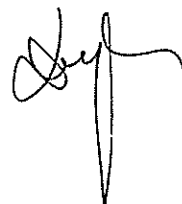
### GENERAL INSTRUCTIONS:

1. The Major project (EES-308) of 4 credits will be continued in both the 3<sup>rd</sup> and 4<sup>th</sup> Semester. The evaluation of the Major project will be done after fourth semester by external examiner.
2. The ordinance of Choice Based Credit System (CBCS) of the university will be followed by the department.



3. The departmental elective courses will be allotted to the students on the basis of their preference and percentage of marks in the previous semesters of M.Sc. Environmental Science
4. The evaluation of courses shall be as under:

Theory Courses components	Weightage (4 credits)	Weightage (3 credits)	Weightage (2 credits)	Evaluation
Mid term	20	15	10	Internal
Assignment	05	05	05	Internal
Attendance	05	05	05	Internal
End term exam	70	50	30	External
Total	100	75	50	



**EES-101**  
**EARTH PROCESSES**

Credit : 4

Marks: 100

Time: 3Hrs

Theory +Internal assessment: 70+30

**Note for the Paper setter:** The question paper will consist of nine questions in all. The first question (5X2 =10 marks) will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions (15 marks each) from each of the four units. The candidate is required to attempt four questions of 15 marks each, selecting at least one question of 15 marks from each unit.

**UNIT I**

Origin and evolution of earth through geological time, Primary differentiation and formation of crust, mantle and core, Atmosphere and Hydrosphere, Geological time scale. Geochemical classification of elements

**UNIT II**

Rock Types: Magma generation and formation of Igneous Rocks, Sedimentary and Metamorphic rocks, Rock cycle, Weathering, Erosion, Transportation and deposition of Earths materials by Running water, winds and Glaciers.

**UNIT III**

Thermal, Magnetic and gravitational fields of the earth, Theories of Continental Drift and Plate tectonics-Sea floor spreading, mountain building.

**UNIT IV**

Geological hazards and disaster: Earthquake and Seismic hazards, , Impacts, Himalayan Seismicity, Avalanches; Landslides, Volcano, Tsunami, Flood , Drought, Cyclone

**Reference Books**

1. Environmental Geology- Edward A. Keller
2. Physical Geology- C.W. Montgomery
3. Essentials of Geology- Tarback
4. Fundamentals of Geology- A. B. Roy
5. Geology and the Environment- Bernad, Trent, Hazlett & Bierman.
6. Essentials of Physical Geology- Wicander & Monroe
7. Historical Geology- Wicander & Monroe
8. Natural hazards and Disasters- Hyndman & Hyndman
9. Disaster management- Jagbir Singh



**EES-102**  
**ECOLOGY**

Credit : 4

Marks: 100

Time: 3Hrs

Theory +Internal assessment: 70+30

**Note for the Paper setter:** The question paper will consist of nine questions in all. The first question (5X2 =10 marks) will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions (15 marks each) from each of the four units. The candidate is required to attempt four questions of 15 marks each, selecting at least one question of 15 marks from each unit.

**UNIT I**

**Introduction:** Aims and Scope of Ecology, Organization level of biosphere, Laws of Tolerance and Limiting factor.

**UNIT II**

**Ecosystem:** Structure, Function and Services, Ecological pyramids, Food webs, Trophic levels, Ecological efficiencies, Model of energy flow, Energy budget, Primary and secondary production. Biogeochemical cycle: Gaseous cycles and Sedimentary Cycles, Human impact on Nutrient cycling.

**UNIT III**

**Population Ecology:** Demography, Population characteristics, Evolutionary strategy, r and k selection, Population growth and Regulation, Human population dynamics, Age structure, Population interaction, Symbiotic association, Competition, Parasitism, Prey-predator Relations.

**UNIT IV**

**Community Ecology:** Community Ecology, Analytical and Synthetic characters, Species diversity, Biomes and their types, Concept of niche, Keystone species, Ecad, Ecotype, Ecotone and Edge effect, Endemic species, Ecological succession: Types, trends and models, concept of climax.

**Reference Books**

1. Element of Ecology- Smith & Smith
2. Text Book of Ecology- Peter Sterling
3. Fundamentals of Ecology- E.P. Odum
4. Ecology- Russel, Rolfe, Hertz, Starr & Macmillan
5. Ecology and environment- P.D. Sharma
6. Ecology- Miller
7. Essentials of Ecology and Environmental Science- S.V.S. Rana



**EES-103**  
**ENVIRONMENTAL CHEMISTRY**

Credit : 4

Marks: 100

Time: 3Hrs

Theory +Internal assessment: 70+30

**Note for the Paper setter:** The question paper will consist of nine questions in all. The first question (5X2 =10 marks) will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions (15 marks each) from each of the four units. The candidate is required to attempt four questions of 15 marks each, selecting at least one question of 15 marks from each unit.

**UNIT I**

**Atmospheric Chemistry:** Chemical composition of the atmosphere-particles, ions, and radicals, Formation of particulate matter, Photochemical and chemical reaction in the atmosphere, Smog, Acid rain, Chemistry of Ozone layer depletion, Global warming, and Greenhouse effect.

**UNIT II**

**Water Chemistry:** Water quality parameters (Physical, chemical & biological parameters); Water quality standards for domestic, drinking and surface water quality ; Chemistry of inland water bodies (lentic system, lotic system); Solubility of gases in water, Carbonate system, Redox potential, Solubility product, Acids- Base reaction.

**UNIT III**

**Soil Chemistry:** Chemical and mineralogical composition, Soil formation, soil profile, Soil properties (physical, chemical, biological), soil nutrients (Organic and Inorganic nutrients), Ion exchange reactions in soil, soil fertility, soil pollutants (Pesticides, Heavy metals) and their effects.

**UNIT IV**

**Thermodynamics:** Stoichiometry; Firstlaw of thermodynamics, Enthalpy, Second law of thermodynamics, Carnot's cycle, Entropy. Third law of thermodynamics, Gibb's free energy, Chemical equilibrium and chemical potential.

**Reference Books**

1. Environmental Chemistry- Mannhan
2. Environmental Chemistry- A. K. De
3. Environmental Chemistry- Balram Pani
4. Soil sampling, preparation and analysis- Kim H. Tan
5. Soils: Micheal J. Singer and Donald N. Munns
6. Environmental Engineering and Science: Gilbert M. Masters and W. P. Ela
7. Fundamentals of Soil Sciences: Henery D. Futh
8. Text book of Limnology: G.A. Cole
9. Environmental Chemistry: Sharma and Kapoor





**EES-104**  
**PHYSICAL ENVIRONMENT**

Credit : 4

Marks: 100

Time: 3Hrs

Theory +Internal assessment: 70+30

**Note for the Paper setter:** The question paper will consist of nine questions in all. The first question (5X2 =10 marks) will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions (15 marks each) from each of the four units. The candidate is required to attempt four questions of 15 marks each, selecting at least one question of 15 marks from each unit.

**UNIT I**

**Earth Atmosphere:** Composition of Atmosphere, Atmospheric composition as a function of height, Thermal structure of atmosphere, Lapse rates and its types, Concept of Air Parcel, Vertical stability of atmosphere, Inversions, Mixing Height, Atmospheric stability and Plume behavior, Hydrostatic equilibrium.

**UNIT II**

**Earth Sun Relations:** Relationship between earth and sun, Latitudinal and seasonal distribution of Insolation, Solar radiation, Interaction of solar radiation with atmosphere, Terrestrial radiation, Atmospheric window, Albedo, Planetary Albedo, Heat budget of the earth, History of climate change, Methods for climate change detection, Milankovitch's theory of climatic change, Climatic feedback mechanism,

**UNIT III**

**Meteorology:** Scales of meteorology, Atmospheric Moisture, Coriolis force, Pressure, Global pressure belt systems, Cloud formation and classification, Precipitation, South-Westerly and North-Easterly Monsoon and its patterns

**UNIT IV**

**Aquatic Ecosystems:** Limnology- Physicochemical properties of Water, Types of freshwater bodies lentic and lotic; water mixing in lakes; Oceanography- Origin and Composition of sea water, Variation in Sea water Salinity and pH, Marine Biozones, Ocean waves and currents, Marine geological environment, Marine sediments.

**Reference Books**

1. The atmosphere: An introduction to Meteorology: F.K. Lutgens and E.J. Tarbuck
2. Atmospheric science: An Introductory Survey: J.M. Wallace and P.V. Hobbs
3. Confronting climate change: I.M. Mintzer
4. Atmosphere, Weather and Climate: Navarraa
5. Essentials of Oceanography: T. Garrison
6. Essentials of Oceanography: H.V. Thurman and A.P. Trujillo
7. Oceanography: G. Gross
8. Oceanography, An introduction to the Marine Environment: Richard Davis



**EES-105 (A)**  
**NATURAL RESOURCES**

Credit : 4

Marks: 100

Time: 3Hrs

Theory +Internal assessment: 70+30

**Note for the Paper setter:** The question paper will consist of nine questions in all. The first question (5X2 =10 marks) will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions (15 marks each) from each of the four units. The candidate is required to attempt four questions of 15 marks each, selecting at least one question of 15 marks from each unit.

**UNIT I**

**Biological resources**

Forest types in India,. Floral and Faunal resources of the world, Floral and Faunal resources of India, BSI, FSI, ZSI, plants of medicinal importance, Ethno botanical importance, Range lands and their importance

**UNIT II**

**Water Resources**

Water resources types, Surface water: Rivers, Lake etc, Underground water, Current scenario of water related issues.

**UNIT III**

**Land Resources**

Major Soil types of India, Mineral resources and reserves, ocean ore and recycling of resources, processing and smelting of Mineral, oceans as need areas for exploitation of mineral resources.

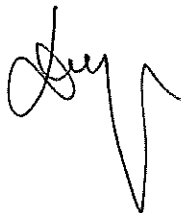
**UNIT IV**

**Energy Resources**

Sources of renewable and non renewable resource. Solar energy, solar radiations, fossil fuels classification, composition, Physico- chemical characteristics and energy content of coal, petroleum& and Natural gas, Wind Energy, Geothermal Energy, Tidal energy, Biomass Energy, Nuclear Energy

**Reference**

1. Ecology and Environment- P.D. Sharma
2. Essentials of Ecology and Environmental Science- S.V.S. Rana
3. Natural resources conservation: Oliver Owen and Chiras
4. Living in the environment: T. J. Miller
5. Ecology of Natural resources: Ranade
6. Global biodiversity: W.R.L. (IUCN)
7. [www.moef.gov.in](http://www.moef.gov.in)
8. [www.unep.org](http://www.unep.org)



**EES-105 (B)**  
**ENVIRONMENTAL AWARENESS AND PLANNING**

Credit : 4

Marks: 100

Time: 3Hrs

Theory +Internal assessment: 70+30

**Note for the Paper setter:** The question paper will consist of nine questions in all. The first question (5X2 =10 marks) will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions (15 marks each) from each of the four units. The candidate is required to attempt four questions of 15 marks each, selecting at least one question of 15 marks from each unit.

**UNIT I**

Environmental awareness approach, Role of different media in environmental awareness, Role of NGOs, Role of public participation in Environmental awareness.

**UNIT II**

Environmental ethics, Ecomark, Basic concepts of environmental planning, Energy resources and water resources planning in India, Urban and rural planning, Landuse planning, Major issues related to Himalayan ecology, Deserts and Mangroves.

**UNIT III**

Environmental Economics: Cost and benefit of GHG's controlling, carbon trading and CDM mechanism, Cost benefit analysis-its relevance, concept of consumer surplus, willingness to pay and accept, estimation methods of non market benefits-Contingent valuation, Travel cost approach, Hedonic price approach, Green accounting, Agricultural marketing, Ecomark.

**UNIT IV**

Concept of Sustainable development, Principles of Sustainability, Pillars of Sustainability, Ecological and Economic and Social aspects of Sustainability, Ecological Footprint, Natural Capital, Poverty and Environment, Millennium Development Goals (MDGs), World Summit on Sustainable Development (WSSD).

**Reference Books**

1. Environmental Economics- Charles D Kolstad
2. Environmental Ethics- David R Keller
3. Environmental Studies & Ethics- Gouri Suresh
4. Environmental Awareness- Annette Bogler
5. Living in the Environment: Principles, Connections, and Solutions: Miller & Spoolman



**EES-106**  
**Lab I: ECOLOGY**

Credit : 4

Practical Hrs: 4 + 4

Marks: 100

Exam duration: 6 hrs

1. Biomass Estimation of Plant Sample.
2. Determination of minimum size of the quadrat.
3. Determination of minimum numbers of the quadrat.
4. Determination of population density by quadrat method.
5. Species richness and evenness (Biodiversity) by quadrat method.
6. Determination of Frequency of a plant community by quadrat method.
7. Determination of Abundance of a plant community by quadrat method.
8. Determination of Relative Dominance of plant community by quadrat method.
9. Determination of Importance Value Index (IVI) of species by quadrat method.



LAB II: ENVIRONMENTAL MONITORING (SOIL)

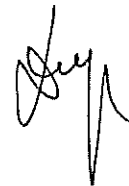
Credit : 4

Marks: 100

Practical Hrs: 4 + 4

Exam duration: 6 hrs

1. Determination of pH in soil sample.
2. Determination EC in soil sample.
3. Determination of Carbonate content in soil sample.
4. Determination of Total Organic Carbon (TOC) in soil sample.
5. Determination of Particle Size Analysis (PSA) in soil sample.
6. Mineralogical analysis of soil and rock samples.
7. Heavy metal analysis of soils.
8. Determination of water holding capacity of soil sample.
9. Determination of different forms of Nitrogen by Kjeidahl method.



**SEMESTER II  
EES-201**

**ENVIRONMENTAL IMPACT ASSESSMENT**

Credit : 4

Marks: 100

Time: 3Hrs

Theory +Internal assessment: 70+30

**Note for the Paper setter:** The question paper will consist of nine questions in all. The first question (5X2 =10 marks) will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions (15 marks each) from each of the four units. The candidate is required to attempt four questions of 15 marks each, selecting at least one question of 15 marks from each unit.

**UNIT I**

Origin and development of EIA, EIA Methodology-project screening, scoping, base line data, impact identification, and prediction, evaluation, monitoring and auditing and mitigation, public participation, presentation, review and decision making in EIA process; Environmental impact statement (EIS).

**UNIT II**

Environmental impact of mining industries, Nuclear power plants; Coal Fired Thermal Power plant, EIA of Hydroelectric Projects-Tehri dam, Sardar sarovar and Almetti dam.

**UNIT III**

Environmental Management Systems: Elements of environmental management, environmentally sound technologies, concept of cleaner production, clean development mechanism (CDM), Environmental management plan ISO-14000, Life Cycle Analysis (LCA), Strategic Environmental Assessment (SEA).

**UNIT IV**

Environmental Risk: Definition of risk, nature of risk (voluntary and in voluntary risk), risk perception, important environmental risk, risk assessment- hazard identification, exposure assessment Dose-response assessment and risk characterization (integrated exposure uptake biokinetic-IEUBK model); ecological risk assessment; uncertainty; risk management- risk identification, risk estimation, risk evaluation

**Reference Books**

1. Environmental impact assessment: John Glasson
2. Methods of Environmental impact assessment: Morris & Therivel
3. Environmental impact assessment: L.W. Canter
4. Introduction to Environmental Engineering and Science: Gillbert masters.
5. Soil and Environmental Quality: G. M. Pierzynski, J. T. Sims and G. F. Vance

**EES-202**  
**ANALYTICAL TECHNIQUES**

Credit : 4

Marks: 100

Time: 3Hrs

Theory +Internal assessment: 70+30

**Note for the Paper setter:** The question paper will consist of nine questions in all. The first question (5X2 =10 marks) will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions (15 marks each) from each of the four units. The candidate is required to attempt four questions of 15 marks each, selecting at least one question of 15 marks from each unit.

**UNIT 1**

**Environmental Sampling:** Water, Air and Soil, High Volume Air Sampler, Cascade Impactor.

**UNIT II**

**Spectroscopy:** Principles of spectroscopy, UV-Visible spectrophotometry, Colorimetry, Flame photometry, Atomic Absorption Spectroscopy, Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES).

**UNIT III**

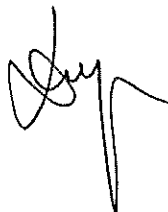
**Chromatographic technique:** Theory and Principle, Paper chromatography, Thin layer chromatography (TLC), Column chromatography, Ion exchange chromatography, Gas chromatography (GC), High Pressure Liquid Chromatography (HPLC).

**UNIT IV**

Fluorometry, X-Ray Diffraction (XRD), Electrophoresis, Titrimetry: Complexometry, Neutralization titrations, Oxidation-Reduction Titrations, Potentiometric titrations.

**Reference Books**

1. Textbook of Quantitative Chemical Analysis: J. Mendham, R.C. Denney, J.D. Barnes
2. Instrumental Methods of Chemical Analysis: G.R. Chatwal, S.K. Anand
3. Undergraduate instrumental analysis: James W. Robinson
4. Model method of chemical analysis: Robert, Shields, Carins, Willim.



**EES-203**  
**BIODIVERSITY AND CONSERVATION**

Credit : 4

Marks: 100

Time: 3Hrs

Theory +Internal assessment: 70+30

**Note for the Paper setter:** The question paper will consist of nine questions in all. The first question (5X2 =10 marks) will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions (15 marks each) from each of the four units. The candidate is required to attempt four questions of 15 marks each, selecting at least one question of 15 marks from each unit.

**UNIT I**

Biodiversity: Definition, Significance, Threats, Genetic variability, Status of Wild Life of India and world, Forest Types, Forest wealth of India. Floral, Faunal and Microbial Diversity in India, Agro-diversity in India. Biogeographical zones of India. Mega diversity zones of the world

**UNIT II**

Biodiversity conservation strategies: *In situ* and *Ex-situ* conservation, Man and Biosphere Programme (MAB), Concept of Gene bank, National Parks, Sanctuaries and Biosphere reserves in India, Status of Biodiversity in India.

**UNIT III**

IUCN, Concept of Red Data Book, and Red list Categories, Concept of Biodiversity Hotspot, Biodiversity Hotspots in India. concept of species extinction

**UNIT IV**

Concept of Exotic Species, Invasive Species, Endemic species, Key stone species, Bioprospecting. Sustainable Development:- Principles and practices in relation to Biodiversity

**Reference**

1. Natural resources conservation: Oliver Owen and Chiras
2. Living in the environment: T. J. Miller
3. Ecology of Natural resources: Ranade
4. Global biodiversity: W.R.L. (IUCN)
5. <http://www.enfor.nic.in>.
6. <https://www.iucn.org/>
7. [www.moef.gov.in](http://www.moef.gov.in)
8. <http://www.ramsar.org/>
9. <http://www.cites.org>
10. <http://www.ipcc.ch>





**EES-204**  
**ENVIRONMENTAL POLLUTION**

Credit : 4

Marks: 100

Time: 3Hrs

Theory +Internal assessment: 70+30

**Note for the Paper setter:** The question paper will consist of nine questions in all. The first question (5X2 =10 marks) will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions (15 marks each) from each of the four units. The candidate is required to attempt four questions of 15 marks each, selecting at least one question of 15 marks from each unit.

**UNIT I**

**Water pollution:** Sources, Consequences, Ecological and Biochemical aspects of water pollution, Characteristic of domestic, industrial, and agricultural wastes, their effect on water bodies, Water quality parameters, Criteria and standards. Marine pollution, Thermal pollution.

**UNIT II**

**Air pollution:** sources, Classification and properties of air pollutant, Behavior fate of air pollutant, Effect of air pollution on human health and materials, Air pollution meteorology.

**UNIT III**

**Soil pollution:** Soil pollution form the use of Fertilizers, Pesticides, Heavy metals, Industrial effluent and surfactant. Detrimental effects of soil pollutant, Soil sediment as pollutant, Remedial measures for soil pollution.

**UNIT IV**

**Noise pollution:** Definition, Sound pressure level, noise spectra, Octave band. Frequency, Weighting network, noise monitoring and sound level meter, equivalent continuous noise level, Effects of noise pollution.

**Reference Books**

1. Industrial Noise Control – Bell & Bell
2. Introduction to Environmental Engineering and Science- Gillbert Masters
3. Geoenvironment- V. Aswathanarayan
4. Soil chemistry – Bolt & Buggenwert



**EES-205 (A)**  
**BIOSTATISTICS AND COMPUTER APPLICATIONS**

Credit : 4

Marks: 100

Time: 3Hrs

Theory +Internal assessment: 70+30

**Note for the Paper setter:** The question paper will consist of nine questions in all. The first question (5X2 =10 marks) will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions (15 marks each) from each of the four units. The candidate is required to attempt four questions of 15 marks each, selecting at least one question of 15 marks from each unit.

**UNIT I**

Basic concepts of computer, hardware, operating systems: Windows, Unix and Linux, use of common application software in biology: word processing, spreadsheets, graphics and data base, introduction to web browsing software and search engines with special reference to online environmental resources.

**UNIT II**

Statistics and its application in environmental data analysis, Sampling, Sampling Technique, Data collection, Data representation measures of central tendency: mean, median, mode, geometric mean, harmonic mean.

**UNIT III**

Measure of dispersion: moments, matrices, standard deviation, Variance, Skewness and kurtosis

**UNIT IV**

Correlation and linear regression of one independent variable, Basic concept of binomial, poisson, and normal distribution, Testing of hypothesis and its significance, "t" test, chi square test, ANOVA.

**Reference Books**

1. Statistics for Environmental Science & Management- Bryar F.J. Manly
2. Introduction to Statistics- Kapoor & Sanchita.
3. Statistics for Earth and Environmental Science- Schuenemeyer & Drew
4. Biostatistics- Daniel
5. Principals of Biostatistics- Pagaro & Gauvrear



**EES-205 (B)**  
**IPR & BIOSAFETY**

Credit : 4

Marks: 100

Time: 3Hrs

Theory +Internal assessment: 70+30

**Note for the Paper setter:** The question paper will consist of nine questions in all. The first question (5X2 =10 marks) will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions (15 marks each) from each of the four units. The candidate is required to attempt four questions of 15 marks each, selecting at least one question of 15 marks from each unit.

**Unit I**

Introduction to Intellectual Property Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of GMOs IP as a factor in R&D. Agreements and Treaties History of GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments

**Unit II**

Basics of Patents and Concept of Prior Art Introduction to Patents; Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; Specifications: Provisional and complete; Forms and fees Invention in context of "prior art"; Patent databases; Searching International Databases; Country-wise patent searches (USPTO, esp@cenet(EPO), PATENTSCOPE(WIPO), IPO, etc.)

**Unit III**

Patent filing procedures National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Precautions while patenting – disclosure/non-disclosure; Financial assistance for patenting - introduction to existing schemes Patent licensing and agreement Patent infringement-meaning, scope, litigation.

**Unit IV**

Introduction to Biological Safety Cabinets; Primary containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines - Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartagena Protocol.

**References**

1. P. Narayanan, Intellectual Property Laws, Eastern Law House.
2. Meenu Paul, Intellectual Property Laws, Allahabad Law Agency.
3. Intellectual Property Law containing Acts and Rules, Universal Law Publication Company.

LAB III: ENVIRONMENTAL MONITORING (WATER)

Credit : 4

Marks: 100

Practical Hrs: 4 + 4

Exam duration: 6 hrs

1. Determination of pH in a given water sample.
2. Determination of various form of alkalinity in a given water sample
3. Determination of Total hardness, calcium and magnesium hardness in a given water sample.
4. Determination of Total solids, suspended solid and dissolved solids in a given water sample.
5. Determination of conductivity in a given water sample.
6. Determination of Turbidity in a given water sample.
7. Determination of DO in given water sample.
8. Determination of BOD 5 day and ultimate BOD in sewage sample.
9. Determination of COD by open and closed reflux method in given waste water sample.
10. Determination of mineral contents in a given water sample (Calcium, Sodium, Potassium Fluoride, Chloride, Phosphate and Sulphate).



Lab VI: ENVIRONMENTAL MONITORING (Air & Noise)

Credit : 4

Marks: 100

Practical Hrs: 4 + 4

Exam duration: 6 hrs

1. Determination of Suspended particulate matter using high volume sampler in Residential area.
2. Determination of Suspended particulate matter using high volume sampler in Institutional area.
3. Determination of  $SO_x$  in ambient air.
4. Determination  $NO_x$  in ambient air.
5. Estimation of Atmospheric Dust fall.
6. Estimation of Noise in Residential area.
7. Estimation of Noise in Institutional area.



**SEMESTER III**  
**EES-301**  
**ENVIRONMENTAL MICROBIOLOGY**

Credit : 4

Marks: 100

Time: 3Hrs

Theory +Internal assessment: 70+30

**Note for the Paper setter:** The question paper will consist of nine questions in all. The first question (5X2 =10 marks) will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions (15 marks each) from each of the four units. The candidate is required to attempt four questions of 15 marks each, selecting at least one question of 15 marks from each unit.

**UNIT I**

**Microbial world:** Introduction of environmental microbiology, relation with other allied sciences, Major groups of micro-organisms, Microbial interactions- neutralism, commensalism, synergism, mutualism, competition, ammensalism, parasitism, predation; interaction of microorganisms with plant and animals.

**UNIT II**

**Air microbiology:** Microflora of air: Outdoor and indoor microflora, Transmission of Microflora in air, enumeration and assessment of microorganisms in air, sources of contaminations, control of airborne microorganisms.

**UNIT III**

**Water microbiology:** Microbes in aquatic system, pathogens in water, Biofilms, bacteriological analysis of water and tests for indicator organisms, standard plate count method (SPC), most probable number count method (MPN), membrane filter method (MF), Role of microbes in wastewater treatment.

**UNIT IV**

**Soil microbiology:** distribution of different types of soil microorganisms, factors influencing microbial population, Rhizosphere effect, microbes in decomposition, mineralization and recycling process, Bioremediation, Solubilization of phosphate (PSB).

**Reference Books**

1. Microbiology: J.G. Black
2. Environmental and applied Microbiology: K.C. Agrawal
3. Microbiology: Pelzar
4. Microbial Botechnology: A.N. Glazer
5. Microbial Ecology: R.M. Atlas and Barthas



**EES-302**  
**POLLUTION CONTROL & MANAGEMENT**

Credit : 4

Marks: 100

Time: 3Hrs

Theory +Internal assessment: 70+30

**Note for the Paper setter:** The question paper will consist of nine questions in all. The first question (5X2 =10 marks) will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions (15 marks each) from each of the four units. The candidate is required to attempt four questions of 15 marks each, selecting at least one question of 15 marks from each unit.

**UNIT I**

**Waste water management:** Primary treatment methods-screening, grit removal, primary sedimentation; Secondary treatment methods-activated sludge process, trickling filters, rotating biological contactors, oxidation ponds and lagoons, Advanced waste water treatment methods-removal of nutrients and solids; waste water reuse and sludge treatment and disposal.

**UNIT II**

**Air pollution control:** Control methods for particulates-gravitational settling chambers, centrifugal collectors, wet collectors/scrubbers, fabric filters, electrostatic precipitators, Control methods for gaseous pollutants-adsorption, absorption, condensation and combustion.

**UNIT III**

**Solid and hazardous waste management:** Types and sources of Municipal Solid waste, Characterization (Physical and Chemical), Collection, Transportation, Handling, Treatment, Disposal and Recycling of solid waste, composting, vermicomposting, incineration and Sanitary landfills; Hospital waste management; Hazardous waste: Definition, sources and categorization, generation, collection, treatment, and disposal; electronic waste management.

**UNIT IV**

**Noise pollution control:** Adsorbing materials, barrier materials, damping materials, acoustical enclosures, reactive silencers and filters; Active noise control methods.

**Reference Books**

1. Environmental Pollution Control Engineering: C.S. Rao
2. Management of Municipal Solid waste: T.V. Ramchandra
3. Prospects and Perspectives of Solid Waste Management: B.B. Hosetti
4. Air pollution: Rao & Rao
5. Environmental Engineering: Peavy
6. Introduction to Environmental Engineering and science: Gilbert M. Masters
7. Industrial Noise Control: Bell & Bell



**EES-303**  
**ENVIRONMENTAL BIOTECHNOLOGY**

Credit : 4

Marks: 100

Time: 3Hrs

Theory +Internal assessment: 70+30

**Note for the Paper setter:** The question paper will consist of nine questions in all. The first question (5X2 =10 marks) will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions (15 marks each) from each of the four units. The candidate is required to attempt four questions of 15 marks each, selecting at least one question of 15 marks from each unit.

**UNIT I**

An Introduction to Environmental Biotechnology, Fundamentals of Environmental Biotechnology. Concept of Genetic Engineering, Recombinant-DNA Technology, Genetically Modified Organism, *Bt* Cotton, Concept of Biosensor, types and applications.

**UNIT II**

Application of Biotechnology in Environmental management, Bioremediation, Phytoremediation, Application of Biotechnology in Agriculture, Forestry, wasteland reclamation, Biotechnological approaches for preserving biodiversity: Gene banks, Germ plasm bank, Microbial culture banks,

**UNIT III**

Concept of Green revolution, Significance of Agriculture in Indian Economy, Indian Council of Agriculture Research (I.C.A.R.), Concept of Crop rotation, Silviculture, Agro-forestry, Social Forestry, Joint Forest Management (JFM), Vanpanchayats.

**UNIT IV**

Environmental Issues related to agrochemicals, concept of Sustainable Agriculture, Organic farming and its Ecological significance, Integrated Nutrient Management (INM), Integrated Pest Management (IPM), Allelopathy, Biofertilizer, Biopesticide, Fermentation Technology, Composting, Vermicomposting.

**Reference Books**

1. Environmental Biotechnology- S.N. Jogdanel
2. Text book of Environmental Biotechnology- P. K. Mohapatra
3. Biofertilizer and Biopesticide- Shalini Suri
4. Environmental Science & Biotechnology:- Murugesan & Rajakumari
5. Environmental Biotechnology- Indu Shekhar Thakur
6. Environmental Microbiology - Maier, Pepper & Gerba
7. Agriculture for Food security and Rural growth- Vibha Dhawan
8. Hand book of Agriculture- ICAR, NewDelhi



**EES-304 (A)**  
**ENVIRONMENTAL ISSUES**

Credit : 4

Marks: 100

Time: 3Hrs

Theory +Internal assessment: 70+30

**Note for the Paper setter:** The question paper will consist of nine questions in all. The first question (5X2 =10 marks) will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions (15 marks each) from each of the four units. The candidate is required to attempt four questions of 15 marks each, selecting at least one question of 15 marks from each unit.

**UNIT I**

**National Issues and Initiatives:-**Issues related to surface (Eutrophication, Heavy Metal, Pesticides etc ) and Ground water (Arsenic, Fluoride ), Desertification, Deforestation. Mass movement for Environmental conservation: Narmada Bachao Andolan, Tehri Movement, Chipko Movement, Appiko Movement, Silent Valley.

**UNIT II**

National River Conservation Directorate, National Ganga River basin authority, Capacity Building for Industrial Pollution Management. Project Elephant, Project Tiger, Rain water harvesting, Wetland conservation

**UNIT III**

**International Issues and Initiatives:-** Climate Change, Transboundary Movement of Pollutants, The Club of Rome report, United Nations Conference on the Human Environment (Stockholm Declaration 1972), Agenda 21, WCS (World Conservation Strategy), IGBP(International Geosphere Biosphere Programme) Outer Space treaty, Vienna convention & Montreal Protocol, Kyoto Protocol, united nations Conference on Environment and Development- Rio Convention ( Earth Summit 1992), Antarctic Treaty, IPCC (Inter-governmental panel for Climate change), UNFCCC(United Nations Framework Conventions of Climate Change),.

**UNIT IV**

IUCN (International union for Conservation of Nature and Natural Resources), CITES (Convention on international Trade of Endangered Species of Wild Flora and Fauna), Man and Biosphere Programme (MAB). Convention on Biodiversity (CBD), Ramsar Convention on wetlands

**References**

<http://www.enfor.nic.in>  
<http://www.ipcc.ch>  
<https://www.iucn.org>  
<http://www.ramsar.org/>  
<http://www.cbd.int>  
<http://www.cites.org>  
<http://unfccc.int>  
<http://www.igbp.net>



EES-304(B)

ENVIRONMENTAL LAW

Credit : 4

Marks: 100

Time: 3Hrs

Theory +Internal assessment: 70+30

**Note for the Paper setter:** The question paper will consist of nine questions in all. The first question (5X2 =10 marks) will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions (15 marks each) from each of the four units. The candidate is required to attempt four questions of 15 marks each, selecting at least one question of 15 marks from each unit.

**UNIT I**

Environmental legislation in India, India's Ancient Traditions for Protection of Environment, Constitutional Provisions for Protection of Environment. National conservation strategy and Policy statement on Environment and Development 1992.

**UNIT II**

Wildlife Protection Act, 1972, & 1991; Indian Forest Act, 1982 Forest Conservation Act, 1980 Indian Forest act, 1982; National Forest Policy, 1988; Biodiversity Conservation Act, 2002.

**UNIT III**

The Water (prevention and Control of Pollution) Act, 1974;; The Air (prevention and Control of Pollution) Act, 1981; ; Ozone depleting Substances Regulation and Control rules 2000; Environmental Protection Act, 1986; Noise Pollution Regulation and Control Rules, 2000. Environmental Audit Notification 1992; Environmental Impact Assessment Notification 1994, Ecomark.

**UNIT IV**

Biomedical Waste Management and Handling Rules, 1998, Hazardous Waste Management and Handling rules, 1989. Municipal Solid Wastes (Management and Handling) Rules, 2000, Energy Act 2002, Public Liability Insurance Act, 1991, Disaster Management Act 2005, National Green Tribunal Act 2010, Green Bench.

**Reference Books**

1. Environmental Law- Sumeet Malik
2. Environmental Law - S. C. Shastri
3. International Environmental Law- Sethi & Kulkarni
4. Environmental Noise Pollution-V. Mahandiyani
5. Environmental Laws in India- A. K. Tiwari
6. Environmental Law and Policy in India- Diwan & Armin
7. Environmental Policy & Law- Garg, Bishnoi & Mallik



**EES-305**  
**Lab V: ENVIRONMENTAL MICROBIOLOGY**

Credit : 4

Marks: 100

Practical Hrs: 4 + 4

Exam duration: 6 hrs

1. Preparation of different culture media.
2. Isolation of fungi from soil sample.
3. Isolation of bacteria from soil sample.
4. Isolation of fungi from water sample
5. Isolation of bacteria from water sample.
6. Isolation of fungi from waste water sample
7. Isolation of bacteria from waste water sample
8. Gram Staining.
9. Slide preparation of fungal and bacterial samples for microscopic studies.
10. Estimation of Fungal and bacterial biomass in liquid media
11. Calculation of Fungal colony by Colony Forming Units (CFU).



EES-306(A)

Lab VI: Biostatistics & Computer Applications

Credit : 4

Marks: 100

Practical Hrs: 4 + 4

Exam duration: 6 hrs

1. Environmental Sampling by different methods
2. Data Analysis
3. Estimation of mean
4. Estimation of mode
5. Estimation of median
6. Estimation of Standard deviation
7. Correlation analysis
8. Regression analysis
9. Computer application in Environmental Science
10. Application of MS-Word in Environmental Science
11. Application of MS-Excel in Environmental Science
12. Application of Power Point in Environmental Science
13. Internet application in Environmental Science



EES-306(B)

Lab VI: Solid Waste

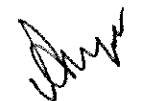
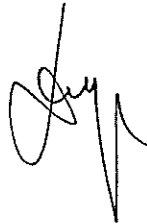
Credit : 4

Practical Hrs: 4 + 4

Marks: 100

Exam duration: 6 hrs

1. Characterization of Solid Waste
2. Composition of Solid waste in Rural settlement
3. Composition of Solid waste in Urban settlement
4. Estimation of Bulk Density of solid waste
5. Estimation of Moisture Content of Solid waste
6. Estimation of Volume of Solid waste
7. Field Visit to Sanitary land Fill site (Report)



**SEMESTER IV**  
**EES-401**  
**ENERGY RESOURCES**

Credit : 4

Marks: 100

Time: 3Hrs

Theory +Internal assessment: 70+30

**Note for the Paper setter:** The question paper will consist of nine questions in all. The first question (5X2 =10 marks) will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions (15 marks each) from each of the four units. The candidate is required to attempt four questions of 15 marks each, selecting at least one question of 15 marks from each unit.

**UNIT I**

Energy consumption pattern in India, Energy conservation strategy, Energy sources, their availability and impacts on environment, Rural Energy consumption patterns, Rural Energy Programmes in India.

**UNIT II**

Non-renewable Energy- Fossil fuel (Classification, composition and characterization of Coal, Petroleum and Natural gas), Different Type of nuclear reactors and Nuclear energy in Indian scenario.

**UNIT III**

Renewable energy- Solar energy, Characteristic of solar radiation, Solar radiation measurement, solar collectors, Photo-Voltaic Cells, Solar pond, Hydro-Power

**UNIT IV**

Wind energy, Geothermal energy, Ocean energy: Tidal energy, wave energy and Ocean Thermal Energy Conversion (OTEC) and Bioenergy: Biomass conversion Technologies, Biogas, Producer gas, Energy Plantations/Petrocrops.

**Reference Books**

1. Natural resources conservation - Oliver S. Owen and Chiras
2. Living in the Environment - T.J. Miller
3. Environmental science - Cunninham Saigo
4. Non-conventional energy sources - G.D. Rais



**EES-402**  
**ENVIRONMENTAL HEALTH AND TOXICOLOGY**

Credit : 4

Marks: 100

Time: 3Hrs

Theory +Internal assessment: 70+30

**Note for the Paper setter:** The question paper will consist of nine questions in all. The first question (5X2 =10 marks) will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions (15 marks each) from each of the four units. The candidate is required to attempt four questions of 15 marks each, selecting at least one question of 15 marks from each unit.

**UNIT I**

**Occupational Health Hazards**

Major occupational Diseases, Safety measures, International and National organizations in the field of occupational health, Bhopal gas Tragedy.

**UNIT II**

**Diseases and Disorders**

Epidemiological Issues- Goiter, Fluorosis and Arsenic poisoning. Trace element deficiency and disorder. Water borne diseases and Food borne diseases. Malaria, Life cycle of *Plasmodium vivax* and *Plasmodium falciparum*, Tuberculosis and AIDS.

**UNIT III**

**Toxicology**

Introduction and Principles of Toxicology, Toxic responses in animal and plant system, Toxic chemicals in the environment and their effects, Xenobiotic Compounds, Types of Pesticide, Toxic effects of popular Pesticides such as DDT, Endosulphan, 2. 4 D. Mode of entry of Toxic substances in human body and Detoxification sites in human body, Bioaccumulation, Biotransformation. Harmful effects of Heavy Metal such as Lead, Cadmium, Chromium, and Mercury.

**UNIT IV**

**Radioactive pollution**, Sources of Radiation in Environment, Radioactivity, Radioactive waste. Effect of Radioactive pollution on Plants and Human Health, Chernobyl disaster.

**Reference Books**

1. Introduction to Environmental Toxicology- Landis, Sofield & Hoyu
2. Pesticides: Methods and their residue estimation- Kumari & Kathpal
3. Text Book of Toxicology- Balram Pani
4. Environmental Toxicology- Trivedi , Jaiswal, Pandey & Shukla



**EES-403**  
**REMOTE SENSING AND MODELLING**

Credit : 4

Marks: 100

Time: 3Hrs

Theory +Internal assessment: 70+30

**Note for the Paper setter:** The question paper will consist of nine questions in all. The first question (5X2 =10 marks) will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions (15 marks each) from each of the four units. The candidate is required to attempt four questions of 15 marks each, selecting at least one question of 15 marks from each unit.

**UNIT I**

Basic concepts and principals of remote sensing, Sensors and platforms, Physical Basis of remote sensing, Photo interpretation and photogrammetry. Geographical Information System (GIS) and Global Positioning System (GPS).

**UNIT II**

Application of remote sensing in Environmental Sciences: Environmental management, Forest Mapping, Landuse pattern, Natural disasters, Cryosphere studies, Vegetation studies, Identification of Paleo Channels.

**UNIT III**

Role of modelling in environmental sciences, Model classification: Deterministic model, Stochastic model, Steady state model, Dynamic model, Different stages involved in model building. Methods for the formulation of dynamic balance equation- Mass balance procedures, Energy balance procedures.

**UNIT IV**

Streeter Phelps Oxygen Sag model, Box model, Gaussian Plume model, Two Species population growth model of competition, Lotka-Volterra Prey predator model, Logistic Growth Curve, Maximum sustainable yield, Carrying capacity.

**Reference Books**

1. Fundamentals of Remote Sensing- G. Joseph
2. Remote Sensing and Image Interpretation- T.M. Lillesand, R.W. Kiefer, J.W. Chipman
3. Dynamics of Environmental Bioprocesses- Modeling and Simulation: Snaps and Dunn
4. Introduction to Environmental Remote Sensing- Curtis





EES-404(A)

**NATURAL RESOURCE MANAGEMENT**

Credit : 4

Marks: 100

Time: 3Hrs

Theory +Internal assessment: 70+30

**Note for the Paper setter:** The question paper will consist of nine questions in all. The first question (5X2 =10 marks) will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions (15 marks each) from each of the four units. The candidate is required to attempt four questions of 15 marks each, selecting at least one question of 15 marks from each unit.

**UNIT I**

Natural Resource: Definition, Principle of natural resource conservation, types of natural resources, major issues related to natural resources.

**UNIT II**

**Biological resource management**

Forest and their importance, Range lands and their importance. Management of tropical and temperate forest, effects of de-forestation, desertification, Management of Wetlands, Wildlife Management, Forest management.

**UNIT II**

**Water Resource management**

Water resources management-management of watersheds, Rehabilitation of Eutrophicated lakes, rehabilitation of polluted rivers- Ganga action plan, Yamuna action plan; rain water harvesting.

**UNIT III**

**Land Resource management**

Soil conservation; Watershed Management, wasteland management, Wetland Management, Reclamation of usar, alkaline and saline soil.

**Reference Books**

1. Conservation Ecology – G.W. Cox
2. Restoration of degraded lands (Ed)-J.S. Singh
3. Natural Resource Conservation- Owen & Chiras
4. Biotechnology Environmental Management-Biotol Series
5. Environmental Chemistry- B K Sharma
6. Wetland Ecosystem- Mitsch, Gosselink, Anderson & Zhang

**ENVIRONMENTAL HAZARDS AND DISASTERS**

Credit : 4

Marks: 100

Time: 3Hrs

Theory +Internal assessment: 70+30

**Note for the Paper setter:** The question paper will consist of nine questions in all. The first question (5X2 =10 marks) will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions (15 marks each) from each of the four units. The candidate is required to attempt four questions of 15 marks each, selecting at least one question of 15 marks from each unit.

**UNIT I**

**Natural Hazard:** Preparedness, Zoning, Prediction and Mitigation; Human and hazard, Global climate and hazard, Natural vs. Man-made Disaster.

**UNIT II**

**Geological hazards and disaster:** Earthquake and Seismic hazards, Earthquake intensity and scales, Impacts, Himalayan Seismicity, Avalanches; Landslides, Volcano, Tsunami. Uttarakhand Disaster.

**UNIT III**

**Climatic hazards and disaster:** Tropical Cyclones, Western disturbances and Winter Rains in India, Anticyclones, Blizzards, Windstorms, Hail storms, Cloud burst, Floods, Drought, El-Nino, La-Nina.

**UNIT IV**

**Chemical and Biological hazards:** Outbreak of epidemic and pandemic diseases: Bird Flu, Biological warfare, Biological terrorism: Anthrax. Radioactive hazards, Chernobyl Disaster, Bhopal gas Tragedy, Exxon Valdez Oil spill. National and International efforts for disaster management.

**Reference Books**

1. Environmental Geology: Edward A. Keller
2. Confronting climate change: I.M. Mintzer
3. Atmosphere, Weather and Climate: Navarraa
4. Climatology- Rohli & Vega
5. Natural hazards and Disasters- Hyndman & Hyndman
6. Disaster management- Jagbir Singh
7. Geology and the Environment- Pipkin, Trent, Hazlett & Bierman



EES-405(A)  
LAB VIII: PRACTICAL: ENVIRONMENTAL BIOCHEMISTRY

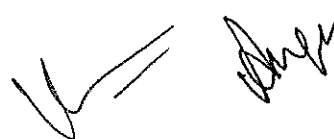
Credit : 4

Marks: 100

Practical Hrs: 4 + 4

Exam duration: 6 hrs

1. Principle and working of spectrophotometer
2. Spectrophotometric estimation of Chlorophyll a, Chlorophyll b, Total Chlorophyll
3. Spectrophotometric estimation of Total Carotenoid in plant sample.
4. Concept and Preparation of standard curve.
5. Spectrophotometric estimation of Total Phenol in plant sample.
6. Spectrophotometric estimation of Proline in plant sample.
7. Spectrophotometric estimation of Protein in plant sample.
8. Spectrophotometric estimation of Total Carbohydrate in plant sample.



**LAB IX: PRACTICAL ASPECTS OF ENERGY**

Credit : 4

Marks: 100

Practical Hrs: 4 + 4

Exam duration: 6 hrs

1. To determine the Calorific value of given materials.
2. To understand the principle and working of solar power panel.
3. To understand the principle and working of solar cooker.
4. To understand the principle and working of solar heater.
5. To determine the total shining hour using sunshine recorder.
6. To understand the principle and working of biogas plant.
7. To understand the principle and working of solar pond.
8. Field visit to Energy harvesting system: Solar /Windmill / Tidal energy/ OTEC/ Geothermal /Hydro Electricity (Report)



**EES-OEC-001**  
**ENVIRONMENTAL AWARENESS**

Credit : 4

Marks: 100

Time: 3Hrs

Theory +Internal assessment: 70+30

**Note for the Paper setter:** The question paper will consist of nine questions in all. The first question (5X2 =10 marks) will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions (15 marks each) from each of the four units. The candidate is required to attempt four questions of 15 marks each, selecting at least one question of 15 marks from each unit.

**UNIT I**

Definition, Fundamental Concepts, components and Significance of Environment

**UNIT II**

Global issues: Climate Change, Global warming, Ozone depletion, Sea level rise, melting of glacier, population explosion, Pollution and its effects.

**UNIT III**

International organizations and initiatives, national organizations and initiatives, Non-governmental organizations and initiatives,

**UNIT IV**

Role of Environmental education in environmental awareness, Role of Society and people in environmental awareness, Role of Mass media in environmental awareness, Tehri movement, Narmada Movement, Chipko Movement.

**Reference Books**

1. Environmental Economics- Charles D Kolstad
2. Environmental Ethics- David R Keller
3. Environmental studies & Ethics- Gouri Suresh
4. Environmental Awareness- Annette Bogler



**EES-OEC-002**  
**DISASTER MANAGEMENT**

Credit : 4

Marks: 100

Time: 3Hrs

Theory +Internal assessment: 70+30

**Note for the Paper setter:** The question paper will consist of nine questions in all. The first question (5X2 =10 marks) will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions (15 marks each) from each of the four units. The candidate is required to attempt four questions of 15 marks each, selecting at least one question of 15 marks from each unit.

**Unit 1:**

Introduction to Natural hazards & disasters; Natural Hazards: Global climate and hazard, Natural vs. Man-made Disaster. Earthquake and Seismic hazards, Earthquake intensity and scales, Impacts, Avalanches; Landslides, Volcano, Tsunami Floods, Cyclone, Cloud Burst, Drought.

**UNIT II**

Introduction to manmade hazards & disasters, Chemical and Biological hazards: Outbreak of epidemic and pandemic diseases: Biological warfare, Biological terrorism: Anthrax. Radioactive hazards, Bhopal gas Tragedy, Oil spills;

**UNIT III**

Disaster management continuum, Disaster preparedness, Zoning, Prediction and Mitigation; Post-disaster management activities; impact of hazards.

**Unit IV:**

National and International efforts for disaster management, Role of Governmental Organisations and NGO in disaster management, NDRF, Disaster management Act 2005, Role of mass media and society in disaster management, Role of remote sensing in disaster management, Environment Protection Act, 1986, Relief and Rehabilitation.

**Reference Books**

1. Environmental Geology: Edward A. Keller
2. Natural hazards and Disasters- Hyndman & Hyndman
3. Disaster management- Jagbir Singh
4. Geology and the Environment- Pipkin, Trent, Hazlett & Bierman



**EES-OEC-003**  
**ENVIRONMENT AND SOCIETY**

Credit : 4

Marks: 100

Time: 3Hrs

Theory +Internal assessment: 70+20

**Note for the Paper setter:** The question paper will consist of nine questions in all. The first question (5X2 =10 marks) will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions (15 marks each) from each of the four units. The candidate is required to attempt four questions of 15 marks each, selecting at least one question of 15 marks from each unit.

**UNIT I**

Demography, poverty & population explosion as environmental problems, Effects of environment, family welfare programmes, role of individual, self-help groups

**UNIT II**

Social movements: Chipko, Appiko, Save silent valley, Narmada bachao andolan, Ecofeminism, Kenyan green belt movement, role of Non governmental organization (NGO), Civil society organization (CSO), Joint Forest Movement.

**UNIT III**

Environmental Ethics (ecocentric and anthropocentric worldview), Religious traditions for protection of environment in Hinduism, Jainism, Budhism, Christianity, Islam, Sikhism, Bishnoi.

**UNIT IV**

Govemrntal initiatives: Swacch bharat abhiyaan, National mission for cleaning ganga (NMCG), concept of adarsh village.

**Reference Books**

1. Environmental Ethics- David R Keller
2. Environmental studies & Ethics- Gouri Suresh
3. Environmental Awareness- Annette Bogler

