

M. Sc. ENVIRONMENTAL SCIENCE & TECHNOLOGY
DEPARTMENT OF DLSBT, SCHOOL OF SCIENCES,
C.S.J.M. UNIVERSITY, KANPUR NAGAR, U.P., INDIA

PREAMBLE

This course curriculum for post graduate studies presented in this document follows the nationwide exercise undertaken by the **New Education Policy 2020** University Grants Commission as part of curriculum restructuring initiative. The course curriculum is interdisciplinary and draws content from different allied disciplines. Ideally, a post graduate programme should equally focus on theory and practical for the relevant subject and **skill development**. So that students enable necessary skills on **innovation, entrepreneurship** and also to get best employment in the global platform. Therefore, a number of skill-based papers have been identified and made a part of this curriculum.

In this era of science and technology this course would be boon for the **sustainable development**. This course would help the students in future prospects and would open various new avenues in global market (Private/ Government Sector) like **Researcher, Academician, Environmental Officer, Environmental Manager, Environmentalist** etc. Now a days, most of the students with this degree getting lots of opportunities in various organizations like Ministries Ministry of Environment Forest and Climate Change (**MoEFCC**), Ministry of Water Resources (**MoWR**), Ministry of Home Affairs (**MHA**), Ministry of Earth Science (**MoES**) Government of India etc., Research institutes (**CSIR, ICAR** etc.), Academics, etc. This course is designed for the best learning outcomes from the students. This popular course will lead to enhance the creativity and intellectual growth of a student.

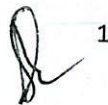
This is the best time because we are facing the impact of global climate change so that this course is on the demand for environmental sustainability and ecological balance. A latest demand for the subject exists not in India but globally due to climate change. It is also expected that Environmental Science postgraduates, in the long run, will also significantly contribute to the vision of '**Zero liquid discharge**', '**Zero Defect, Zero Effect**', Environmental Conservation, Water Conservation (As per Budget 2022) etc. and would become trainer various planning & policy initiative environmental issues and of Government of India.


Prof. Ram Narain

Prof. Neelam Pathak

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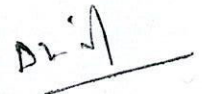


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SCOPE OF THE STUDY

This course provides ample job opportunities in **Industries, Ministries, Judiciary, Research Organizations, Universities, Colleges, Multinational Companies, Administration & NGOs, etc.** The present course is designed to meet the national and international requirements of Environmental sustainability, Environmental Monitoring and Management, Environmental Impact Assessment, ISO Certification, Environmental Legislations, Disaster, Hazards & Risk Management, Remote sensing and GIS, Air/Water/Soil Pollution/ Hazardous waste Management, Biodiversity Conservation, Natural Resource Management, Energy Resource Conservation, Recycling of plastic, Electronic waste etc.waste Materials, Social Issues of the Environment, Environmental Protection and Policies for the sustainable development.

VISION

The vision is to be a centre of excellence in environmental science education and research for the benefit of environment and humanity. To be a leading and renewed department for producing post graduates and researchers through value based quality education with innovative means and collaborative interdisciplinary approaches who can address current and evolving environmental challenges for self –reliance, sustenance and betterment of society.

MISSION

- ✓ To develop, nurture and empower the students to their full potential to cope with the environmental challenges for achieving the sustainable development.
- ✓ To adopt state-of-the-art technologies to optimize use of teaching and research for enhancing knowledge, skills and entrepreneurship amongst the young generations.
- ✓ To be recognised as an excellent centre in educating and training the students / teachers to provide solutions to environmental and climatic issues through innovative approaches.



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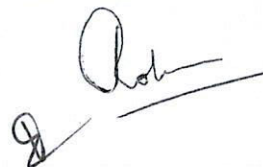


Program Educational Objectives (PEOs)

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| The M. Sc. Environmental Sciences and Technology program describe accomplishments that post graduates are expected to attain within five to seven years after graduation | |
| PEO1 | The students could get employment opportunities in Central Pollution Control Board (CPCB) and State Pollution Control Board (SPCB), Research Institutions, Colleges, Universities and Non-governmental organizations. |
| PEO2 | After successful completion of the course, the students could get job opportunities in urban and rural environmental mitigation and awareness including social forestry programs, bio-fertilizer and bio-pesticide industries, waste management and organic farming divisions funded by National, International and Regional agencies. |
| PEO3 | The students could get employment perspectives in R & D laboratories of waste water treatment plants, metal, chemical and textile effluent treatment plants, municipal solid waste management units and waste management in biomedical industries and hospitals. |
| PEO4 | The students could find employment opportunities in agro industries, forest departments, water harvesting and watershed management sectors, bioresources utilization and biodiversity conservation organizations, food and feed Industries, environment friendly and integrated livestock management sectors |
| PEO5 | Students also having the immense opportunities to pursue higher studies in various research fields such as environmental pollution, environmental chemistry, waste management and bioremediation, environmental microbiology, waste water treatment, recycle, reuse and management, sustainable environmental food security, bio-resource utilization and biodiversity conservation, functional and ecosystem ecology, environmental toxicology, agro-waste ecosystem, non-biodegradable synthetic chemicals and polymers in environment, occupational health and industrial safety, environment analytical techniques, environmental impact assessment, remote sensing and geographical information system, environmental biotechnology, carbon sequestration, natural disaster management and mitigation, climate change, marine pollution and resources utilization, restoration of different ecosystems, renewable and green energy and environmental law, policies and auditing. |



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Program Outcomes (POs)

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| POS1 | Acquired fundamental knowledge of different aspects of environment and local, regional, national and global environmental problems. |
| POS2 | Developed environmental monitoring skills, including conduct of experiments and data analysis. |
| POS3 | Understand the physical and chemical and biological components of earth's environment, the ecological concepts, principles, processes including human and natural disturbances that impact the environment. Obtained exposure to the environmental pollution control technologies. |
| POS4 | Acquired the knowledge and skills needed for the environmental design and management. Assess the potential environmental impact of developmental projects and design mitigation measures. |
| POS5 | Acquired skills in the preparation, planning and implementation of environmental projects. |
| POS6 | The students passing M.Sc. Degree in the subject Environmental Science and Technology subjects have the opportunity of job and services in the field of Teaching, Researches, Projects, Effluent Treatment Plants of various Industries/Companies/Factories, Municipal Councils/Corporations, Central Pollution Control Board, State Pollution Control Boards, National Research Institutes/Organizations/Laboratories, NEERI, EIA, GIS, Environmental Monitoring Projects, Environmental Consultants, Different Laboratories, NGO's, Forest department, Water Purification and Treatment Plants and Various Sectors related to the field of Environment. |



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Program Specific Outcomes (PSOs)

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| PSOS1 | Understand the basic concepts of Environments and its components along with their interactions through study of Ecology, Biodiversity, Environmental Chemistry, and Environmental Microbiology, Biotechnology and Geology |
| PSOS2 | Understand the different kinds of Pollutions and their sources through study of Climate and Air Pollution Studies, Hazardous Waste & Environmental Toxicology and Soil Pollution and different laws about pollution |
| PSOS3 | Analyze and determine pollution using Environmental Analytical Techniques, Biostatistics and Computational Techniques. Design and conduct experiments as well as to analyze and interpret data through laboratory and field exercises. |
| PSOS4 | Understand different technologies like biotechnology, water and Wastewater treatment technology to find the solutions and their applications in abatement of Pollution and other environmental problems. |
| PSOS5 | Use of different tools for the management of Environment, Energy resources, solid wastes, Biodiversity conservation like Remote Sensing & Geographical Information Systems and different methodologies. |
| PSOS6 | Understand the disaster management and industrial safety. Determine the environmental impact due to different developmental projects and find solution to eliminate these impacts. |
| PSOS7 | Through Dissertation, student can identify a particular environmental problem, review the literature for finding the gaps, develop research methodology, collect data and carry out data analysis and interpretation for finding a suitable solution and acquire the ability to write the research findings in the form of structured thesis and communicate the research results through oral or poster presentations |
















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DISTRIBUTION OF PAPERS AND CREDITS IN ALL SEMESTERS (YEAR WISE STRUCTURE OF PG PROGRAM)

| YEAR | SEM | SUBJECT | | | | MARKS | | MAX. |
|------|-----|--|--|---------|----------------------------|-------|-----|------|
| | | MAJOR (OWN FACULTY) | Course paper | CREDITS | MINOR ELECTIVE (4 CREDITS) | SEE | ISA | |
| I | I | ENVT-1001 | Fundamental of Environmental Science | 4 | | 75 | 25 | 100 |
| | | ENVT-1002 | Natural Resources and their Management | 4 | | 75 | 25 | 100 |
| | | ENVT-1003 | Environmental Hazards & Disasters | 4 | | 75 | 25 | 100 |
| | | ENVT-1004 | Remote Sensing & GIS Technology | 4 | | 75 | 25 | 100 |
| | | ENVT-1005 | Practical based on theory papers/ Field work | 2x4=8 | | 100 | | |
| | | MAJOR PROJECT/ DISSERTATION- 1 (* Project report/Dissertation evaluation in final years.) | | | | | | |
| | | TOTAL | | | | 24 | 300 | 100 |

Note: ISA – Intra Semester Assessment, SEE- Semester End Examination


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 Prof. Deewan Bahall } Online


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| YEAR | SEM | SUBJECT | | | MARKS | | MAX | |
|------|-----|---|---|---------|---|-----|-----|-----|
| | | MAJOR (OWN FACULTY) | Course paper | CREDITS | MINOR ELECTIVE (4 CREDITS) | SEE | | ISA |
| I | II | ENVT-2001 | Environmental Chemistry | 4 | | 75 | 25 | 100 |
| | | ENVT-2002 | Instrumentation & Biostatistics | 4 | | 75 | 25 | 100 |
| | | ENVT-2003 | Environmental Geoscience | 4 | | 75 | 25 | 100 |
| | | ENVT-2004 (A) | | 4 | Climate Change & Meteorology | 75 | 25 | 100 |
| | | ENVT-2004 (B) | | | Soil Science | | | |
| | | ENVT-2004 (C) | | | Fundamental of Visual Art or (Any other optional paper from other faculty) | | | |
| | | ENVT-2005 | Practical based on theory papers/ Field work /Industrial tour | 2x4=8 | | | | |
| | | MAJOR PROJECT/ DISSERTATION-1 (* Project report/Dissertation evaluation in final years.) | | 8 | | | | |
| | | TOTAL | | | 32 | | 300 | 100 |

Note: ISA – Intra Semester Assessment, SEE- Semester End Examinations

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| YEAR | SEM | SUBJECT | | | MARKS | | MAX. | |
|-------|-----|---|---|---------|---|-----|------|-----|
| | | MAJOR (OWN FACULTY) | Course paper | CREDITS | MINOR ELECTIVE (4 CREDITS) | SEE | | ISA |
| II | III | ENVT-3001 | Environmental Impact Assessment and Sustainable Development | 4 | | 75 | 25 | 100 |
| | | ENVT-3002 | Energy Resources & Management | 4 | | 75 | 25 | 100 |
| | | ENVT-3003 | Environmental Toxicology | 4 | | 75 | 25 | 100 |
| | | ENVT-3004 (A) | | 4 | Biodiversity & Wildlife Conservation | 75 | 25 | 100 |
| | | ENVT-3004 (B) | | | AI & ML in Environmental modelling | | | |
| | | ENVT-3004 (C) | | | Communication and Counselling Or (Any other optional paper from other faculty) | | | |
| | | ENVT-3005 | Practical based on theory papers/ Field work | 2x4=8 | | | | 100 |
| | | MAJOR PROJECT/ DISSERTATION-2 (* Project report/Dissertation evaluation in final years.) | | | | | | |
| TOTAL | | | 24 | | 300 | 100 | 500 | |

Note: ISA – Intra Semester Assessment, SEE- Semester End Examination

Prof. Ran Narsing
Prof. Neelam Khatwal

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| YEAR | SEM | SUBJECT | | | MARKS | | MAX. | | |
|------------------|-----|---------------------|--|---------|---|------------|-------------|------------|------------|
| | | MAJOR (OWN FACULTY) | Course paper | CREDITS | MINOR ELECTIVE (4 CREDITS) | SEE | | ISA | |
| II | IV | ENVT-4001 | Environmental Legislations | 4 | | 75 | 25 | 100 | |
| | | ENVT-4002 | Green Technologies for Pollution control | 4 | | 75 | 25 | 100 | |
| | | ENVT-4003 (A) | | 4 | Environmental Microbiology & Biotechnology | 75 | 25 | 100 | |
| | | ENVT-4003 (B) | | | Innovation and Entrepreneurship | | | | |
| | | ENVT-4003 (C) | | | (Any other optional paper from other faculty) | | | | |
| | | ENVT-4004 (A) | | 4 | Research Methodology | 75 | 25 | 100 | |
| | | ENVT-4004 (B) | | | IPR, Bioethics & Biosafety | | | | |
| | | ENVT-4004 (C) | | | (Any other optional paper from other faculty) | | | | |
| | | | MAJOR PROJECT/ DISSERTATION-2 /Industrial training/ Internship/ Review paper 1. Project report 2. Presentation | | 8 | | | | 200 |
| | | TOTAL | | | 24 | | 300 | 100 | 600 |
| ALL TOTAL | | | 104 | | 1200 | 400 | 2200 | | |

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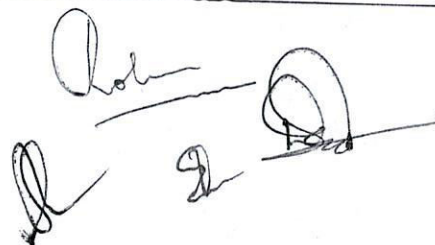
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SEMESTER –I

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| Programme | Year: First | Semester: First |
| Paper-1 (Theory) | Subject: Environmental Sciences & Technology | |
| Course Code: ENVT-1001 | Course Title: Fundamental of Environmental Science | |
| <p>Course Outcome (CO): After completing the course the student will be able to:</p> <ul style="list-style-type: none"> ➤ Developing understanding about ecosystem dynamic and relationships between ecosystems and the natural environment, including land, air, and water. ➤ Learn basic element of ecology and environmental factor. Develop conceptual skills about biogeochemical cycles ➤ Learn the interaction between physical environment and organisms. ➤ Able to understand the relationship between man and environment. ➤ Understand the structure and composition of different earth 's atmosphere | | |
| Unit/ Topic | | |
| <p>Unit-1: Principles and scope of Environmental Sciences; Man and environment, Multidisciplinary Nature of Environmental Education, Environmental Institutions, Role of Environmentalist in Environmental awareness, Ecotourism, Impact of COVID-19 on the Environment and vice versa, Ecosensibility.</p> <p>Unit-2: Structure and composition of Atmosphere, Hydrosphere, Lithosphere, Biosphere, Anthrosphere, Cryosphere.</p> <p>Unit-3: Ecology: Basic principles of Environment and Ecology, Ecosystem, Food Chain, Food Web, Ecological Pyramids (Number/ Biomass/ Energy), Environmental factors (Abiotic and Biotic), Biogeochemical cycles, Ecotone.</p> <p>Unit-4: Ecological Succession, Model of Succession, Climax Community and Type of climax, Environmental performance index, Environmental education and communication, Environmental Sustainability. Environmental Performance Index.</p> <p>Unit-5: Concept of Habitat, Functional role and Niche, Global distribution and Characteristics of Forest Lands, Grass Lands, Wetlands, Coral Reef, Mangrove, Arid Lands. Biome, Environmental Calendar, Ecological Footprints</p> | | |
| SUGGESTED BOOKS: | | |
| <ul style="list-style-type: none"> 📖 Environmental Science: Earth as a Living Planet by Botkin and Keller; JOHN WILEY & SONS, INC. 📖 A text Book of Environment Studies, Asthana, D. K. and Asthana, M. 2006, S. Chand & Co. 📖 Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p 📖 Atmosphere, Weather and Climate, Barry, R. G. 2003, Routledge Press, UK. 📖 Environmental Science: S. C. Santra, New Central Book Agency. | | |

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| Programme | Year: First | Semester: First |
| Paper-2 (Theory) | Subject: Environmental Sciences & Technology | |
| Course Code: ENVT-1002 | Course Title: Natural Resource & their Management | |
| <p>Course Outcome (CO) : After completing the course the student will be able to:</p> <ul style="list-style-type: none"> ➤ Learn utilization of major natural resources and the future sustainability ➤ Characterize natural resources and be able to quantify at least one of these resources. ➤ Understand the different functions played by ecosystem. ➤ Describe how the use, management and allocation of natural resources are affected by: laws, policies, economic factors (both market and non-market), and characteristics (including demographic, cultural, ethnic, and "values" differences) of private and public resource owners and users. ➤ Develop conceptual skills of management actions needed to achieve those objectives. ➤ Communicate effectively with colleagues, stakeholders, and the public about environmental and resource management issues. | | |
| Unit/ Topic | | |
| Unit-1: Classification of Natural Resources, Global distribution of Natural Resources, Geographical Indicators | | |
| Unit-2: Water Resources: Global Distribution of Water Causes of Scarcity, Water Conservation and Management, Rainwater Harvesting, Watershed management, Traditional Practices for Water Conservation. | | |
| Unit-3: Land Resources: Definition, Land Degradation, Classification, Land Used /Land cover Pattern, Desertification, Causes and Impacts of Infrastructure i.e. Road/ Railways/ Dam Building on the Environment, Land related Policy and Management. | | |
| Unit-4: Mineral Resources: Geographical Distribution, Mineral Exploration, Impact of Mining on the Environment, Mineral Exploration for Sustainable Development, Energy Resources, Renewable and Non-Renewable, Development vs. Environment, Mineral Resource Management. | | |
| Unit-5: Forest Resource: Classification, Causes of Degradation, Consequences, Conservation and Management, Forestry, Afforestation, Reforestation, Deforestation, Sacred Grooves, Social Forestry, Agro Forestry, Heritage tree, Urban Forest, Forest Restoration | | |
| SUGGESTED BOOKS: | | |
| <ul style="list-style-type: none"> Moorthy V. V. N., Land and water management, Kalyani 2006 Gaston K.J. and Spicer: Biodiversity – An Introduction, Blackwell Publishing Krishnamurthy K. V. (2003) Textbook of Biodiversity, CRC Press. 2004 Krishnamurthy K. V. An Advanced Textbook on Biodiversity: principles and Practice, Oxford & IBH Pub. Co. Pvt. Ltd. 2008 B.N. Pandey. Biodiversity Issues Threats and Conservation. Narendra Publishing Navjot S. Sodhi and Paul R. Ehrlich (Eds.) 2010. Conservation Biology for All. Oxford University Press 2012. | | |

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| Programme | Year: FIRST | Semester: FIRST |
| Paper-3 (Theory) | Subject: Environmental Sciences & Technology | |
| Course Code: ENVT-1003 | Course Title: Natural Hazards and Disaster | |
| <p>Course Outcome (CO): After completing the course the student will be able to:</p> <ul style="list-style-type: none"> ➤ To discuss the various components of the disaster cycle and how these interrelate ➤ To evaluate the various methods used to manage environmental hazards and disasters. ➤ Identify, describe and discuss the physical and environmental systems of the Earth from macro to micro scales. ➤ Identify, describe and discuss the causes of primary and secondary impacts associated with particular natural environmental hazards | | |
| Unit/ Topic | | |
| <p>Unit-1: Hazards, Vulnerability, Risk, Disaster, Disaster Management Cycle, Nuclear Hazards, Biological Hazards & Chemical Hazards, Drought, Early Warning System.</p> <p>Unit-2: Masswasting: Definition, Landslides, Classification, Types, Role of Human Activity, Prevention and Control, Avalanche, Glacial Hazards, GLOF, Land Subsidence.</p> <p>Unit-3: Coastal Hazards: Tropical Cyclones, Tsunamis, Typhoon, Coastal Erosion, Sea Level Changes and It's Impact on Coastal regions, Coastal Regulation Zones, Flood: Causes, Impacts, Flash flood, Urban Flooding, Flood Hazard Mapping & Management, Cold Wave, Heat Wave.</p> <p>Unit-4: Earthquakes: Nature of Earthquakes, Causes, Mercalli Intensity Scale, Richter Scale, Intensity and Magnitude of Earthquakes, Geographic Distribution of Earthquakes Zones in India, Seismic Waves and Seismicity.</p> <p>Unit-5: Volcanism: Definition, Types of Volcanoes, Geographic Distribution of Volcanoes, Causes of Volcanic eruption, Significance of Volcanic eruption, Forest Fire, Ring of Fire</p> | | |
| SUGGESTED BOOKS: | | |
| <ul style="list-style-type: none"> 📖 Bell F.G., Geological Hazards: Their Assessment, Avoidance & Mitigation, Taylor and Francis, 2003. 📖 Alexander D., Natural Disasters, ULC press Ltd, London, 1993. 📖 E. Bryant, Natural Hazards, 2nd Edition, Cambridge University Press. 📖 National Policy on Disaster Management, NDMA, New Delhi, 2009. 📖 A Global Report - Reducing Disaster Risk, A Challenge for Development; UNDP→ Publication, 2004 | | |

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| Programme | Year: FIRST | Semester: FIRST |
| Paper-4 (Theory) | Subject: Environmental Sciences & Technology | |
| Course Code: ENVT-1004 | Course Title: Remote Sensing & GIS Technology | |
| <p>Course Outcome (CO) : After completing the course the student will be able to:</p> <ul style="list-style-type: none"> ➤ Learning the fundamental of meteorology ➤ Learning the Scales of meteorology, application of meteorological principles to transport and diffusion of pollutants, scavenging processes. ➤ Learning the Atmospheric disturbances ➤ Building a foundation for understanding Remote Sensing and Geographic Information System (RS-GIS) as a powerful tool for geospatial analysis. ➤ Build the foundation of understating of cartography, digital image, spatial and non-spatial data and geospatial terminology. ➤ Learn about data and sources (RS based and other sources, field data collection) and integrate those into GIS environment for analysis. ➤ Appreciate the application of RS-GIS techniques to the matrices of environment and Resource management. | | |
| Unit/ Topic | | |
| <p>Unit-1: Remote Sensing: History, Principles, Electromagnetic Spectrum (EMS), Resolution, Atmospheric Window, Visual Image Interpretation, Satellite Data, LIDAR, RADAR, Multispectral, Hyperspectral, Mars mission.</p> <p>Unit-2: Platforms and Sensors: Ground Based, Air Borne, Space Borne, Aerial Photography, and Image Interpretation. Digital Image Processing, Supervised, Unsupervised Classification, Accuracy assessment, Drone Technology, Mobile Mapping.</p> <p>Unit-3: Geographical Information System (GIS): Landuse /Land Cover Mapping, Change Detection Analysis, Agricultural Crop Mapping, Digital Terrain Model (DTM), Digital Surface Model (DSM), Digital Elevation Model (DEM) Population Dynamics, Urban sprawl, Geoinformatics, Spatial and Non Spatial data.</p> <p>Unit-4: Global Positioning System (GPS): DGPS, Application in Environmental Mapping. Map Composition</p> <p>Unit-5: Application of RS/ GIS/ GPS in Environmental Managements (Air/ Water/ Land/ Forest/ Disaster/ Geosciences/ EIA/ Pollution/Waste Management/ Biodiversity Conservation/ Wildlife Management/ Ecotourism and Global Climate Change)</p> | | |
| SUGGESTED BOOKS: | | |
| <ul style="list-style-type: none"> ☞ Lillesand T. M., Remote Sensing and Image Interpretation. John Wiley, 7th Edition, 2015 ☞ Burrough P.A. and McDonnell R.A., Principles of Geographical Information Systems. 2nd Edition, Oxford University Press, 2006. ☞ Jense J. R., Remote Sensing of the Environment – An earth resource perspective. Pearson Education, 2nd Edition, 2013 | | |

ENVT-1005: PRACTICAL BASED ON THEORY PAPERS/ FIELD WORK (1, 2, 3 & 4).

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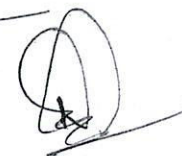
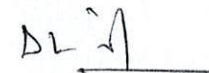
SEMESTER –II

| | | |
|--|---|-------------------------|
| Programme | Year: First | Semester: Second |
| Paper-1 (Theory) | Subject: Environmental Sciences & Technology | |
| Course Code: ENVT-2001 | Course Title: Environmental Chemistry | |
| <p>Course Outcome (CO) : After completion of the course, students will be able to:</p> <ul style="list-style-type: none"> ➤ Learn the basic principles of environmental chemistry. ➤ Learn the chemical reactions in the atmosphere and water, including important chemical reactions in connection with SO_x, NO_x, photochemical smog, Ozone chemistry and acid rain chemistry. ➤ Learning fundamental of environmental chemistry. ➤ Demonstrate an understanding of major concepts, theoretical principles and experimental findings in chemistry. ➤ Use and application of laboratory methods and scientific instrumentation to investigate a scientific hypothesis, conduct experiments, analyze data and interpret results ➤ They will be able to apply previous knowledge on analytical chemistry to environmental processes and samples. | | |
| Unit/ Topic | | |
| <p>Unit-1: Air Chemistry: Formation of Inorganic and Organic Particulate Matter, Thermo-Chemical Reaction in the Atmosphere. VOCs, Green Chemistry, Antigon, Air Purification Tower, Vertical Garden, Smart Tree, Atmospheric Science</p> <p>Unit-2: Oxygen and Ozone Chemistry, Chemistry of Air Pollutants, Smoke, Fog, Mist, Photochemical Smog.</p> <p>Unit-3: Water Chemistry: Properties of Marine Water, Surface Water, Ground Water, Chemical Composition, Eutrophication, Sedimentation, Coagulation, Filtration, Redox Potential, Waste Water Treatment Plant (WWTP), Effluent Treatment Plant (ETP), Sewage Treatment Plant (STP), Bio Water, Water ATM, Biomagnification, Heavy Metals (Hg, As, Pb etc.), Desalination, RO water, Mineral Water, Drinking water.</p> <p>Unit-4: Environmental Parameters: Physical, Chemical and Biological, pH Scale, Acidity, Hardness, Alkalinity, Nitrate, Nitrite, DO, BOD, COD, Eutrophication, Bioindicators, Environmental Standards for Air/Water/Soil (National/ International)</p> <p>Unit-5: Soil Chemistry: Chemical Composition of Soil, Soil Health, Bioremediation, Phytoremediation, Phytogrid Technology, Composting, Vermicomposting, Organic Farming, Green Manure, Soil Resistivity Meter, Silviculture.</p> | | |
| SUGGESTED BOOKS: | | |
| <ul style="list-style-type: none"> ☞ Environmental Chemistry: Anil K. De New Age International Publisher ☞ A Text Book Environmental Chemistry, V. Subramanian, I K International Publishing House Pvt. Ltd. ☞ Introduction of Environmental Chemistry 2nd Edition: Julian E. Andrews, Peter Brimblecombe, Tim D. Jickells , Peter S. Liss , Brian Reid, Publisher Wiley-Blackwell. ☞ Textbook of Environmental Chemistry: Balram Pani, Second Edition, Publisher I K International Publishing House Pvt. Ltd ☞ Advanced Environmental Chemistry: V. K Ahluwalia, Publisher The Energy and Resources Institute (TERI) Press New Delhi. ☞ Environmental Chemistry: Colin Baird and Michael Cann, Fifth Edition, Publisher : WH Freeman | | |

| | | |
|---|---|-------------------------|
| Programme | Year: First | Semester: Second |
| Paper-2 (Theory) | Subject: Environmental Sciences & Technology | |
| Course Code: ENVT-2002 | Course Title: Instrumentation and Biostatistics | |
| Course Outcome (CO): After completion of the course, students will be able to: | | |
| <ul style="list-style-type: none"> ➤ Learns the application of electron microscopy to structural biology, Gets acquainted with various types of dyes used for fluorescence microscopy. Understands the principle and application of chromatography in general. ➤ Learns about methods to determine concentrations of biological macromolecules through use of UV absorption spectroscopy. ➤ Analyze working of all types of spectrometers which is based on law of photometry ➤ Knows about the utility of 2-dimensional electrophoresis in analyzing mixture of proteins. ➤ Demonstrate extensive knowledge of the disciplinary foundation in the various areas of Instrumentation, as well as insight into contemporary research and development in environmental monitoring. ➤ Demonstrate specialized methodological knowledge in the specialized areas of Instrumentation and biostatistics about professional literature, statistical principles and reviewing scientific work. Know basic concepts of probability and biostatistics. ➤ Able to describe statistical methods and probability distributions relevant for environmental (Air/Water/Soil/Noise) monitoring. | | |
| Unit/ Topic | | |
| Unit-1: Microscopy: Compound, Phase Contrast, Florescent, Electron Microscope, Electrophoresis, BOD Incubator, COD Digester, Water Quality Analysis Kit, Soil Quality Analysis Kit. | | |
| Unit-2: Spectrocolorimeter, Spectrofluorimetry, Atomic Absorption Spectrophotometer, ICPMS, Flame Photometer, Sound Level Meter, pH Meter, Stack Monitoring Kit, Electrophoresis, XRD, NMR, Piezometer. | | |
| Unit-3: Chromatography: Paper Chromatography, Gas and High Pressure Liquid Chromatography (HPLC), Smoke Meter, Respirable Dust Sampler (RDS), High Volume Sampler (HVS), Fine particulate sampler (PM 2.5, Ultrafine), CO Analyzer, Ozone monitor, Continuous Air Quality Monitoring Index, Anemometer, VOCs meter. | | |
| Unit-4: Application of Biostatics in Environmental science, Data Collection, Sampling Methods, Data Classification, Tabulation, Graphical and Diagrammatic Presentation, SPSS, Innovation in Environmental Instrumentation Technologies. | | |
| Unit-5: Probability, Mean, Arithmetic Mean, Geometric Mean, Median, Mode, Central Tendency, Standard Deviation, T-Test, F-Test, Chi-Square Test, Analysis of Variance, ANOVA, Correlation and Regression. | | |
| SUGGESTED BOOKS: | | |
| <ul style="list-style-type: none"> Wilson, K and Walker J.: Principles and Technique of Biochemistry and molecular Biology, Cambridge. Seader, J.D. and Henley, E.J.: Separation Processes Principle, John Wiley and Sons, Inc. New York. Mark F. Vitha: Chromatography: Principles and Instrumentation., Wiley A.K. Sharma: Text Book of Biostatistics & Marcello Pagano and Kimberlee Gauvreau: Principles of Biostatistics. Veer Bala Rastogi: Biostatistics. | | |





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| Programme | Year: First | Semester: Second |
| Paper-3 (Theory) | Subject: Environmental Sciences & Technology | |
| Course Code: ENVT-2003 | Course Title: Environmental Geoscience | |
| Course Outcome (CO): After completing the course the student will be able to: | | |
| <ul style="list-style-type: none"> ➤ Learn the basic principles of Environmental geosciences. ➤ Learn the earth processes. ➤ Learning rock types and rock cycle. ➤ Learn the chemical properties of rock, geomorphology, structural geology ➤ Learning the engineering geology. | | |
| Unit/ Topic | | |
| Unit-1: The Earth: Composition of Crust, Mantle, Core, Importance of Discontinuities, Plate Tectonic Movement, Hardness Scale, Need and Impacts, Environmental Geology for Environmental Sustainability, Earth Science | | |
| Unit-2: Rocks: Types of Rock (Igneous, Sedimentary, Metamorphic), Rock Cycle, Geology Vs. Development, Impacts of Mineral Exploration on the Environmental, Mining Projects. | | |
| Unit-3: Geomorphology, Lithology, Stratigraphy, Geological Time Scale, Aquifers, Aquitard, Aquiclude, Ground Water Potential Zones, Medical Geology, Lithology, Paleosciences, Schmidt Hammer | | |
| Unit-4: Structural Geology, Fault, Fold, Lineament, Impacts of Interlinking of Rivers, Drainage Patterns, Geology Compass, Geophysical Resistivity meter, Geodesy. | | |
| Unit-5: Engineering Geology, Geotourism (National/ International), Geoheritage Sites, Infrastructure Developmental Projects (Roads/ Railways/ Dam/Canal/ Tunnel/ Valley) | | |
| SUGGESTED BOOKS: | | |
| <ul style="list-style-type: none"> 📖 Bell F.G., Geological Hazards: Their Assessment, Avoidance & Mitigation, Taylor and Francis, 2003. 📖 Don L. Anderson, Theory of the Earth. Blackwell Scientific Publications, 1989. 📖 Smith K. and Ward R., Floods: Physical Process and Human Impacts, John Wiley and Sons, 1998 📖 Kale V.S., Flood studies in India, Geological Society of India, 1998 📖 Krauskopf K.B. and Bird D.K., Introduction to Geochemistry. McGraw-Hill, 1994 📖 Bell F.G., Environmental Geology - Principles and Practice, Blackwell Science, 1998 | | |

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ELECTIVE (ANY ONE)

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| Programme | Year: First | Semester: Second |
| Paper-4 (Theory) | Subject: Environmental Sciences & Technology | |
| Course Code: ENVT-2004 (A) | Course Title: Climate Change and Meteorology | |
| Course Outcome (CO): After completing the course the student will be able to: <ul style="list-style-type: none"> ➤ Learning the impacts of climate change ➤ Understand the climatic shifts due to climatology ➤ Learning the fundamental of meteorology ➤ Learning the Scales of meteorology, application of meteorological principles to transport and diffusion of pollutants, scavenging processes. ➤ Learning the Atmospheric disturbances over polar regions of the earth (arctic and Antarctica) | | |
| Unit/Topic | | |
| Unit-1: Climate Change: Theory of Climate Change, Climate and Society, Global Warming Potential (GWP), Ozone Depletion, Acid Rain, Earth Summit, Kyoto Protocol, Montreal Protocol, COP, IPCC, UNEP, UNESCO, UNDP | | |
| Unit-2: Meteorology Fundamentals: Pressure, Temperature, Wind, Evaporation, Condensation, Fog and Effect of Meteorological Parameters on Pollutants and vice-versa, Wind Rose, Topographic Effects, Atmospheric Stability, Adiabatic Processes, Environmental Lapse Rate, Black Carbon, IMD, WMO | | |
| Unit-3: Climatology, Clouds, Seasons Of India. Monsoon, Weather, Climate, El Nino, La Nina, Paleoclimatology, Environmental Isotopes, Atmospheric Science | | |
| Unit-4: Oceanography, Greenhouse Gases, Impacts Of Sea Level Rise, Global Cooling, Impacts of Oil Spills, Marine Pollution, Diatoms, Carbon Sequestration, Economic Corridors, Ecosensitive Zones, Coral Bleaching, Marine Resource, Blue Economy, Marine Ecology, Marine Pollution | | |
| Unit-5: Policies and Technologies to reduce impacts of Climate Change on Antarctic (South Pole), Arctic (North Pole), Southern Ocean and Indian Himalayas. | | |
| SUGGESTED BOOKS: <ul style="list-style-type: none"> ☞ Lillesand T. M., Remote Sensing and Image Interpretation. John Wiley, 7th Edition, 2015 ☞ Burrough P.A. and McDonnell R.A., Principles of Geographical Information Systems. 2nd Edition, Oxford University Press, 2006. ☞ Jense J. R., Remote Sensing of the Environment – An earth resource perspective. Pearson Education, 2nd Edition, 2013 | | |

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| Programme | Year: First | Semester: Second |
| Paper-4 (Theory) | Subject: Environmental Sciences & Technology | |
| Course Code: ENVT-2004 (B) | Course Title: Soil Science | |
| Course Outcome (CO): After completing the course the student will be able to: | | |
| <ul style="list-style-type: none"> ➤ Learn the basic principles of Soil Science. ➤ Learn the soil forming factor, soil forming processes ➤ Learning Soil classification. ➤ Learn the chemical properties of soil colloids, ion exchange (cation and anion exchange phenomena) CEC, pH, SAR, ESP and buffering capacity. ➤ Learning the Soil biology related to soil fertility and soil enzymes. | | |
| Unit/ Topic | | |
| <p>Unit-1: Soil Genesis: Weathering Processes (Physical/ Chemical/ Biological) and Soil Formation (Soil Forming Factor and Processes) Pedology.</p> <p>Unit-2: Soil Classification: US Soil Classification (Taxonomy), Canadian Soil Classification, Indian Soil Classification.</p> <p>Unit-3: Physico-Chemical Properties of Soils (Soil Colour, Structure, Texture, Particle Density, Bulk Density, Porosity, Moisture, Infiltration, Soil Aeration), Soil Colloids, CEC, pH, SAR, ESP, Buffering Capacity, Soil sampling</p> <p>Unit-4: Soil Organic Matter: Sources, Composition, Microbial Decomposition of Organic Matter, Nature and Properties of Humus, Role of Microbes in Soil Fertility, Soil Profile.</p> <p>Unit-5: Land Degradation, Sodic Soils, Soil Erosion, Types and Causes of Soil Erosion, Soil Conservation. Soil Museum, Types of Soil in India. Waste Land and It's Management.</p> | | |
| SUGGESTED BOOKS: | | |
| <ul style="list-style-type: none"> ☞ Brady, N.C. and Well, R.R.: The nature of properties of soil 14th Eds. Pearson Education Inc. Upper Saddle River New Jersey USA (2008). ☞ Boul, SW, Hole, FD., McCracken RJ. et al., 1997. Soil genesis and classification. 4th Eds. Ames. IA. Iowa state University Press. ☞ Boul., SW., Southord., P.J., Graham, R.C. and McDaniel, F.A.: Soil genesis and classification. 6th Edition John Wiley and Sons. New Yourk (2011). ☞ Soil Survey Division Staff.: Soil Survey Manual. USDA-NRCS Handbook No. 18, Washington, D.C. p. 437 (1993) ☞ Soil survey staff : Key to soil taxonomy USDA, NRCS (2010). | | |

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| Programme | Year: First | Semester: Second |
| Paper-4 (Theory) | Subject: Environmental Sciences & Technology | |
| Course Code: ENVT-2004 (C) | Course Title: Fundamental of Visual Art | |
| Course Outcome (CO): After completing the course the student will be able to: | | |
| <ul style="list-style-type: none"> ➤ Learns the application of visual art. ➤ Gets acquainted with various types of drawing in environment related issues. ➤ Know basic concepts of practice of elements. ➤ Apply their knowledge in environmental science and technology. | | |
| Unit/ Topic | | |
| Unit-1: Basic Introduction of Fine Art, Type of Art | | |
| Unit-2: Practice of Elements of Art (Line, Form Colour, Tone, Texture, Shape etc.) | | |
| Unit-3: Still Life: Objective Drawing (Medium-Pencil, Pastle, Poster Colour), | | |
| Unit-4: Nature Drawing- Tree Study, Animal Study etc. (Medium-Pencil, Pastle, Poster Colour) | | |
| Unit-5: Design-2D, 3D, Letter Writing (Medium-Poster Colour), Sketchers-20 (Object/ Figure/ Nature etc. | | |
| SUGGESTED BOOKS: | | |
| <ul style="list-style-type: none"> ➤ The Eerdmans Encyclopedia of Early Christian Art and Archaeology, 3 Vols. by Paul Corby Finney, ed. ➤ The Encyclopedia of Italian Renaissance and Mannerist Art by Jane Turner (Editor) ➤ The Oxford Encyclopedia of the Bible and the Arts, 2 Vols. by Timothy K. Beal, ed. ➤ Handbook of the Arts in Qualitative Research: Perspectives, Methodologies, Examples, and Issues by J. Gary Knowles and Ardra L. Cole, eds. ➤ Critical Survey of Graphic Novels: Independents and Underground Classics by Bart Beaty and Stephen Weiner, eds. | | |

ENVT-2005: PRACTICAL BASED ON THEORY PAPERS/ FIELD WORK AND INDUSTRIAL TRAINING/ DISSERTATION/ PROJECT WORK-1/ REVIEW PAPER (1, 2, 3 & 4).

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SEMESTER –III

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| Programme | Year: Second | Semester: Third |
| Paper-1 (Theory) | Subject: Environmental Sciences & Technology | |
| Course Code: ENVT-3001 | Course Title: Environmental Impact Assessments and Sustainable development | |
| <p>Course Outcome (CO): After completing the course the student will be able to:</p> <ul style="list-style-type: none"> ➤ Explain the concepts about the environmental Impact assessment (EIA) and prepared EIA report. ➤ Identify and explore impact assessment fields and approaches. ➤ Develop skill to evaluate the issues and problems in environmental assessment from the perspective of process and methods, and the goals of EIA. ➤ Enable to practice EIA that examines the environmental consequences of development actions, in advance for environmental sustainability ➤ Lay foundation on the concept and components of environmental impact assessment and sustainable development ➤ Enable to practice EIA that examines the environmental consequences of development actions, in advance. | | |
| Unit/ Topic | | |
| Unit-1: Environmental Impact Assessment: Introduction, Concept, Significance, Comprehensive and Rapid EIA, Strategic Environmental Assessment (SEA), TOR, EAC & SEAC, Methods of EIA. | | |
| Unit-2: Environmental Impact Assessment of Major and Minor Development Project: Industries, Mining, Thermal Power Plants, Atomic Power Station, Transport, Tourism and Bricks etc. | | |
| Unit-3: Predictions and Assessment of Impact on Air, Water and Noise Pollution, Waste, Environmental Clearance. | | |
| Unit-4: Life Cycle Assessment for Environmental Management, Environmental Management System Standard, EMS Standard: ISO 14000 Series | | |
| Unit-5: Environmental Audit: Introduction, Concepts, Waste Audit, Cost Benefit Analysis, Environmental Design, Ecomark, Eco-Labeling | | |
| SUGGESTED BOOKS: | | |
| <ul style="list-style-type: none"> ① Judith, P. 1999. Handbook of Environmental Impact Assessment. Blackwell Science. ① Marriott, B. 1997. Environmental Impact Assessment: A Practical Guide. McGrawHill, New York, USA.–N.S. ① Raman, A.R. Gajbhiye, S.R. Khandeshwar: Environmental Impact Assessment, Wiley. ① Benard A Omoyeni , Principles and Application of Environmental Impact Assessment (EIA) Publisher: Benard a Omoyeni. ① Andrew Chadwick, John Glasson, Riki Therivel, Introduction to Environmental Impact Assessment, publisher Routledge. ① Environmental Impact training manual https://www.iisd.org/learning/eia/wp-content/uploads/2016/06/EIA-Manual.pdf ① Peter Wathern, Environmental Impact Assessment - Theory and Practice, Publisher: Taylor & Francis Ltd | | |

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| Programme | Year: Second | Semester: Third |
| Paper-2 (Theory) | Subject: Environmental Sciences & Technology | |
| Course Code: ENVT-3002 | Course Title: Energy Resources & Management | |
| Course Outcome (CO): After completing the course the student will be able to: | | |
| <ul style="list-style-type: none"> • Gain skill on conventional and non-conventional sources of energy • Concept of solar energy, Utilization of it, Principles involved in solar energy collection and conversion of it to electricity generation. • Understand the present scenario of state on different energy issue. • Explore the concepts involved in wind energy conversion system by studying its components, types and performance. • Illustrate ocean energy and explain the operational methods of their utilization. • Acquire the knowledge on biomass and geothermal energy. | | |
| Unit/Topic | | |
| <p>Unit-1: Conventional and Nonconventional Energy Resources: Scope, Application of CNCE, Application of Alternative Energy Resources, Green Hydrogen.</p> <p>Unit-2: Green Energy: Solar Energy, Application of Solar Energy, Fossil Fuels, Coal, Petroleum, Natural Gas, CNG, PNG. Innovation in Green Technologies, Concept of 3 'R' and 5 'R', Environmental Economics.</p> <p>Unit-3: Bioenergy: Energy From Biomass, Conversion Technology, Biogas and Biogas Plant, Wind Energy, Chemical Energy, Magneto Hydro Dynamic (MHD) Power Generation, Biofuels, Concept of waste to wealth.</p> <p>Unit-4: Ocean Energy: OTEC, Tides and Wave Energy, Geothermal Energy</p> <p>Unit-5: Nuclear Energy: Fission and Fusion, Cryogenics, Space Pollution: Causes, Impacts and Management.</p> | | |
| SUGGESTED BOOKS: | | |
| <ul style="list-style-type: none"> • John Twidell and Tony Weir: Renewable Energy Resources • N. K. Bansal : Non-Conventional Energy Resources • K.C. Kothari, D.P.Ranjan: Renewable energy sources and emerging Technology • G.D. Rai: Non-Conventional Energy sources, Khanna Publisher | | |

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| Programme | Year: Second | Semester: Third |
| Paper-3 (Theory) | Subject: Environmental Sciences & Technology | |
| Course Code: ENVT-3001 | Course Title: Environmental Toxicology | |
| <p>Course Outcome (CO): After completing the course the student will be able to:</p> <ul style="list-style-type: none"> ➤ Understand toxicology and associated terms. Learn chemical properties of different group of compound and biological effects. ➤ The applied knowledge in biology and/or chemistry with specialization in the field of environmental toxicology. ➤ Gain skill of exposure assessment, dose response relationship and understanding of the mechanisms of action and effect of xenobiotics at multiple levels of biological organization. ➤ Understand the principles of environmental toxicology and how to assess toxicity. ➤ Use technical and analytical skills to quantify the level and effect of xenobiotics in environmental components (air, water, soil and biota). | | |
| Unit/ Topic | | |
| <p>Unit-1: Toxicology: Principles, Importance of Toxicology, Classification of Environmental Toxicants, Animal Toxicity Test, Statistical Concept of LC₅₀/ LD₅₀, Frequency and Cumulative Responses, Responses of toxicants to Crop/ Animal/ Human, Dose Effect & Response relationship.</p> <p>Unit-2: Translocation & Toxic Effect of Xenobiotic, Mutagenic and Carcinogenic Compound, Influence of Ecological Biological and Chemical Factors, Environmental Pollution (Air/ Water/ Soil) by various Paint/ Leather/ Sugar/ Food/ Nuclear Industries etc.</p> <p>Unit-3: Biotransformation: Site, Enzymes and Reaction, Aquatic Toxicity Test (Acute, Sub-Acute Chronic and Sub-Chronic Test) Statistical Test of LC₅₀, Epidemiology.</p> <p>Unit-4: Basics Principles of Environmental Health, Industrial Toxicology, Principles and Methods of Occupational Health, Relationship of Occupational Health & Hygiene, Safety Measures.</p> <p>Unit-5: Health Maintenance: Health Survey and Analysis, Environmental legislations for Health and Safety, Health issues in the Working Environment, Environmental Hazards: Physical/ Chemical/ Biological and Ergonomics, Vital Statistic and Epidemiological Data for Demography, Hazard Evaluation in Environment pollution zone with specific emphasis on Radiological data. Role of technology in Occupational Health and Safety Management.</p> | | |
| SUGGESTED BOOKS: | | |
| <ul style="list-style-type: none"> 📖 Encyclopedia of Toxicology, 3rd Edition, Elsevier 📖 Karen E Brown, Thomas M Brown: Principle of Toxicology 3rd Edition, CRC Press 📖 Casarett & Doull's Toxicology: The Basic Science of Poisons, 9th edition. 📖 Spiegel M, Stephens LJ, Schaum's Outline of Statistics, McGraw Hill Forsyth D, Probability and Statistics for Computer Science, Springer 📖 R.K.Jain and Sunil S.Rao , Industrial Safety, Health and Environment Management Systems, Khanna publishers , New Delhi (2006) 📖 Industrial Safety -National Safety Council of India. Grimaldi and Simonds , Safety Management, AITBS Publishers , New Delhi (2001) | | |

ELECTIVE (ANY ONE)

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| Programme | Year: Second | Semester: Third |
| Paper-3 (Theory) | Subject: Environmental Sciences & Technology | |
| Course Code: ENVT-3003 (A) | Course Title: Biodiversity Conservation & Wildlife Management | |
| <p>Course Outcome (CO): After completing the course the student will be able to:</p> <ul style="list-style-type: none"> ➤ Learn basic elements of ecology and environmental factors ➤ Developing understanding about ecosystem dynamics. ➤ Understand the different functions played by ecosystem. ➤ Learn the positive and negative interaction of the organism. ➤ Develop conceptual skills about biogeochemical cycles | | |
| Unit/Topic | | |
| <p>Unit-1: Biodiversity: types, Hotspots, Biogeographic Zones in India, Agro climatic Zones, Natural and Anthropogenic Causes of Depletion, Red Data Book, Rare, Endangered, Threatened and Extinct species, Environmental Ethics.</p> <p>Unit-2: Biodiversity conservation: In-Situ And Ex-Situ Conservation, Biodiversity Park, Green Corridors, Green Belt, Green Muffler, Environmental Movements-Chipko, Silent Valley, Bisnois of Rajasthan</p> <p>Unit-3: Wildlife: Ecological balance, Importance and Impacts of Human wildlife conflicts, Wildlife Management, Agenda-21, Cartagena protocol, Nagoya protocol, Aichi biodiversity targets, CBD, Aquaculture, Watershed.</p> <p>Unit-4: Geographical distribution of wildlife, causes of depletion and extinction of wildlife, UNESCO World Heritage (Natural/ Cultural) Sites, Criteria-10, Environmental Psychology</p> <p>Unit-5: Ecosensitive Zones, Biosphere Reserves and Protected Area, National Parks, Tiger Reserves, Wildlife Sanctuaries, Butterfly Park, Botanical Garden, Zoological Garden, Bird Sanctuaries.</p> | | |
| SUGGESTED BOOKS: | | |
| <ul style="list-style-type: none"> 📖 Ecology and Environment: P.D. Sharma., Rastogi Publication. 📖 Fundamental of Ecology: E. P. Odum, W. B. Saunders Company, USA 8. Ecology, 2nd Edition by Paul Colinvaux, Wiley. 📖 Ecology: From Individuals to Ecosystems by Michael Begon & Colin R. Townsend & John L. Harper; Blackwell publishing. 📖 Ecology: Theories and Applications (4th Edition) by Peter Stiling; Prentice Hall. Text Book of Environmental Studies, Erach Bharucha, Orient longman Pvt. Ltd., Ernakulam. | | |

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| Programme | Year: Second | Semester: Third |
| Paper-3 (Theory) | Subject: Environmental Sciences & Technology | |
| Course Code: ENVT-3003(B) | Course Title: Artificial Intelligence and Machine learning in environmental modelling | |
| <p>Course Outcome (CO): After completing the course the student will be able to:</p> <ul style="list-style-type: none"> ➤ Able to understand the Artificial intelligence and machine learning. ➤ Familiarise with different technologies for application in environmental modelling. ➤ Develop understanding about different types of monitoring techniques available for solid, liquid and gaseous environmental pollutants by artificial intelligence. ➤ Ability to apply recycling vis-à-vis resource recovery technologies for useful conversion of specific waste type to eco-friendly products with latest technologies | | |
| Unit/Topic | | |
| <p>Unit-1: Modern Programming Methods, Computational Mathematics.</p> <p>Unit-2: Applying Computational/Data Science in Climate change, Global Warming, Population dynamics, Air, Water, Land, Disaster Management, Biodiversity conservation, Wildlife management, Smart City, Eco-Villages</p> <p>Unit-3: Environmental Data Management, AI/ ML Application in Environmental Pollution, conservation and management, Hazardous Waste, Biomedical Waste, Solid Waste, Plastic Waste, E-Waste Management.</p> <p>Unit-4: Big Data Analytics for Environmental Modelling, Space Pollution, Nuclear War, Chemical War and Biological War.</p> <p>Unit-5: Artificial Intelligence, Machine Learning, Application of AI/ ML in Environmental Management.</p> | | |
| SUGGESTED BOOKS: | | |
| <ul style="list-style-type: none"> ④ Allegrini I, De Santis F. (Ed), Urban Air Pollution: Monitoring and Control Strategies, Springer ④ Environmental and Pollution Science. Elsevier Academic Press. ④ Clarke A.G. , Industrial Air Pollution Monitoring, Springer ④ Air Pollution: Health and Environmental Impacts. CRC Press, Taylor & Francis. ④ Ecology, Environment & Pollution. Agrobios Publications. | | |

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| Programme | Year: Second | Semester: Third |
| Paper-3 (Theory) | Subject: Environmental Sciences & Technology | |
| Course Code: ENVT-3003 (C -1) | Course Title: COMMUNICATION AND COUNSELLING | |
| Course Outcome (CO): After completing the course the student will be able to: | | |
| <ul style="list-style-type: none"> ➤ Acquire knowledge about the basic principles and process of communication. ➤ Understand communication skills for social workers ➤ Develop an understanding of counselling. Impart knowledge about approaches and types of counselling | | |
| Unit/ Topic | | |
| Unit-1: Communication: Concept, Definitions, Nature & Characteristics, Communication Process, Components, Significance, Steps, Methods, Channels & Principles of Communication, Barriers's and Types of Communication | | |
| Unit-2: Communication Skills for Social Workers: Generic Skills for Commuters and Counsellors, Verbal Skills, Presentations at Seminars, Workshop, Conferences, Symposium & Public Speaking, TED Talks, | | |
| Unit-3: Official Letters, CV and Resume Writing, Ethical principles and issues of Counsellor, Interview with media | | |
| Unit-4: Types of Counselling: Individual and Group, Couple and Family, Psychotherapeutic, Clinical, Telephonic and Helpline counselling, Social services. | | |
| Unit-5: Environmental journalism, scientific writing, Crowd management, Impact of counselling on human Population, NGO, SHG, Impact of effective communication and counselling on Environmental science and technology. | | |
| SUGGESTED BOOKS: | | |
| <ul style="list-style-type: none"> ☞ Counselor awareness of the consequences of certification and licensure. Journal of Counseling and Development, 72(1), 33- 38, Alberding, B., Lauver, P., & Patnoe, J. (1993). ☞ Counseling transgendered, transsexual, and gender-variant clients . Journal of Counseling and Development, 80, 131-139, Carroll , L., Gilroy, P. 1., & Ryan, 1. (2002) . ☞ A self-efficacy approach to the career development of women. Journal oJ Vocational Behavior, 5, 419-441 . Hackett, G., & Betz, N. E. (1981). | | |

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| Programme | Year: Second | Semester: Fourth |
| Paper-3(Theory) | Subject: Environmental Sciences & Technology | |
| Course Code: ENVT-3003(C -2) | Course Title: *NOTE: (Any other optional paper from other faculty of CSJM University, Kanpur Nagar, U.P., India) | |

ENVT-1005: PRACTICAL BASED ON THEORY PAPERS/ FIELD WORK (1, 2, 3 & 4).

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SEMESTER -IV

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| Programme | Year: Second | Semester: Fourth |
| Paper-1 (Theory) | Subject: Environmental Sciences & Technology | |
| Course Code: ENVT-4001 | Course Title: Environmental Legislation | |
| <p>Course Outcome (CO): After completing the course the student will be able to:</p> <ul style="list-style-type: none"> ➤ Understand, develop & apply insights into the role of environmental laws for environmental protection and its people from activities that upset the earth and its life-sustaining capacities. ➤ Demonstrate the strengths and weaknesses in environmental law and its enforcement for developing strategies to overcome the same. ➤ Gain insights into the politics of environmental issues at globally. Debate on environmental policies and regulations and various movements in India. Develop perspective on important environmental issues that have become a matter of global policy making, international negotiations and trade disputes. | | |
| Unit/ Topic | | |
| <p>Unit-1: Environmental Law: Significance, Indian Constitution, Article 48A, Article 51A(g), National and International Organizations dealing with Global Environmental Issues and Sustainable Development.</p> <p>Unit-2: Water (Prevention and Control of Pollution) Act-1974, The Water (Prevention and Control of Pollution) Cess Act, 1977, Water (Prevention and Control of Pollution) Cess Rules, 1978, Environmental Protection Act-1986.</p> <p>Unit-3: Hazardous Waste (Management and Handling) Rule 1989, Biomedical Waste (Management and Handling) Rule-1998, E-Waste (Management and Handling) Rules-2011, Batteries (Management and Handling) Rules, 2001, Recycled Plastics, Plastics Manufacture and Usage Rules 1999, Basel Convention on Control of Trans boundary Movements on Hazardous Wastes and Their Disposal 1989, Hazardous Wastes (Management and Handling) Amendment Rules, 2003</p> <p>Unit-4: Wild Life Protection Act-1972, Biodiversity Act-2002, The Prevention of Cruelty to Animals Act-1960, Indian Forest Act-1972, Forest Conservation Act-1980, Disaster Management Act 2005, The Public Liability Insurance Act, 1991 National Green Tribunal Act-2010.</p> <p>Unit-5: Coastal Regulation zone notification 2018, The Energy Conservation Act, 2001, Compensatory Afforestation Fund Act, 2016, The Ozone-Depleting Substances (Regulation and Control) rules 2000, Air (Prevention and Control of Pollution) Act-1981, Air (Prevention and Control of Pollution) (Union Territories) Rules, 1983, Noise Pollution (Regulation and Control Rules-2000.</p> | | |
| SUGGESTED BOOK | | |
| <ul style="list-style-type: none"> ☞ Abraham, C.M. 1999. Environmental Jurisprudence in India. Kluwer Law International. ☞ Agarwal, V.K. 2005. Environmental Laws in India: Challenges for Enforcement. Bulletin of the National Institute of Ecology 15: 227-238. ☞ Divan, S. & Rosencranz, A. 2002. Environmental Law and Policy in India: Cases, Materials and Statues (2nd edition). Oxford University Press. ☞ Leelakrishnan, P. 2008. Environmental Law in India (3rd edition). LexisNexis India. ☞ Naseem, M. 2011. Environmental Law in India Mohammad. Kluwer Law International. | | |

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| Programme | Year: Second | Semester: Fourth |
| Paper-2 (Theory) | Subject: Environmental Sciences & Technology | |
| Course Code: ENVT-4002 | Course Title: Green technologies for Pollution Control | |
| Course Outcome (CO): After completing the course the student will be able to: | | |
| <ul style="list-style-type: none"> ➤ Able to understand the green chemistry. Familiarise with different technologies for green technology. ➤ Develop understanding about different types of monitoring techniques available for solid, liquid and gaseous environmental pollutants. ➤ Ability to apply recycling vis-à-vis resource recovery technologies for useful conversion of specific waste type to eco-friendly products ➤ Examine the critical linkage between various environmental pollution (like air/ water/soil etc.) and their impacts on human health. ➤ Will develop understanding on the mode of various source, causes of diseases as triggered by the spread of contaminants in soil, water and air. Understand and analyze different types of pollution and the guidelines for their control in the context of public health. | | |
| Unit/Topic | | |
| Unit-1: Green Technology: Definition and Concepts, Major Challenges and Opportunities, Green Planning: Role of Governmental Bodies, Land Use Planning, Concept of Green Cities, Waste Reduction and Recycling in Cities. | | |
| Unit-2: Green Infrastructure: Green Buildings; History of Green Buildings, Need of Green Buildings over Conventional Buildings, Construction of Green Buildings, Wind Turbines, Solar Panels, Applications of Green Technologies: Green House Gases, Emissions Reduction, Carbon Capture and Storage (CCS) Technologies, Global Warming Potential, Ground Water Potential Zones, Locust attack, Stubble burning and management. | | |
| Unit-3: Air Pollution, Air Borne Diseases, Technologies for Air Pollution Monitoring, Vehicular Pollution, Air Quality Index, Water Pollution: Types, Sources and Effects, Water Borne Diseases, Technologies for Water Pollution Management, Water Quality Index. | | |
| Unit-4: Soil Pollution, Causes, Sources and Effects, Technologies for Soil Pollution Management, Flyash, Noise Pollution, Sources & Effects on human and animal health. Innovative Technologies for Noise pollution control, Plastic pollution, waste management | | |
| Unit-5: Thermal Pollution, Radioactive Pollution, Space Pollution, Nuclear Pollution, Types, Sources and effects of Pollutants, Technologies for Environmental Pollution Management, Light pollution, Radioactive pollution | | |
| SUGGESTED BOOKS: | | |
| <ul style="list-style-type: none"> 1. Environmental and Pollution Science. Elsevier Academic Press. 5. Purohit, S.S. & Ranjan, R. 2007. 2. Ecology, Environment & Pollution. Agrobios Publications. 6. Vesilind, P.J., Peirce, J.J., & Weiner R.F. 1990. 3. Air Pollution and Health. The Royal Society of Chemistry, UK. 3. Park, K. 2015. 4. Textbook of Preventive and Social Medicine (23rd edition). Banarsidas Bhanot Publishers. 4. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2006. 5. Text book of preventive and social medicine, Banarsi Das & Bhanot, Jabalpur. Smith, K.R. 2013. 6. Biofuels, air pollution and health: a global review. Springer Science & Business Media. | | |

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ELECTIVE (ANY ONE)

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| Programme | Year: Second | Semester: Fourth |
| Paper-3 (Theory) | Subject: Environmental Sciences & Technology | |
| Course Code: ENVT-4003 (A) | Course Title: Environmental Microbiology and Biotechnology | |
| <p>Course Outcome (CO): After completing the course the student will be able to:</p> <ul style="list-style-type: none"> ➤ Impart knowledge on microbial diversity and recent advancement. Gain in depth knowledge of role of beneficial and pathogenic microorganism in environment. ➤ Understand the application of microbes for production of different eco-friendly products. • Understand biotechnology and its application in Environment management. ➤ Understands the role of microbes in management of waste plant biomass and can apply knowledge in designing microbe-based processes for pulp, textile, biofuel and animal feed production industries. ➤ Will have gained insight on industrially important microbes, recent developments in fermentation processes and various optimization strategies at fermenter level. | | |
| Unit/ Topic | | |
| <p>Unit-1: Microbes: Definition, Characters, Types and Importance, Xenobiotics.</p> <p>Unit-2: Fermentation Technology, Vermiculture Technology, Biofertilizer Technology, Significance of Biofertilizer in Agriculture, Role of Microbes in Degradation of waste, Bioaccumulation, Biomagnifications. Biodegradation of Leather, Fiber, Food, Paper and Wood</p> <p>Unit-3: Micro-Flora of Atmosphere, Air, Water and Soil Sampling Techniques, Identification of Aeroallergens, Air Borne Diseases and Allergies, Soil Borne Diseases, Environmental Impacts on Food Technology, Entrepreneurial Microbiology.</p> <p>Unit-4: GEMs, Effect of Environmental Factors on Microorganism, Control of Air Pollution by Plants, Responses of Plants and Animals to Change in Physiochemical Characteristics and Distribution of Plants in relation to Pollution (Microphytes, Phytoplanktons, Periferons and Macrophytes). Nanotechnology, Sugar technology, Leather Technology, Role of Biomedical Sciences in environmental Management, Significance of Pharmaceutical Sciences in ecological balance.</p> <p>Unit-5: Environmental Biotechnology: Concept, Technique, Transgenic Plants and Animals, Vaccines, Production of Vaccines, Culturing of Microbes, Animal Cells and Plant Cells, Plant Tissue Culture.</p> | | |
| SUGGESTED BOOKS: | | |
| <p>📖 Prescott, L.M., Hurley J.P.Klein, J.P.: Prescott's Microbiology, 11th Edition, McGraw Hill Publication, New York.</p> <p>📖 Jacquelyn G Black, Laura J. Black Microbiology: Principles and Explorations 11th Edition, Wiley R.C. Dubey.</p> <p>📖 Text book of Biotechnology, S. Chand publication.</p> | | |

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| Programme | Year: Second | Semester: Fourth |
| Paper-3 (Theory) | Subject: Environmental Sciences & Technology | |
| Course Code: ENVT-4003 (B) | Course Title: Innovation and Entrepreneurship | |
| <p>Course Outcome (CO): After completing the course the student will be able to:</p> <p>Upon successful completion students should be able to:</p> <ul style="list-style-type: none"> ➤ Research and develop entrepreneurship with strong ethics. Get acquainted with regulatory practices undertaken at commercial level. ➤ Understand communication and management skills to usher next generation of Indian industrialists and researchers. ➤ Know the importance and scope of the IPR in Environmental Science & Technology | | |
| Unit/ Topic | | |
| <p>Unit-1: Entrepreneurship: Concept and need of entrepreneurship, Institutes involved, Entrepreneur & Enterprise, Government contributions to entrepreneur, Innovation and Entrepreneurship in Environmental Pollution Monitoring and Control Technologies, Bioenergy Generation, Use of alternative energy in environmental science & technology</p> <p>Unit-2: Entrepreneur development, Selection, Demand and Feasibility for a given Product & Production under given constraints of raw materials, Energy input, Financial situations export potential etc.,</p> <p>Unit-3: Recycling of wastes: Bioremediation, Production of biofuels-ethanol, methane, hydrogen, other hydrocarbons, compost, Vermicomposting, mushroom cultivation, Bio plastics. Bioleaching of copper, gold and uranium,</p> <p>Unit-4: Agriculture technologies: Waste to wealth generation from agro waste, Mycorrhiza, use of agricultural and agro-industrial waste for biodegradable packaging, Dietary fiber, food colours/dyes. Genetic engineering in biological control, Transgenic plants for biotic and abiotic stress resistance, quality enhancement,</p> <p>Unit-5: Green Technologies for Environmental Management: Business Idea to Start-up opportunities, sources, challenges and factors influencing opportunity identification- risk assessment and development, Role of Biotechnology, Nanotechnology and microbes in bioremediation of environmental pollutants like petroleum hydrocarbons, pesticides, plastic and electronic waste; also understands utility of microbes in mineral and oil recovery.</p> | | |
| SUGGESTED BOOKS: | | |
| <p>📖 Prescott LM, Harley JP and Klein DA (2003) Microbiology (10th edition) McGraw Hill, New York.</p> <p>📖 Pelczar Jr, M.J. Chan, E.C.S and Krei N.R (1993) Microbiology McGraw Hill, New York.</p> <p>📖 Subba Rao NS (1997). Biofertilizer in Agriculture and Forestry, 3rd edition, Oxford & IBU Publications.</p> <p>📖 Goyal P (2017) Before You Start Up: How to Prepare to Make Your Startup Dream a Reality. Fingerprint! Publishing</p> | | |

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| Programme | Year: Second | Semester: Fourth |
| Paper-3(Theory) | Subject: Environmental Sciences & Technology | |
| Course Code: ENVT-4003(C) | Course Title: *NOTE: (Any other optional paper from other faculty of CSJM University, Kanpur Nagar, U.P., India) | |
| Programme | Year: Second | Semester: Fourth |
| Paper-4 (Theory) | Subject: Environmental Sciences & Technology | |
| Course Code: ENVT-4004 (A) | Course Title: Research Methodology | |
| Course Outcome (CO): After completing the course the student will be able to: | | |
| <ul style="list-style-type: none"> ➤ To become familiar with recent research methodologies in the field of environmental science and technology. ➤ To provide basic knowledge of global research on environmental science and technology. ➤ Will be able to know about various research concepts methods on environment related issues. ➤ Will be able to upgrade the knowledge on the recent advancement on the issues of environmental pollution. ➤ To learn the research methodologies for creation of innovative ideas on environmental conservation and management. | | |
| Unit/ Topic | | |
| Unit-1: Introduction to Research Methodology: Objectives and Motivation in Research and Innovation in Environmental Science and Technology. | | |
| Unit-2: Defining The Research Problem: Selecting and Defining a Research Problem, Reviewing And Conducting Literature Search, Developing a Research Plan, Project Proposal. | | |
| Unit-3: Types and Methods of Research: Classification of Research, Pure and Applied Research, Exploring or Formulative Research, Descriptive Research, Diagnostic Research/ Study, Evaluation of Research/ Studies, Action Research, Experimental Research. Poster presentation, Oral presentation, Review paper | | |
| Unit-4: Designing of Experiment: Different Experimental Designs – Single and Multifactorial Design, Making Measurements and Sources of Error in Measurements, Methods of Data Collection and Record Keeping. | | |
| Unit-5: Data Processing and Statistical Analysis: Processing Operations, Tabulation, Graphical Representation, Statistics in Research: Concepts of Sample and Population, Report Writing, Writing a Research Paper - Abstract, Acknowledgement Introduction, Methodology, Results and Discussion, References, Journal Research Paper Writing, Book Writing, Book chapter writing, Scientific article writing, Documentary making | | |
| SUGGESTED BOOKS: | | |
| <ul style="list-style-type: none"> ① Research Methodology: Methods & Techniques by C.R. Kothari, New Age International Publishers. ② Statistical Methods for Research Workers by Fisher R.A., Cosmo Publications, New Delhi. ③ Design and Analysis of Experiments by Montgomery D.C. (2001), John Wiley. ④ Research Methodology: A step by step for beginners by Ramjet Kumar, Sage Publication | | |

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| Programme | Year: Second | Semester: Fourth |
| Paper-4 (Theory) | Subject: Environmental Sciences & Technology | |
| Course Code: ENVT-4004 (B) | Course Title: IPR, Bioethics & Biosafety | |
| <p>Course Outcome (CO): After completing the course the student will be able to:</p> <ul style="list-style-type: none"> • To become familiar with India's and global biosafety and bioethics policies. • To provide basic knowledge on biosafety and bioethics and their implications in Environmental Science and Technological research. • Will be able to differentiate the change detection of different acute and chronic diseases caused due to environmental pollution. • To learn biosafety and risk assessment of products derived from innovative ideas of environmental conservation and management and regulation of such products. Learning of intellectual property rights and their significance. | | |
| Unit/ Topic | | |
| <p>Unit-1: Intellectual Property Rights: Types of IP, Patents, Trademarks, Copy Rights and Related Rights, Industrial Design, Traditional Knowledge, Geographical Indication, IPs of relevant to Environmental Science & Technology.</p> <p>Unit-2: Introduction to Indian Patent Law. World Trade Organization and Its related Intellectual Property provisions. Patenting in Research, Economic, Ethical and Depository Considerations.</p> <p>Unit-3: Bioethics–Necessity of Bioethics, Different Paradigms of Bioethics – National & International. Ethical Issues against the Environmental Science & Technologies.</p> <p>Unit-4: Bioethics in Research – Biodiversity conservation, Wildlife management, Waste management, Environmental Conservation and Management, Environmental Pollution, Disaster Management, Green technology</p> <p>Unit-5: Patents and secret process: History of patenting, composition, subject matter and characteristics of a patent, inventor, infringement, cost of patent. Patents in India and other countries. Fermentation economics, Advances and trends, ethical issues, quality control, legislation, FDA & FPO, (India), safety and security at workplace.</p> | | |
| <p>SUGGESTED BOOKS:</p> <ul style="list-style-type: none"> 📖 Indian Patent Law. Kalyan C Kankanala ; Arun K. Narasani ; Vinita Radhakrishnan. Oxford University Press, New Delhi 📖 Karen F. Greif and Jon F. Merz, Current Controversies in the Biological Sciences - Case 📖 Studies of Policy Challenges from New Technologies, MIT Press 📖 Kuhse, H. (2010). Bioethics: an Anthology. Malden, MA: Blackwell. 📖 National Biodiversity Authority. http://www.nbaindia.org | | |

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| Programme | Year: Second | Semester: Fourth |
| Paper-4(Theory) | Subject: Environmental Sciences & Technology | |
| Course Code: ENVT-4004(C) | Course Title: *NOTE: (Any other optional paper from other Kanpur Nagar, U.P., India) | |

CSJM University,

ENVT-4005: PRACTICAL BASED ON THEORY PAPERS/ FIELD WORK AND INDUSTRIAL
PROJECT WORK-2/ REVIEW PAPER (1, 2, 3 & 4).

TRAINING/ DISSERTATION/

Proposed Seat-30

Proposed Fees-45,000/- per Year

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13/05/2022

Prof. Ranu N
Prof. Neelam } Online

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