

Batch 2024-25

Syllabus

2nd Semester

M.Sc. (Environmental Science)

SCHEME A2: M.Sc. ENVIRONMENTAL SCIENCE (w.e.f. Academic Session 2024-25)

Scheme: Semester 2nd

Course Code	Course Title	Course ID	L T P			Credits			Total Credits	MARKS					
			(Hrs)			Core Course(s)				TI	TE	PI	PE	Total	
CC-A04	Environmental Geosciences	241/EVS/CC204	03	00	02	03	00	01	04	25	50	05	20	100	
CC-A05	Water Pollution and Control Technologies	241/EVS/CC205	03	00	02	03	00	01	04	25	50	05	20	100	
CC-A06	Instrumental Techniques for Environmental Analysis	241/EVS/CC206	03	00	02	03	00	01	04	25	50	05	20	100	
Discipline Specific Elective Courses (Select any one course from the following)															
DSE-02	Environmental Microbiology and Biotechnology	241/EVS/DS202	02	00	02	02	00	01	03	15	35	05	20	75	
	Environment Health and Safety	241/EVS/DS202													
Multidisciplinary Course(s)															
MDC-02	One from the Pool	241/EVS/MD202	03	00	00	03	00	00	03	25	50	00	00	75	
Ability Enhancement Course(s)															
AEC-02	One from the Pool		02	00	00	02	00	00	02	00	50	00	00	50	
Skill Enhancement Course(s)															
SEC-01	One from the Pool	241/EVS/SE201	02	00	00	02	00	00	02	00	50	00	00	50	
Total Credits									22					550	

Note: internship or field training or project of 4-6 weeks during summer vacation @ 4 credits.

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241/EVS/CC204

M.Sc. ENVIRONMENTAL SCIENCE – SEMESTER- II
SUBJECT NAME: ENVIRONMENTAL GEOSCIENCES

Course code: CC-A04

Course ID: 241/EVS/CC204

NO. OF CREDITS: 4

L T P

3 0 1

TI : 25

TE : 50

PI : 05

PE : 20

Total : 100

- Note:** 1. Nine questions will be set in all. All questions will carry equal marks.
 2. Question no. 1 which will be short answer type, covering the entire syllabus will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit I to IV. The candidates will be required to attempt question no.1 and four more questions.

COURSE OUTCOMES:

At the completion of this course, the learner will be able to:

CO1: Understand the basics of the Earth's structure, composition and evolution of landforms

CO2: Analyze the effects of meteorological parameters on the dispersion of pollutants.

CO3: Understand and apply the basic concepts of meteorology, climatology and oceanography for solving relevant environmental issues.

CO4: Identify the issues related to climate change, understand reasons and recommend remedial measures

UNIT-I: EARTH PROCESSES

Earth Structure and Materials of the Earth; Minerals and Rocks; Weathering and Erosion. Plate tectonics; Volcanicity; Seismicity; Geological Time Scale.

UNIT-II: METEOROLOGY

Fundamentals of meteorology, Scales of meteorology, Parameters of meteorology- pressure, wind, temperature, humidity, radiation; Radiation laws, shortwave and long wave radiations, Albedo, Emissivity, Inversion; The boundary layer; Radiation balance of the Earth; Heating of Earth' surface and its atmosphere; Rotation of the Earth- Coriolis acceleration; Circulation of water and energy in atmosphere, El Nino, La Nina

UNIT-III: CLIMATOLOGY

Seasons and monsoons, Precipitation, Cloud classification and formation Local microclimate Weather and Climate in India, Climatic classification schemes, Climate change - Emissions and Global warming.

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UNIT-IV: OCEANOGRAPHY

Sea water properties, Chemistry of seawater, Waves, Tides and Currents, Upwelling and El Nino, Marine Resources, Marine Pollution, Global Warming and Oceans - Greenhouse effect, Ocean warming, Sea level rise, Acidification, Carbon sequestration.

REFERENCE BOOKS:

1. Bell F. G., (1998). *Environmental Geology: Principles and Practice*. Blackwell Science Publisher, USA.
2. Critchfield H. J. (2009). *General Climatology*, PHI Learning, New Delhi.
3. Kale, V. S. and Gupta, A. (2001). *Introduction to Geomorphology*. Orient Longman, Bangalore.
4. Singh, S. (2011), *Physical Geography*, Prayag Pustak Bhavan, Allahabad.
5. Strahler, A.N. and Strahler (1996). *An Introduction to Physical Geography*. John Wiley & Sons, UK.
6. D.S. Lal (2011). *Climatology*, Sharda Pustak.
7. Frank Press, Raymond Siever, John Grotzinger, *Understanding Earth*. Editors Thomas H. Jordan, Tom Jordan W. H. Freeman & Co Ltd ISBN-10: 1464138745; ISBN-13: 978-1464138744
8. Frederick K. Lutgens Edward J. Tarbuck Pearson Education, *The Atmosphere An Introduction to Meteorology* Inc. ISBN-10 0-32-158733-2 ISBN-13 978-0-321-58733-6
9. Tom Garrison *Essentials of Oceanography* ISBN-13: 978-0-495-55531-5 ISBN-10: 0-495-55531-Brooks/Cole Cengage Learning 10 Davis Drive Belmont, CA 94002-3098 USA

SUGGESTED WEB SOURCES:

1. http://envis.nic.in/ENVIS_html/ENVISSubject/subject.html
2. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14>

MODE OF TRANSACTION:

Lecture, Demonstration, PowerPoint presentation, E-tutoring, Discussion, Assignments, Case study.

LMS/ICT TOOLS: Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources

LAB III

Outcomes: After completion of course, learners will be able to:

- CO.1 to demonstrate the basic lab skills: identifying minerals and rocks;
CO.2 Inferring rock origin from examination of specimens; reading, drawing and interpreting contour maps and profiles;
CO.3 Using terrestrial coordinates.

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List of practical:

1. Toposheet Analysis, Their Number, Scale and Index. Determination of physiographical features with the help of toposheet.
2. Preparation of Contour line map (choose one suitable sector of toposheet) and demarcation of higher and lower landmarks with direction.
3. Preparation of Drainage map and drainage density of a given watershed area.
4. Preparation of watershed map and analysis of slope of sub watershed area
5. Laboratory observations of different folds and faults
6. To draw the profile/section of different beds in the given Geological map
7. Drawing of strike line & determination of true dip & apparent dip
8. Laboratory Study and Observations of Physical Properties of Minerals.
9. Study of rock specimens and its physical properties (Igneous, Sedimentary and Metamorphic rock).
10. Study through GPS-Latitude, Longitude, Elevation etc
11. Study of Water table fluctuation through secondary data and Calculation of TARR value

Note: This list of experiments is indicative. Addition and deletion in the list of experiments may be made from time to time by the department depending on the availability of resources.

Reference Books:

1. Textbook of Geology – G. B. Mahapatra, CBS.
2. Textbook of Geology – P. K. Mukherjee, World Press.
3. Practical Geology – Dr. Harish Kapasya, Himanshu Publication.

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241/EVS/CC205

M.Sc. ENVIRONMENTAL SCIENCE – SEMESTER- II
SUBJECT NAME: WATER POLLUTION & CONTROL TECHNOLOGIES

Course Code: CC-A05
Course ID: 241/EVS/CC205

NO. OF CREDITS: 4

L T P

3 0 1

TI : 25
TE : 50
PI : 05
PE : 20
Total : 100

- Note:** 1. Nine questions will be set in all. All questions will carry equal marks.
 2. Question no. 1 which will be short answer type, covering the entire syllabus will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit I to IV. The candidates will be required to attempt question no.1 and four more questions.

COURSE OUTCOMES:

At completion of this course, the learner will be able to:

- CO1: Acquire the knowledge of basic rationale of water quality management.
 CO2: Characterize the typical inorganic and organic pollutants from a variety of sources entering into water bodies.
 CO3: Design and develop water purification techniques for safe drinking water and wastewater treatment technologies for abatement of water pollution.
 CO4: Apply the knowledge of various methods for water resource management.

UNIT-I: DRINKING WATER CHARACTERISTICS AND PURIFICATION TECHNIQUES

Water Sources – Availability and quality of Surface water and Groundwater, Water Requirements for Domestic Consumption (Population forecasting), Drinking water standards (physical, chemical & bacteriological), Water Treatment process – Principal, process design and applications (Aeration, flocculation, Sedimentation, Filtration, Disinfections (Chlorination, UV, Ozonation), water softening.

UNIT-II: WATER POLLUTION

Sources, types, Causes and consequences of water pollution, water pollutants (organic, inorganic, biological and radioactive pollutants), Marine pollution, Thermal pollution, Oil pollution, Classification of wastewater, Bioindicators.

Characteristics of water and wastewater, Sampling of water and wastewater, collection and storage, physical chemical and biological analysis of water and wastewater.

UNIT-III: WASTEWATER TREATMENT

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Wastewater generation, objectives of waste water treatment, Primary, secondary, Tertiary treatment: sedimentation, coagulation and flocculation, filtration, disinfection, activated sludge process, trickling filters, and anaerobic (UASB) processes, Suspended, attached and hybrid reactors. Sludge treatment – Preliminary operation, Thickening, Conditioning, Dewatering, Filtration, Digestion and Drying of sludge, Sludge disposal. An introduction to common ETPs and STPs. wastewater treatment for small communities – Oxidation ditch, SBR, aerated lagoon.

UNIT-IV: WATER RESOURCE MANAGEMENT

Eutrophication, Recovery of eutrophicated lakes, rehabilitation of polluted rivers-Ganga Action Plan, Yamuna Action Plan and new Plans introduced by Govt. of India.

REFERENCE BOOKS:

1. *Wastewater Engineering: Treatment, disposal, Reuse* – Metcalf & Eddy Inc. 4th ed. TMGHI, New Delhi, 2003.
2. *Environmental Engineering*- Peavy, HS, Donald RR & G. Tchobanoglous, MGH Int. Ed. New York, 1985.
3. Edzwald, James K. (ed.) *Water quality & treatment: A handbook on drinking water*
4. Ujang, Zaini (Ed.) *Municipal wastewater management in developing countries: Principles and Engineering.*
5. *Natural Resources conservation*-Oliver S Owen & Chiras
6. *Natural Resource Conservation*-Owen & Chiras
7. *Living in the Environment* –T.J.Miller

SUGGESTED WEB RESOURCES

1. <https://cpcb.nic.in/>
2. <https://www.epa.gov/environmental-topics>
3. <https://www.unccd.int/issues/land-and-drought>

MODE OF TRANSACTION:


Lecture, demonstration, Power point, E-tutoring, discussion, assignments, case study, e-learning, Experimentation, Tutorial, Problem solving, Self-learning

LMS/ICT TOOLS: Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources

LAB III (Water & Soil Analysis)

COURSE OUTCOME: At the completion of this course, the learner will be able to:

- CO1: Illustrate the different physio-chemical analysis of water, wastewater and soil.
 CO2: Apply the appropriate method of physico-chemical analysis to research and field applications.
 CO3: Estimate the pollution levels in water, wastewater and soil
 CO4: Apply the skill acquired in planning of various treatment technologies.


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LIST OF EXPERIMENTS:

1. Study of Physical characteristics of water: Colour, Odour, Turbidity, Temperature.
2. Determine the water holding capacity and moisture content in soil sample.
3. Determination of ORP of the water/soil sample.
4. Determination of Salinity of the water/soil sample.
5. Determination of DO of the water sample.
6. Determination of Fluoride content in the water sample by Spectrophotometric method.
7. Estimation of Nitrate in water sample by Spectrophotometric method.
8. Estimation of Phosphate in water sample by Spectrophotometric method.
9. Determination of cations (Na, K, Ca and Mg) in a given water/soil sample by using a Flame photometer.
10. Determination of Cation Exchange Capacity of soil.
11. Determination of Total Kjeldahl Nitrogen (TKN) in soil samples.
12. Determination of Total Organic Carbon of a soil samples.
13. Determination of Heavy metals in soil samples.
14. Determine the Lime and gypsum requirements of soils.
15. Group Activity
16. Field Activity/ Visit and Report submission

Note: This list of experiments is indicative. Addition and deletion in the list of experiments may be made from time to time by the department depending on the availability of resources.

REFERENCE BOOKS:


1. American Public Health Association (APHA) (2012). *Standard method for examination of water and wastewater*, 22nd edn. APHA, AWWA, WPCF, Washington.
2. Yadav, M. S. (2008). *Instrumental methods of chemical analysis*, Campus Books International. Delhi.
3. Quevauviller, P. (2006). *Analytical methods for drinking water: Advanced in sampling and analysis*, John Wiley Publisher.
4. Patnaik, P. (2010). *Handbook of environmental analysis: chemical pollutants in air, water, soil, and solid wastes*, London: CRC Press.
5. Nollet, L. M. L (2007). *Handbook of water analysis*, London: CRC Press.
6. Gupta, P. K. (2009). *Methods in environmental analysis water, soil and air*, Jodhpur: Agrobios.

SUGGESTED WEB SOURCES:

1. <http://moef.gov.in/>
2. <https://cpcb.nic.in/>
3. <https://www.icmr.gov.in/>
4. <https://bis.gov.in/>

MODE OF TRANSACTION:

Demonstration, Lecture, E-tutoring, Hands on training, discussion, assignments, Practical


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241/EVS/CC206

M.Sc. ENVIRONMENTAL SCIENCE – SEMESTER- II
SUBJECT NAME: Instrumental Techniques for Environmental Analysis

Course Code: CC-A06

Course ID:

NO. OF CREDITS: 4

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TI	: 25
TE	: 50
PI	: 05
PE	: 20
Total	: 100

- Note:** 1. Nine questions will be set in all. All questions will carry equal marks.
 2. Question no. 1 which will be short answer type, covering the entire syllabus will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit I to IV. The candidates will be required to attempt question no.1 and four more questions.

COURSE OUTCOMES:

At the completion of this course, the learner will be able to:

CO1: Understand the problem and identify suitable techniques to analyze the environmental samples.

CO2: Explain and use suitable sampling methods for collection of different samples to perform physical, chemical and biological characterization of environmental pollutants.

CO3: Appraise the principles, working and applications of the instrumental techniques used for analysis of physical, chemical and biological entities.

CO4: Differentiate between the various analytical methods and capable to design method required for quantitative and qualitative analysis of environmental components.

UNIT I: BASICS OF ANALYTICAL APPROACH

Analytical Approach: Defining of Problem and Designing of Analytical Method; Sampling: Types and Methods for Solid, Liquid and Gaseous Matrix; Sample Storage; Sample Preparation; Measurement and Assessing of Data; Method Validation and Documentation;

Wet Chemical Methods: Titrimetry; Gravimetry

UNIT-II: SPECTROMETRIC ANALYTICAL TECHNIQUES

UV- Visible spectrophotometer, Flame photometry, atomic absorption spectrophotometry; Plasma Emission Spectroscopy; X-Ray Spectroscopy (X-Ray Fluorescence, X-Ray Diffraction); Fourier-transform Infrared Spectroscopy (FTIR); Nephelometry and Turbidimetry

UNIT-III: CHROMATOGRAPHIC TECHNIQUES

Chromatographic Techniques (Paper Chromatography, Thin Layer Chromatography, Gas Liquid Chromatography, High Performance Liquid Chromatography, Ion-exchange Chromatography);

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UNIT IV: MICROSCOPY TECHNIQUES

Optical Microscopy (Brightfield and Darkfield, Phase Contrast, Fluorescence, Confocal); Electron Microscopy (Scanning and Transmission Electron Microscopy)

REFERENCE BOOKS:

1. Hussain, C. M., & Kecili, R. (2019). *Modern Environmental Analysis Techniques for Pollutants*. Elsevier.
2. Khopkar, S.M. (2015). *Basic Concepts of Analytical Chemistry*. Wiley Eastern Ltd., New Delhi.
3. Mitra, S., & Keccakus, B. B. (2018). *Environmental Chemical Analysis*. CRC Press.
4. Robinson, J. W., Frame, E. M. S., & Frame, G. M. (2014). *Undergraduate Instrumental Analysis*. CRC Press, New York
5. Skoog, D. A., Holler, F. J., & Crouch, S. R. (2017). *Principles of Instrumental Analysis*. Cengage learning.
6. Willard, H.H., Merritt, L.L, Deen, J.A. and Settle, F.A. (2015). *Instrumental Methods of Analysis*. CBS Publishers and Distributers, New Dehi.
7. Patnaik, P. (2017). *Handbook of Environmental Analysis: Chemical Pollutants in Air, Water, Soil, and Solid Wastes*. CRC Press.

SUGGESTED WEB SOURCES:

1. http://envis.nic.in/ENVIS_html/ENVISSubject/subject.html
2. <https://nptel.ac.in/courses/103/106/103106162/>
3. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14>
4. <https://swayam.gov.in/>

MODE OF TRANSACTION:

Lecture, Demonstration, PowerPoint presentation, E-tutoring, Discussion, Assignments, Case study

LMS/ICT TOOLS: Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources

EVS LAB IV (Air, noise sampling & analysis):**COURSE OUTCOME:**


At the completion of this course, the learner will be able to:

CO1: Explain the different methods followed for sampling and analysis of air pollutants.

CO2: Appraise the quality of air and suggest management plans to control the air pollutants.

CO3: Determine the air pollutants level in stationary sources and explain the dispersion pattern with reference to the meteorological conditions.

CO4: Assess the noise level at different locations and the possible measures to control the noise level for minimizing the impacts


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LIST OF EXPERIMENTS

1. To study principle, components and working operation of Respirable Dust Sampler (RDS) for collection of respirable dust.
2. To study principle, components and working operation of Fine Dust Sampler for sampling.
3. Assessment of PM₁₀ level in the ambient air.
4. Assessment of fine dust (PM_{2.5}) concentration in the outdoor environment.
5. Understanding of principle, component and working of gaseous sampler for sampling of gaseous air pollutants in surrounding air.
6. Determination of gaseous air pollutants concentration in the ambient air
 - i. Oxides of Nitrogen (NO_x)
 - ii. Oxides of Sulphur (SO₂)
 - iii. Ammonia (NH₃)
 - iv. Ozone (O₃)
7. Assessment of Ambient Air Quality and Air Quality Index (AQI) of the ambient air
8. Plot Wind Rose diagram to summarize meteorological condition.
9. Study of plume behavior in relation with wind velocity in your surrounding area.
10. Determination of SPM and gaseous pollutants concentration from stack emission of an industrial unit.
11. Determination of different noise indices (L₁₀, L₅₀, L₉₀, L_{eq}) at different locations (residential, industrial, commercial and silent zone) using Sound Level Meter.
12. Group Activity
13. Field Activity/ Visit and Report submission

Note: This list of experiments is indicative. Addition and deletion in the list of experiments may be made from time to time by the department depending on the availability of resources.

REFERENCE BOOKS:

1. Csuros, M. (2018). *Environmental sampling and analysis: lab manual*. Routledge.
2. Forbes, P. (2015). *Monitoring of air pollutants: sampling, sample preparation and analytical techniques*. Elsevier.
3. Gupta, P. K. (2018). *Methods in environmental analysis: water, soil and air*, 2nd Edition). Jodhpur, India: Agrobios Publication.
4. Hess-Kosa, K. (2018). *Indoor air quality: the latest sampling and analytical methods*. CRC press.
5. Lodge Jr, J. P. (2017). *Methods of air sampling and analysis*. 3rd Edition, CRC Press.
6. Maiello, M. L., & Hoover, M. D. (Eds.). (2019). *Radioactive air sampling methods*, 1st Edition, CRC press.
7. Patnaik, P. (2017). *Handbook of environmental analysis: chemical pollutants in air, water, soil, and solid wastes*, 3rd Edition, CRC Press.

MODE OF TRANSACTION:

Lecture, Demonstration, PowerPoint presentation, E-tutoring, Discussion, Practical

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241/EVS/DS209

M.Sc. ENVIRONMENTAL SCIENCE – SEMESTER- II
SUBJECT NAME: ENVIRONMENTAL MICROBIOLOGY AND BIOTECHNOLOGY

Course code: DSE-02

Course ID:

NO. OF CREDITS: 3

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TI : 15

TE : 35

PI : 05

PE : 20

Total : 75

- Note:** 1. Nine questions will be set in all. All questions will carry equal marks.
 2. Question no. 1 which will be short answer type, covering the entire syllabus will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit I to IV. The candidates will be required to attempt question no.1 and four more questions.

COURSE OUTCOMES:

After completing this course, the students will be able to:

CO1: Understand various applications of microbiology and biotechnology and techniques for production of microbes and biodiversity conservation.

CO: Understand and apply basic techniques of biotechnology, their applications for detection of environmental contaminants and apply emerging environmental biotechnologies for biodegradation of compounds.

CO3: Apply the concepts for bioremediation of contaminated sites.

CO4: Apply the knowledge for the development of biodegradable and eco-friendly products and analyze the bioethical issues related to biosafety of Genetically Modified Crops.

UNIT-I: INTRODUCTION

Definition and importance of Environmental microbiology and biotechnology, Fermentative technologies, microbial enzymes, Batch and continuous culture of microbes for commercial use. Role of biotechnology in conservation of species: cryopreservation, tissue culture, gene banks

UNIT-II: ENVIRONMENTAL MONITORING AND ROLE OF MICROBES IN BIODEGRADATION

Biosensors in detection of environmental contaminants: BOD, methane, ammonia; Biomarkers of pollution and Bioindicators; Recalcitrance nature of xenobiotics and mechanisms of microbial metal resistance and detoxification. Biodegradation of halogenated hydrocarbons, Polycyclic aromatic hydrocarbons (PAHs) and Pesticides.

UNIT-III: BIOREMEDIATION OF POLLUTED ENVIRONMENTS

Environmental applications of bioremediation techniques, types of bioremediations, bioremediation of oil spills, limitations of bioremediation. Bioleaching. Phytoremediation:

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Phytoremediation of xenobiotics and bioaccumulation of metals using plants. Phytoremediation-remediation using algae and recent approaches.

UNIT-IV: DEVELOPMENT OF BIODEGRADABLE AND ECO-FRIENDLY PRODUCTS

Biofuel and Biodiesel-plant derived fuels, bioethanol, biohydrogen; biofertilizers; biopesticides; bio-polymers. Bioethics in Environmental biotechnology: Genetically engineered microbes and GM Crops and Biosafety of GMM.

REFERENCE BOOKS:

1. Bhattacharyya, B. C., & Banerjee, R. (2007). *Environmental biotechnology*. USA: Oxford university press.
2. Bitton, G. (2013). *Wastewater microbiology*. John Wiley & Sons.
3. Lynch, J. M., & Wiseman, A. (2011). *Environmental biomonitoring: The biotechnology ecotoxicology interface*. Cambridge University Press, New York, NY(USA)
4. Rittmann, B. E., & McCarty, P. L. (2020). *Environmental biotechnology: principles and applications*. Tata McGraw-Hill Education.
5. Scragg, A. H. (2016). *Environmental biotechnology*. New York: OXFORD university press.
6. Thakur, I. S. (2011). *Environmental biotechnology: basic concepts and applications*. IK International.

SUGGESTED WEB RESOURCES

1. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14>
2. https://onlinecourses.nptel.ac.in/noc21_ce07/preview
3. https://onlinecourses.nptel.ac.in/noc21_bt22/preview
4. <https://www.newcastle.edu.au/course/ERAR6010>
5. <https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-89-environmental-microbiology-fall-2004/>
6. <https://www.coursera.org/courses?query=microbiology>

MODE OF TRANSACTION:

Lecture, demonstration, E-tutoring, discussion, assignments, case study, power point

LMS/ICT Tools: Digital Classrooms, DLMS, ZOOM, G Suite, MS Power-Point, Online Resource

Lab IV

At the completion of course learner will be able to:

- CO.1 perform isolation, identification, maintenance and handling of microbial cultures in laboratory settings.
- CO.2 handle microorganisms for isolation and amplification of DNA/RNA
- CO.3 work and handle with techniques such as PCR, electrophoresis, etc.
- CO.4 Plan and execute various microbiology research related practical independently or as a group.

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List of Experiments:

1. Bacterial Growth Curve
2. Gram staining technique for identification of bacteria

PURE CULTURE TECHNIQUES:

3. Serial dilution Method
4. Pour plate Method
5. Spread plate Method
6. Streak plate Method

BIOCHEMICAL TESTS FOR BACTERIAL IDENTIFICATION:

7. Methyl Red Test
8. Voges –Proskauer Test
9. Catalase Test
10. Oxidase Test
11. Acid and Gas production Test

INSTRUMENT

1. Autoclave
2. Laminar Air Flow Chamber

BIOTECHNOLOGY:

1. Isolation of Chromosomal DNA from Microbes
2. Isolation of RNA from Spleen/Liver
3. Separation of DNA by Agarose Gel Electrophoresis
4. Polymerase Chain Reactions- Demonstration
5. MS Medium Preparation.
6. Synthetic Seed Preparation (Group Practical)

Note: This list of experiments is indicative. Addition and deletion in the list of experiments may be made from time to time by the department depending on the availability of resources.

Reference books:

1. *A Photographic Atlas for the Microbiology Laboratory* by Michael J. Leboffe and Burton E. Pierce

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241/EVS/DS203

M.Sc. ENVIRONMENTAL SCIENCE – SEMESTER- II
SUBJECT NAME: ENVIRONMENTAL HEALTH AND SAFETY

Course code: DSE-2

Course ID:

NO. OF CREDITS: 3

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2 0 1

TI : 15

TE : 35

PI : 05

PE : 20

Total : 75

- Note:** 1. Nine questions will be set in all. All questions will carry equal marks.
 2. Question no. 1 which will be short answer type, covering the entire syllabus will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit I to IV. The candidates will be required to attempt question no.1 and four more questions.

COURSE OUTCOMES:

After completion of this course, the students will:

CO1: Learn about the environmental toxicants, their sources, origin and effects of various toxic materials and heavy metals that impact the environment adversely.

CO2: Correlate the common work-related diseases and train on methods used to assess the risk involved at occupational settings.

CO3: Manage handling and storage of hazardous substances at work place.

CO4: Analyze health and safety problems in the working as well as living environment and recommendations, safety measures.

UNIT-I: INTRODUCTION

Basic Principle of Occupational Environment & Health and its implications.

Environmental Health: - Environmental health criteria. Effects of Industrial pollutants like mercury, lead, chromium, cadmium, arsenic and nitrate on human health. Water borne diseases; Prevention and protection of community health from water borne diseases. Indoor Air Quality of workplace and its effect on human health. Respiratory diseases associated with Industrial Environment. Effect of Noise on human health & it's preventive & control.

UNIT-II: OCCUPATION HAZARDS AND HAZARDOUS CHEMICAL

Occupation Hazards: - Occupational Environmental Hazards & its Types - Physical, chemical, biological, mechanical and psychosocial hazards, Occupational diseases, Ergonomics, Healthy workplace and its principles. Industrial hazard Analysis.

Hazardous chemicals: Classification of hazardous chemicals, Material Safety Data Sheet, transportation of hazardous chemicals, Hazchem code, Storage and handling of hazardous

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substances, Compatibility of different chemicals, Emergency preparedness (on site & offsite), Safety mock drills, Safety audit, Concept of fire and explosion, Major accidents involving hazardous substances and consequence analysis. Case studies for Industrial Accidents.

UNIT-III: HEALTH AND SAFETY MEASURES

Health and Safety Measures: - Medical and engineering measures, Stress at work and its management, Personal protection equipment and their significance, Work permit system and its necessity, Risk Assessment with numerical, Risk management: organization and administration; techniques and practices. Disaster Management Plan of Industry.

Health Survey: Survey, analysis and recommendations regarding health and safety problems in the working and living environment. Biostatistics, epidemiology: Application of statistical methods to medical records in the study of health problems of human population in a given environment. First Aid & onsite medical facilities.

UNIT-IV: LEGISLATION MEASURES

Occupational Health and Safety Standards, OHSAS-18001 / ISO 45001, The factory Act, 1948 and its amendments, Manufacturing, storage and import of hazardous chemical rules, 1989 and its amendments. The Chemical Accidents (Emergency Planning, Preparedness & Response) Rules 1996 / 2000, The Public Liability Insurance Act 1991 & amendments, Gas Cylinder Rules, 1984 and amendments, The Static and Mobile Pressure Vessels (Unfired) Rules, 1981 and amendments etc.

REFERENCE BOOKS:

1. Nicholas, P Cheremisinoff, Madelyn L Graffia (1995) *Environmental and Health and Safety Management* 1st edition, William Andrew.
2. Barry S. Levy, David H. Wegman, Sherry L. Baron, Rosemary K. Sokas (2017) *Occupational and Environmental Health: Recognizing and Preventing Disease and Injury* 7th Edition OUP USA.
3. Jain, R. K., Rao S.S., (2000) *Industrial Safety, Health and Environment Management Systems* 4th Edition Khanna Publishers.
4. Robert H. Friis (2018) *Essentials of Environmental Health* 3rd Edition Jones and Bartlett Publishers, Inc.
5. Herman Koren, Michael S. Bisesi (2017) *Handbook of Environmental Health*, Volume I Biological, Chemical, and Physical Agents of Environmentally Related Disease CRC Press.
6. Prashar A. and Bansal P. (2010) *Industrial safety and Environment* S K Kataria and Sons.
7. Phillip Carson and Clive Mumford (1994) *Hazardous Chemicals Handbook* ScienceDirect.


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8. Phillip R. B. (1995) *Environmental Hazards and human health* Lewis Publishers
9. Fulekar M.H. (2006) *Industrial Hygiene and Chemical Safety* I K International Publishing House
10. Major Hazard Control: A Practical Manual - An I.L.O. *Contribution to the International Programme on Chemical Safety* of U.N.E.P., I.L.O., W.H.O(1988) International Labour Office
11. Gupta A K., (2021) *Industrial Safety & Environment* Laxmi Publications

SUGGESTED WEBSITE:

1. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14>
2. <https://swayam.gov.in/>
3. <https://nptel.ac.in/courses/>

MODE OF TRANSACTION:

Lecture, demonstration, E-tutoring, discussion, assignments, case study, power point

LMS/ICT Tools: Digital Classrooms, DLMS, ZOOM, G-Suite, MS-Power-Point, Online Resource

LAB: Practicals will be devised depending on the facilities available.

Sandeep
24.01.25

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