AC/24.02.24/RS1

SIES College of Arts, Science & Commerce (Autonomous)

RISE WITH EDUCATION

NAAC REACCREDITED - 'A' GRADE

SIES College of Arts, Science and Commerce (Autonomous)
Affiliated to University of Mumbai

Syllabus under NEP effective from June 2024 Onwards

Programme: B.Sc.
Subject: Environmental Science
Core Course
Class: SYBSc
Choice Based Credit System (CBCS)

Semester III
Core Course\Vocational Skill Enhancement Course\ Skill Enhancement Course\Open Elective\AEC\IKS\VEC

Name of Program: B.Sc.				**Name of Department:** Environmental Science		
Class	**Semester**	**Course Code**	**Course Name**	**No. of lectures/ per week**	**Credits**	**Marks**
SYBSc	III	SIUESMJ211	Environmental Pollution	3 T + 1 P	3 + 1	100
SYBSc	III	SIUESMJ212	Solid Waste Management	3 T + 1 P	3 + 1	100
SYBSc	III	SIUESMN211	Basic Chemistry - II	3 T + 1 P	3 + 1	100
SYBSc	III	SIUESOE211	Biodiversity and Conservation	2 T	2	50
SYBSc	III	SIUESVS211	Instrumentation and Techniques in Environmental Science	2 P	2	50
SYBSc	III	AEC	Hindi / Marathi	2 T	2	50
SYBSc	III	FP	Individual project to be performed by student and continuous reviewing by faculty	–	2	50
SYBSc	III	CC	Offered across college level	–	2	50

<table>
<tr><td colspan="3">Course Name: Major Subject 1: Environmental Pollution
Credits: 3 Type: Core</td></tr>
<tr><td colspan="3">Expected Course Outcomes
On completion of this course, students will be able to
● Acquire the knowledge of the basic concept of pollution.
● Understand the sources and impacts of pollution.
● Get acquainted with the concept of pollution standards.
● Relate the cause and effect of human activities.</td></tr>
<tr><td>Unit I</td><td>Air Pollution</td><td>15 lectures</td></tr>
<tr><td></td><td colspan="2">● Various sources of air pollution; Point and Non-point sources.
● Classification of air pollutants.
● Effects of air pollution - on plants, animals, human health, environment and material. Case studies.
● Indoor air pollution - causes and effects.
● Acid rain and its effects. Case studies.
● Concept of air quality standards, Ambient air quality standards, NAAQS, AQI, Vehicular emission norms.</td></tr>
<tr><td>Unit II</td><td>Water Pollution</td><td>15 lectures</td></tr>
<tr><td></td><td colspan="2">● Various sources and types of water pollution; Point and Non-point sources.
● Classification of water pollutants.
● Impacts of water pollution - on flora, fauna, human health. Case studies.
● Water quality standards, Water quality criteria, Water quality index in India.</td></tr>
<tr><td>Unit III</td><td>Soil, Noise and Radioactive Pollution</td><td>15 lectures</td></tr>
</table>

	• Soil pollution- natural and anthropogenic causes; classification of soil pollutants; Effects of soil pollution - on plants, animals, human health, environment and material. • Noise pollution – Definition, Sources of noise pollution; Effect of noise pollution - on plants, animals, human health and material; Noise standards - WHO prescribed levels of noise, CPCB sound level standards. • Radioactive pollution – definition, sources of emission of radiations; Effect of radioactive pollution – on plants, animals, human and environment.

Course Name: Major Subject 1 Practical (Environmental Pollution)
Credits: 1

Expected Course Outcomes

On completion of this course, students will be able to:

- Acquire the knowledge of particulate matter estimation in ambient air.
- Assess the quality of air, water and soil samples.
- Observe the levels of radiation exposure in the surroundings.

Practical No.	Title
1.	Estimation of particulate matter in ambient air by respirable dust sampler.
2.	Estimation of Biochemical Oxygen Demand and Chemical Oxygen Demand in water samples.
3.	Estimation of sulphates in soil samples.
4.	Determination of noise levels of selected areas using a sound level meter.
5.	Detection of radiations in different objects and environments.

References

1. Sharma B.K :(2001), Environmental Chemistry, GOEL Publishing House, Meerut (UP)
2. Trivedi, P. R. (2004). Environmental Pollution and Control. India: APH Publishing Corporation.
3. Rao, M. N. (1989). Air Pollution. India: Tata McGraw-Hill.
4. Misra, S. P., Pandey, S. N. (2010). Essential Environmental Studies (2Nd Edition). India: Ane Books India.
5. Singal, S. P. (2005). Noise pollution and control strategy. India: Alpha Science International.
6. Radioactive Pollution and Biological Effects of Radioactivity. (2023). Switzerland: MDPI AG.

7. Maiti, S. K. (2004). Handbook of Methods in Environmental Studies, 1: Water and Wastewater Analysis. India: ABD Publishers.
8. Maiti, S. K. (2010). HandBook Of Methods In Environmental Studies (2 Vol. Set). India: Oxford Book Company.

Course Name: Major Subject 2 (Solid and Hazardous Waste Management)

Credits: 3 Type: Core

Expected Course Outcomes

On completion of this course, students will be able to:

- Acquaint the students with the basic concept of solid waste and management.
- Understand the different techniques of waste treatment.
- Gain understanding of segregation of different types of wastes such as Hazardous and Biomedical waste.

Unit I	**Introduction to solid waste, collection and storage of municipal solid waste**	**15 lectures**
	• Sources and generation of solid waste, Types of solid waste • Classification based on composition, Characterization of waste. • Factors affecting solid waste management. • Impact of solid waste on environment, animals, plants and human health, • Different techniques used in collection, transport, and storage of municipal solid waste.	
Unit II	**Management of Solid Waste**	**15 lectures**
	• Different methods of solid waste treatment and disposal- Introduction to Vermiculture, Composting, Landfill types, Landfill Quality and Control. • Methods of disposal- incineration, pyrolysis. • Concept of Integrated Waste Management (Case study). Zero waste concept of solid waste management. Concept of 12R's. • Green techniques for waste treatment, Concept of waste to energy recovery in India (case study).	
Unit III	**Hazardous and Biomedical waste**	**15 lectures**
	Hazardous waste • Characterization of hazardous waste • Types of hazardous waste	

	• Collection and Storage of hazardous waste • Treatment and disposal of hazardous waste • Impact of hazardous waste on environment and human health **Biomedical waste** • Characterization of biomedical waste • Types of biomedical waste • Collection and Storage of biomedical waste • Treatment and disposal of biomedical waste • Impact of improper handling of biomedical waste

Course Name: Major Subject 2 (Solid Waste Management Practical) Credits: 1	
Expected Course Outcomes On completion of this course, students will be able to • Classify and characterize various types of solid wastes. • Prepare compost and vermicompost at small scale level and analyze it for carbon content. • Explore the designs, construction and working of different machineries used for solid waste disposal. • Survey the awareness regarding waste generation and disposal across different sectors.	
Practical No.	**Title**
1.	Solid waste management-collection and physico-chemical analysis of solid waste characterization and classification of waste.
2.	Composting methods – Pit/Vermicompost.
3.	Estimation of organic carbon in compost.
4.	Design aspects of incinerators, Sanitary landfill site, Biogas plant.
5.	Waste generation pattern – questionnaire and survey.

References

1. Hosetti, B. B. (2006). Prospects and Perspective of Solid Waste Management. India: New Age International (P) Limited.

2. Rao, M., Sultana, R., Kota, S. H. (2016). Solid and Hazardous Waste Management: Science and Engineering. India: Elsevier Science.
3. Bagchi, A. 2004. Design of Landfills and Integrated Solid Waste Management. John Wiley & Sons.
4. Asnani, P. U. 2006. Solid waste management. India Infrastructure Report 570.
5. Blackman, W.C. 2001. Basic Hazardous Waste Management. CRC Press.
6. McDougall, F. R., White, P. R., Franke, M., & Hindle, P. 2008. Integrated Solid Waste Management: A Life Cycle Inventory. John Wiley & Sons.
7. US EPA. 1999. Guide for Industrial Waste Management. Washington D.C.
8. White, P.R., Franke, M. &Hindle P. 1995. Integrated Solid waste Management: A Life cycle Inventory. Blackie Academic & Professionals.
9. Zhu, D., Asnani, P.U., Zurbrugg, C., Anapolsky, S. & Mani, S. 2008. Improving Municipal Solid waste Management in India. The World Bank, Washington D.C.
10. Manual on Municipal Solid Waste Management. (2000). India: Central Public Health and Environmental Engineering Organisation, Ministry of Urban Development, Government of India.

Course Name: Minor Subject 1 (Basic Chemistry-II)

Credits: 3 Type: Core

Expected Course Outcomes

On completion of this course, students will be able to

- Understand the concept of thermodynamics with respect to the first law of thermodynamics.
- Balance redox equations.
- Discuss method of analysis, sample preparation and procedure for analysis
- Learn the rate of a chemical reaction, factors affecting it and its mechanism.
- Discuss the concept of order and molecularity of a reaction and their determination.

Unit I	**Thermodynamics**	**15 lectures**
	• **Thermodynamics:** System, Surrounding, Boundaries Sign Conventions, State Functions, • Internal Energy and Enthalpy: Significance, examples, (Numericals expected.), • Standard free energy change and Equilibrium constant, • Laws of thermodynamics and their application in environmental sciences, Concept of Entropy and Free energy.	
Unit II	**Titrimetry and Gravimetry**	**15 lectures**
	• **Titrimetric Analysis:** Titration, Titrant, Titrand, End Point, Equivalence Point, Titration Error, Indicator, Primary and Secondary Standards, Characteristics and examples	

	• **Types of Titration:** Acid –Base, Redox. Precipitation, Complexometric Titration. Acid – Base Titration.-Strong Acid Vs Strong Base -Theoretical aspects of Titration Curve and End Point Evaluation. • **Theory of Acid –Base Indicators**, Choice and Suitability of Indicators. • **Gravimetric Analysis:** Introduction, principle, Solubility and Precipitation, Factors affecting Solubility, Nucleation, Particle Size, Crystal Growth, Colloidal State, Ageing/Digestion of Precipitate. Co-Precipitation and Post-Precipitation. Washing, Drying and Ignition of Precipitate. (Numerical Expected).	
Unit III	**Reaction Kinetics and Redox Reaction**	**15 lectures**
	• **Reaction Kinetics:** Rate of Reaction, Rate Constant, Measurement of Reaction Rates Order Molecularity of Reaction, Integrated Rate Equation of First and Second order, determination of order of reaction. • **Principles of Oxidation & Reduction Reactions :** Oxidising and Reducing Agents, Oxidation Number, Rules to assign Oxidation Numbers with examples Ions like Oxalate, Permanganate and Dichromate. Balancing Redox Reactions by Ion Electron Method Oxidation, Reduction, Addition and Substitution & Elimination Reactions	

Course Name: Minor Subject 1 (Basic Chemistry-II Practical)
Credits: 1

Expected Course Outcomes

On completion of this course, students will be able to

- Perform experiments to understand laws of thermodynamics.
- Learn the rate of a chemical reaction, factors affecting it and its mechanism
- Study the various types of titrimetric method and role of indicators in titrations.
- Learn various parameters involved during gravimetry.

Practical No.	Title
1.	Determination of enthalpy of dissolution of salt (KNO_3).
2.	Study of hydrolysis of methyl acetate.
3.	Estimation of iron content by iron-dichromate method.
4.	Determination of the percentage purity of a sample of $BaSO_4$ containing NH_4Cl by gravimetric method.
5.	Estimation of hardness of water sample by titrimetric method.

References

1. Atkins P.W. and Paula J.de, Atkin's Physical Chemistry, 10th Ed., Oxford University 12 Press (2014).
2. Ball D.W., Physical Chemistry, Thomson Press, India (2007).
3. Castellan G.W., Physical Chemistry, 4th Ed., Narosa (2004).
4. James Holler, Stanly Crouch, Skoog, West Fundamentals of Analytical Chemistry 9th Ed.
5. Ahluwalia, V. K., 2010 TEXTBOOK OF ORGANIC CHEMISTRY, VOL.I, S. Chand Publishers, Ane Books Pvt. Ltd.
6. McQuarrie D.A. and Simon J.D., Molecular Thermodynamics, Viva Books Pvt. Ltd.,New Delhi (2004).
7. Morrison, R. T. and Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt Ltd. (Pearson Education).2012.
8. Arun Bahl and B. S. Bahl : Advanced Organic Chemistry, S. Chand
9. Lee, J.D. (2008). CONCISE INORGANIC CHEMISTRY, 5TH ED. India: Wiley India Pvt. Limited.

Course Name: Open Elective (Biodiversity and Conservation)

Credits: 2 Type: Elective (Theory and Tutorials)

Expected Course Outcomes

On completion of this course, students will be able to

- Understand the concept and significance of biodiversity.
- Comprehend the status and patterns of biodiversity at various levels.
- Acquaint the knowledge of different strategies of Biodiversity Conservation.
- Appreciate the efforts taken at national and international level for conservation of biodiversity.

Unit I	**Introduction to Biodiversity**	**15 lectures**
	• Concept and Definition of Biodiversity • Significance of Biodiversity • Levels of Biodiversity • Global and National Status of Biodiversity • Patterns in Biodiversity - spatial and altitudinal • Biodiversity Hotspots in India	
Unit II	**Biodiversity Conservation**	**15 lectures**
	• Causes for loss of biodiversity • Categories of threats as per IUCN • Strategies of Biodiversity conservation - *Insitu*: PAN, Sacred groves. *Exsitu:* Botanical gardens, zoological parks, advanced methods.	

	• Case studies on Biodiversity conservation • International efforts for Biodiversity conservation

References
1. Hayley Adams (2021) Wildlife Biodiversity Conservation: Multidisciplinary and Forensic Approaches. Switzerland: Springer International Publishing. 2. Sivaperuman, C. (2018) Indian Hotspots: Vertebrate Faunal Diversity, Conservation and Management Volume 1. Germany: Springer Nature Singapore. 3. Bharucha, E. (2002). The Biodiversity of India. India: Mapin Pub.. 4. Tomback, D. F. (2019). Biodiversity and Conservation in Forests. Switzerland: MDPI AG. 5. Malhotra, K. C. (2007). Sacred Groves in India: An Overview. India: Indira Gandhi Rashtriya Manav Sangrahalaya.

Course Name: VSC (Instrumentation and Techniques in Environmental Science) Credits: 2 Type: Practical	
Expected Course Outcomes On completion of this course, students will be able to 1. Learn the basic principles, construction and working of different ecological instruments. 2. Apply chromatographic techniques for separation of biomolecules in research and in industries. 3. Demonstrate and apply concepts of optical methods with a better understanding of the use of these instruments in environmental science .	
Unit I (Practical)	**Instrumentation and Techniques in Environmental Science**
	1. Study of pH meter, conductivity meter, turbidity meter, spectrophotometer, FES, AAS. 2. Separation of a mixture of chlorophyll pigments by paper chromatography. 3. Separation of a mixture of carotenoids by TLC. 4. Study of different Soil and water sampling techniques. 5. Physical and chemical analysis of soil. 6. Determining the Concentration of a Solution using Beer Lambert Law. 7. Basic microbiological techniques i) Maintaining aseptic conditions ii) Preparation of agar plates iii) Sectioning and staining of given material

References

1. Andreas Hofmann, S. C., n.d. *Wilson And Walker's Principles And Techniques Of Biochemistry And Molecular Biology.* 8 ed. s.l.:s.n.

2. GURDEEP R. CHATWAL, S. K. A. G. R. C. S. K. A., n.d. *Spectroscopy (Atomic and Molecular).* s.l.:Himalaya Publishing House.

3. Joanne M. Willey, C. J. W. L. S., n.d. *Prescott's Microbiology.* 8 ed. s.l.:McGraw-Hill Education.

4. Keith Wilson, K. H. G., n.d. *Biologist's Guide to Principles and Techniques of Practical Biochemistry.* 3 ed. s.l.:Hodder Arnold.

5. R., A., 2014. *Textbook of Microbiology.* 10 ed. s.l.:Universities Press.

6. Veerakumari, L., n.d. *Bioinstrumentation.* s.l.:MJP Publishers.

Semester IV
Core Course\Vocational Skill Enhancement Course\ Skill Enhancement Course\Open Elective\AEC\IKS\VEC

Name of Program: B.Sc.				**Name of Department:** Environmental Science		
Class	**Semester**	**Course Code**	**Course Name**	**No. of lectures/ per week**	**Credits**	**Marks**
SYBSc	IV	SIUESMJ221	Environmental Pollution Monitoring, Control and Management	3 T + 1 P	3 + 1	100
SYBSc	IV	SIUESMJ222	Natural Hazards and Disaster Management	3 T + 1 P	3 + 1	100
SYBSc	IV	SIUESMN221	Life Science - II	3 T + 1 P	3 + 1	100
SYBSc	IV	SIUESOE221	Introduction to Environmental Pollution	2 T	2	50
SYBSc	IV	SIUESVS221	Biometry	1 T + 1 Tu	1 + 1	50
SYBSc	IV	AEC	Hindi / Marathi	2 T	2	50
SYBSc	IV	CEP	Offered across college level	--	2	50
SYBSc	IV	CC	Offered across college level	--	2	50

<table>
<tr><td colspan="3">Course Name: Mandatory Subject 1 (Environmental Pollution Monitoring, Control and Management)
Credits: 3 Type: Core</td></tr>
<tr><td colspan="3">Expected Course Outcomes
On completion of this course, students will be able to
● Get acquainted with the basic concept of environmental pollution
● Learn different sources of pollution and their effects
● Apply the knowledge to control & manage the environmental pollution</td></tr>
<tr><td>Unit I</td><td>Air Pollution Monitoring, Control and Management</td><td>15 lectures</td></tr>
<tr><td></td><td colspan="2">● Monitoring of air quality - Station based monitoring, satellite-based monitoring
● Techniques of air monitoring - Stack gas/dust Sampling technique, Dust Fall Jar, SPM and RSPM using Respirable Dust sample/High Volume Air Sampler (Ambient Air monitoring)
● Sampling - Objective and Criteria of Air Sampling, Selection of Sampling Location; Sampling Methods - Sedimentation, Filtration, Centrifugal and Impingement Method
● Control measures for air pollutants - Particulate matter - Gravitational Settling, Cyclonic Separation, Filtration, Wet Scrubbing, Electrostatic precipitation; VOCs - Absorption in suitable liquids, Condensation, Adsorption, Incineration; Gases - NO2, SO2</td></tr>
<tr><td>Unit II</td><td>Water Pollution Monitoring, Control and Management</td><td>15 lectures</td></tr>
<tr><td></td><td colspan="2">● Objectives, Selection of Sampling Site, Types of Water Samples, Collection, Handling and Preservation, Sampling Equipment
Wastewater Treatment process (ETP & STP)
● Physical unit process, - Screening, Flocculation, Sedimentation, Filtration
● Chemical unit process - Chemical Precipitation, Adsorption process, Disinfection process
● Biological unit process - Role of Micro-organism, Activated sludge process, Aerated lagoons, Stabilization ponds, Trickling Filters, Sludge management.
● Advance wastewater treatment processes - Ion – exchange process, Reverse Osmosis, Electro-dialysis, Carbon Adsorption. Concept of Zero waste discharge.</td></tr>
</table>

Unit III	Soil, Noise and Radioactive Pollution Monitoring, Control and Management	15 lectures
	• **Soil pollution**- Control and prevention of soil pollution: control over the use of agrochemicals, integrated pest management, sustainable agricultural practices, sanitary landfill method, phytoremediation. • **Noise pollution -** Objectives of noise monitoring, noise monitoring system, noise monitoring equipment; Noise management techniques. • **Radioactive Pollution-** Radioactive fallouts and its effect; Control and prevention of radioactive pollution: control of X-ray radiations, disposal of radioactive waste, safety measures at nuclear power plant, individual preventive measures, nuclear reactor operation	

Course Name: Mandatory Subject 1 Practical (Environmental Pollution Monitoring, Control and Management)
Credits: 1

Expected Course Outcomes

On completion of this course, students will be able to

- Identify the amount of air pollutants present in the atmosphere.
- Classify different salts/ions present in soil.
- Estimate the water pollutants

Practical No.	Title
1.	Determination of SOx and NOx in ambient air using RDS/HVS.
2.	Estimation of MLSS, MLVSS and SVI from activated sludge.
3.	Determination of SAR value of soil.
4.	Determination of oil and grease content in polluted water samples.
5.	Air, water, soil, noise and radioactive pollution - case studies from India.

References4jk

1. Sharma B.K :(2001), Environmental Chemistry, GOEL Publishing House, Meerut(UP)
2. Trivedi, P. R. (2004). Environmental Pollution and Control. India: APH Publishing Corporation.
3. Khopkar, S. M. (2007). Environmental Pollution Monitoring and Control. India: New Age International (P) Limited.
4. Singal, S. (2012). Air Quality Monitoring and Control Strategy. United Kingdom: Alpha Science International Limited.

<table>
<tr><td colspan="3">Course Name: Mandatory Subject 2 (Natural Hazard and Disaster Management)
Credits: 3 Type: Core</td></tr>
<tr><td colspan="3">Expected Course Outcomes
On completion of this course, students will be able to
1. describe hazard and its type
2. understand the causes and potential impacts of various natural hazards.
3. assess vulnerability of a geographical region
4. analyze relation between development and disasters
5. develop skills for disaster preparedness</td></tr>
<tr><td>Unit I</td><td>Introduction to Natural Hazards and Types- Earthquake, Volcanoes, Floods</td><td>15 lectures</td></tr>
<tr><td></td><td colspan="2">● Definition of Hazard, Natural Hazard, Anthropogenic Hazard
● Types of Hazard- Natural- Geological, Hydrological, Atmospheric Hazard
● Earthquakes- Seismic waves, epicenter, causes, impact, prevention, control and mitigation
● Volcanoes- Geographical distribution, active volcanoes, causes, impact, disaster management strategies
● Floods- Types of flood, frequency of flooding, causes, impact, prevention, control and mitigation</td></tr>
<tr><td>Unit II</td><td>Landslides, Droughts, Tsunami, Cyclones</td><td>15 lectures</td></tr>
<tr><td></td><td colspan="2">● Landslide- Causes, impact, prevention, control and mitigation
● Droughts- Types, Causes, impact, prevention, control and mitigation
● Tsunamis: causes and location of tsunamis; coastal erosion, sea level changes and its impact on coastal areas
● Tornadoes, Cyclone & Hurricanes- causes, location, impact, prevention, control and mitigation</td></tr>
<tr><td>Unit III</td><td>Disaster Management</td><td>15 lectures</td></tr>
<tr><td></td><td colspan="2">● Concept of risk and vulnerability, Reasons of vulnerability - rapid population growth, urban expansion, environmental pollution, epidemics, industrial accidents, inadequate government policies
● Concept of mitigation; Types of mitigation: structural and non-structural mitigation,</td></tr>
</table>

	• Concept of preparedness; Importance of planning, exercise, and training in preparedness; • Disaster management cycle- Mitigation, preparedness, response, recovery • National Disaster management framework, National response mechanism, Role of Government bodies such as NDMC, IMD.

Reference books

1. S.P. Mishra and S.N. Pandey. Essential Environment Studies
2. Smith, K. 2001. Environmental Hazards: Assessing Risk and Reducing Disaster. Routledge Press.
3. Schneid, T.D. & Collins, L. 2001. Disaster Management and Preparedness. Lewis Publishers, New York, NY
4. Cutter, S.L. 2012. Hazards Vulnerability and Environmental Justice. EarthScan, Routledge Press.
5. Disaster Prepardness in India – Narendrakumar Jain, Adhytma Sadhan Kendra Mehrauli, New Delhi.
6. Disaster Management – Shailendera, K Singh, Subash. C Kundu and Shobu Singh, Mittal Publications, New Delhi (1998).
7. Encyclopedia of Natural Hazards. (2013). Bobrowsky, P. Germany: Springer Netherlands.
8. Keller, E. A., DeVecchio, D. E. (2016). Natural Hazards: Earth's Processes as Hazards, Disasters, and Catastrophes. United Kingdom: Taylor & Francis.
9. Blaikie, P., Cannon, T., Davis, I., Wisner, B. (2014). At Risk: Natural Hazards, People's Vulnerability and Disasters. United Kingdom: Taylor & Francis.
10. Lukasiewickz, A. (2020) Natural Hazards and Disaster Justice: Challenges for Australia and Its Neighbours. Germany: Springer Nature Singapore.
11. Rivera, F. (2019) Emerging Voices in Natural Hazards Research.. United Kingdom: Elsevier Science.
12. Arora, P. (2013) Disaster Management: Medical Preparedness, Response and Homeland Security. United Kingdom: CABI

Course Name: Mandatory Subject 2 Practical (Natural Hazard and Disaster Management)
Credits: 1

Expected Course Outcomes

On completion of this course, students will be able to

- understand the causes and consequences of various natural hazards.
- study the disaster management methods against different natural hazards.
- prepare the disaster management plan.

Practical No.	Title
1.	Case study of natural hazards - report preparation.
2.	Case study of natural hazard and disaster management plan - report preparation
3.	Preparation of disaster management plan for any of the following disasters: drought, landslide, flood, earthquake, cyclone, tsunami and report submission.
4.	Mock drill conduct.

References

1. Arora, P. (2013) Disaster Management: Medical Preparedness, Response and Homeland Security. United Kingdom: CABI.
2. Blaikie, P., Cannon, T., Davis, I., Wisner, B. (2014). At Risk: Natural Hazards, People's Vulnerability and Disasters. United Kingdom: Taylor & Francis.
3. Lukasiewickz, A. (2020) Natural Hazards and Disaster Justice: Challenges for Australia and Its Neighbours. Germany: Springer Nature Singapore.
4. Disaster Prepardness in India – Narendrakumar Jain, Adhytma Sadhan Kendra Mehrauli, New Delhi.
5. Smith, K. 2001. Environmental Hazards: Assessing Risk and Reducing Disaster. Routledge Press.

Course Name: Mandatory Subject 2 (Basic Life Science-II)

Credits: 3 Type: Core

Expected Course Outcomes

On completion of this course, students will be able to

- Describe the salient characteristics and classify different types of bacterias and viruses on the basis of their morphology.
- Explore various staining techniques, understand the chemistry and its importance in microbiology.
- Learn and describe the basic skills such as cultivation, maintaining microbes with different types of culture media.
- Understanding the importance of sterilization and good microbiological practices.

Unit I	Bacteria and Viruses	**15 lectures**
	• Detail Structure of Slime Layer, Capsule, Flagella, Pilli, Cell Wall (Gram Positive and Negative), Cell Membrane, Protoplast and Spheroplast, Cytoplasm and Genetic Material Storage Bodies and Spores	

	• Bacteria: Classification, Types, Morphology (Size, Shape and Arrangement) Modes of cell division, Significance of Bacteria • Introduction to Viruses : General Characters, Classification (Plant, Animal and Bacterial Viruses)	
Unit II	Stains	**15 lectures**
	• Stains and Staining Solutions : Definition of Dye and Chromogen, Structure of Dye and Chromophore, Functions of Mordant and Fixative, Natural and Synthetic Dyes, Classification • Chemistry of stains, Simple Staining, Differential Staining (Gram staining , Romanowsky"s staining & Acid Fast Staining with specific examples) • Fluorescent stains, Fluorescence and phosphorescence, Principles of metachromatic granules	
Unit III	Nutrition and Cultivation of Microorganisms	**15 lectures**
	• Nutrition and Cultivation of Microorganisms: Nutritional Requirements – Carbon, Oxygen, Hydrogen, Nitrogen, Phosphorus, Sulphur and Growth Factors. • Classification of Different Nutritional types of Organisms, Design and Types of Culture Media: Simple Medium, Differential, Selective and Enriched Media • Sterilization of media and glasswares; Concept of Isolation and Methods of Isolation, Pure Culture Techniques	

Course Name: Mandatory Subject 2 Practical (Basic Life Science-II)
Credits: 1

Expected Course Outcomes

On completion of this course, students will be able to

- Understand the laboratory instruments used in microbiological practices.
- Demonstrate proficiency in aseptic techniques for culturing, maintaining and isolation of microorganisms.
- Use staining techniques for the microbial identification and characterization.

Practical No.	**Title**
1.	Introduction of laboratory instruments-Autoclave, Hot air Oven, Incubator, Rotary Shaker and Centrifuge

2.	Isolation of Organisms : T-streak, Polygon method
3.	Isolation of microbes and making pure cultures.
4.	Colony Characteristics of Microorganisms (Bacteria, Molds and fungus)
5.	Monochrome Staining, Negative staining, Differential Staining, Gram Staining

References

1. Willey, J., Sherwood, L., Woolverton, C. (2011). Prescott's Microbiology. Italy: McGraw-Hill Education.
2. Pelczar, M. J., Chan, E. C. S., Krieg, N. R. (2005). 5th Edition, Microbiology: Concepts and Applications. Spain: McGraw-Hill.
3. Practical Handbook of Microbiology. (2021). United Kingdom: CRC Press.
4. Grant, W. D., Long, P. E. (2013). Environmental Microbiology. United Kingdom: Springer US.
5. Stanier et al., General Microbiology, Printice Hall of India Pvt. Ltd., New Delhi
6. Stanier et al., General Microbiology, Printice Hall of India Pvt. Ltd., New Delhi
7. Modi HA, Handbook of Elementary Microbiology, Shanti Prakashan

Course Name: Open Elective (Introduction to Environmental Pollution)

Credits: 2 Type: Elective

Expected Course Outcomes

On completion of this course, students will be able to

- Provide a comprehensive understanding of environmental pollution issues.
- Prepare them to contribute to environmental protection and sustainability efforts in various roles.
- Understand the strategies for pollution prevention, control and remediation.

Unit I	**Air and Water pollution**	**15 lectures**
	• Introduction to environmental pollution and types. • Causes of air pollution and water pollution. • Effects of air pollution and water pollution. • Control and prevention of air pollution and water pollution.	
Unit II	**Soil, Noise and Radioactive pollution**	**15 lectures**

	• Causes of soil pollution and noise pollution. • Effects of soil pollution and noise pollution. • Control and prevention of soil pollution and noise pollution. • Radioactive pollution - sources and effects.

References

1. Hodges, L. (1977). Environmental pollution. India: Holt, Rinehart and Winston.
2. Manivasakam, N. (1984). Environmental Pollution. India: National Book Trust, India.
3. A Textbook of Environmental Chemistry and Pollution Control. (2006). India: S. Chand Limited.
4. Rana, S. V. S. (2011). Environmental Pollution: Health and Toxicology. United Kingdom: Alpha Science International Limited.
5. Khopkar, S. M. (2007). Environmental Pollution Monitoring and Control. India: New Age International (P) Limited.

Course Name: SEC

Credits: 2

Expected Course Outcomes

On completion of this course, students will be able to

- Collect and organize the data for various statistical analyses.
- Apply various techniques in biometry as an analytical tool in the field of environmental science.
- Acquire the basic skills required to analyze and interpret the data obtained.

Unit I	**Biometry**	**15 lectures**
	1. Collection, arrangement and grouping of data; representation of data in the form of bar chart, pie chart, frequency polygon and histogram. 2. Determination of Central tendency- calculation of mean, median, mode, standard deviation from the collected data. Calculation of Coefficient of correlation from given data.	
	(Tutorial / Practical)	**15 lectures**

References

1. Text Book of Biostatistics I. (2005). India: Discovery Publishing House Pvt. Limited.
2. Kulkarni, A. P. (2019). Basics of Biostatistics. India: CBS Publishers & Distributors.

3. Mahajan, B. (2008). Methods in Biostatistics: For Medical Students and Research Workers. India: Jaypee Brothers Medical Publishers Pvt. Limited.
4. Pagano, M., Gauvreau, K., Mattie, H. (2022). Principles of Biostatistics. United Kingdom: CRC Press.
5. ESSENTIALS OF BIOSTATISTICS & RESEARCH METHODOLOGY. (2020). (n.p.): Academic Publishers.

SIES College of Arts, Science and Commerce (Empowered Autonomous) Sion West												
Course Code Under NEP for SY 2024-25												
Course Codes and Syllabus Template for EVS Department												
Sr No	Semester	Course Category	Course Name	Alias	The Class to which the Course is offered	Course Code	Total Credits	Exam Conduction Type	Continous Evaluation Passing Cut Off	Continous Evaluation Marks Out Off	External Passing Cut Off	External Marks Out Off
1	3	Major 1	Environmental Pollution	ESMJ211	SYBSc	SIUESMJ211	3 Theory	Internal, External	10	25	20	50
2	3	Major 1 practical	Environmental Pollution Practical	ESMJP211	SYBSc	SIUESMJP211	1 Practical	External	NA	NA	10	25
3	3	Major 2	Solid Waste Management	ESMJ212	SYBSc	SIUESMJ212	3 Theory	Internal, External	10	25	20	50
4	3	Major 2 Practical	Solid Waste Management Practical	ESMJP212	SYBSc	SIUESMJP212	1 Practical	External	NA	NA	10	25
5	3	Minor 1	Basic Chemistry-II	ESMN211	SYBSc	SIUESMN211	3 Theory	Internal, External	10	25	20	50
6	3	Minor 1 Practical	Basic Chemistry-II Practical	ESMNP211	SYBSc	SIUESMNP211	1 Practical	External	NA	NA	10	25
7	3	Vocational Skill Course (VSC)	Instrumentation and Techniques in Environmental Science	ESVS211	SYBSc	SIUESVS211	2 Practical	External	NA	NA	20	50
8	3	Open Elective (OE)	Biodiversity and Conservation	ESOE211	All SFC except BT	SIUESOE211	1 Theory + 1 Tutorial	External	NA	NA	20	50
9	3	Field Project (FP)	Field Project-I in Environmental Science	ESFP211	SYBSc	SIUESFP211	2 Practical	External	NA	NA	20	50
10	4	Major 1	Environmental Pollution Monitoring, Control and Management	ESMJ221	SYBSc	SIUESMJ221	3 Theory	Internal, External	10	25	20	50
11	4	Major 1 practical	Environmental Pollution Monitoring, Control and Management Practical	ESMJP221	SYBSc	SIUESMJP221	1 Practical	External	NA	NA	10	25
12	4	Major 2	Natural Hazards and Disaster Management	ESMJ222	SYBSc	SIUESMJ222	3 Theory	Internal, External	10	25	20	50
13	4	Major 2 Practical	Natural Hazards and Disaster Management Practical	ESMJP222	SYBSc	SIUESMJP222	1 Practical	External	NA	NA	10	25
14	4	Minor 1	Basic Life Science -II	ESMN221	SYBSc	SIUESMN221	3 Theory	Internal, External	10	25	20	50
15	4	Minor 1 Practical	Basic Life Science-II Practical	ESMNP221	SYBSc	SIUESMNP222	1 Practical	External	NA	NA	10	25
16	4	Skill Enhancement Course (SEC)	Biometry	ESSE221	SYBSc	SIUESVS221	1 Theory + 1 Tutorial	External	NA	NA	20	50
17	4	Open Elective (OE)	Introduction to Environmental Pollution	ESOE221	All SFC except BT	SIUESOE221	1 Theory + 1 Tutorial	External	NA	NA	20	50