

**VEER NARMAD SOUTH GUJARAT
UNIVERSITY
SURAT**

**M. Sc. ENVIRONMENTAL SCIENCE
SYLLABUS (CBCS)**

With Effect from 2019-20

ANNEXURE – II

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M.Sc. Environmental Science
THIRD SEMESTER

Ens 301: Solid & Hazardous Waste Management

Total Hours: 48

1	Solid Waste	12 Hours
1.1	Introduction of solid waste management rules and regulation	
1.2	Sources and types based classification	
1.3	Physical, chemical and biological properties	
1.4	Composition and generation rate	
1.5	Collection, on-site handling, transfer station and transportation	
1.6	Physical, chemical(thermal), biological processing technologies	
1.7	Recycling and reuse: material and energy recovery	
1.8	Disposal methods: open dumping, sanitary landfill, land farming	
2	Hazardous Waste	12 Hours
2.1	Introduction to hazardous waste and harmful effects	
2.2	Sources and classification	
2.3	Identification: characteristics and types of listed hazardous waste	
2.4	Generation, collection - storage , transfer and transport	
2.5	Treatment Methods: physical, chemical, photolytic, thermal, biological, land treatment and composting	
2.6	Preparation of waste for disposal	
2.7	Ultimate disposal of waste: disposal above ground, surface impoundment , deep well disposal of liquids, secured landfill	
2.8	In-situ treatment	
3	Radioactive & E Waste Management	12 Hours
3.1	Introduction to radioactive and E-waste	
3.2	Sources - natural and anthropogenic	
3.3	Harmful effects of radioactive pollution/E-waste	
3.4	Maximum permissible dose values - ICRP standards	
3.5	Preventive and control measures	
3.6	Collection, storage and disposal	

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4	Plastic & Bio medical Waste	12 Hours
4.1	Introduction to plastic and biomedical waste and hazards/harmful effects	
4.2	Sources of generation	
4.3	Types/Categories	
4.4	Segregation, storage & transportation	
4.5	Treatment techniques	
4.6	Disposal methods	

References:

1. Integrated Solid Waste Management: Engineering Principles and Management Issues, George Tchobanoglous, Hilary Theisen, Samuel A Vigil, 1st Edition, 1993, 2nd Reprint, 2014, McGraw-Hill Education (India) P. Ltd.
2. Textbook of Solid Waste Management, Iqbal H. Khan, Naved Ahsan, 1st Edition, 2003, 7th Reprint, 2017, CBS Publishers and Distributors P. Ltd.
3. Management of Municipal Solid Waste, T.V. Ramchandra, 1st Edition, 2006, 5th Reprint, 2014, Teri Press.
4. Environmental Sciences, S.C. Santra, 3rd Edition, April 2013, 3rd Reprint, 2016, New Central Book Agency P. Ltd.
5. Environmental Chemistry, B.K.Sharma, 1st Edition, 1994, 16th Edition, 2016, Krishna Prakashan P. Ltd.
6. Standard Handbook of Hazardous Waste Treatment and Disposal, H.M.Freeman, 2nd Edition, 1997, McGraw Hill.
7. Hazardous waste management, Charles A. Wentz, 2nd Edition, 1995, McGraw Hill.
8. Handbook of Solid waste management, Frank Kreith, 2nd Edition, 1994, McGraw-Hill.
9. Hazardous Waste Management, Michael D La Grega, Phillip L Buckingham, Jeffrey C. Evans, 1st Edition, 1994, McGraw-Hill.
10. Environmental Engineering, Howard S. Peavy, Donald R. Rowe, George Tchobanoglous, 1st Edition, 1984, Mc Graw Hill.

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THIRD SEMESTER

Ens 302: Air and Noise Pollution

Total Hours : 48

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| 1. | Ambient Air & Noise Pollution | 12 Hours |
| 1.1 | Introduction to air and noise pollution | |
| 1.2 | Classification of sources of air pollutants:
Stationary and mobile, natural and artificial | |
| 1.3 | Types: primary and secondary air pollutants | |
| 1.4 | Effects of natural air pollutants,
Effects of air pollution on humans, vegetation and materials | |
| 1.5 | Noise Pollution: Characteristics of sound, measurement of
noise, equipment used for noise measurement | |
| 1.6 | Sources of noise pollution
physiological and psychological effects of noise pollution | |
| 1.7 | Control measures of noise pollutions, noise pollution control in
industries, important parameters in noise control, standards
prescribed for noise in Indian context. | |
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| 2 | Air pollution Meteorology and Thermodynamics | 12 Hours |
| 2.1 | Meteorological parameters | |
| 2.1.1 | Heat, radiation and temperature lapse rate | |
| 2.1.2 | Wind speed, wind direction and wind rose | |
| 2.1.3 | Mixing height | |
| 2.1.4 | Moisture and humidity | |
| 2.1.5 | Rainfall and precipitation | |
| 2.1.6 | High and low pressures | |
| 2.2 | Plume behavior | |
| 2.3 | Effect of topography on pollutant dispersion | |
| 2.4 | Themodynamics of formation of CO, SO _x , NO _x | |
| 2.5 | Thermodynamics of combustion: air fuel ratio | |
| 2.6 | Combustion of coal, oil and natural gas | |
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| 3 | Air Pollution Monitoring and Management | 12 Hours |
| 3.1 | Environmental guidelines for industries | |
| 3.2 | Ambient air quality standards | |
| 3.3 | Stack emission monitoring | |
| 3.3.1 | Stack emission standards | |
| 3.3.2 | Location of sampling ports and traverse points | |
| 3.3.3 | Sampling train | |
| 3.3.4 | Isokinetic sampling | |

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- 3.3.5 Determination of stack characteristics
- 3.3.6 Stack monitoring procedure
- 3.4 Ambient air quality monitoring: SPM and gaseous sampling
- 3.5 Ambient air quality survey
- 3.6 Air quality management in India

4 Air Pollution Control Technology 12 Hours

- 4.1 Control of particulate pollutants
 - 4.1.1 Control at source
 - 4.1.2 Control equipments: settling chambers, cyclones, fabric filters, electrostatic precipitators, scrubbers (spray towers, venturi scrubbers, cyclone and packed scrubbers)
- 4.2 Control of gaseous pollutants: adsorption, absorption, combustion, condensation
- 4.3 SO_x control
- 4.4 NO_x control
- 4.5 Automobile pollution: vehicular emissions, automotive fuels, motor fuel combustion, control of motor vehicle emissions
- 4.6 Pollution control in chemical process industry

References:

1. Air Pollution, M. N. Rao and H. V. N. Rao, 26th Edition, 2007, Tata McGraw Hills.
2. An introduction to air pollution, R. K. Trivedy, P. K. Goel, 1st Edition, 2003, ABD Publishers.
3. Textbook of Air Pollution And Its Control, S. C. Bhatia, 1st Edition, 2007, Atlantic Publishers.
4. Air Pollution Control Engineering, Noel De Nevers, 2nd Edition, 2000, McGraw Hill.
5. Environmental pollution and control in chemical industries, S. C. Bhatia, 2nd Edition, 2014, Khanna Publishers.
6. Methods of Air Sampling and Analysis, James P. Lodge, JR., 3rd Edition, 2016, CRC Press.
7. Air Pollution Engineering Manual, Wayne T. David, 2nd Edition, 2000, John Wiley and Sons.
8. Air Pollution and Control, K.V.S.G. Murlikrishnan, 2nd Edition, 2017, University Science Press

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THIRD SEMESTER

Ens 303: Industrial Wastewater Treatment

Total Hours: 48

1	Sources, Characteristic & Treatment of Wastewater from different Industries	12 Hours
1.1	Textiles and Dye Manufacturing	
1.2	Metal Plating	
1.3	Fertilizer	
1.4	Drugs and Pharmaceuticals	
1.5	Sugar and Dairy	
1.6	Petrochemicals	
2	Common Effluent Treatment Plant	12 Hours
2.1	Introduction of ETP and CETP	
2.2	Need for effluent treatment and principle of ETP	
2.3	Common problems, design and management of CETP	
2.4	Sources and characteristics of industrial waste water	
2.5	Indian standards for disposal of industrial effluents	
3	Treatment of Industrial Effluent	12 Hours
3.1	Primary treatment: screening, neutralization, equalization, sedimentation and coagulation	
3.2	Secondary treatment: aerobic biological - activated sludge process, oxidation pond, aerated lagoon, trickling filter. anaerobic digestion.	
3.3	Tertiary treatment: removal of dissolved inorganic matter, organics (biodegradable & other organics), oil & grease, acid and alkali, toxic material, carbon, nitrogen, phosphorus and microorganisms.	
4	Waste Reduction and Disposal Methods	12 Hours
4.1	Flow measurement	
4.2	Volume reduction	
4.3	Strength reduction	
4.4	Treatment and disposal of sludge solids	
4.5	Methods of waste water disposal: Natural, artificial and combined	
4.6	Wastewater disposal on land & land treatment	

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References:

1. Industrial Wastewater Treatment, M. N. Rao, A. K. Dutta, 2nd Ed, 2007, Reprint, 2014, Oxford & IBH Publishing Co.Pvt.Ltd.
2. Water Supply and Sanitary Engineering, G.S. Birdie & J. S. Birdie, 9th Edition 2011, Reprint, 2015, Dhanpat Rai Publishing Company.
3. Chemistry of Environmental Engineering and Science, C. N. Sawyer and P. L. Mc Carty, 5th Edition, 2003, 21st Reprint, 2015, McGraw Hill Education (India) Pvt. Ltd.
4. Hand book of drinking water quality by John DeZuane, 2nd Edition, 1997, Reprint, 2013, Wiley India Pvt. Ltd.
5. Environmental Problems Protection and Control, Vol-1 & 2, Arun Kumar, 1st Edition, 1999, Anmol Publications Pvt. Ltd.
6. Environmental Pollution and Control in Chemical Process Industries, S.C. Bhatia, 2nd Edition, 3rd Reprint, 2014, Khanna Publishers.
7. Industrial Wastewater Treatment, A.D. Patwardhan, 1st Edition, 2nd Reprint, 2009, PHI Learning Private Limited.

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Ens 304: Geo Microbiology

Total Hours : 48

1	Introduction, History, Earth as Microbial Habitat	10 Hours
1.1	Introduction to Geolomicrobiology, geological importance, features and biosphere	
1.2	Beginnings and evolution of life through the Precambrian	
1.3	The evidence	
2	Geomicrobial Process: A Physical and Biochemical overview	14 Hours
2.1	Types of geomicrobial agents	
2.2	Geomicrobially important physiological groups of procaryotes and its role	
2.3	Types of microbial activities influencing geological processes	
2.4	Microbes as catalysts of geochemical processes	
2.5	Microbial mineralization and geomicrobial transformations	
3	Methods in Geomicrobiology	12 Hours
3.1	Detection and isolation of geomicrobially active organisms	
3.2	<i>In situ</i> study of past and ongoing geomicrobial activity	
3.3	Quantitative study of growth on surfaces	
3.4	Enzymatic and nonenzymatic geomicrobial activity and transformation	
4	Geomicrobiology of Fossil Fuels	12 Hours
4.1	Natural abundance of fossil fuels	
4.2	Methane	
4.3	Peat	
4.4	Coal	
4.5	Petroleum	

References:

1. Geomicrobiology, Henry Lutz Ehrlich and Dianne K. Newman., 5th Edition, 2009, CRC press.
2. Geomicrobiology, S.K. Jain; A.A. Khan, M.K.Rai, 1st Edition, 2010, CRC press.
3. Introduction to Geomicrobiology, Kurt O. Konhauser , 1st Edition, 2006 , Wiley-Blackwell.
4. Geomicrobiology: Molecular and Environmental Perspective, Larry L. Barton, Martin Mandl, Alexander Loy, 1st Edition, 2010, Springer.
5. Analytical Geomicrobiology: A Handbook of Instrumental Techniques, Janice P. L. Kenney, , Harish Veeramani, Daniel S. Alessi, 1st Edition, 2019, Cambridge University Press.

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EnS 305: Laboratory Practicals

EnS 301: Sampling and Analysis of Solid Waste

1. Determination of % of Moisture, Volatile Matter, Ash and Fixed Carbon by Proximate analysis and Calculation of Calorific value of solid waste.
2. Chemical analysis of Organic Carbon and Organic Nitrogen of solid waste.
3. Chemical analysis of Total Phosphate and Pottasium of solid waste.

EnS 301: Sampling and Analysis of Landfill Leachate

1. Chemical analysis of pH and Electrical Conductivity of Leachate sample.
2. Chemical analysis of BOD, COD, $\text{NH}_4^+ - \text{N}$, Solids in Leachate sample.
3. Chemical analysis of Heavy metals in Leachate sample.
4. Chemical analysis of Cl^- , F^- in Leachate sample.

EnS 302: Air Pollution Monitoring:

1. Sampling and chemical analysis of the concentration of SO_x in ambient air.
2. Sampling and chemical analysis of the concentration of NO_x in ambient air.
3. Sampling and gravimetric analysis of the PM_{10} and $\text{PM}_{2.5}$ in ambient air.
4. To study the Stack Monitoring Kit.
5. Sampling and microbiological analysis of air from different location.

EnS 303:Industrial Wastewater Analysis:

Sampling and Analysis of Physico-chemical characteristics of effluent from various industries:

1. Analysis of pH and Electrical Conductivity, BOD of industrial wastewater.
2. Chemical analysis of, COD, $\text{NH}_4^+ - \text{N}$, Solids in industrial wastewater.
3. Chemical analysis of Heavy metal in industrial wastewater.

EnS 304:Geo Microbiology:

1. Isolation of *Geobacter* spp from sedimentary environment.
2. Isolation of anaerobic bacteria from mud sample.
3. Isolation of *Arthrobacter* spp. from soil.
4. Isolation of methanogens from cattle dung.