



## ಗುಲಬರ್ಗಾ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಕಲಬುರಗಿ.

ಪ್ಲಾನ್ ಗಂಗಾ, ಕಲಬುರಗಿ-585 106, ಕರ್ನಾಟಕ, ಭಾರತ

(ಕರ್ನಾಟಕ ರಾಜ್ಯ ವಿಶ್ವವಿದ್ಯಾಲಯಗಳ ಅಧಿನಿಯಮ 1976ರನ್ವಯ 30-09-1980 ರಂದು ಸ್ಥಾಪಿಸಲಾದ ವಿಶ್ವವಿದ್ಯಾಲಯ ಮತ್ತು 2000ರ ಅಧಿನಿಯಮದ ಅಡಿಯಲ್ಲಿ ಬದಲಾಯಿಸಿದಂತೆ)  
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ವಿದ್ಯಾಮಂಡಲ



ಕ್ರ.ಸಂ.ಗುವಿಕ/ವಿಮವಿ/ಬಿಟಿಎಸ್/2023-24/ 419

ದಿನಾಂಕ: 09.11.2023

### ಅಧಿಸೂಚನೆ

ವಿಷಯ: ಸ್ನಾತಕ ಪದವಿ ಕೋರ್ಸಿನ ಪರಿಷರ ಅಧ್ಯಯನ ವಿಷಯದ ಐದನೇ ಹಾಗೂ ಆರನೇ ಸೆಮಿಸ್ಟರ್ ಪಠ್ಯಕ್ರಮ ಅನುಮೋದಿಸಿ 2023-24ನೇ ಶೈಕ್ಷಣಿಕ ಸಾಲಿನಿಂದ ಜಾರಿಗೊಳಿಸಿದ ಬಗ್ಗೆ.

- ಉಲ್ಲೇಖ:1. ಸರ್ಕಾರದ ಆದೇಶ ಸಂಖ್ಯೆ ಇಡಿ 104 ಯುಎನ್ಇ 2023 ಬೆಂಗಳೂರು, ದಿನಾಂಕ:20.07.2023  
2. ಪರಿಷರ ಅಧ್ಯಯನ ವಿಷಯದ ಸ್ನಾತಕ ಅಧ್ಯಯನ ಮಂಡಳಿಯ ನಿರ್ಣಯ ದಿನಾಂಕ: 22.09.2023.  
3. ವಿಜ್ಞಾನ ನಿಕಾಯಗಳ ಸಮಿತಿ ಸಭೆಯ ನಿರ್ಣಯ ದಿನಾಂಕ: 06.11.2023  
4. ಮಾನ್ಯ ಕುಲಪತಿಗಳ ಅನುಮೋದನೆ ದಿನಾಂಕ:08.11.2023

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ಸರ್ಕಾರದ ನಿರ್ದೇಶನದಂತೆ, 2023-24ನೇ ಶೈಕ್ಷಣಿಕ ಪ್ರಸಕ್ತ ಸಾಲಿನಿಂದ ಜಾರಿಗೊಳಿಸಿರುವ ಸ್ನಾತಕ ಪದವಿ ಐದನೇ ಮತ್ತು ಆರನೇ ಸೆಮಿಸ್ಟರ್ ಪಠ್ಯಕ್ರಮವನ್ನು ಜಾರಿಗೊಳಿಸಬೇಕಾಗಿರುವ ಪ್ರಯುಕ್ತ ಪರಿಷರ ಅಧ್ಯಯನ ವಿಷಯದ ಅಧ್ಯಯನ ಮಂಡಳಿಯು ಪಠ್ಯಕ್ರಮವನ್ನು ಪರಿಷ್ಕರಿಸಿ ಶಿಫಾರಸ್ಸು ಮಾಡಿರುವುದರಿಂದ ಸದರಿ ಪಠ್ಯಕ್ರಮವನ್ನು ವಿಜ್ಞಾನ ನಿಕಾಯದ ಸಭೆಯಲ್ಲಿ ಒಪ್ಪಿಗೆ ಪಡೆದಿರುವಂತೆ, ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯ ಘಟನೋತ್ತರ ಅನುಮೋದನೆಯನ್ನು ನೀಡಿಸಿ ಸದರಿ ಪಠ್ಯಕ್ರಮವನ್ನು ಪ್ರಸ್ತುತ ಸ್ನಾತಕ ಪದವಿ ಕೋರ್ಸಿನ ಪರಿಷರ ಅಧ್ಯಯನ ವಿಷಯದ ಐದನೇ ಮತ್ತು ಆರನೇ ಸೆಮಿಸ್ಟರ್ 2023-24ನೇ ಶೈಕ್ಷಣಿಕ ಸಾಲಿನಿಂದ ಅನ್ವಯವಾಗುವಂತೆ ಜಾರಿಗೊಳಿಸಲಾಗಿದೆ.

ಈ ಮಾಹಿತಿಯನ್ನು ಸಂಬಂಧಪಟ್ಟ ಶಿಕ್ಷಕರ ಹಾಗೂ ವಿದ್ಯಾರ್ಥಿಗಳ ಗಮನಕ್ಕೆ ತರಲು ಸೂಚಿಸಲಾಗಿದೆ. ಪಠ್ಯಕ್ರಮದ ವಿವರಗಳನ್ನು ಗುಲಬರ್ಗಾ ವಿಶ್ವವಿದ್ಯಾಲಯದ ವೆಬ್‌ಸೈಟ್ [www.gug.ac.in](http://www.gug.ac.in) ದಿಂದ ಪಡೆಯಬಹುದಾಗಿದೆ.

ಕುಲಸಚಿವರು

ಗುಲಬರ್ಗಾ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಕಲಬುರಗಿ.

08.11.2023

ಗೆ,

1. ಮುಖ್ಯಸ್ಥರು, ಪರಿಷರ ಅಧ್ಯಯನ ವಿಭಾಗ, ಗುಲಬರ್ಗಾ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಕಲಬುರಗಿ.
2. ಎಲ್ಲಾ ಪದವಿ ಕಾಲೇಜುಗಳ ಪ್ರಾಂಶುಪಾಲರುಗಳಿಗೆ.

ಪ್ರತಿಗಳು:

1. ಡೀನ್‌ರು, ವಿಜ್ಞಾನ ನಿಕಾಯ, ಗುಲಬರ್ಗಾ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಕಲಬುರಗಿ ರವರ ಮಾಹಿತಿಗಾಗಿ.
2. ಕುಲಸಚಿವರು (ಮೌಲ್ಯಮಾಪನ) ಗುಲಬರ್ಗಾ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಕಲಬುರಗಿ
3. ನಿರ್ದೇಶಕರು, ಪಿಎಂಇಬಿ ಗುಲಬರ್ಗಾ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಕಲಬುರಗಿ ರವರ ಮಾಹಿತಿಗಾಗಿ.
4. ಗ್ರಂಥಪಾಲಕರು, ಗುಲಬರ್ಗಾ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಕಲಬುರಗಿ ರವರ ಮಾಹಿತಿಗಾಗಿ.
5. ವಿಜ್ಞಾನ ನಿಕಾಯದ ಎಲ್ಲಾ ಅಧ್ಯಯನ ವಿಭಾಗಗಳ ಮುಖ್ಯಸ್ಥರಿಗೆ ಗು.ವಿ. ಕಲಬುರಗಿ
6. ಸಂಯೋಜಕರು, ಟಾಸ್ಕ್‌ಫೋರ್ಸ್ ಸಮಿತಿ, ಗುಲಬರ್ಗಾ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಕಲಬುರಗಿ ರವರ ಮಾಹಿತಿಗಾಗಿ.
7. ವಿಶೇಷಾಧಿಕಾರಿಗಳು, ಆಡಳಿತ, ವಿದ್ಯಾಮಂಡಲ, ಪರೀಕ್ಷಾ, ಅಭಿವೃದ್ಧಿ ಗು.ವಿ. ಕಲಬುರಗಿ ರವರ ಮಾಹಿತಿಗಾಗಿ.
8. ಮುಖ್ಯಸ್ಥರು, ಗಣಕ ಕೇಂದ್ರ, ಗು.ವಿ. ಕಲಬುರಗಿ ರವರಿಗೆ ವೆಬ್‌ಸೈಟ್‌ನಲ್ಲಿ ಪ್ರತ್ಯೇಕ ಪೋರ್ಟಲ್‌ನಲ್ಲಿ ಪ್ರಕಟಿಸಲು ಸೂಚಿಸಲಾಗಿದೆ.
9. ನೋಡಲ್ ಅಧಿಕಾರಿಗಳು, UUCMS, ಗು.ವಿ.ಕಲಬುರಗಿ ಇವರ ಮಾಹಿತಿಗಾಗಿ
10. ಕುಲಪತಿಗಳ ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿ/ಕುಲಸಚಿವರ ಆಪ್ತ ಸಹಾಯಕರ ಗು.ವಿ. ಕಲಬುರಗಿ ರವರ ಮಾಹಿತಿಗಾಗಿ.



**GULBARGA UNIVERSITY**

**KALABURAGI**

**Proposed Curriculum Framework of**

**ENVIRONMENTAL SCIENCE  
(V and VI SEMESTER)**

**for**

**UNDERGRADUATE PROGRAMME**

**COLLEGES AFFILIATED**

**To**

**GULBARGA UNIVERSITY**

**By**

**CHAIRMAN**

**DEPARTMENT OF STUDIES AND RESEARCH IN ENVIRONMENTAL SCIENCE**

**2023-24 Onwards**

## CURRICULUM STRUCTURE

Programme: B.Sc. (Honors)

Subject: Environmental Science

### 1. Environmental Science as one of the DSCC –A with another subject as DSCC- B

Sem	Discipline Specific Core Courses	Hours of Teaching/week		Discipline Specific Elective Courses (DSE)/Vocational courses (VC)/OE	Hours of Teaching/Week	
		Credit	Hours		Credit	Hours
I	ES 1T1: Divisions of Environment ES 1P1: Water quality analysis	4 2	4 4	ES1OE1: Environmental Conservation Movements OR ES1 OE2: Environmental Pollution	3	4
II	ES 2T1: Ecology – Theory and Practice ES 2P1: Ecological analysis	4 2	4 4	ES2 OE1: Climate Change and Its Implications ES2 OE2:Environment and Public Health in Contemporary Society	3	4
III	ES 3T1: Natural Resources and Management ES 3P1: Mineralogy, Petrology, Energy Resources and Medicinal Plants	4 2	4 4	ES3 OE1:Women and Environment ES3 OE2:Environmental Disasters and Management	3	4
IV	ES 4T1: Biodiversity, Wildlifeand Conservation ES 4P1: Biodiversity Assessment, Ecosystem Services.	4 2	4 4	ES4 OE1:Environment and Sustainable Agriculture ES4 OE2:: Initiative for Environmental Management	3	4
V	ES5T1: Air Pollution, Water Pollution And Environmental Engineering	4	4			
	ES5P1: Air and Wastewater Analysis	2	2			
	ES5T2:Noise, land, Radiation pollution and Solid Waste Management ES5P2: Soil Analysis, Noise Measurement And Solid Waste Analysis	4 4	2 2			
VI	ES6T1: Environmental Microbiology	4	4			
	ES6P1: Environmental Microbiology	2	2			
	ES 6T2 - Environmental Impact Assessment And Risk Assessment	4	2			
	ES6P2: Methods of Environmental Impact Assessment and Risk Assessment	4	2			

AECC 1 : Language 1  
AECC 2 : Language 2  
AECC 3 : Environmental Studies  
AECC 4 : Constitution of India  
SEC1 : Digital fluency

SEC2 : Artificial Intelligence  
SEC3 : Cyber Security  
SEC4 : Professional Communication

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**PROPOSEDCURRICULUMSTRUCTUREFORUNDERGRADUATEENVIRONMENTALSCIENCEDEGREEPROGRAMME**

**IIA. Model Programme structure for Bachelor of Science (Basic/Hons.) with practical with two major subjects**

Sem.	Discipline Specific - Core (DSC), Elective (DSE) Courses (Credits) (L+T+P)	Minor/ Multidisciplinary/ Open Elective (OE) Courses (Credits) (L+T+P)	Ability Enhancement Courses (AEC)(Credits) (L+T+P) (Languages)	Skills Enhancement Courses (SEC) (Credits) (L+T+P)/ Value Added Courses (Credits) (L+T+P) (common for all UG Programs)/ Summer Internship.		Total Credits
I	DSC Env. Science-A1(4), A2(2) Other Core-B1(4), B2(2)	OE-1 (3)	L1-1(3), L2-1(3) (4 hrs each)	SEC-1: Digital Fluency (2) (1+0+2)/ Env. Studies (3)	Health, Wellness & Yoga (2) (1+0+2)	25/26
II	DSC Env. Science-A3(4), A4(2), Other Core-B3(4), B4(2)	OE-2 (3)	L1-2(3), L2-2(3) (4 hrs each)	Env. Studies (3)/ SEC-1: Digital Fluency (2)(1+0+2)	Sports/NCC/NSS/R&R(S&G) / Cultural (2) (0+0+4)/ SEC (2)	26/25
Students exiting the programme after securing 46 credits will be awarded UG Certificate in Disciplines A and B provided they secure 4 credits in work based vocational courses during summer term or internship/Apprenticeship in addition to 6 credits from skill-based courses earned during the first year.						
III	DSC Env. Science-A5(4), A6(2), Other Core-B5(4), B6(2)	OE-3 (3)/ India and Indian Constitution (3)	L1-3(3), L2-3(3) (4 hrs. each)	SEC-2: AI/Financial Edu. & Inv. Aw. (2) (1+0+2)	Sports/NCC/NSS/R&R(S&G)/ Cultural (2) (0+0+4)/ SEC (2)	25
IV	DSC Env. Science-A7(4), A8(2), Other Core-B7(4), B8(2)	India and Indian Constitution (3) / OE-3(3)	L1-4(3), L2-4(3) (4 hrs. each)	SEC-3: Financial Edu. & Inv. Aw. /AI (2) (1+0+2)	Sports/NCC/NSS/R&R(S&G)/ Cultural (2) (0+0+4)/ SEC (2)	25
Students exiting the programme after securing 92 credits will be awarded UG Diploma in Disciplines A and B provided they secure additional 4 credits in skill based vocational courses offered during the first- or second- year summer term.						
V	DSC Env. Science-A9(4), A10(2), A11(4), A12(2)	DSC -B9(4), B10(2), B11(4), B12(2)		SEC-4: Employability Skills/Cyber Security (3) (2+0+2)		27
VI	DSC Env. Science-A13(4), A14(2), A15(4), A16(2)	DSC -B13(4), B14(2), B15(4), B16(2)		Internship (2)		26
Students exiting the programme after 3-years will be awarded UG Degree in Discipline A with Discipline B as Major upon securing 136 credits and satisfying the minimum credit requirements under each category of courses prescribed.						

Note: L+T+P= Lecturing in Theory + Tutorial + Practicals. Numbers in the parenthesis refer to credits.

*Arka*

*Rampir*

*Pomadi*

*20/04/2024*

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**CURRICULUM STRUCTURE FOR THE UNDERGRADUATE DEGREE PROGRAMME - B.Sc. (BASIC/HONS.)IN ENVIRONMENTAL SCIENCE**

Total Credits for the Programme: 193

Starting year of implementation: 2021-2022

Name of the Degree Programme: B.Sc. (Basic/Hons.)

Discipline/Subject: Environmental Science

**Programme Articulation Matrix**

Semester	Title /Name of the course	Programme outcomes that the course addresses (not more than 3 per course)	Pre-requisite course(s)	Pedagogy	Assessment
5	DSC ENV C9-T-AIR POLLUTION, WATER POLLUTION AND ENVIRONMENTAL ENGINEERING (4)	Have developed knowledge and understanding of Air, Water and Land Pollution and Application of control measures.	Diploma in Science with Environmental Science as a subject and a total credit score of 100	Theory, Self-study and Case studies	Continuous internal assessment (Formative assessment) - 40% End Semester Examination (Summative assessment) - 60%
	DSC ENV C10-P-AIR AND WASTEWATER ANALYSIS (2)	Be able to analyse vital parameters of Wastewater, interpret and suggest suitable treatment methods, analyse vital air pollutants, interpret and suggest suitable control methods.		Hands-on-training	
	DSC ENV C11-T-NOISE, LAND, RADIATION POLLUTION AND SOLID WASTE MANAGEMENT (4)	Have developed knowledge and understanding of Noise, Land, Radiation Pollution and Solid Waste Management		Theory, Self-study and Case studies	
	DSC ENV C12-P-SOIL ANALYSIS, NOISE MEASUREMENT AND SOLID WASTE ANALYSIS (2)	Be able to analyse noise levels, identify and categories land pollution and be capable of developing a solid waste management plan for urban areas.		Hands-on-training	
Semester	Title /Name of the course	Programme outcomes that the course addresses (not more than 3 per course)	Pre-requisite course(s)	Pedagogy	Assessment
6	DSC ENV C14-T ENVIRONMENTAL MICROBIOLOGY (4)	Have developed knowledge and understanding of Environmental Microbiology.		Theory and practices	Continuous internal assessment (Formative assessment) - 40% End Semester Examination (Summative assessment) - 60%
	DSC ENV C15-P ENVIRONMENTAL MICROBIOLOGY (2)	Be able to culture and identify Bacteria and Fungi; be able to detect the faecal contamination of drinking water.		Hands-on-training and practices	
	DSC ENV C16-T- ENVIRONMENTAL IMPACT ASSESSMENT AND RISK ASSESSMENT(4)	Have developed knowledge and understanding of various process involved in Environmental Impact Assessment, be able to employ assessment techniques and analyse the reports. Have developed knowledge to enable identification of risk perception and implement assessment protocols.		Theory, Self-study and Case studies	
	DSC ENV C17-P-METHODS OF ENVIRONMENTAL IMPACT ASSESSMENT AND RISK ASSESSMENT (2)	Be able to make appropriate choices of impact identification methodologies such as checklist and matrices. Be able to compile the collected data, suggest suitable amelioration measures and develop monitoring protocols.		Hands-on-training	

Exit option with Bachelor of Science, B.Sc. Degree in Environmental Science (149 credits) or continue studies with Major in the Fourth year

*Arha* *Deenip*

*Ponreddy*  
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## Job opportunities for the Exit option with Bachelor of Science Degree

- Assistants in Central and State Pollution Control Boards
- Environmental Health and Safety Assistant in industries
- Occupational Health and Safety Assistant in industries/theme parks
- Public Health/Waste Management Officers in Municipalities
- Wastewater Treatment Plant Managers
- Environmental/Production Quality Assurance Executive - Junior
- Environmental Analyst (Validation)
- Research Assistant/Staff
- R&D Lab Assistant
- Water testing labs or chemical suppliers/ Entrepreneurship
- Liaison Officer
- Watershed Management Assistant
- Mineral/Energy Resource Exploration Assistant
- Solar energy/alternate energy Executives
- Micro irrigation Executives
- Organic Farming Executives/Entrepreneurship
- NGOs/Consultancy firms
- Teachers in Schools
- Self-employment











## B.Sc. (Basic/Hons.) Semester 5

### ES5T1: AIR POLLUTION, WATER POLLUTION AND ENVIRONMENTAL ENGINEERING

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours/semester
4	60	2	60

#### Programme Specific Objectives

PSO 1	To develop competency in understanding the concepts of pollution and pollutants.
PSO 2	To instill an introductory knowledge of engineering concepts for controlling the pollution.
PSO 3	To motivate and inspire to acquire contemporary understanding and skills leading to issue identification.
PSO 4	To develop knowledge on act and rules related to pollution.

#### Programme Outcomes

PO 1	Demonstrate an entry level competence in understanding the environmental pollutants and their impacts.
PO 2	Demonstrate the ability to carry out air and water quality analysis in the laboratory and interpret the results.
PO 3	Ability to understand the harmful impact of pollutants on environment and human health.
PO 4	Be able to understand the existing treatment technologies and scope of developing these methods.

#### Content of Theory Course 5

60 Hrs

##### Unit – 1

15

**Meteorology:** Definition. Significance of meteorology.  
 Meteorological parameters: Solar radiation, Temperature, Humidity (Absolute, Specific & Relative), Wind speed & direction, Pressure and Precipitation.  
**Air pollution:** Definition. Sources of air pollution (Point and non-point).  
 Classification of air pollutants – Particulates, gaseous and aerosols.  
 Meteorology of air pollution: Airshed – Concept and Scope. Atmospheric stability, Temperature inversions. Plume Behaviour.  
 Effects of air pollution on humans, plants and materials (CO, CO<sub>2</sub>, SO<sub>x</sub>, NO<sub>x</sub>, PAN, Ground level Ozone, PM<sub><10µm</sub>, PM<sub><2.5µm</sub>, PM<sub><1µm</sub>, Acid rain, Thermochemical – CO<sub>2</sub>, and Photochemical reactions - O<sub>3</sub> & Smog) in atmosphere.  
 Respiratory and cardiovascular diseases, neuropsychiatric complications, the eyes irritation, skin diseases and long-term chronic diseases. Pneumoconiosis. Necrosis, Chlorosis and Senescence.  
 Discoloration, Stone cancer and material loss.  
**Automobile pollution:** Definition. Sources – Petrol, Diesel, LPG, CNG, Biodiesel, Ethanol, Hydrogen and Fuel cells. Emerging fuels – Biobutanol, Dimethyl ether, Methanol and Renewable hydrocarbon biofuels. Electric Vehicles – issues and management.  
 Internal Combustion Engines (Two stroke and Four stroke: Carburettor and Fuel

Injection systems) – Exhaust emissions, Evaporative emissions and Crankcase blow-by. Mild hybrid, Full hybrid and Plug-in hybrid engines. Effects and control of automobile pollution.	
<b>Unit – 2</b>	<b>13</b>
<p><b>Air Pollution Control Engineering</b></p> <p>Monitoring and Control of Air Pollution: Scope and significance. Air Sampling: Ambient, Indoor and Stack - Gaseous and particulates. National Ambient Air Quality Monitoring Programme (NAQMP) – Introduction, Guidelines for Sampling and Measurement of notified Ambient Air Quality Parameters (NAAQS), National Ambient Air Quality Standards. Bharat Stage Emission Standards (BSES) – Introduction, Timeline of Implementation of BSES in India. Current Emissions norms. Air Quality Indices. Concept of Air Pollution Tolerance Index and Industrial Greenbelts. Gaseous – Absorption, Adsorption and Condensation. Particulate – Settling Chambers, Inertial Separators, Cyclones, Filters (Baghouse), Electrostatic Precipitators and Scrubbers. Salient features of Air Pollution (Prevention and Control) Act, 1981 and latest amendments; National Clean Air Programme 2019 and latest amendments.</p>	
<b>Unit - 3</b>	<b>12</b>
<p>Water pollution: Definition, Sources (Point and non-point). Classification of Water Pollutants. Heavy metal pollution: Sources/Causes, Effects and Control Measures with reference to Lead and Mercury. Fertiliser pollution: Sources/Causes, Effects and Control Measures with reference to Nitrogen, Phosphorus and Potassium. Agriculture runoff and detergents as pollutants. Eutrophication. Pesticide pollution: Sources/Causes, Effects and Control Measures with reference to Organo-chlorine and Organo-phosphate pesticides. Thermal pollution: Sources/Causes, Effects and Control Measures. Oil pollution: Sources/Causes, Effects and Control Measures. Groundwater pollution: Sources/Causes, Effects and Control Measures with reference to Nitrate, Fluoride and Arsenic. Coliform contamination of water</p>	
<b>Unit - 4</b>	<b>20</b>
<p>Treatment of water for potable purposes: Intake, screening, aeration, pre-chlorination, coagulation, flocculation, sedimentation, filtration (SSF and RSF), disinfection and distribution. Characteristics of domestic and industrial wastewater: <i>Physical</i> – Colour, Odour, Turbidity, Temperature and Solids (Dissolved, Suspended, Settleable, Volatile; MLSS &amp; MLVSS); <i>Chemical</i> – Organic, Inorganic and Volatile Organic compounds; and <i>Biological</i> – Coliforms and other organisms. Disposal of sewage on land; disposal of sewage by dilution. Aerobic and Anaerobic methods of treatment. Preliminary and Primary treatment: Screening (fine, medium and coarse – stationary, moving and movable – disposal of screenings), pumping, grit removal (sedimentation tank and detritus tank – types; disposal of detritus) and skimming. Secondary treatment: Activated Sludge Process and Tricking filters. Sludge</p>	



<p>management.</p> <p>Tertiary treatment: Chlorination; Reverse Osmosis, Activated Carbon.</p> <p>Advanced treatment methods: Filtration, ion exchange, activated carbon adsorption, electro dialysis, nitrification, de-nitrification and Phosphorous removal.</p> <p>Other treatment methods: Oxidation ponds; oxidation ditches; septic tanks Anaerobic lagoons, Anaerobic filter reactors and Up-flow anaerobic digesters.</p> <p>Treatment of Industrial Effluents: Dairy and Electroplating industry.</p> <p>Monitoring of water pollutants: Scope and significance.</p> <p>Salient features of Water Pollution (Prevention and Control) Act, 1974; Water Quality Standards – Drinking water - IS 10500 &amp; Surface water - IS 2296.</p>	
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### References

1. Anjaneyulu Yerramilli. (2019). *Air Pollution Prevention and Control Technologies*. BS Publications. 1-828.
2. Bhatia, S. C. (2003). *Managing Industrial Pollution*. Macmillan India Ltd.
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4. Garg, S.K. (1990). *Environmental Engineering Vol I &II Sewage Disposal and Air Pollution Engineering*, Khanna Publ. Delhi.
5. J. Paul Guyer. (2021). *An Introduction to Air Pollution Control Engineering*. UNICORN Publishing Group. 1-182.
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7. Phiri, N. B. (2021). *Factors Affecting Tutoring Effectiveness in Finance-Related Modules*. University of Johannesburg (South Africa).
8. Rao, M. N. and Rao, H. V. N. (1988). *Air Pollution*. Tata McGraw – Hill Publishing Co. Ltd.
9. Santra, C. S. (2001). *Environmental Science*. (1st Ed.), New Central Book Agency
10. Stern, A. C. (1986). *Air pollution* Vol. I – VIII. Academic Press Inc.

Formative Assessment – Continuous Internal Assessment = 40% (40 Marks)	
Assessment Occasion/ type	Weightage in Marks
End Semester Examination	60% (60 Marks)
Total	100% (100 Marks)

## List of Experiments to be conducted

### ES5P1: AIR AND WASTEWATER ANALYSIS

(Total Teaching Hours = 60; Total Credits = 2)

13 experiments can be chosen from the list below and incorporated into the syllabus delivered in different Institutions based on the availability of resources.

1. Study of meteorological parameters – Light, Temperature, Pressure and Rainfall
2. Study of meteorological parameters – Relative Humidity, Wind Speed and Direction
3. Construction of a Wind rose
4. Sampling techniques of air
5. Determination of Particulate Matter
6. Determination of Sulphur-di-oxide in ambient air
7. Determination of Nitrogen-di-oxide in ambient air
8. Determination of Carbon-di-oxide in ambient air
9. Calculate Air Quality Indices from secondary data sources
10. Sampling techniques of waste water
11. Determination of total solids in wastewater
12. Determination of Chromium in liquid effluents
13. Determination of Copper in liquid effluents
14. Determination of Iron in liquid effluents
15. Determination of BOD
16. Determination of COD

### References

1. Donn, W. L. 1975. Meteorology. McGraw – Hill Book Co.
2. Harrison, R. M. and Perry, R. 1986. Handbook of Air Pollution Analysis. Chapman and Hall.
3. Kazt, M. 1969. Measurement of Air Pollutants. WHO.
4. NEERI Manual. 1982. Air Quality Monitoring. NEERI Publications.
5. Sawyer, C. N. and Mc Carty, P. L. 1978. Chemistry for Environmental Engineering. McGraw – Hill International.
6. Stern, A. C. 1986. Air pollution Vol. I – VIII. Academic Press Inc. Standard Methods for Examination of Water and Wastewater. 2012. APHA – WEF.

Formative Assessment – Practical Internal Assessment = 50% (25 Marks)	
Assessment Occasion/ type	Weightage in Marks
End Semester Examination	50% (25 Marks)
Total	100% (50 Marks)

*Handwritten signatures and initials in blue ink:*  
Ankur, Ranjiv, Pooja, [Signature], [Signature]

## ES 5T2: NOISE, LAND, RADIATION POLLUTION AND SOLID WASTE MANAGEMENT

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours/semester
4	60	2	60

### Programme Specific Objectives

PSO 1	To develop competency in understanding the pollution from noise and radiation.
PSO 2	To instil a knowledge of types of waste and develop skill for waste management.
PSO 3	To motivate and inspire to acquire contemporary understanding and skills leading to issue identification.
PSO 4	To inculcate creativity and innovative spirit in the domain of human-environment interface leading to vocation/entrepreneurial opportunities.

### Programme Outcomes

PO 1	Demonstrate an entry level competence in understanding about the noise, land and radiation pollution and its control measures.
PO 2	Demonstrate the ability to carry out sampling/monitoring and analysis in field conditions/laboratories and make appropriate judgments.
PO 3	Ability to understand different types of waste and their management.
PO 4	Be able to understand the demands of the society with respect to waste management.

Content of Theory Course	60 Hrs
<p><b>Unit – 1</b></p> <p>Noise Pollution: Definitions of sound and noise. Sources of noise – Transport, neighbourhood industrial and indoor. Noise, Vibration and Harshness. Decibel scale. Metrics of noise – pressure, intensity and frequency. Sound pressure level (SPL). Energy average equivalent level of the A-weighted sound - LAeq; Day-time level - LAeqD or Lday; Night-time level - LAeqN or Lnight; Maximum level, Lmax; Sound exposure level of A-weighted sound - SEL; Percentile-derived measurements (L10, L50, L90). Special noise environments: Infrasound, ultrasound, impulsive sound and sonic boom. Effects of noise on human beings: Noise Induced Hearing Loss (NIHL), Sleep apnea and others; Psychoacoustics and annoyance rating schemes. Control measures - at source; in the transmission path and protection at the receiver end. Engineering and administrative controls. Noise standards. The Noise Pollution (Regulation and Control) Rules.</p>	<b>15</b>
<p><b>Unit – 2</b></p> <p>Radioactive pollution: Radiation and their types. Wave and particle radiation. Sources; Radiation Dose; Effects on human beings; Preventive measures. Radioactive waste management. Atomic Energy (Radiation Protection) Rules. Soil Pollution: Soil Characteristics - Physical, Chemical and Biological characteristics; Macronutrients, Micronutrients and Organic matter; Cation exchange capacity. Sources and Classification of Soil Pollutants. Water logging and soil salinity.</p>	<b>15</b>

<p>Reclamation of saline and alkaline soils. Synthetic Fertiliser and Pesticide Pollution - Causes, effects and control; Effects of industrial and urban wastes (solid and liquid) on soil.</p> <p>Methods of Soil Management: Farm Yard Manure (FYM), Biopesticides, Integrated Pest Management (IPM), Phytoremediation technology.</p>	
<p><b>Unit – 3</b></p>	<p>15</p>
<p>Solid Wastes and Management: Definition, Types, Sources and Characteristics of solid waste - <i>Density, Moisture content, Size of Waste constituents, Calorific Value, Field capacity, Permeability of compacted wastes and Compressibility</i>. Impacts of Solid Waste on Environment - <i>Infectious diseases, land and water pollution, obstruction of drains, loss of biodiversity and implications on climate</i>. Principles of Integrated Solid Waste Management. Methods of Solid Waste Management - <i>Source reduction, Reuse, Source and plant sorting, Recycling, Composting, Recovery of energy &amp; materials and Final disposal of residual waste</i>. Sanitary Value Chain. Environmentally Sound Solid Waste Management (ESSWM), Factors affecting Solid Waste Management. Waste stream assessment (WSA). Solid Waste Management Rules, 2016.</p> <p>Urban Solid Waste Management (USWM): Definition, Classification of solid wastes (source and type based), Elements of USWM - onsite storage, processing and handling, collection, transfer and transport, resource recovery, and final disposal. Case study of USWM of Bengaluru/local town.</p> <p>E-wastes and management: Definition, sources and composition. Effects of E-waste on human health and Environment. E-waste disposal - <i>Domestic, Commercial and Industrial</i>. Steps in E-waste management - <i>Collection, Sorting, Repair, Refurbishing and Dismantling of disused Electrical and Electronic products</i>. Recovery of valuable metals. Life Cycle Assessment (LCA) of E-waste. E-Waste (Management) Rules, 2016.</p>	
<p><b>Unit – 4</b></p>	<p>15</p>
<p><b>Hazardous wastes and management:</b> Definition, Sources, Classification and Characteristics of Hazardous Waste - <i>Ignitability, Corrosivity, Reactivity and Toxicity</i>. Hazardous Waste Management - Waste Minimization; Waste exchange, recycling and recovery. Treatment Technologies: Chemical treatment – <i>Stabilization, solidification</i>, neutralization, precipitation, ion exchange, reduction or oxidation. Thermal treatment – Incineration. Biological treatment – <i>Land farming, Bioreactors and Anaerobic decomposition</i>; and Physical treatment – <i>Solidification, flotation, sedimentation, evaporation or filtration</i>. Disposal of Hazardous Waste - <i>Sanitary landfill and Underground disposal</i>. Treatment, Storage and Disposal Facilities (TSDF). Hazardous Waste Management Rules, 2016.</p> <p><b>Biomedical Waste Management:</b> Definition, Sources, Generation, Classification, Storage, Transportation and Disposal. Impacts of biomedical wastes. Biomedical Waste Treatment: <i>Disinfection, Irradiation and Incineration</i>. Biomedical Waste Management Rules, 2016.</p> <p><b>Plastic (Polymer) Waste Management:</b> Definition, Sources and Types of plastics (Recyclability). Impact of Plastics on terrestrial and aquatic biota. Plastic wastes: Generation, Classification, Storage, Transportation and Disposal. Microplastics. Bioplastics. Alternatives to plastics. Plastic Waste Management Rules, 2022.</p> <p><b>Battery Waste Management:</b> Definition, Sources and Types of battery wastes. Impact of Batteries/battery waste on Environment. Battery wastes: Generation,</p>	

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Collection, Segregation, Recycling, Treatment and Disposal. Battery Waste Management Rules, 2022.

**Construction and Demolition (C&D) Waste Management:** Definition, Sources and Types of C&D wastes. Impact of C&D on the Environment. Recycling of C&D waste - *sorting, crushing and sieving of aggregates*. Construction and Demolition Waste Management Rules, 2016.

**Methods of Waste Management Technologies** - Issues in waste disposal, disposal options and selection criteria. Sanitary landfill, Landfill gas emission, Leachate formation and landfill operation issues.

## References

1. Anjaneyulu Yerramilli, Valli Manickam. (2021). Environmental Impact Assessment Methodologies. BS Publications. 1-588.
2. B. B. Hosetti. (2006). Prospects and Perspective of Solid Waste Management. New Age International (P) Limited. 1-216.
3. Bhatia, S.C. (2003). Managing Industrial Pollution. Macmillan India Ltd.
4. Carla Di Stefano, Gabriella Marfe. (2020). Hazardous Waste Management and Health Risks. Bentham Science Publishers. 1-226.
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19. Simon Watson Pain. (2018). Safety, Health and Environmental Auditing - A Practical Guide, Second Edition. CRC Press, Taylor & Francis Group. 1-286.
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23. Tchobanoglous, G., Theisen, H., & Eliassen, R. (1977). Solid wastes: Engineering principles and management issues
24. Thomas H. Truitt. (1983). Environmental Audit Handbook - *Basic Principles of Environmental Compliance Auditing*. Executive Enterprises Publications. 1-363.
25. Vasudevan Rajaram., Faisal Zia Siddiqui., Sanjeev Agarwal and Mohammed Emran Khan.2022. Solid and Liquid Waste Management. *Waste to Wealth*. Asoke K. Ghosh, PHI Learning Pvt.Ltd., New Delhi.

Formative Assessment – Continuous Internal Assessment = 40% (40 Marks)	
Assessment Occasion/ type	Weightage in Marks
End Semester Examination	60% (60 Marks)
Total	100% (100 Marks)

## List of Experiments to be conducted

### ES 5P2: SOIL ANALYSIS, NOISE MEASUREMENT AND SOLID WASTE ANALYSIS

(Total Teaching Hours = 60; Total Credits = 2)

13 experiments can be chosen from the list below and incorporated into the syllabus delivered in different Institutions based on the availability of resources.

1. Sampling techniques of Soil
2. Determination of Soil Moisture and Texture
3. Determination of Specific Gravity of Soil
4. Determination of Particle Density of Soil
5. Determination of Water Holding Capacity of Soil
6. Characterization of Solid Wastes
7. Determination of pH and Electrical Conductivity in Soil/Refuse matter
8. Determination of Calcium and Magnesium in Soil/Refuse matter
9. Determination of Lime Content in Soil/Refuse matter
10. Determination of Organic Carbon in Soil/Refuse matter
11. Determination of available Nitrogen in Soil/Refuse matter
12. Determination of available Phosphorus in Soil/Refuse matter
13. Determination of available Potassium in Soil/Refuse matter
14. Determination of C/N ratio in Soil/Refuse matter
15. Measurement of Noise

### References

1. Baruah, T. C. and Barthakur, H. P. 1997. *Textbook of Soil Analysis*. Vikas Publishing House Pvt. Ltd.
2. Daji, J.A. 1988. *Textbook of Soil Science*. Media Promoters and Publishers. Firman, E. B. 1964. *Chemistry of Soils*. Oxford IBH Publishing Co.
3. Jackson, M. L. 1973. *Soil – Chemical Analysis*. Prentice Hall Publications.
4. Miller, R. W. and Donahue, R. L. 1992. *Soils – Introduction to Soils and Plant Growth*. Prentice Hall of India.
5. Rowell, T. L. 1994. *Soil Sciences – Methods and Applications*. Longman Scientific and Technical.

Formative Assessment – Practical Internal Assessment = 50% (25 Marks)	
Assessment Occasion/ type	Weightage in Marks
End Semester Examination	50% (25 Marks)
Total	100% (50 Marks)

Ankur

Pravin - Bhusari

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