Department of Environmental Science and Engineering

Scheme of Examination and Syllabus for Under Graduate Programme

Under Multiple Entry and Exit, Internship and CBCS-LOCF as per NEP-2020 w.e.f. session 2024-25 (in phased manner)

Subject: Environmental Science

Guru Jambheshwar University of Science &Technology
Hisar-125001, Haryana

(A+ NAAC Accredited State Govt. University)

Guru Jambheshwar University of Science and Technology
Hisar-125001, Haryana
('A+' NAAC Accredited State Govt. University)

Scheme of Examination and Syllabus for Under Graduate Programme w.e.f. session 2024-25
For affiliated Degree Colleges according to National Education Policy-2020

Subject: Environmental Science

SEMESTER-I

Type of Course	Course Code	Nomenclature	Credits	Hours/Week	Marks			Exam hours
					External	Internal	Total	
Multidisciplinary Course (MDC)	C24MDC130T	Environmental Issues in India	3 (2L+1T)	3	50	25	75	2.5
Skill Enhancement Course (SEC)	C24SEC123T	Water Quality Analysis	2	2	35	15	50	2
	C24SEC123P	Water Quality Analysis Lab	1	2	15	10	25	3
Value Added Course (VAC)	C24VAC101T	Environmental Studies-I	2	2	35	15	50	2

SEMESTER-II

Type of Course	Course Code	Nomenclature	Credits	Hours/ Week	Marks			Exam hours
					External	Internal	Total	
Multidisciplinary Course (MDC)	C24MDC230T	Disaster Management	3 (2L+1T)	3	50	25	75	2.5
Skill Enhancement Course (SEC)	C24SEC223T	Food Waste and Byproduct Utilization	2	2	35	15	50	2
	C24SEC223P	Food Waste and Byproduct Utilization Lab	1	2	15	10	25	3
Value Added Course (VAC)	C24VAC101T OR C24VAC301T	Environmental Studies-I OR Environmental Studies-II	2	2	35	15	50	2

SEMESTER-III

Type of Course	Course Code	Nomenclature	Credits	Hours/ Week	Marks			Exam hours
					External	Internal	Total	
Multidisciplinary Course (MDC)	C24MDC330T	Atmospheric Chemistry	3 (2L+1T)	3	50	25	75	2.5
Skill Enhancement Course (SEC)	C24SEC323T	Waste Water Treatment	2	2	35	15	50	2
	C24SEC323P	Waste Water Treatment Lab	1	2	15	10	25	3
Value Added Course (VAC)	C24VAC301T	Environmental Studies-II	2	2	35	15	50	2
	C24VAC305T	Sustainable Development Goals	2	2	35	15	50	2
	C24VAC307T	Ecology and Environment	2	2	35	15	50	2

SEMESTER-IV

Type of Course	Course Code	Nomenclature	Credits	Hours /Week	Marks			Exam hours
					External	Internal	Total	
Value Added Course (VAC)	C24VAC301T	Environmental Studies-II	2	2	35	15	50	2
	C24VAC305T	Sustainable Development Goals	2	2	35	15	50	2
	C24VAC307T	Ecology and Environment	2	2	35	15	50	2
	C24VAC403T	Environmental Ethics	2	2	35	15	50	2
	C24VAC411T	Environmental Toxicology	2	2	35	15	50	2

* Environmental Studies-I (Semester I/II) and Environmental Studies-II (Semester II//III/IV) must be studied as compulsory paper as per Hon'ble Supreme court directions and UGC guidelines.

Programme Outcomes

PO1 Sound knowledge of the basic concepts of Environment and its components along with their interactions through study of Ecology, Biodiversity, Environmental Chemistry, Sustainable Development, and Environmental Microbiology.

PO2 Understanding different types of Pollution and their sources through study of Climate and Air Pollution Studies, Hazardous Waste, Environmental Toxicology and Soil Pollution and different laws about pollution.

PO3 Basic knowledge about analysis of pollution using Environmental Analytical and Computational Techniques

PO4 Understanding different technologies like water and Wastewater treatment technology to find solutions and their applications in abatement of pollution and other environmental problems.

PO5 Use of different tools for the management of Environment, Energy resources, solid wastes and Biodiversity conservation, Disaster management.

PO6 Prediction the environmental impacts due to different developmental projects and find solution to eliminate these impacts.

Environmental Science
Environmental Issues in India (Semester-I)
Multidisciplinary Course (MDC)

Paper Code: C24MDC130T
45 Hrs. (3 Hrs /week) **External Marks:50**
Credits: 3 **Internal Marks: 25**
Time: 2.5 Hrs **Total Marks: 75**

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2 marks each. In addition to this, eight more questions (each question may be of 2-3 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt five questions in all selecting one from each unit consisting of 10 marks each in addition to the compulsory Question No.1. All questions carry equal marks.

UNIT-I

Significant global environmental issues: acid rain, climate change, biodiversity loss, ozone layer depletion, resource depletion and conservation, Sustainable development, International concerns and efforts for environmental protection: Stockholm Summit, Rio Summit.

UNIT-II

Regional Environmental Issues: Forest and Wildlife management, desertification, reclamation of degraded land; Human intervention on wetlands, siltation and eutrophication, reclamation of wetlands, Mining and Environment, Open cast mining, Deforestation and their impact on environment.

UNIT-III

Pollution: Air Pollution: Causes of air pollution, some important pollutants of air (CO, SOX, NOX and HC and Particulates) – their sources and effects on living and non-living organisms. Water Pollution: Sources of pollution of surface and ground water, Types of water pollutants.

UNIT-IV

Solid Waste – Sources, characterization, disposal and management. Soil Pollution: Sources, Pollution and residual toxicity from the application of insecticides, pesticides and fertilizers.

References:

1. Singh, J.S., Singh, S.P. & Gupta, S.R. (2017). Ecology, Environment and Conservation. S. Chand (G/L) & Company Ltd.
2. Kumar, A. & Roy, P. K. (2008). Environmental Issues and Solutions. Daya Publishing House, New Delhi
3. Vashistha, A. & Johari, S. (2020). Case Studies: Contemporary Environmental Issues and Challenges. Bloomsbury Publishing.
4. Sudhir, M.A. & Masillamani, M.A. (2003). Environmental Issues. Reliance Publishing House.
5. Gope, A., Sarkar, A., Sarkar, P., Majumdar, S. & Gosai. K. (2019). Environmental Issues & Sustainable Development. Notion Press Media Pvt Ltd.

Course Outcomes (COs):

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

CO1 Gain knowledge about major global environmental issues related to industrialization and urbanization and international efforts for environmental protection.
CO2 Understand the issues related to exploitation of resources, degradation and pollution
CO3 Understand the issues related to different types of pollution and their effect on environment in total.
CO4 Understand the issues related to Solid waste and soil pollution

Mapping of CO's with PO's
C24MDC130T

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	S	S	M	S	M	S
CO2	S	M	M	M	M	M
CO3	S	S	S	S	S	S
CO4	S	S	M	S	S	S

S=Strong, M=Medium, W=weak

Environmental Science
Water Quality Analysis (Semester-I)
Skill Enhancement Course (SEC)

Paper Code: C24SEC123T
30 Hrs. (2 Hrs /week) **External Marks:35**
Credits: 2 **Internal Marks: 15**
Time: 2 Hrs **Total Marks: 50**

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2-3 parts) will be set consisting of two questions from each unit of 10 marks each. The student/candidate is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

UNIT-I

Introduction: Physical, chemical, and biological properties of water, types of water sources, occurrence, and importance. Water sampling techniques. Drinking water quality standards as per Bureau of Indian Standards and WHO.

UNIT-II

Physico-chemical and biological methods of water analysis: Theory and principles of physico-chemical parameters of Water analysis such as pH, color, odour, EC, Total Alkalinity and Total Hardness, Dissolved oxygen in water.

Water Quality Analysis lab

Paper Code: C24SEC123P
30 Hrs. (2Hrs /week) **External Marks:15**
Credits: 1 **Internal Marks: 10**
Time: 3Hrs **Total Marks: 25**

Practicals:

1. To study about various sources of water in your localities.
2. Report writing on sample collection and physico-chemical analysis of pond water.
3. Report writing on sample collection and biological analysis of pond water.
4. Report writing on sample collection and physico-chemical analysis of Household water.
5. Report writing on sample collection and biological analysis of Household water.

***Students/Candidates are required to obtain minimum passing marks separately in practical component and theory as per the University rules.**

References:

1. R. Shangi, M. M. Srivatsava, "Green Chemistry" Narosa Publishers, New Delhi, 2003.
2. P.T. Anasta, Green Chemistry: Theory & Practice, Oxford University Press, 2000.
3. A. E. Marteel-Parrish, M.A. Abraham, Green Chemistry & Engineering: A Pathway to Sustainability, Wiley, 2014.
4. V. K. Ahluwalia, Green Chemistry: A Textbook, Alpha Science International, 2012.
5. Mike Lancaster. Green Chemistry: An Introductory Text, Royal Society of Chemistry, 2010

Course Outcomes (COs): *After completing this course, the learner will be able to*:
CO1. Acquire a basic knowledge of various treatment technologies and quality parameters of wastewater.
CO2. Understand the principles of treatment technologies and analysis of water quality parameters.
CO3. Training on determining the common water contaminants
CO4. Water quality analysis.

Mapping of CO's with PO's
C24SEC123T and C24SEC123P

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	S	S	S	M	S	S
CO2	S	M	M	M	S	M
CO3	M	S	M	M	M	S
CO4	S	M	S	M	S	S

S=Strong, M=Medium, W=weak

Environmental Science
Environmental Studies-I (Semester-I/II)
Value Added Course (VAC)

Paper Code: C24VAC101T
30 Hrs. (2Hrs /week) **External Marks:35**
Credits: 2 **Internal Marks: 15**
Time: 2 Hrs **Total Marks: 50**

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2-3 parts) will be set consisting of two questions of 10 marks from each unit. The student/candidate is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

UNIT-I

The multidisciplinary nature of environmental studies, Definition, scope and importance, Need for public awareness. Ecosystems: Structure and function. Producers, consumers and decomposers. Energy flow in the ecosystem, Ecological succession · Food chains, food webs and ecological pyramids.

UNIT-II

Biodiversity and its conservation: Introduction–Biogeographical classification of India; Value of biodiversity: India as a mega-diversity nation; Hot-spots of biodiversity; Threats to biodiversity: Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

References:

1. Kaushik, A &Kaushik, C.P. 2022. Perspectives in Environmental Studies. New Age International Pvt Ltd New Delhi.
2. Bharucha, E. 2021. A Textbook of Environmental Studies for Undergraduate Courses, Orient Blackswan Pvt Ltd.
3. Goswami, P., Mandal, J. & Singh, S. 2022. A Textbook on Environmental Studies, Ashok book stall, Assam.
4. Joshi, P.C. & Joshi, N. 2009. A Text Book of Environmental Science. APH Publishing Corporation.
5. Basu, M. & Xavier Savarimuthu, S.J. 2017. Fundamentals of Environmental Studies. Cambridge University Press.
6. Singh, R.P. & Islam, Z. 2012. Environmental Studies. Concept Publishing Company.

Course Outcomes (CO)*: After completing this course, the learner will be able to:*

CO1 Understand the concept of environmental studies, and ecosystem.
CO2 Learn about the biodiversity and its conservation.
CO3 Know about the types of pollution, solid waste management.

Mapping of CO's with PO's
C24VAC101T

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	S	M	S	M	M	S
CO2	S	S	M	S	M	S
CO3	M	S	M	S	S	S

S=Strong, M=Medium, W=weak

Environmental Science
Disaster Management (Semester-II)
Multidisciplinary Course (MDC)

Paper Code: C24MDC230T
45 Hrs. (3 Hrs /week) **External Marks: 50**
Credits: 3 **Internal Marks : 25**
Time: 2.5 Hrs **Total Marks: 75**

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2 marks each. In addition to this, eight more questions (each question may be of 2-3 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt five questions in all selecting one from each unit consisting of 10 marks each in addition to the compulsory Question No.1. All questions carry equal marks.

UNIT-I

Introduction to disaster: Definition, difference between hazard and disaster, understanding natural and manmade disasters, risk and vulnerability in disaster, reasons of disaster- population growth, urban expansion, pollution, epidemics, and accidents. Disaster profile of India.

UNIT-II

Natural disaster: Earthquake- causes, types and impacts; Floods- types and impacts; landslides- responsible factors, causes and effects; drought: different types of droughts- meteorological, agricultural, hydrological and effects; cyclone and hurricanes; tsunamis: reasons and its impacts.

UNIT-III

Anthropogenic disaster: Types, causes and effects of: Technological hazards- Industrial hazards, Structural collapse, Power outage, Fire (building fire and forest fire), CBRN: Chemical disasters, biological disasters, Radiological disaster, Nuclear disasters, Sociological hazards- Crime, Terrorism, War.

UNIT-IV

Disaster Preparedness and mitigation: Definition, Disaster management cycle of earthquake, floods, drought, landslides and cyclone: prevention, preparation and mitigation, Disaster Information, Disaster Response: Disaster Rehabilitation, Reconstruction and Recovery. Role of National Disaster Management Authority (NDMA).

References:

1. Singh V., Aleya L., Singh M., and Singh K.K. (2010). Natural Disaster, APH Publishing Corporation, New Delhi.
2. Sahni P., Dhamija A. and Medury U. (2011). Disaster Mitigation: Experiences and Reflections, PHI; New title edition.
3. Pandey, M. (2014). Disaster Management, Wiley India Pvt. Ltd.
4. Rajan C.K. and Pandharinath N. (2009) Earth and Atmospheric Disaster Management: Nature and Manmade S Publication, Hyderabad.
5. Sharma S.C. (2021). Disaster Management, Khanna Publishing House, 2021.
6. Murthy D.B.N. (2019). Disaster Management. Deep and Deep Publication PVT. Ltd. New Delhi.

Course Outcomes (COs): *After completing this course, the learner will be able to:*

CO1 Understand basic conceptual understanding of disasters.
CO2 Understand the causes, types and impacts of natural disasters.
CO3 Understand the different types of manmade disasters and their effects.
CO4 Build skills to respond to disaster and to understand the prevention, preparedness and mitigation for disaster.

Mapping of CO's with PO's
C24MDC230T

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	S	S	M	S	M	S
CO2	S	S	M	S	M	S
CO3	S	S	M	M	M	S
CO4	S	S	M	S	S	S

S=Strong, M=Medium, W=weak

Environmental Science
Food Waste and Byproduct Utilization (Semester-II)
Skill Enhancement Course (SEC)

Paper Code: C24SEC223T
30 Hrs. (2Hrs /week) **External Marks: 35**
Credits: 2 **Internal Marks: 15**
Time: 2 Hrs **Total Marks: 50**

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2-3 parts) will be set consisting of two questions of 10 marks from each unit. The student/candidate is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

UNIT-I

Introduction to Food Waste: Definition and types of food waste; Environmental impacts of food waste. Food Waste Management and Reduction: Source reduction strategies; Food donation and redistribution programs.

UNIT-II

Applications of Food Waste By-Products; Animal feed and pet food production; Composting and anaerobic digestion, Fertilizer and soil amendment production

Food Waste and Byproduct Utilization Lab

Paper Code: C24SEC223P
30 Hrs. (2Hrs /week) **External Marks:15**
Credits: 1 **Internal Marks: 10**
Time: 3 Hrs **Total Marks: 25**

Practicals:
1. To conduct an on-campus food waste audit.
2. To study the process of composting to convert food waste to compost.
3. To study a successful food waste and by-product utilization project.
4. To visit a local food processing industry and prepare a report.

***Students/Candidates are required to obtain minimum passing marks separately in practical component and theory as per the University rules.**

References:

1. Subbulakshmi, G., Udipi, S.A. and Ghurge, P.S. 2021. Food Processing and Preservation. New Age International Private Limited.
2. Westendorf, M. L. 2007. Food Waste to Animal Feed. John Wiley (WSE & Wiley India).
3. Arvanitoyannis, I.S. 2008. Waste Management for the Food Industries (Food Science and Technology). Academic Press Inc.
4. Joshi, V. K. and Sharma, S. K. 2011. Food Processing Waste Management. New India Publishing Agency
5. Waldron, K. 2007. Handbook of Waste Management and Co-Product Recovery in Food 2098

Course Outcomes (COs)*: After completing this course, the learner will be able to:*
CO1 Understand the concept of food waste and its impact on the environment.
CO2 Explore different methods and technologies for food waste management and reduction
CO3 Understand sustainable strategies for utilizing food waste & by-products to create value-added products.
CO4 Understand how to utilize food waste and by-products.
CO5 Understand various applications of food waste by products.

Mapping of CO's with PO's C24SEC223T and C24SEC223P

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	M	M	M	M
CO2	S	M	M	M	M	M
CO3	S	S	M	M	M	S
CO4	S	S	S	S	S	S
CO5	S	S	S	S	S	S

S=Strong, M=Medium, W=weak

Environmental Science
Environmental Studies-II (Semester-II/III/IV)
Value Added Course (VAC)

Paper Code: C24VAC301T
30 Hrs. (2Hrs /week) **External Marks: 35**
Credits: 2 **Internal Marks: 15**
Time: 2 Hrs **Total Marks: 50**

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2-3 parts) will be set consisting of two questions of 10 marks from each unit. The student/candidate is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

UNIT-I

Natural Resources: Renewable and non-renewable resources: Natural resources and associated problems. Forest, Water, Mineral, Food, Energy, and Land Resources, Role of an individual in conservation of natural resources. · Equitable use of resources for sustainable lifestyles.
Environmental Pollution Definition · Causes, effects and control measures of: a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear pollution; Solid waste management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution, Pollution case studies.

UNIT-II

Social Issues and the Environment, Environmental Protection Act; Air (Prevention and Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; Issues involved in enforcement of environmental legislation, Human Population and the Environment: Population growth, variation among nations; Population explosion – Family Welfare Programmes; Environment and human health; Human Rights; Value Education; HIV / AIDS; Women and Child Welfare; Role of Information Technology in Environment and Human Health; Case Studies

References:

1. Kaushik, A & Kaushik, C.P. 2022. Perspectives in Environmental Studies. New Age International Pvt Ltd, New Delhi.
2. Bharucha, E. 2021. A Textbook of Environmental Studies for Undergraduate Courses, Orient Blackswan Pvt Ltd.
3. Goswami, P., Mandal, J. & Singh, S. 2022. A Textbook on Environmental Studies, Ashok book stall, Assam.
4. Joshi, P.C. & Joshi, N. 2009. A Text Book of Environmental Science. APH Publishing Corporation.
5. Basu, M. & Xavier Savarimuthu, S.J. 2017. Fundamentals of Environmental Studies. Cambridge University Press.
6. Singh, R.P. & Islam, Z. 2012. Environmental Studies. Concept Publishing Company.

Course Outcomes (COs): *After completing this course, the learner will be able to:*
CO1 Understand the concept of Natural Resources.
CO2 Learn about the Social Issues and the Environment.
CO3 Know about the environmental law and legislation.
CO4 Know about the human population and the environment.

Mapping of CO's and PO's C24VAC301T

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	S	M	M	S
CO2	S	S	M	S	M	S
CO3	M	S	M	S	S	S
CO4	S	S	S	S	S	S

S=Strong, M=Medium, W=weak

Environmental Science
Atmospheric Chemistry (Semester-III)
Multidisciplinary Course (MDC)

Paper Code: C24MDC330T
45 Hrs. (3 Hrs /week) **External Marks: 50**
Credits: 3 **Internal Marks: 25**
Time: 2.5 Hrs **Total Marks: 75**

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2 marks each. In addition to this, eight more questions (each question may be of 2-3 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt five questions in all selecting one from each unit consisting of 10 marks each in addition to the compulsory Question No.1. All questions carry equal marks.

UNIT-I

Atmospheric Chemistry Overview – physical properties and structure of the troposphere and the stratosphere, temperature profile, concentration profiles. Atmospheric Chemistry of the Troposphere – tropospheric chemical cycles, hydroxyl and chlorine radical, chemical cleansing, hydrocarbons in the troposphere, sources and sinks

UNIT-II

Atmospheric Chemistry of the Stratosphere – stratospheric ozone cycle, depletion, NOx, halogen cycles, polar stratospheric cloud chemistry

UNIT-III

Chemistry of Global Climate Change – Historical account of greenhouse gas and aerosol concentrations, carbon dioxide, ozone and altitude, aerosol uncertainties.

UNIT-IV

Urban Smog - VOC/NOx – Historical account of air pollution, progress and problems in experiments and modelling, assessing human impact on the atmosphere.

References:

1. A. K. De (2019). Environmental Chemistry. New Age International Publishers, Publisher
2. Introduction to atmospheric chemistry: Supplemental questions and problems Daniel J. Jacob
3. Advances in Atmospheric Chemistry, ohn R Barker Allison L Steiner
4. Manahan, S.E. (2000). Environmental Chemistry. Seventh Edition. Lewis Publishers, New York

Course Outcomes (COs): *After completing this course, the learner will be able to:*

CO1. Obtain basic knowledge about reactions in atmosphere.
CO2. Understand about the atmospheric chemistry of stratosphere.
CO3. Understand about the chemistry of global climate change.
CO4. Understand about the urban smog.

Mapping of CO's with PO's
C24MDC330T

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	M	M	M	S
CO2	S	M	M	M	M	S
CO3	S	S	M	M	S	S
CO4	S	S	S	S	S	S

S=Strong, M=Medium, W=weak

Environmental Science
Waste Water Treatment (Semester-III)
Skill Enhancement Course (SEC)

Paper Code: C24SEC323T
30 Hrs. (2Hrs /week) **External Marks:35**
Credits: 2 **Internal Marks: 15**
Time: 2 Hrs **Total Marks: 50**

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2-3 parts) will be set consisting of two questions of 10 marks from each unit. The student/candidate is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

UNIT-I

Wastewater Treatment: Preliminary Treatment: Screening and filtering, Grit removal and large object removal, Filtration and sedimentation, Disposal of Screenings and Grit. Primary, Secondary and Tertiary treatment methods.

UNIT-II

Sludge processing and disposal: Sources and effects of sludge on environment. Methods of sludge disposal. Use of digested Sludge.

Waste Water Treatment Lab

Paper Code: C24SEC323P
30 Hrs. (2Hrs /week) **External Marks: 15**
Credits: 1 **Internal Marks: 10**
Time: 3 Hrs **Total Marks: 25**

Practicals:
1. To study about the various sources of wastewater generation in the locality.
2. Report preparation on visit to a local industrial wastewater treatment plant/sewage disposal site.
3. To study about the working of sewage treatment plant/disposal pumping station-case study.

***Students/Candidates are required to obtain minimum passing marks separately in practical component and theory as per the University rules.**

References:

1.Biotreatment Systems, Volume II; D.L. Wise.
2.Advances in Biotechnological Process; Mizrahi &Wezel.
3. Biodegradation and Bioremediation. Academic Press; 2nd edn. Martin Alexander.
4.GabrielBitton (Author). Wastewater Microbiology, 2nd Edition. Wiley-Liss; 2nd edition (Feb. 16, 1999).
5.Milton Wainwright. An Introduction to Environmental Biotechnology. Kluwer Academic Publishers, Boston. Hardbound, ISBN 0-7923-8569-1. July 1999, 192.

Course Outcomes (COs): *After completing this course, the learner will be able to*:
CO1. Identify various types sources of wastewater.
CO2. Develop fundamental skills to understand the treatment mehods for wastewater.
CO3. Describe and design common water unit processes in water and wastewater treatment.
CO 4. Help students develop the ability to apply basic understandings of different waste water treatment techniques and suggest for better environment.
CO5. Apply theoretical knowledge to practical scenarios related to waste water treatment.

Mapping of CO's with PO's
C24SEC323T and C24SEC323P

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	M	M	M	M
CO2	S	M	M	M	M	M
CO3	S	S	M	M	M	S
CO4	S	S	S	S	S	S
CO5	S	S	S	S	S	S

S=Strong, M=Medium, W=weak

Environmental Science
Sustainable Development Goals (Semester-III/Semester-IV)
Value Added Course (VAC)

Paper Code: C24VAC305T
30 Hrs. (2Hrs /week) **External Marks: 35**
Credits: 2 **Internal Marks: 15**
Time: 2 Hrs **Total Marks: 50**

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2-3 parts) will be set consisting of two questions of 10 marks from each unit. The student/candidate is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

Unit-I

Concept of sustainable development; Understanding the significance of the following SDGs and their sub goals: SDG I-VIII

Unit-II

Understanding the significance of the following SDGs and their sub goals: SDG IX-XVII

References:

1. https://www.un.org/sustainabledevelopment/sdgbookclub/
2. Sustainable Development Goals Series- Somnath Hazra and Anindya Bhukta
3. TOWARDS SUSTAINABLE DEVELOPMENT: William M. Lafferty and OlufLanghelle
4. Reid, D. (1995). Sustainable Development. An Introductory Guide, London: Earthscan Publications.
5. Pearce, D.W. and Warford, J.J. (1993). World without End: Economics, Environment, and Sustainable Development. Oxford: Oxford University Press. Pezzey, J. (1989). 'Economic Analysis of Sustainable Growth and Sustainable Development'. Environment Department Working paper No. 15, The World Bank.

Course Outcomes (COs): After completing this course, the learner will be able to:

CO1. Learn about sustainable development and understand the SDG I; SDG II; SDG II ; SDG-IV
CO2. Understanding the significance of SDG V; SDG VI; SDG VII- ; SDG-VIII
CO3. Understanding the significance of the SDG IX; SDG X; SDG XI; SDG-XII
CO4. Understanding the significance of the SDG XII; SDG XIV; SDG XV; SDG-XVI; SDG-XVII

Mapping of CO's with PO's C24VAC305T

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	S	M	M	M	M	S
CO2	S	S	S	S	M	S
CO3	M	S	M	S	M	S
CO4	S	S	S	S	S	S

S=Strong, M=Medium, W=weak

Environmental Science
Ecology and Environment (Semester-III/Semester-IV)
Value Added Course (VAC)

Paper Code: C24VAC307T
30 Hrs. (2Hrs /week) **External Marks: 35**
Credits: 2 **Internal Marks: 15**
Time: 2 Hrs **Total Marks: 50**

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2-3 parts) will be set consisting of two questions of 10 marks from each unit. The student/candidate is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

Unit-I

Environmental components: biotic and abiotic components and their interactions. Concept of habitat and niche; Major terrestrial biomes. Population ecology: Species Interactions: Types of interactions, interspecific competition.

Unit-II

Community Ecology: Nature of communities; levels of species diversity and its measurement; Ecotypes, Ecads and Ecotones, Community structure and organization, keystone species, ecotone and edge effect. Methods of plant community analysis. Applied Ecology

References:

1. Odum, E.P. (1983). Basic Ecology. Sanders, Philadelphia.
2. Odum, E.P. (1971). Fundamentals of Ecology. W.B. Sounders.
3. Robert, R. (2001). The Ecology of Nature. Fifth Edition. W.H. Freeman and Company.
4. Smith, R.L. (1996). Ecology and Field Biology. Harper Collins, New York.
5. Botkin, D.B. & Keller, E.A. (2000). Environment Science: Earth as a living planet. Third Edition.John Wiley and Sons Inc.
6. Singh, J.S., Singh, S.P. & Gupta, S.R. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications.

Course Outcomes (COs): After completing this course, the learner will be able to:

CO1. Know about basics of ecological science.
CO2. Understand various strategies for research and development on ecological succession and dynamics.
CO3. Improve their knowledge about conservation science.
CO4. Describe about various conservation projects

Mapping of CO's with PO's C24VAC305T

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	S	M	M	M	M	S
CO2	S	M	M	M	M	M
CO3	S	S	M	S	S	S
CO4	S	S	S	S	S	S

S=Strong, M=Medium, W=weak

Environmental Science
Environmental Ethics (Semester-IV)
Value Added Course (VAC)

Paper Code: C24VAC403T
30 Hrs. (2Hrs /week) **External Marks: 35**
Credits: 2 **Internal Marks: 15**
Time: 2 Hrs **Total Marks: 50**

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2-3 parts) will be set consisting of two questions of 10 marks from each unit. The student/candidate is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

Unit-I

Nature and Scope of Environmental Ethics; Basic Concepts and Issues.Nature, Man and Society: A Plea for Non-Anthropocentrism; Climate Change: Meaning, Causes and Preventions.

Unit-II

Environmental Ethics and Ecology: Nature and Scope of Ecology: Main characteristics of Ecology. Sustainable Development and Environment; Deep Ecology: Meaning and Definition: Characteristics of Deep Ecology; Gaia Theory.

References:

1. Environmental Ethics (2020) Joel Kassiola, SFSU
2. Ethics and the Environment (2019) Dale Jamieson and Kyle Ferguson, NYU
3. Australian Environmental Philosophy (2019) N.A.J. Taylor, University of Melbourne
4. Environmental Ethics (2019) Dan Shahar, University of New Orleans
5. Ethical Thought and Moral Values (2019) KianMintz-Woo, Princeton University
6. Values and the Environment (2017-18) Emily Brady, University of Edinburgh
7. Environmental Ethics (2018) Alex Lenferna, University of Washington
8. Environmental Ethics (2018) Marion Hourdequin, Colorado College
9. Philosophy, Globalization, and Sustainability (2010) Chris Frakes, University of Colorado

Course Outcomes (COs): After completing this course, the learner will be able to:

CO1. Understand the students ethically concerned about the environment.
CO2. Understand the essential features of moral or ethical thinking;
CO3. Understand about the important and distinguishing characteristics in environmental ethics
CO4. To deploy moral discourse for leadership in environmental fields.

Mapping of CO's with PO's C24VAC403T

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	S	M	S	S	S	S
CO2	M	S	M	S	S	S
CO3	M	M	M	S	S	S
CO4	M	M	M	S	S	S

S=Strong, M=Medium, W=weak

Environmental Science
Environmental Toxicology (Semester-IV)
Value Added Course (VAC)

Paper Code: C24VAC411T
30 Hrs. (2Hrs /week) **External Marks: 35**
Credits: 2 **Internal Marks: 15**
Time: 2 Hrs **Total Marks: 50**

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2-3 parts) will be set consisting of two questions of 10 marks from each unit. The student/candidate is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

Unit-I

Introduction to Environmental Toxicology: Emergence of toxicity in the environment, Classical toxicology, ecotoxicology and environmental toxicology, Classification of toxicants, their Biotransformation and elimination from environment.

Unit-II

Food additives, air, water and soil pollutants and Bioindicators. Effect of pollutant on ecosystem with case study of important Organo-phosphorous and Organo-chlorine pesticides and Nitrates. Toxicological risk assessment and management.

References:

1. Ecotoxicology: The study of pollutants in ecosystems. 3rd Ed. Elsevier by Moriarty, F.
2. Environment concerns and strategies. Ashish Pub. House, NDL by T.N. Khushoo.
3. Environmental biology. Akashdeep Pub. House by R.R. Trevedi Gurdeep Raj.
4. Textbook: A Textbook of Modern Toxicology. Third Edition by E. Hodgson (Ed.). John Wiley & Sons, Inc. (Posted on the D2L content page.)
5. Environmental Health by Monroe T. Morgan
6. Handbook of Environmental Health and Safety – principle and practices by H. Koren; Lewis Publishers

Course Outcomes (COs): After completing this course, the learner will be able to:

CO1. The awareness about toxic agents, their different routes of exposure and their effects on humans and their livestock will be appraised.
CO2.The students will have the knowledge about mode of transformation of toxicants
CO3. It will help in creating skilled personnel in the field of environment protection and research.
CO4. Students will have an understanding of ill-health and diseases that are related to exposure to chemicals in human everyday life

Mapping of CO's with PO's C24VAC411T

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	S	M	M	M	M	S
CO2	M	M	M	S	M	S
CO3	S	S	M	M	S	S
CO4	S	S	S	S	S	S

S=Strong, M=Medium, W=weak