List of courses and Syllabi
on
Environment & Sustainability

1.3.1 - List of courses on Environment and Sustainability

S.No	Name of the programme	Course Code	Name of the Course	Acad. Council
1	B.Sc Economics Hons.	ECO 502	Environmental Economics And Policies	16th AC
2	B.Tech Civil Engineering	CE 308	Environmental Engineering - I	14th AC
3	B.Tech Civil Engineering	CE 402	Advanced Environmental Engineering	14th AC
4	B.Tech Civil Engineering	CE 308L	Environmental Engineering Lab	14th AC
5	B.Tech Computer Science and Engineering	ENV 111	Environmental Science	13th AC
6	B.Tech Computer Science and Engineering	ENV 111L	Environmental Science Lab	13th AC
7	B.Tech Computer Science and Engineering	ANT 100	Climate Change, Resilience And Vulnerability	20th AC
8	B.Tech Computer Science and Engineering	ENV 115	Water And Climate Adaption	20th AC
9	B.Tech Computer Science and Engineering	LBA 001	Sustainable Cities And Climate Change	20th AC
10	B.Tech Computer Science and Engineering	OEC 103	Water Climate And Politics	20th AC
11	B.Tech Electronics and Communication Engineeri	ENV 113	Technology For Wildlife	20th AC
12	BBA	BBA 602	Water And Waste Management	14th AC

SRM University – AP, Andhra Pradesh
Neerukonda, Mangalagiri Mandal
Guntur District, Mangalagiri, Andhra Pradesh 522240

Environmental Economics and Policies

Course Code	ECO 502	Course Category	Core	L-T-P-C	4	0	0	4
Pre-Requisite Course(s)		Co-Requisite Course(s)	Departmental Elective	Progressive Course(s)				
Course Offering Department	Economics	Professional / Licensing Standards						

Course Objectives / Course Learning Rationales (CLRs)
Objective 1: To understand the economic perspectives on the challenging environmental issues.
Objective 2: To understand human economy and environmental linkages.
Objective 3: To understand the public goods, externalities, and market failure.
Objective 4: To examine environmental policy measures and introduction to environmental valuation.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	**Bloom's Level**	**Expected Proficiency Percentage**	**Expected Attainment Percentage**
Outcome 1	To state and explain the economic perspectives on the challenging **environmental & sustainability issue**s, linkages, policy measures	2	70	70
Outcome 2	To apply the economic perspectives to real life situations	3	60	60
Outcome 3	To identify and analyse real-life examples as externalities and market failure	4	60	60
Outcome 4	To solve for **environmental valuation**	3	70	70

Course Articulation Matrix (CLO) to (PLO)

CLOs	**Program Learning Outcomes (PLO)**														
	Scientific and Disciplinary	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	**3**						**3**	**1**					**1**		
Outcome 2	**3**	**3**	**3**			**1**	**3**	**1**	**2**			**2**	**3**		**3**
Outcome 3	**3**	**3**	**3**			**1**	**3**	**1**	**2**			**2**	**3**		**3**
Outcome 4	**3**	**3**					**3**						**2**		
Course Average	**3**	**3**	**3**			**1**	**3**	**1**	**2**			**2**	**2**		**3**

Course Unitization Plan - Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**UNIT I: INTRODUCTION**	**26**		
	Concepts and Definitions	4	1	1
	Review of Microeconomics	4	1	1
	Review of Welfare Economics	4	1	1
	Pareto Optimality	4	1,3	1,3
	Market Failure in the Presence of Externalities	6	1,3	1,3
	Property Rights	2	1,3	1,3
	Coase Theorem.	2	1,3	1,3
Unit 2	**UNIT II- THE DESIGN AND IMPLEMENTATION OF ENVIRONMENTAL POLICY**	**14**		
	Overview	2	1,3	1,3
	Pigouvian Taxes and Effluent Fees	6	1,3	1,2
	Tradable Permits	2	1,3	1,4
	Choice between Taxes and Quotas Under Uncertainty	2	1,3	1,4
	Implementation of Environmental Policy	2	1,3	1,2
Unit 3	**UNIT III: INTERNATIONAL ENVIRONMENTAL PROBLEMS**	**8**		
	Trans-boundary Environmental Problems	2	1,2,3	1,3
	Economics of Climate Change	4	1,2,3	1,2
	Trade and Environment	2	1,2,3	1,2
Unit 4	**UNIT IV: MEASURING THE BENEFITS OF ENVIRONMENTAL IMPROVEMENTS**	**6**		
	Non-Market Values and Measurement Methods	4	1,2,3,4	1,3
	Risk Assessment and Perception	2	1,2,3,4	1,3
Unit 5	**UNIT V: SUSTAINABLE DEVELOPMENT**	**6**		
	Concepts; measurement	3	1,2,3,4	1,2
	Sustainable Development Goals, Climate Change	3	1,3,4	1,2
Total Contact Hours		**60**		

Recommended Resources

Charles Kolstad, Intermediate Environmental Economics, Oxford University Press, 2nd edition, 2010.
Robert N. Stavins (ed.), Economics of the Environment: Selected Readings, W.W. Norton, 5th edition, 2005.
Roger Perman, Yue Ma, James McGilvray and Michael Common, Natural Resource and Environmental Economics, Pearson Education/Addison Wesley, 3rd edition, 2003.
Maureen L. Cropper and Wallace E. Oates, 1992, ―Environmental Economics: A Survey,‖

Learning Assessment (Theory)

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)				End Semester Exam (50%)
		CLA-1 (10%)	Mid-1 (15%)	CLA-2 (10%)	Mid-2 (15%)	
Level 1	Remember	80	70	70	60	60
	Understand					
Level 2	Apply	20	30	30	40	40
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

SRM University – AP, Andhra Pradesh
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Environmental Engineering – 1

Course Code	**CE 308**	Course Category	**Core Course (CC)**	L-T-P-C	**3**	**0**	**0**	**3**
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)				
Course Offering Department	**Civil Engineering**	Professional / Licensing Standards						

Course Objectives / Course Learning Rationales (CLRs)

Objective 1: Students will have the ability to be conversant with sources of water and its demand.
Objective 2: Students will be able to understand the basic characteristics of water and its determination.
Objective 3: Students s will have adequate knowledge about the water treatment processes and its design.
Objective 4: Students will have adequate knowledge on distribution network and water supply to buildings.
Objective 5: Students will study the effects of air and noise pollution and their control measures.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	**Bloom's Level**	**Expected Proficiency Percentage**	**Expected Attainment Percentage**
Outcome 1	List the characteristics of water and its **importance to the environment.**	1	80%	80%
Outcome 2	Discuss the design of water treatment units	2	70%	70%
Outcome 3	Compute water demand and their design components for the given water distribution systems	3	70%	70%
Outcome 4	Select the control devices to reduce the level of air and noise pollutants in the atmosphere.	2	70%	70%

Course Articulation Matrix (CLO) to (PLO)

CLOs	**Program Learning Outcomes (PLO)**														
	Engineering	Problem Analysis	Design and	Analysis, Design	Modern Tool and	Society and	Environment and	Moral, and	Individual and	Communication	Project Manage	Self-Directed	PSO 1	PSO 2	PSO 3
Outcome 1	3	1	1	1			3						1	1	1
Outcome 2	3	3	3	3			3						3	3	3
Outcome 3	3	3	3	3			3						3	3	3
Outcome 4	3	2	1	1			3						3	2	2
Course Average	**3**	**2**	**2**	**2**			**3**						**2**	**2**	**2**

Course Unitization Plan - Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Sources, Quality and Quantity Perspectives of Water**	**5**		
	Surface and subsurface sources	1	1, 2	1, 2, 3
	Physical, chemical, and biological characteristics	1	1, 2	1, 2, 3
	Estimation of water demand, water consumption rate, fluctuations in rate of demand	1	2	1, 2, 3
	Design period and population forecasting methods	2	2	1, 2, 3
Unit 2	**Collection and Conveyance of Water**	**6**		1, 2, 3
	Intakes, types of Intakes	2	2	1, 2, 3
	Factors governing location of intakes	1	2	1, 2, 3
	Pumps	1	2	1, 2, 3
	Types of conduits	1	2	1, 2, 3
	Types of pipes, pipe appurtenances	1	2	1, 2, 3
Unit 3	**Water Treatment**	**20**		1, 2, 3
	Working principles and design of water treatment units	2	2	1, 2, 3
	Screening	1	2	1, 2, 3
	Coagulation and Flocculation	4	2	1, 2, 3
	Sedimentation	4	2	1, 2, 3
	Filtration	4	2	1, 2, 3
	Disinfection	2	2	1, 2, 3
	Miscellaneous water treatment techniques	3	2	1, 2, 3
Unit 4	**Distribution System**	**6**		1, 2, 3
	Requirements of a good distribution system	1	3	1, 2, 3
	Methods of distribution, systems of supply of water, Distribution reservoirs	2	3	1, 2, 3
	Layout of distribution system, design of distribution system, analysis of pipe networks	2	3	1, 2, 3
	Appurtenances in distribution system, detection, and prevention of wastage of water in distribution system	1	3	1, 2, 3
Unit 5	**Air and Noise Pollution**	**8**		1, 2, 3
	Types of pollutants, their sources and impacts, air pollution meteorology, air pollution control, air quality standards and limits	4	4	1, 2, 3
	Types of noise, Impacts of noise, permissible limits of noise pollution, measurement of noise and control of noise pollution.	4	4	1, 2, 3
Total Contact Hours		**45**		

Recommended Resources

- Environmental Engineering, Peavy, H.S, Rowe, D.R., and G. Tchobanoglous, McGraw Hill Education, 2017 First Indian Edition
- Environmental Engineering (Vol. I): Water supply Engineering, P.N. Modi, Standard Book House, 2018, 5th Edition
- Environmental Engineering (Vol. II): Sewage Disposal and Air Pollution Engineering, S.K. Garg, Khanna Publishers, 1999, 40th Edition

Other Resources

- Environmental Engineering (Vol. I): Water supply Engineering, S.K. Garg, Khanna Publishers, 2017, 34th Edition
- MWH's Water Treatment: Principles and Design John C. Crittenden, R. Rhodes Trussell, David W. Hand, Kerry J. Howe, George Tchobanoglous, John Wiley & Sons, Inc., 2012, 3rd Edition
- Water and Wastewater Engineering: Design Principles and Practice, Mackenzie L. Davis, McGraw Hill Education, 2017,1st Edition
- Water Supply and Sewerage, Terence Mcghee, McGraw-Hill Education, 1991, 6th edition
- Introduction to Environmental Engineering and Science, Masters, G.M., Ela W.P., Prentice Hall of India, 1994, 3rd Edition

Learning Assessment (Theory)

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)				End Semester Exam (50%)
		CLA-1 (10%)	Mid-1 (15%)	CLA-2 (10%)	Mid-2 (15%)	
Level 1	Remember	100%	100%	70%	60%	60%
	Understand					
Level 2	Apply			30%	40%	40%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

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CE 402 - Advanced Environmental Engineering

Course Code	**CE 402**	Course Category	**Core Course (CC)**	L-T-P-C	**3**	**0**	**0**	**3**
Pre-Requisite Course(s)	**CE 308**	Co-Requisite Course(s)		Progressive Course(s)				
Course Offering Department	**Civil Engineering**	Professional / Licensing Standards						

Course Objectives / Course Learning Rationales (CLRs)

Objective 1: Students will have the ability to learn the basics of sewage composition and its characteristics.

Objective 2: Students will have adequate knowledge about various sewage treatment processes and their design, including sewer networks.

Objective 3: Students will adequate information on various disposal standards for effluents and their effective disposal methods to the receiving environment.

Objective 4: Students will have adequate knowledge about solid waste management and Environmental Impact Assessment.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe the characteristics and importance of wastewater and solid waste	2	80%	80%
Outcome 2	Illustrate the plan and design components of **wastewater treatment systems in sustainability.**	3	70%	70%
Outcome 3	Demonstrate sludge treatment and disposal systems	3	70%	70%
Outcome 4	Design and develop solid waste collection systems and assess the **environmental impacts** for the wastes generated	4	70%	70%

Course Articulation Matrix (CLO) to (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT Usage	Society and Multicultural Skills	Environment and Sustainability	Moral, and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Project Management and Finance	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	1	1	1			3						1	1	1
Outcome 2	3	3	3	3			3						3	3	3
Outcome 3	3	3	3	3			3						3	3	3
Outcome 4	3	2	1	1			3						3	2	2
Course Average	**3**	**2**	**2**	**2**			**3**						**3**	**2**	**2**

Course Unitization Plan - Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Quality and Quantity Perspectives of wastewater**	**4**		
	Physical, chemical, and biological characteristics of wastewater	1	1, 2	1, 2, 3
	Analysis of wastewater	1	1, 2	1, 2, 3
	Importance of BOD and COD	1	1, 2	1, 2, 3
	Effluent standards and impacts of disposal	1	1, 2	1, 2, 3
Unit 2	**Sewers and sewer appurtenances**	**6**		
	Wastewater Collection, Estimation of dry weather flow and storm water flow	1	2	1, 2
	Hydraulic design of sewers, Limiting velocities, effect of variation in flow of sewage on velocity of flow in sewers	2	2	1, 2
	Types of sewers	1	2	1, 2
	Construction of sewers: factors affecting the selection of material for sewer construction, materials for sewers, joints in sewers, shapes of sewers, maintenance, cleaning & ventilation of sewers.	1	2	1, 2
	Sewer appurtenances	1	2	1, 2
Unit 3	**Treatment of wastewater**	**20**		
	Preliminary & primary treatment of wastewater: screening, grit removal basins, removal of oil and grease, sedimentation, sedimentation aided with coagulation	3	2	1, 2
	Secondary treatment of Wastewater: Principles and classification of secondary treatment, activated sludge process, trickling filters, miscellaneous methods such as oxidation ditch, oxidation ponds, aerated lagoons, rotating biological contractors	10	2	1, 2
	Tertiary wastewater treatment: necessity and principles	2	2	1, 2
	Industrial wastewaters and effluent treatment plants including institutional and industrial waste management	2	3	5
	Disposal of wastewater, self-purification of streams, sewage irrigation	1	3	5
	Treatment and disposal of sludge, On-site disposal methods	2	3	5
Unit 4	**Municipal Solid Wastes**	**8**		
	Characteristics of MSW	1	4	4
	Elements of solid waste management	1	4	4
	Engineered systems for solid waste management	3	4	4

	Disposal of MSW, Hazardous waste, Biomedical and e-waste disposal	3	4	4
Unit 5	**Environmental Impact Assessment**	**7**		
	Indian environmental legislations and major environmental acts such as Water Act (1974), Air Act (1981), Environmental (Protection) Act (1986); International Environmental Treaties; Kyoto protocol, Montreal protocol, COP21, CDM.	2	4	6
	Life cycle assessment, methodological framework. Environmental impact assessment, Methodologies for EIA, Environmental management plan (EMP), environmental monitoring plan, EIS, case studies of infrastructure and industrial projects	3	4	6
	Environmental Management System: ISO 14000: General requirements; Cleaner technology (CT) of production, waste management hierarchy implementation of CT, barriers for adoption of CT.	2	4	6
Total Contact Hours		**45**		

Recommended Resources

- Environmental Engineering, Peavy, H.S, Rowe, D.R., and G. Tchobanoglous, McGraw Hill Education, 2017 First Indian Edition
- Theory and Practice of Water and Wastewater Treatment, Ronald Droste and Ronald Gehr, Wiley, 2019, 2nd Edition
- Chemistry for Environmental Engineering and Science, Sawyer, C. N., McCarty, P. L., and Perkin, G.F., McGraw-Hill Inc., 2002, 5th Edition
- Integrated Solid Waste Management, Engineering Principles and Management Issues, Tchobanoglous G, Theisen H and Vigil SA, McGraw Hill Education, 2014, Indian Edition
- Industrial Wastewater Management, Treatment and Disposal, WEF Manual of practice No. FD-3, WEF Press and McGrawHill, 2008, 3rd Edition
- Richard Welford, Corporate Environmental Management Systems and Strategies, Universities Press (I) Ltd., Hyderabad, 1996.

Other Resources

- Standard methods for the examination of water and wastewater, Washington: APHA, 2012, 21st Edition
- Wastewater Engineering Treatment and Reuse, Metcalf & Eddy, McGraw Hill Education, 2017, 4th Edition
- Water and Wastewater Engineering: Design Principles and Practice, Mackenzie L. Davis, McGraw Hill Education, 2017,1st Edition
- Introduction to Environmental Engineering and Science, G.B. Masters, Pearson, 2013, 3rd Edition
- Environmental Engineering (Vol. II): Sewage Waste Disposal and Air Pollution Engineering, S.K. Garg (1999), Khanna Publishers, 2018, 40th Edition
- Paul L. Bishop, Pollution Prevention: Fundamental and Practice, McGraw Hill, International, 2000. Freeman, H.M., Industrial Pollution Prevention Handbook, McGraw Hills 1995

Learning Assessment (Theory)

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)				End Semester Exam (50%)
		CLA-1 (10%)	Mid-1 (15%)	CLA-2 (10%)	Mid-2 (15%)	
Level 1	Remember	100%	80%	70%	40%	30%
	Understand					
Level 2	Apply		20%	30%	60%	70%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

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Environmental Engineering Lab

Course Code	**CE 308L**	Course Category	**Core Course (CC)**	L-T-P-C	**0**	**0**	**2**	**1**
Pre-Requisite Course(s)	**CE 308**	Co-Requisite Course(s)		Progressive Course(s)				
Course Offering Department	**Civil Engineering**	Professional / Licensing Standards						

Course Objectives / Course Learning Rationales (CLRs)

Objective 1: To apply different analysis techniques for the measurement of physical and chemical parameters of wastewater
Objective 2: To quantify the pollutant concentration in water and wastewater
Objective 3: To recommend the degree of treatment required for the water and wastewater
Objective 4: To assess the microbial contamination in water

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Demonstrate the physical and chemical characteristics of **water and wastewater**	2	80%	80%
Outcome 2	Compute the chemical requirement for turbidity removal	3	70%	70%
Outcome 3	Estimate the organic strength of wastewater	3	70%	70%
Outcome 4	Demonstrate the growth of **microorganisms** and its quantification	3	70%	70%

Course Articulation Matrix (CLO) to (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT Usage	Society and Multicultural Skills	Environment and Sustainability	Moral, and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Project Management and	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	2	3			3						3	3	3
Outcome 2	3	3	3	3			3						3	3	3
Outcome 3	3	3	3	3			3						3	3	3
Outcome 4	3	3	3	3			3						3	3	3
Course Average	**3**	**3**	**3**	**3**			**3**						**3**	**3**	**3**

Course Unitization Plan - Lab

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
	Water Sampling Methods for Lab Analysis	1	1	1, 2, 3, 4
2.	Determination of pH	1	1	1, 2, 3, 4
3.	Determination of Turbidity	1	1, 2	1, 2, 3, 4
4.	Determination of Total Solids, Dissolved Solids and Suspended Solids	1	1	1, 2, 3, 4
5.	Determination of Alkalinity	2	1	1, 2, 3, 4
6.	Determination of Hardness	2	1	1, 2, 3, 4
7.	Determination of Chloride	2	1	1, 2, 3, 4
8.	Determination of Sulfate	2	1	1, 2, 3, 4
9.	Determination of Iron	2	1	1, 2, 3, 4
10.	Determination of Dissolved Oxygen	2	1, 3	1, 2, 3, 4
11.	Determination of 5-day Biochemical Oxygen Demand	4	1, 3	1, 2, 3, 4
12.	Determination of Chemical Oxygen Demand	2	1, 3	1, 2, 3, 4
13.	Determination of Optimum Coagulant Dosage	2	1, 2	1, 2, 3, 4
14.	Determination of Total and Fecal Coliform	4	1, 3, 4	1, 2, 3, 4
15.	Determination of Breakpoint Chlorination	2	1, 3, 4	1, 2, 3, 4
Total Contact Hours		**30**		

Recommended Resources

- Chemistry for Environmental Engineering and Science, Sawyer, C. N., McCarty, P. L., and Perkin, G.F., McGraw-Hill Inc., 2002, 5th Edition
- Water and Wastewater Engineering: Design Principles and Practice, Mackenzie L. Davis, McGraw Hill Education, 2017,1st Edition
- Handbook of Water and Wastewater Treatment Technologies, Nicholas P. Cheremisinoff, Butterworth- Heineman, 2001, 1st Edition
- Wastewater Engineering Treatment and Reuse, Metcalf & Eddy, McGraw Hill Education, 2017, 4th Edition

Other Resources

- Environmental Engineering, Peavy, H.S, Rowe, D.R., and G. Tchobanoglous, McGraw Hill Education, 2017 First Indian Edition
- Environmental Engineering (Vol. I): Water supply Engineering, P.N. Modi, Standard Book House, 2018, 5th Edition
- Environmental Engineering (Vol. I): Water supply Engineering, S.K. Garg, Khanna Publishers, 2017, 34th Edition
- MWH's Water Treatment: Principles and Design John C. Crittenden, R. Rhodes Trussell, David W. Hand, Kerry J. Howe, George Tchobanoglous, John Wiley & Sons, Inc., 2012, 3rd Edition
- Water Supply and Sewerage, Terence Mcghee, McGraw-Hill Education, 1991, 6th edition
- Introduction to Environmental Engineering and Science, Masters, G.M., Ela W.P., Prentice Hall of India, 1994, 3rd Edition

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)			End Semester Exam (50%)
		Lab Performance (20%)	Observation Notes (10%)	Model Exam (20%)	
Level 1	Remember	30%	100%	40%	40%
	Understand				
Level 2	Apply	70%		60%	60%
	Analyse				
Level 3	Evaluate				
	Create				
Total		**100%**	**100%**	**100%**	**100%**

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ENV 111 - Environmental Science

Course Code	**ENV 111**	Course Category	**Basic Sciences (BS)**	**L-T-P-C**	**2**	**0**	**2**	**3**
Pre-Requisite Course(s)		Co-Requisite Course(s)		**Progressive Course(s)**				
Course Offering Department	**Environmental Science**	Professional / Licensing Standards						

Course Objectives / Course Learning Rationales (CLRs)
Objective 1: Aims to provide a comprehensive introduction to wide-ranging environmental issues and their drivers.
Objective 2: To understand numerous approaches to reduce a variety of contemporary environmental problems for a sustainable future.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course, the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Apply **sustainable solutions** for given environmental issues.	3	80%	70%
Outcome 2	Interpret the functioning of ecosystems, matter cycling, and diversity of species around us.	3	80%	70%
Outcome 3	Investigate natural resources and impact of their **overexploitation on our environment.**	4	80%	70%
Outcome 4	Inspect the extent **of environmental pollution** and diverse regulations, policies, and efforts to reduce the environmental burden.	4	80%	70%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT Usage	Society and Multicultural Skills	Environment and Sustainability	Moral, and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Project Management and Finance	ected and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1							3	1				1			
Outcome 2		1					3					1			
Outcome 3							3					1			
Outcome 4		1					3					1			
Course Average		**1**					**3**	**1**				**1**			

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	eferences Used
Unit 1	**ENVIRONMENTAL CRISIS AND SUSTAINABLE DEVELOPMENT**	**3**	1	1, 2
	Need for environmental science studies, Fundamentals of ENV – Atmosphere, lithosphere, hydrosphere, biosphere. Global environmental crisis and its causes, Man-Environment relationship & interaction	2		
	Ecological footprint, Sustainable development	1		
Unit 2	**ECOSYSTEMS**	**5**	2, 3	1, 3
	Ecosystem - Structure and functions of an ecosystem	1		
	Energy flow in an ecosystem, biomass flow in an ecosystem, food chain and web, Ecological Succession	1		
	Ecological pyramid, Water cycle, Carbon cycle, Sulphur cycle, Nitrogen cycle	1		
	Forest ecosystems: tropical rain forest, coniferous forests, tundra forests, temperate forests, Grasslands, and desert ecosystems	1		
	Aquatic ecosystems: Freshwater zones, streams, rivers, state of rivers in India, wetlands, Zones in ocean, ocean activities, coastal zones, Estuaries, Mangroves	1		
Unit 3	**RENEWABLE AND NON-RENEWABLE RESOURCES**	**5**	3, 4	1, 2
	Energy resources: Global energy crisis, energy sources, energy needs, global energy consumption, Renewable and Non-renewable energy sources: Hydropower, Solar, tidal, wind, energy, Bioenergy, coal, natural gas	2		
	Energy resources: fossil fuel vs renewable fuels, peak oil Conventional and unconventional oil, oil price determination	1		
	Environmental implications of Energy use: India and world, Energy use pattern – national and global	1		
	Water availability, Water for irrigation, water situation in India	1		
Unit 4	**BIODIVERSITY**	**6**	2, 3	1, 2, 3
	Significance of biodiversity, Current state of biodiversity: National and global, Causes of biodiversity loss	2		
	Biological hotspots, aquatic biodiversity	1		
	Endangered species and endemic species of India	1		
	Biodiversity conservation: Seed banks, botanical gardens, marine biodiversity protection, national and international efforts	2		
	Environmental Pollution and Control	**11**		

Unit 5	Types of Environmental Pollution Air pollution: Sources, effects, and control	2	1, 4	1, 2, 4

	Air standards, Air pollution in India and the world Sources of air pollution, Outdoor & Indoor air pollution Point source, mobile, area source, Effects of air pollution: Smog, urban heat island, ozone layer depletion, acid rain, Controlling air pollution: Emission regulation, e-cars			
	Water pollution: Sources & effects, Water Quality standards, Water pollutants, eutrophication, thermal pollution, biomagnification, Wastewater treatment, Methods of water purification	2		
	Soil pollution: Sources, causes and effects Control of soil pollution: Air purging, phytoremediation, and bioremediation	2		
	Solid waste management, Types and sources of solid wastes, Hazardous waste, and electronic wastes, Recycling, and management of solid wastes (4Rs), Sanitary landfills and leachate management	2		
	Noise pollution: Sources, effects, and control Air quality standards with respect to noise	1		
	Introduction to Climate change: Impact of climate change, IPCC assessment, Carbon footprint, carbon sequestration, carbon trade, carbon credits, Kyoto protocol, Montreal protocol, Paris agreement	2		
	Lab Experiment / Practical	**30**		
1	Determination of turbidity and pH of water	3		
2	Determination of total suspended solids and total dissolved solids	3	1,2,3,4	4
3	Measurement of Alkalinity & Acidity	4		
4	Measurement of dissolved oxygen using Winkler Method	4		
5	Determination of Biochemical Oxygen Demand	4		
6	Determination of Chemical Oxygen Demand	4		
7	Determination of hardness of water	4		
8	Determination of iron concentration in water	4		
	Total Contact Hours	**60**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (10%)		Mid-1 (15%)		CLA-2 (10%)		Mid-2 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	70%	70%	70%	70%	30%	30%	30%	30%	30%	20%
	Understand										
Level 2	Apply	30%	30%	30%	30%	70%	70%	70%	70%	70%	80%
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

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ENV 111L - Environmental Science Lab

Course Code	**ENV 111L**	Course Category	**Basic Sciences (BS)**	L-T-P-C	**2**	**0**	**0**	**2**
Pre-Requisite Course(s)	-	Co-Requisite Course(s)	-	Progressive Course(s)	-			
Course Offering Department	**Environmental Science**	Professional / Licensing Standards	-					

Course Objectives / Course Learning Rationales (CLRs)

Objective 1: Aims to provide a comprehensive introduction to wide-ranging environmental issues and their drivers.

Objective 2: To understand numerous approaches to reduce a variety of contemporary environmental problems for a sustainable future.

Course Outcomes / Course Learning Outcomes (CLOs)

Outcomes	**At the end of the course, the learner will be able to**	**Bloom's Level**	**Expected Proficiency Percentage**	**Expected Attainment Percentage**
Outcome 1	Apply **sustainable solutions** for given environmental issues.	3	80%	70%
Outcome 2	Interpret the functioning of ecosystems, matter cycling, and diversity of species around us.	3	80%	70%
Outcome 3	Investigate natural resources and impact of their **overexploitation on our environment.**	4	80%	70%
Outcome 4	Inspect the extent of **environmental pollution** and diverse regulations, policies and efforts to reduce the environmental burden.	4	80%	70%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	**Program Learning Outcomes (PLO)**														
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT Usage	Society and Multicultural Skills	Environment and Sustainability	Moral, and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Project Management and	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	1	-	-	-	-	-	3	1	-	-	-	1			
Outcome 2	1	1	-	-	-	-	3	-	-	-	-	1			
Outcome 3	1	-	-	-	-	-	3	-	-	-	-	1			
Outcome 4	1	1	-	-	-	-	3	-	-	-	-	1			
Course Average	**1**	**1**	-	-	-	-	**3**	**1**	-	-	-	**1**			

Course Unitization Plan

Exp No	Experimenta Name	Required Contact Hours	COs Adderessed	References Used
1	Determination of turbidity and pH of water	3	1-4	1-4
2	Determination of total suspended solids and total dissolved solids	3		
3	Measurement of Alkalinity & Acidity	4		
4	Measurement of dissolved oxygen using Winkler Method	4		
5	Determination of Biochemical Oxygen Demand	4		
6	Determination of Chemical Oxygen Demand	4		
7	Determination of hardness of water	4		
8	Determination of iron concentration in water	4		
Total Contact Hours		**30**		

Recommended Resources

R. Rajagopalan (2016). Environmental Studies (3rd edition), Oxford University Press.
Deeksha Dave, S.S. Katewa (2012). Textbook of Environmental Studies (2nd edition), Cengage.
W. Cunningham, M. Cunningham (2016). Principles of Environmental Science (8th Edition), McGraw-Hill.
APHA and AWWA (1999): Standard Methods for the Examination of Water and Wastewater. American Public Health Association (APHA), 20th Ed, Washington, D.C., USA.

Other Resources

KL Rao (1979). India's water wealth. Orient Black Swan.
Saadat, S., Rawtani, D., & Hussain, C. M. (2020). Environmental perspective of COVID-19. Science of The Total Environment, 138870.

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (10%)		Mid-1 (15%)		CLA-2 (10%)		Mid-2 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember		30%		30%		30%		30%		30%
	Understand										
Level 2	Apply		70%		70%		70%		70%		70%
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

ANT 100. Anthropology: Climate Change, Resilience and Vulnerability

Course Code	ANT 100	Course Category	OE	L-T-P-C	3	0	0	3
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)				
Course Offering Department	Liberal Arts	Professional / Licensing Standards						

Course Objectives / Course Learning Rationales (CLRs)

Objective 1: To provide the students with an understanding of the interaction between human beings and climate change.

Objective 2: To Explain to the students the importance of anthropology in an interdisciplinary approach to studying climate change impacts on biodiversity and human society.

Objective 3: To explore various mechanisms and strategies being followed by multiple communities in response to climate change at the global level through adaptation to the environment.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the completion of the course learners will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Define **climate challenges** at the global level	2	70%	80%
Outcome 2	Critical understanding and analysis of industrialization and modernization impacts on biodiversity and human settlements;	2	70%	70%
Outcome 3	Articulate and explain how climate change has affected the most vulnerable communities worldwide.	2	60%	70%
Outcome 4	Define and analyse indigenous knowledge of nomadic pastoral peoples to **resilience to changing climatic conditions.**	2	60%	60%
Outcome 5	Apply unique adaptation and mitigation methods for urban/cities to build green and **climate-resilient cities** by resolving issues.	1	70%	70%

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	3		3			3				3	3		
Outcome 2	2	2	2					2				2		2	
Outcome 3	3	2	3		3			3				3		3	
Outcome 4	2		2		2			2				2			3
Outcome 5	2	2	2		2			2				2	2		
Course Average	**2**	**2**	**2**		**3**			**2**				**2**	**3**	**3**	**3**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction; anthropology and Climate Change**	**9**	1	2,3, 5,7
	What is Anthropology	3		
	Climate Change	3		
	Resilience and Vulnerability	3		
Unit 2	**Unit-2: Climate Change impacts on Biodiversity**	**9**	2	3,5.7
	Sea/Ocean Species	3		
	Desert wildlife	3		
	Fire and other displacement of wildlife	3		
Unit 3	**Climate Change and vulnerable communities or Groups-Case Studies**	**9**	3	3,5
	Agricultural and Climate Change	2		
	Fishery and Climate Change	2		
	Tribal, displaced people	2		
	Gender and Climate Change	3		
Unit 4	**Pastoral Nomads, Climate Change and Resilience**	**9**	4	1,13
	Himalayan herders,	3		
	Desert herders,	3		
	Semi-arid and deccan herders	3		
Unit 5	**Cities and Climate change: Adaptation and Mitigation**	**9**	5	8,10, 11,12,14
	City slums settlements,	3		
	Migrants' workers,	3		
	Industrial and other wastages	3		
Total Contact Hours		**45**		

Recommended Resources

- Agrawal, A. (1993). Mobility and Cooperation among Nomadic Shepherds: The case of the Raikas. *Human Ecology*, 21(3), 261–279.
- Barnes, J., Dove, M., Lahsen, M. et al. (2013). *Contribution of anthropology to the study of climate change. Nature Climate Change*, 3, 541–544.
- Crate, S.A., and Nuttall, M. (2016). *Anthropology and Climate Change: From Actions to Transformations* (2nd ed.). New York: Routledge.
- Dodman, D. (Chichester: John Wiley & Sons.2009). Blaming cities for climate change? An analysis of Urban Greenhouse Gas Emissions Inventories Environment and Urbanization, 21, 185-201.
- Dove, M.R. (Ed.,). (2013). *The anthropology of Climate Change: An Historical Reader*. Chichester: John Wiley & Sons.
- Gmelch, G. Zenner, W. P. & Kemper, R. V. (Eds.,). *Urban Life Readings in the Anthropology of the City*. Illinois: Waveland Press Inc. 4th Edition. pp. 403-412.
- Hylland, T. (2021). "Climate Change". In *The Cambridge Encyclopaedia of Anthropology*, edited by Felix Stein. Online: http://doi.org/10.29164/21climatechange.

- Hunt, A. & P.Watkiss. (2011). Climate Change Impacts and Adaptation in Cities: A Review of The Literature. *Climate Change.* 104(1): 13-49.
- Intergovernmental Panel on Climate Change's Fifth Assessment Report (to be published in late 2013).
- Khosla, R., and Bhardwaj, A. (2019). Urbanization in the time of climate change: Examining the response of Indian cities. *Climate Change. Vol.*10(1), e560.
- Malik, T, Y and Awan. (2017). Urbanization and Transforming Urban Form of Asian Cities – Cases of Bangkok, Tokyo & Mumbai. *International Journal of Engineering Research in Mechanical and Civil Engineering* (IJERMCE).
- Revi, A. (2008). Climate Change Risk: An Adaptation and Mitigation agenda for Indian Cities. *Environment and Urbanization*, 20(1), 207-229.
- Saberwal, V. (1996). Pastoral politics: gaddi grazing, degradation, and biodiversity conservation in Himachal Pradesh, India, *Conservation Biology*, 10 (3):741-749.
- United Nations Human Settlements Programme (2011). *Cities and Climate Change: Global Report on Human Settlements*. London and Washington DC, Earthscan.

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)				End Semester Exam (50%)
		CLA-1 (10%)	Mid (15%)	CLA-2 (10%)	CLA-3 (15%)	
		Theory	Theory	Theory	Theory	Theory
Level 1	Remember	30%	40%	30%	40%	50%
	Understand					
Level 2	Apply	70%	60%	70%	60%	50%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

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Water and Climate Change Adaption								
Course Code	ENV 115	Course Category	Open Elective (OE)	L-T-P-C	2	1	0	3
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)				
Course Offering Department	Environmental Science and Engineering	Professional / Licensing Standards						

Course Objectives / Course Learning Rationales (CLRs)
Objective 1: To show the existing water crisis from local to global scale.
Objective 2: To understand links between water crisis, climate change and politics.
Objective 3: To learn opportunities in water technologies

Course Outcomes / Course Learning Outcomes (CLOs)

Outcomes (CO)	At the end of the course, the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Identify the sources of freshwater and assess their current state	2	80%	70%
Outcome 2	Assess the state of the **global water crisis**	2	80%	70%
Outcome 3	Demonstrate water as the centre of **climate change** and its links to global politics	3	80%	70%
Outcome 4	Develop technologies and **sustainable solutions** to combat water crisis across the globe	4	80%	70%

Course Articulation Matrix (CLO) to Program Learning Outcomes – Engineering (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT Usage	Society and Multicultural Skills	Environment and Sustainability	Moral, and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Project Management and Finance	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	1	2	-	-	-	-	3	1	-	-	-	1	-	-	-
Outcome 2	1	2	-	-	-	-	3	1	-	-	-	1	-	-	-
Outcome 3	1	2	-	-	-	-	3	1	-	-	-	1	-	-	-
Outcome 4	1	2	-	-	-	-	3	1	-	-	-	2	-	-	-
Course Average	1	2	-	-	-	-	3	1	-	-	-	2	-	-	-

Course Articulation Matrix (CLO) to Program Learning Outcomes – BA/BSc/BCom (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	**1**	**1**	**2**	**1**	**-**	**-**	**3**	**2**	**1**	**2**	**-**	**2**	**-**	**-**	**-**
Outcome 2	**1**	**1**	**2**	**1**	**-**	**-**	**3**	**2**	**1**	**2**	**-**	**2**	**-**	**-**	**-**
Outcome 3	**1**	**1**	**2**	**1**	**-**	**-**	**3**	**2**	**1**	**2**	**-**	**2**	**-**	**-**	**-**
Outcome 4	**1**	**1**	**2**	**1**	**-**	**-**	**3**	**2**	**1**	**2**	**-**	**2**	**-**	**-**	**-**
Course Average	**1**	**1**	**2**	**1**	**-**	**-**	**3**	**2**	**1**	**2**	**-**	**2**	**-**	**-**	**-**

Course Articulation Matrix (CLO) to Program Learning Outcomes – BBA (PLO)

CLOs	Program Learning Outcomes (PLO)													
	Management Knowledge	Analytical Reasoning and	Critical and Reflective Thinking	Strategic Thinking and Logical	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	1	**1**	**2**	**1**	**-**	**3**	**2**	**1**	**2**	**-**	**2**	**-**	**-**	**-**
Outcome 2	1	**1**	**2**	**1**	**-**	**3**	**2**	**1**	**2**	**-**	**2**	**-**	**-**	**-**
Outcome 3	1	**1**	**2**	**1**	**-**	**3**	**2**	**1**	**2**	**-**	**2**	**-**	**-**	**-**
Outcome 4	1	**1**	**2**	**1**	**-**	**3**	**2**	**1**	**2**	**-**	**2**	**-**	**-**	**-**
Course Average	**1**	**1**	**2**	**1**	**-**	**3**	**2**	**1**	**2**	**-**	**2**	**-**	**-**	**-**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Water facts**	**5**	**1**	**1,2**
	Water - properties and different forms; Water planet;	*1*		
	water crisis – state of ground water, surface water, and glaciers.	*2*		
	Who owns water? Privatisation of water.	*2*		
Unit 2	**Water and the global commons**	**8**	**1,2**	**3,4,5**
	Tragedy of the commons; water as a global common.	*2*		
	More people – More water usage	*1*		
	Agriculture and water footprint;	*1*		
	Industrial water usage – more coal, more water;	*1*		
	Great Indian water crisis – historical perspectives and future.	*3*		

Unit 3	**Water centric climate change**	**6**	**2, 3**	**1, 4,5**
	Climate change and water crisis, Floods, draughts, and storms;	*2*		
	Status of glaciers and snow cover; sea-level rise	*2*		
	Food security; Forests and water	*2*		
Unit 4	**Potential Conflicts to Corporation Potential**	**6**	**3**	**1, 4, 5**
	Water shortage and water tensions; State of global water crisis	*2*		
	Water wars – theory and evidence	*1*		
	International cooperation and their weakness,	*1*		
	Inter-State River disputes in India	*2*		
Unit 5	**Water technologies: Concerns**	**5**	**4**	**5**
	Desalination	*1*		
	Wastewater treatment; Sewage treatment plants	*2*		
	Wastewater – a new market?	*1*		
	Water data – an opportunity? WRIS	*1*		
Tutorials		**15**		
1	Water – essential for life – what makes earth a habitable planet?	3	1	2
2	Water history of India – colonial era, agricultural practices, and coal driven energy production	3	2	5
3	Before the flood - Leonardo DiCaprio's journey around the globe	3	3	6
4	River linking, electricity subsidies for farmers, Jal Jeevan mission – where have we reached?	3	3,4	5
5	Why do we fail to treat our sewage?	3		1
Total Contact Hours		**45**		

Recommended Resources

Back to the Well – Rethinking the future of water. Marq de Villiers (2015). ISBN 978-1-77310-046-3. Goose Lane Editions.

Watershed – How we destroyed India's water and how we can save it. Mridula Ramesh (2021). ISBN 978-93-91028-68-8, Hachette Book Publishing India, Pvt Ltd.

Other Resources

The Big Thirst: The secret life and turbulent future of water. Charls Fishman (2011). ISBN: 924-1-598-417

Humanity's Footprint – Momentum, Impact, and our Global Environment. Water K. Dodds (2008). ISBN 978-0-231-13967-0.

3. Global Environmental Politics – problems, policy and practice. Hayley Stevenson (2017). Cambrige University Press ISBN:

4. Website: https://www.beforetheflood.com/

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (10%)		Mid-1 (15%)		CLA-2 (12.5%)		CLA-3 (12.5%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	65%	-	70%	-		-		-	100%	-
	Understand					30%		30%			
Level 2	Apply					70%		70%			
	Analyse	35%		25%							
Level 3	Evaluate										
	Create										
Total		100%		100%		100%		100%		100%	

LBA 001-Sustainable Cities and Climate Change

Course Code	LBA 001	Course Category	OE	L-T-P-C	3	0	0	3
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)				
Course Offering Department	Liberal Arts	Professional / Licensing Standards						

Course Objectives / Course Learning Rationales (CLRs)

Objective 1: To understand the diverse backgrounds to draw on various human and climate change discourses in the city's context.

Objective 2: To provide students with an understanding of the relationship between cities, people's settlements, and their environment.

Objective 3: To describe, analyse, and explore (and learn) ongoing policy-level discussion on cities and climate change. It also draws and suggests the best design of sustainable cities which could positively impact climate change.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the completion of the course learners will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Define **climate challenges** at the global urban and cities for the 21st century;	2	70%	80%
Outcome 2	Critical analysis of rapid urban/city growth and its impacts on the **climatic conditions** and human settlements;	2	70%	70%
Outcome 3	Articulate and explain concepts such as adaptation, **sustainability, climate change,** pollution, sustainable cities, climate mitigations, planning, and designing of green cities;	2	60%	70%
Outcome 4	Analyse anthropological knowledge, to build **climate-sensitive cities** considering the local context and knowledge.	2	60%	60%
Outcome 5	Apply unique adaptation and mitigation methods for urban/cities to build green and climate-resilient cities by resolving issues.	1	70%	70%

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	3		3			3				3		3	
Outcome 2	2	2	2					2				2	3		
Outcome 3	3	2	3		3			3				3		2	
Outcome 4	2		2		2			2				2			2
Outcome 5	2	2	2		2			2				2	2		
Course Average	**2**	**2**	**2**		**3**			**2**				**2**	**3**	**3**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction to Sustainable Cities and Climate Change**	**9**	1	3, 9, 10, 15, 16, 17
	History of Urban, City centres and Climate Change	3		
	Overview of Cities of 21st Century and Climate Change	3		
	Indian Cities and Climate Change	3		
Unit 2	**Effects of Climate Change on Cities**	**9**	2	3, 9,10, 15,16, 18, 19, 23, 25
	The impact of Climate Change on Cities	2		
	American (North-South) Cities	2		
	European Cities	2		
	Asian Cities	3		
Unit 3	**Cities as Contributors to Climate Change**	**9**	3	1,8,9, 14,15, 17, 18
	American Cities	3		
	European Cities	3		
	Asian Cities	3		
Unit 4	**Cities, Peoples, and Climate Initiatives and Policies.**	**9**	4	3, 9,10, 15,16, 18, 19
	Specific adaptation, Mitigation	3		
	Slums and settlements major cities across the world	3		
	Case Study of New York and Tokyo	3		
Unit 5	**Toward Sustainable Cities.**	**9**	5	6,7,8,12, 13,14, 19, 20, 21,22, 24
	Global and local policy-level discussion on cities and climate change	3		
	Sustainable Development Goals (SDGs 4, 8, 9, 11, 12 and 17) for Cities and Climate Change.	3		
	Sustainability, Conservation, Climate change and beyond.	3		
	.			
Total Contact Hours		**45**		

Recommended Resources

- Aoyagi, K; Nas, P. J. M. & Traphagan, J.W. (Eds.,). (1998). *Toward Sustainable Cities: Reading in the Anthropology of Urban Environments,* Leiden Development Studies-15, Leiden University: Netherlands.
- Auch, T & Acevedo (2004). *Urban Growth in American Cities: Glimpses of U.S. Urbanization* (Report, Series no 1252, USGS Numbered Series).
- Betsill, M. & Bulkeley, H. (2007). Looking Back and Thinking Ahead: A Decade of Cities and Climate Change Research. *Local Environment* 12(5): 447-456.
- Clark, M & Nunley (2018). *The Story of Your City: Europe and its Urban Development,* 1970 to 2020, EIB.
- Dodman, D. (2009). Blaming cities for climate change? An analysis of Urban Greenhouse Gas Emissions Inventories Environment and Urbanization, 21, 185-201.
- Cartwright, A., S. Parnell, G. Oelofse & S. Ward, (Eds.,). (2012). *Climate Change at the City Scale: Impacts, Mitigation and Adaptation in Cape Town*. New York, Routledge: Abingdon.
- Hoornweg, D., M. Freire, M. Lee, J, P. Bhada-Tata & B. Yuen, (Eds.,). (2011). *Cities and Climate Change: Responding to an Urgent Agenda*. Washington DC, The World Bank.
- Hunt, A. & P. Watkiss. (2011). Climate Change Impacts and Adaptation in Cities: A Review of The Literature. *Climate Change.* 104(1): 13-49.
- Intergovernmental Panel on Climate Change's Fifth Assessment Report (to be published in late 2013).
- Leonard, K., I. (2010). Hyderabad Continuity and Transformation. In Gmelch, G. Zenner, W. P. & Kemper, R. V. (Eds.,). *Urban Life Readings in the Anthropology of the City*. Illinois: Waveland Press Inc. 4th Edition. pp. 403-412.
- Malik, T, Y and Awan. (2017). Urbanization and Transforming Urban Form of Asian Cities – Cases of Bangkok, Tokyo & Mumbai. *International Journal of Engineering Research in Mechanical and Civil Engineering* (IJERMCE).
- Nel-lo, O. and Mele, R. (Eds.,). (2020). *Cities in the 21st Century*. London and New York: Routledge.
- Smith, M. E. (2010). The Earliest Cities. In Gmelch, G. Zenner, W. P. & Kemper, R. V (Eds.,). *Urban Life Readings in the Anthropology of the City*. Illinois: Waveland Press Inc. 4th Edition. pp. 3-19.
- Stone, B. (2012). *The City and the Coming Climate: Climate Change in the Places we live.* Cambridge University Press.
- United Nations Human Settlements Programme (2011). *Cities and Climate Change: Global Report on Human Settlements*. London and Washington DC, Earthscan.

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)				End Semester Exam (50%)
		CLA-1 (10%)	Mid (15%)	CLA-2 (10%)	CLA-3 (15%)	
		Theory	Theory	Theory	Theory	Theory
Level 1	Remember	30%	40%	30%	40%	50%
	Understand					
Level 2	Apply	70%	60%	70%	60%	50%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

SRM University – AP, Andhra Pradesh
Neerukonda, Mangalagiri Mandal
Guntur District, Mangalagiri, Andhra Pradesh 522240

Technology for Wildlife

Course Code	**ENV 113**	Course Category	**Open Elective (OE)**	L-T-P-C	**2**	**1**	**0**	**3**
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)				
Course Offering Department	**Environmental Science**	Professional / Licensing Standards						

Course Objectives / Course Learning Rationales (CLRs)
Objective 1: Aims to provide basic knowledge and understanding about Wildlife conservation in India
Objective 2: Aims to provide understanding of different tools and technologies used in wildlife conservation and management in Indian forest
Objective 3: Train personnel at various levels for conservation and management of wildlife
Objective 4: Build up scientific knowledge on wildlife resources

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	**Bloom's Level**	**Expected Proficiency Percentage**	**Expected Attainment Percentage**
Outcome 1	Describe the wildlife and biogeography of India	2	80%	70%
Outcome 2	Apply the tools used in **Wildlife conservation**	3	70%	60%
Outcome 3	Illustrate the threats and management approaches for **wildlife conservation**	2	70%	60%
Outcome 4	Demonstrate **conservation and management** strategies	3	65%	60%

Course Articulation Matrix (CLO) to (PLO) *For B. A. / B. Sc. / B. Com*

CLOs	**Program Learning Outcomes (PLO)**														
	Scientific and Disciplinary	Analytical Reasoning and	Critical and Reflective	Scientific Reasoning and	Research Related Skills	Modern Tools and ICT Usage	Environment and	Moral, Multicultural	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong	PSO 1	PSO 2	PSO 3
Outcome 1	2	1	1	1	-	1	3	-	1	-	-	1	-	-	-
Outcome 2	2	3	2	2	-	3	3	-	1	-	-	1	-	-	-
Outcome 3	2	2	2	1	-	2	3	-	1	-	-	1	-	-	-
Outcome 4	2	2	2	1	-	2	3	-	1	-	-	1	-	-	-
Course Average	**2**	**2**	**2**	**1**	**-**	**2**	**3**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**-**

Course Articulation Matrix (CLO) to (PLO) *For B. Tech*

CLOs	Program Learning Outcomes (PLO)														
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and	Modern Tool and	Society and Multiculture	Environment and	Moral, and Ethical	Individual and	Communication Skills	Project Management	Self-Directed and	PSO 1	PSO 2	PSO 3
Outcome 1	-	1	-	1	-	1	3	-	1	-	-	1	-	-	-
Outcome 2	2	2	2	1	2	1	3	-	1	-	-	1	-	-	-
Outcome 3	2	1	-	1	1	1	3	-	1	-	-	1	-	-	-
Outcome 4	2	1	-	1	1	1	3	-	1	-	-	1	-	-	-
Course Average	2	1	2	1	1	1	3	-	1	-	-	1	-	-	-

Course Articulation Matrix (CLO) to (PLO) *For B.B.A.*

CLOs	Program Learning Outcomes (PLO)														
	Management Knowledge	Analytical Reasoning and	Critical and Reflective	Strategic Thinking and	Modern Tools and ICT Usage	Environment and	Moral, Multicultural	Individual and Teamwork	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong	PSO 1	PSO 2	PSO 3
Outcome 1	1	1	1	1	-	3	-	1	-	-	1	-	-	-
Outcome 2	2	1	2	1	2	3	-	1	-	-	1	-	-	-
Outcome 3	2	1	1	1	1	3	-	1	-	-	1	-	-	-
Outcome 4	2	1	1	1	2	3	-	1	-	-	1	-	-	-
Course Average	**2**	**1**	**1**	**1**	**2**	**3**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**-**

Course Unitization Plan - Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Indian wildlife and Biogeography**	**6**	1	2,3,4
	Biogeography of India	1		
	Concept of Biodiversity	1		
	Introduction to Indian Wildlife	2		
	Zoogeography of Indian Mammals	2		
Unit 2	**Wildlife Conservation and Management**	**15**	3	1,2,6,9
	Management of special habitats	2		
	Management plan for Protected Areas	2		
	Population estimation methods	3		
	Conservation Ethics and Values of Wildlife in India	1		
	Ex-situ and in-situ conservation	1		
	Captive breeding and Propagation	2		
	Important conservation projects undertaken in India	2		
	Wildlife corridors and connecting the protected areas	1		
	Tiger Reintroduction in Panna Tiger Reserve	1		
Unit 3	**Capture & Handling of Wild Animals**	**6**	2,3	1,5

	Restraints, Capture and Animals Barriers	3		
	Drug immobilization	3		
Unit 4	**UAV, Remote Sensing and GIS in Wildlife**	**12**		
	Application of Remote sensing in wildlife management	1		
	Aerial photography and satellite imagery	1		
	Introduction to GIS	2		
	Data entry, analysis, and visualization	2	2,4	7,8
	Drones and Future of Wildlife monitoring	1		
	UAVs in Wildlife Conservation	2		
	Wildlife Survey and Population Monitoring	1		
	Surveillance and Protective Drones	1		
	Use of global positioning system	1		
Unit 5	**Telemetry and Sono-Taxonomy**	**6**		
	Radio and Satellite Telemetry	2		
	Radio-telemetry studies in India	1		
	Sono taxonomy- sound based identification of species with reference to wildlife	1	2,4	1,2,6
	Principles of bioacoustics and vocalization	1		
	Advantage of sound-based identification and monitoring of species	1		
Total Contact Hours		**45**		

Recommended Resources

- The Wildlife Techniques Manual: Volume 1: Research. Volume 2: Management. Silvy, N.J. ed., 2020. JHU Press.
- Fundamentals of Wildlife Management. Gopal. R., 2021. Natraj Publishers

Other Resources

- Ecology and biogeography in India (Vol. 23). Mani, M.S. ed., 2012. Springer Science & Business Media.
- Indian mammals: a field guide. Menon, V., 2014. Hachette India.
- A manual on chemical immobilization of wild animals. Sontakke, S., Umapathy, G., Kumar, D. and Singh, D.N., 2017. LaCONES and Central Zoo Authority, Hyderabad.
- Wildlife ecology, conservation, and management. Fryxell, J.M., Sinclair, A.R. and Caughley, G., 2014. John Wiley & Sons.
- Remote sensing for biodiversity and wildlife management: Synthesis and applications. Franklin, S.E., 2010. McGraw-Hill Education.
- Drones for Biodiversity Conservation and Ecological Monitoring. Díaz-Delgado, R. and Mücher, S. eds., 2019. MDPI.
- Corridor ecology: linking landscapes for biodiversity conservation and climate adaptation. Hilty, J.A., Keeley, A.T., Merenlender, A.M. and Lidicker Jr, W.Z., 2019. Island Press.

https://www.thebetterindia.com/202329/panna-tiger-reserve-conservation-story-first-department-inspiring-india/
https://www.youtube.com/watch?v=fHk-T8hB0lw
https://www.youtube.com/watch?v=iQxlogLMd8o
https://www.youtube.com/watch?v=E4hNjgJ3-Bs
https://www.youtube.com/watch?v=ttiI1dGxbxM

Learning Assessment (Theory)

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)				End Semester Exam (50%)
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