BANKURA UNIVERSITY

SYLLABUS FOR 3-YEAR DEGREE /4-YEAR HONOURS

IN

ENVIRONMENTAL SCIENCE

Under
Curriculum and Credit Framework for Undergraduate Program (CCFUP), as per NEP-2020

w.e.f- 2025-26

Objectives of the programme:-

The prime objective of the programme is:-

1. To reach the unreached and help to provide environmental education at the doorstep of the learners and according to their convenience.
2. To contribute to eco-sustainability and efficient use of natural resources through integrated nexus for the long-term benefit and welfare of society through quality education, innovative research, outreach and grassroot activities and overall networking with the environment.
3. To attract young minds to choose a career in broad areas of Environmental Science and applications.
4. To fulfill the requirement of technical man power in various sectors including academia-industry linkage and elsewhere.

PROGRAMME OUT COME (PO):

PROGRAMME NAME	**PROGRAMME OUT COME(PO)**
PO1	To demonstrate rational understanding of rudimentary concepts, principles and processes underlying the academic field of Environmental Science with its various subfields like Ecology, Biodiversity, Earth sciences, pollution control technology, Environmental Physics and Chemistry, Environmental Health & Safety, Atmospheric Sciences, Environmental Laws, Environmental Impact Assessment, Environmental Biotechnology, Toxicology, Waste Treatment Techniques, Renewable and Non-Renewable Energy, Restoration, Environmental economics, Environmental statistics, Remote sensing and GIS, Climate change and sustainability, etc.
PO2	To know about different types of professionals in the field of Environmental Science and related subfields.
PO3	To address the environment related issues and challenges for the protection and conservation of available natural resources and environment.
PO4	To identify, formulates, review research literature, and analyse current environment related problems. Use of laboratory and field techniques relevant to academia and industry, generic skills, and global competencies, including knowledge and skills that enable students to undertake further Studies in the field of Environmental science.
PO5	To create, select, and apply appropriate techniques, and to model environmental activities with an understanding of the limitations. Ability to use high end equipments for the analysis of environmental resources.
PO6	To integrate knowledge from disciplines such as biology, chemistry, geography, geology, and policy studies to understand complex environmental issues.
PO7	To identify and appreciate the importance of the Environmental Science and its application in academic, industrial, economic, and social context

PO8	To undertake research and on field activities which develop problem solving abilities required for successful career in Environmental Science. Impart Communication Skills; Ability to work effectively as individual or team; Ability to handle project and to manage finance related issues.

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PROGRAMME SPECIFIC OUT COME (PSO):

PROGRAMME NAME	PSO
PSO1	The course provides wide range of knowledge on various aspects of different spheres of the environment viz atmosphere, hydrosphere, lithosphere and biosphere and generate awareness on Environmental Pollution, toxicology along with their inter linkages to human health. Climatic Change.
PSO2	The course conveys education among students on Environmental Impact Assessment study of various environmental components, environmental laws, their effectivity and their long term outcome from environmental point of view.
PSO3	The course provides knowledge on concepts, tools and modern techniques and instruments for analysis of various components of eco-environment and their management. Also enable to tackle various environmental challenges in friendly and sustainable manner and educate students on Natural resource management for sustainable development.
PSO4	The course includes training for capacity building, to offer professional and job oriented course curricula, to strengthen R & D activities and extension activities.

SEMESTER-I

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
S/ENV/101/MJC-1	Earth and Earth Surface Processes Earth and Earth Surface Processes (Practical)	4	10	25 15	50	3	NA	2
S/ENV/102/MN-1	Earth and Earth Surface Processes Earth and Earth Surface Processes (Practical)	4	10	25 15	50	3	NA	2
S/ENV/103/MD-1	Environment and Society	3	10	40	50	2	NA	NA
ACSHP/104/AEC-1	Communicative English : Literature and Communication	2	10	40	50	2	NA	NA
S/ENV/105/SEC-1	Remote Sensing, Geographic Information System and Modeling Remote Sensing, Geographic Information System and Modeling (Practical)	3	10	25 15	50	2	NA	2
ACS/106/VAC-1	Environmental Studies	4	10	40	50	4	NA	NA
Total in Semester-I		**20**	**60**	**240**	**300**	**16**		**6**

N.B: MJC-Major Paper, MN –Minor Paper; MD –Multidisciplinary Paper, AEC-Ability enhancement course, SEC-Skill enhancement course, VAC-Value added course. Theory:-1Credit=1hour/Week, Practical:-1Credit=2hours/Week, Tutorial:-1Credit = 1hour/Week

SEMESTER–II

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
S/ENV/201/MJ C-2	Physics and Chemistry of Environment Physics and Chemistry of Environment (Practical)	4	10	25 15	50	3	NA	2
S/ENV/ 202/MN-2	Physics and Chemistry of Environment Physics and Chemistry of Environment (Practical)	4	10	25 15	50	3	NA	2
S/ENV/ 203/MD-2	Human Wildlife Conflict and Management	3	10	40	50	2	NA	NA
ACS/204 /AEC-2	English/Hind/MIL	2	10	40	50	2	NA	NA
S/ENV/ 205/SEC-2	Environmental Impact and Risk Assessment Environmental Impact and Risk Assessment (Practical)	3	10	25 15	50	2	NA	2
ACS/206 /VAC-2	A:Health and Wellness B:Understanding India: Indian Philosophycal Traditional and Value System C:Basics of Indian Constitution D:Arts and Crafts of Bengal E:Historical tourism in West Bengal	4	10	40	50	4	NA	NA
Total in Semester-II		**20 + 4**	**60**	**240**	**300**	**16**		**6**
TOTAL IN FIRST YEAR		**40 +4**	**120**	**480**	**600**			

N.B: MJC-Major Paper, MN –Minor Paper; MD –Multidisciplinary Paper, AEC-Ability enhancement course, SEC-Skill enhancement course, VAC-Value added course. Theory:-1Credit=1hour/Week, Practical:-1Credit=2hours/Week, Tutorial:-1Credit = 1hour/Week

***Certificate course in Environmental Science will be awarded to a student if he or she completes Summer Internship of 4 credits in addition to total 40 credits in Semester I & II**

SEMESTER–III

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
S/ENV/301/ MJC-3	Water and Water Resources Water and Water Resources (Practical)	4	10	25 15	50	3	NA	2
S/ENV/ 302/MJC-4	Land and Soil Conservation and Management Land and Soil Conservation and Management (Practical)	4	10	25 15	50	3	NA	2
S/ENV/ 303/MN-3	Water and Water Resources Water and Water Resources (Practical)	4	10	25 15	50	3	NA	2
S/ENV/ 304/MD-3	Gender and Environment	3	10	40	50	2	NA	
S/ENV/ 305/SEC-3	Soil Conservation Management and Ecotourism. Soil Conservation Management and Ecotourism (Practical)	3	10	25 15	50	2	NA	2
ACS/306 /AEC-3	MIL	2	10	40	50	2	NA	NA
Total in Semester-III		**20**	**60**	**240**	**300**	**15**		**8**

N.B.- MN –Minor Paper; MD –Multidisciplinary Paper; Theory: 1Credit=1hour/Week, Practical:-1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1hour/Week

SEMESTER-IV

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
S/ENV/ 401/MJC - 5	Ecology and Ecosystem Ecology and Ecosystem (Practical)	4	10	25 15	50	3	NA	 2
S/ENV/ 402/MJC - 6	Environmental Biotechnology Environmental Biotechnology(Practical)	4	10	25 15	50	3	NA	 2
S/ENV/ 403/MJC - 7	Atmosphere and Global Climate Change Atmosphere and Global Climate Change(Practical)	4	10	25 15	50	3	NA	 2
S/ENV/ 404/MJC - 8	Systematics and Biogeography Systematics and Biogeography (Practical)	4	10	25 15	50	3	NA	 2
S/ENV/ 405/MN-4	Ecology and Ecosystem Ecology and Ecosystem(Practical)	4	10	25 15	50	3	NA	 2
ACS/4 06/AEC-4	MIL	2	10	40	50	2	NA	NA
Total in Semester-IV		**22**	**60**	**240**	**300**	**17**		**10**
TOTAL IN SECOND YEAR		**42**	**120**	**480**	**600**			

N.B:- MJC-Major Paper, MN – Minor Paper; MD– Multidisciplinary Paper ; Theory: 1 Credit= 1 hour/Week, Practical:- 1Credit=2hours/Week, Tutorial:-1Credit=1 hour/Week.* Diploma in Environmental Science will be awarded to a student if he or she completes Summer Internship of 4 credits at least1 in2years in addition to total 82 credits in Semester III & IV

SEMESTER-V

Third Year (Degree in Environmental Science)

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
S/ENV/501/ MJC-9	**Urban Ecosystem** **Urban Ecosystem (Practical)**	4	10	25 15	50	3	NA	 2
S/ENV/502/ MJC-10	**Environmental Legislation and Policy** **Environmental Legislation and Policy(Practical)**	4	10	25 15	50	3	NA	2
S/ENV/503/ MJC-11	**Energy and Environment** **Energy and Environment (Practical)**	4	10	25 15	50	3	NA	2
S/ENV/504/ MJC-12	**Environmental Economics** **Environmental Economics (Practical)**	4	10	25 15	50	3	NA	2
S/ENV/505/ MN-5	**Urban Ecosystem** **Urban Ecosystem (Practical)**	4	10	25 15	50	3	NA	2
S/ENV/506/ SI-1	**Summer Internship**	2	10	40	50	4	NA	4
Total in Semester–V		**22**	**60**	**240**	**300**	**19**		**14**

SEMESTER-VI

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
S/ENV/ 601/MJC-13	**Biodiversity and Conservation** **Biodiversity and Conservation (Practical)**	4	10	25 15	50	3	NA	2
S/ENV/ 602/MJC-14	**Organismal and Evolutionary Biology** **Organismal and Evolutionary Biology (Practical)**	4	10	25 15	50	3	NA	2
S/ENV/ 603/MJC-15	**Natural Hazards and Disaster Management** **Natural Hazards and Disaster Management (Practical)**	4	10	25 15	50	3	NA	2
S/ENV/ 604/MJC-16	**Solid Waste Management** **Solid Waste Management (Practical)**	4	10	25 15	50	3	NA	2
S/ENV/ 605/MN-6	**Biodiversity and Conservation** **Biodiversity and Conservation (Practical)**	4	**10**	25 **15**	**50**	**3**	**NA**	**2**
Total in Semester–VI		**20**	**50**	**200**	**250**	**15**		**10**
TOTAL IN THIRD YEAR		**42**	**110**	**440**	**550**			

SEMESTER-VII

(Fourth Year Honours/ Honours with Research in Environmental Science)

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
S/ENV/ 701/MJC-17	**Environmental Pollution and Human Health** **Environmental Pollution and Human Health (Practical)**	4	10	25 15	50	3	NA	2
S/ENV/ 702/-MJC-18	**Green Technologies** **Green Technologies (Practical)**	4	10	25 15	50	3	NA	2
S/ENV/ 703/MJC-19	**Environmental Statistics** **Environmental Statistics (Practical)**	4	10	25 15	50	3	NA	2
S/ENV/ 704/MJC-20	**Sustainable Development** **Sustainable Development (Practical)**	4	10	25 15	50	3	NA	2
S/ENV/ 705/MN-7	**Environmental Pollution and Human Health** **Environmental Pollution and Human Health (Practical)**	4	10	25 15	50	3	NA	2
Total in Semester – VII		**20**	**50**	**200**	**250**	**15**		**10**

SEMESTER-VII

Major T- 17

ENVIRONMENTAL POLLUTION AND HUMAN HEALTH

(S/ENV/ 701/MJC-17)

Total credit- 04

Course Out come (CO):

To analyze how pollutants affect biodiversity, climate, and ecosystem balance.
To assess the health impacts of pollution, including respiratory diseases, neurological disorders, and waterborne illnesses.
To analyze how pollutants affect biodiversity, climate, and ecosystem balance.
To evaluate the effects of air pollution (e.g., smog, particulate matter, greenhouse gases) on human health and the environment.

Full marks: 25 **Lectures 50**

Unit 1: Introduction (02 Lectures)

Definition of pollution; pollutants; classification of pollutants.

Unit 2: Air pollution (06 Lectures)

Ambient air quality: monitoring and standards (National Ambient Air Quality Standards of India); air quality index; sources and types of pollutants (primary and secondary); smog (case study); effects of different pollutants on human health (NO_x, SO_x, PM, CO, CO_2, hydrocarbons and VOCs) and control measures; indoor air pollution: sources and effects on human health.

Unit 3: Water pollution (06 Lectures)

Sources of surface and ground water pollution; water quality parameters and standards; organic waste and water pollution; eutrophication; COD, BOD, DO; effect of water contaminants on human health (nitrate, fluoride, arsenic, chlorine, cadmium, mercury, pesticides); water borne diseases; concept and working of effluent treatment plants (ETPs).

Unit 4: Soil pollution (05 Lectures)

Causes of soil pollution and degradation; effect of soil pollution on environment, vegetation and other life forms; control strategies.

Unit 5: Noise pollution (05 Lectures)

Noise pollution – sources; frequency, intensity and permissible ambient noise levels; effects on communication, impacts on life forms and humans - working efficiency, physical and mental health; control measures.

Unit 6: Radioactive and thermal pollution (05 Lectures)

Radioactive material and sources of radioactive pollution; effect of radiation on human health (somatic and genetic effects); thermal pollution and its effects.

Unit 7: Marine pollution (05 Lectures)

Marine resources and their importance; sources of marine pollution; oil spill and its effects; coral reefs and their demise; coastal area management; existing challenges and management techniques (planning, construction, environmental monitoring of coastal zones).

Unit 8: Chemistry of environmental pollutants (08 Lectures)

Solubility of pollutants (hydrophilic and lipophilic pollutants), concept of biotransformation and bioaccumulation, concept of radioactivity, radioactive decay and half of pollutants; organometallic compounds, acid mine drainage.

Unit 9: Pollution control (08 Lectures)

Activated Sludge Process (ASP) – Trickling Filters – oxidation ponds, fluidized bed reactors, membrane

bioreactor neutralization, ETP sludge management; digesters, up flow anaerobic sludge blanket reactor, fixed film reactors, sequencing batch reactors, hybrid reactors, bio scrubbers, bio trickling filters; regulatory framework for pollution monitoring and control; case study: implementation of CNG.

Practical: Marks: 15

A) Identification and listing of different types of water and soil pollutants in the locality.
B) Visit and report to study the functioning of water treatment or sewage treatment plant.
C) LC_{50} calculation by probit analysis with data provided (theoretical).

Suggested Readings

1. Gurjar, B.R., Molina, L.T. & Ojha C.S.P. 2010. Air Pollution: Health and Environmental Impacts. CRC Press, Taylor & Francis.
2. Hester, R.E. & Harrison, R.M. 1998. Air Pollution and Health. The Royal Society of Chemistry, UK.
3. Park, K. 2015. Park's Textbook of Preventive and Social Medicine (23rdedition). Banarsidas Bhanot Publishers.
4. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2006. Environmental and Pollution Science. Elsevier Academic Press.
5. Purohit, S.S. & Ranjan, R. 2007. Ecology, Environment & Pollution. Agrobios Publications.
6. Vesilind, P.J., Peirce, J.J., & Weiner R.F. 1990. Environmental Pollution and Control. Butterworth-Heinemann, USA.
7. Saha T.K. 2010. Ecology and Environmental Biology, Books and Allied (P) Ltd. Kolkata. 8. Santra S.C. 2005. Environmental Science, New Central Book Agency (P) Ltd. Kolkata.
9. Environmental Studies—Prof S.V.S Rana.—Rastogi Publication.
10. Text book of Ecology: The Experimental Analysis of distribution & abundance-- (Charles J. Krebs). Pearson Education.

Major T- 18

GREEN TECHNOLOGIES

(S/ENV/702/MJC-18)

Total credit- 04

Course Out come (CO):

To explain the principles of green technologies and their importance in sustainable development.
To evaluate energy-efficient technologies and strategies for reducing energy consumption in industries, buildings, and transportation.
To explore eco-friendly waste management techniques, including waste-to-energy conversion, recycling, and composting.
To understand sustainable industrial processes, green chemistry, and the use of biodegradable and recyclable materials.

Full marks: 25 Lectures 50

Unit 1: Introduction (05 Lectures)

Definition and concepts: green technology, green energy, green infrastructure, green economy, and, green chemistry; sustainable consumption of resources; individual and community level participation such as small scale composting pits for biodegradable waste, energy conservation; encouraged use of public transport instead of private transport.

Unit 2: Green technologies (05 Lectures)

Green technologies in historical and contemporary perspectives; successful green technologies: wind turbines, solar panels; 3 R's of green technology: recycle, renew and reduce; paradigm shift from 'cradle to cradle' to 'cradle to grave'.

Unit 3: Green infrastructure, planning and economy (11 Lectures)
Concept and frame of Green buildings; construction of green buildings; associated costs and benefits; outlined examples of green buildings; LEED certified building. Green planning: role of governmental bodies, land use planning, concept of green cities, waste reduction and recycling in cities, role of informal sector in waste management, public transportation for sustainable development, green belts; Introduction to UNEP's green economy initiative, inclusive economic growth of the society, REDD+ initiative, and cap and trade concept; green banking.

Unit 4: Applications of green technologies (11 Lectures)
Compact fluorescent lights (CFLs), motion detection lighting, or programmable thermostats. Green House Gas (GHG) emissions reduction: carbon capture and storage (CCS) technologies, purchase and use of carbon offsets. Basics of- Pollution reduction and removal, Flue Gas Desulfurization (FGD) methods, catalytic or thermal destruction of NO_X, Fluidized Bed Combustion, Dioxins reduction and removal methods, Thermal Oxidizers or Wet Scrubbers to neutralize chemicals or heavy metals, solvent recovery systems, Low Volatile Organic Compound (VOC) paints and sealers.

Unit 5: Green chemistry (08 Lectures)
Introduction to green chemistry; principles and recognition of green criteria in chemistry; green nanotechnology; reagents, reactions and technologies by green alternatives eg., H_2O_2, TiO_2, Chitin.

Unit 6: Green future (10 Lectures)
Agenda of green development; reduction of ecological footprint; role of green technologies towards a sustainable future; green practices to conserve natural resources (organic agriculture, agroforestry, reducing paper usage and consumption, etc.); development of environmental friendly technologies.

Practical: Marks: 15
Submit a project report related to green technologies.

Suggested Readings
1. Anastas, P.T. & Warner, J.C. 1998. Green Chemistry: Theory & Practice. Oxford University Press.
2. Arceivala, S.L. 2014. Green Technologies: For a Better Future. Mc-Graw Hill Publications.
3. Baker, S. 2006. Sustainable Development. Routledge Press.
4. Hrubovcak, J., Vasavada, U. & Aldy, J. E. 1999. Green technologies for a more sustainable Agriculture (No. 33721). United States Department of Agriculture, Economic Research Service.
5. Thangavel, P. & Sridevi, G. 2015. Environmental Sustainability: Role of Green Technologies. Springer Publications.
6. Woolley, T. & Kimmins, S. 2002. Green Building Handbook (Volume 1 and 2). Spon Press.

Major T- 19

ENVIRONMENTAL STATISTICS
(S/ENV/703/MJC-19)

Total credit- 04

Course Out come (CO):
To understand key statistical concepts and their applications in environmental science and ecological research.
To use statistical tools to summarize, interpret, and infer conclusions from environmental data sets.
To apply regression models and correlation techniques to study relationships between environmental

variables.
To conduct hypothesis testing and confidence interval estimation for environmental studies and policy-making.

Full marks: 25 Lectures 50

Unit-1: Introduction to Environmental Statistics (05 Lectures)
Importance of statistics in environmental science, Types of environmental data (spatial, temporal, qualitative and quantitative), Sources of environmental data (satellite, field measurements, surveys).
Unit-2: Descriptive Statistics (05 Lectures)
Measures of central tendency (mean, median, mode), Measures of dispersion (variance, standard deviation and range), Data visualization (histograms, box plots and scatter plots).
Unit-3: Probability Theory & Distributions (05 Lectures)
Basics of probability theory, Common probability distributions (Normal, Poisson and Binomial), Applications in environmental science (e.g., pollution concentration and species distribution).
Unit-4: Sampling & Data Collection (05 Lectures)
Sampling methods (random, stratified and systematic), Sample size determination, Bias in environmental data collection.
Unit-5: Hypothesis Testing & Inferential Statistics (05 Lectures)
Confidence intervals, t-tests, ANOVA, chi-square tests, Environmental applications (e.g., testing pollution levels).
Uniot-6: Regression & Correlation Analysis (05 Lectures)
Simple and multiple linear regressions, Correlation analysis, Case studies on environmental modeling.
Unit-7: Spatial Statistics & GIS Applications (07 Lectures)
Geostatistics and spatial autocorrelation, Geographic Information Systems (GIS) in environmental analysis, Kriging and spatial interpolation.
Unit- 8: Multivariate Statistical Methods (07 Lectures)
Principal Component Analysis (PCA), Cluster analysis, Factor analysis in environmental studies.
Unit-9: Risk Assessment & Environmental Decision Making (06 Lectures)
Uncertainty analysis, Monte Carlo simulations, Case studies on risk assessment (e.g., water contamination and air pollution).

Practical:
Full marks: 15, Credit 02

a. Problems based on measures of central tendency.
b. Application based problems using normal distribution.
c. Simple Linear Regression.
d. Tests for Linear Hypothesis

Suggested Readings:
1. S. C. Gupta and V. K. Kapoor. 1986. Fundamentals of Mathematical Statistics. S. Chand & Co.
2. Aslam Mahmood. 1993. Statistical Methods in Geographical Studies. Rajesh Publications, New Delhi.
3. J.Medhi. Statistical Methods: 1992. An Introductory Text. New Age International Ltd. Publishers.
4. Gupta, S. P. 2000. Statistical Methods. Sultan Chand & Sons, New Delhi.
5. Bio-statistic: A Foundation for analysis in the health sciences : Wayne W – Daniel John Wiley and sons Inc.
6. Survival models and data analysis: Elandt – Johnson and Johnson, John Wiley and sons Inc. 2003.
7. Statistical Method for the analysis of Biomedical data: Wool son John wiley and Sons Inc.
8. Statistical Methods for Environmental and Agricultural Sciences A – Reza Horseman
CRC Press Boca Raton Network.
9. Text book of Environmental Engineering: P. Venugopala Rao, Prentice – Hall of India Pvt. Ltd. Delhi.
10. Computer Fundamental: P. K. Sinha, BPB Publications, New Delhi.
11. Digital Computer fundamentals: Thomas C. Bastee, Mc Graw Hall international book Company Tollyo.

12. Mathematical models in Biology and Medicine: J. N. Kapur, Affiliated East-west Press Pvt. Ltd., Bangalore.

Major T- 20

Sustainable Development

(S/ENV/704/MJC- 20)

Total credit- 04

Course Out come (CO):

.To explain the concept, principles, and dimensions of sustainable development
.To describe sustainability challenges at local and global levels
.To evaluate conservation strategies
.To explain principles of sustainable agriculture and agro-ecosystems

Full marks: 25 Lectures 50

Unit 1: Fundamentals of Sustainable Development (12 Lectures)

The conflicts between Environment and development. The definition and genesis of the term Sustainable Development. Brudtlands' Commission Report. The need for sustainable development. The role of World Commission on Environment and Development in conceiving the concept of sustainable development.

Unit 2: The Sustainability Science (10 Lectures)

Concept of sustainability. Introduction to deep ecology and shallow ecology. Development and conflicts among weak and strong sustainability concepts. Development of concept of carrying capacity of the earth and ecological footprints. Sustainability Index.

Unit 3: Global efforts for Sustainable development (12 Lectures)

Rio Summit and sustainable development. 27 Principles of sustainable development. Role of International Chamber of Commerce (ICC) in promotion of sustainable development. Business Charter. Role of UNDP, UNFAO, UNHCR, WMF, AWB in promotion of sustainable development. The evolution through decades: Millennium Ecosystem Assessment, Millennium Development Goals (2000 -2015) and Sustainable Development Goals (2016 -2030).

Unit 4: Sustainable Urban Development (08 Lectures)

The problems of urban area: urban sprawls, slums, urban heat islands. Sustainable urban planning. Urban resource management, urban waste disposal and ways of recycling.

Unit 5: Sustainable Agriculture (08 Lectures)

Concept of sustainable agriculture. Green revolution and its environmental impacts. Concept of Green farming. Drip irrigation, No tillage agriculture, Integrated Pest Management.

PRACTICAL:
Full marks: 15, Credit 02

1. Poster or Model presentation on any aspect of sustainable development.
2. Preparation of rural / urban survey report on any aspect of sustainable development.

Suggested Readings:

1. Our Common Future - World Commission on Environment and Development. Oxford University Press.
2. Sustainable Development — C. J. Barrow. Routledge.

3. Introduction to Sustainable Development — Susan Baker: Routledge.
4. The Sustainability Revolution — Andres R. Edwards. New Society Publishers.
5. Environmental Studies — Erach Bharucha.Universities Press (India).
6. Fundamentals of Ecology — Eugene P. Odum & Gary W. Barrett.Brooks/Cole (Cengage Learning).
7. Agroecology: The Ecology of Sustainable Food Systems — Stephen R. Gliessman.CRC Press
8. Sustainable Agriculture — G. P. Obi Reddy. Scientific Publishers (India).
9. Organic Farming for Sustainable Agriculture — N. K. Fageria. CRC Press.
10. *Environmental Economics — Nick Hanley, Jason F. Shogren & Ben White.* Oxford University Press
11. Human Development Report — United Nations Development Programme. UNDP.

Minor T-7

ENVIRONMENTAL POLLUTION AND HUMAN HEALTH

(S/ENV/705/MN-7)

Total credit -04

Course Out come (CO):

To analyze how pollutants affect biodiversity, climate, and ecosystem balance.
To assess the health impacts of pollution, including respiratory diseases, neurological disorders, and waterborne illnesses.
To analyze how pollutants affect biodiversity, climate, and ecosystem balance.
To evaluate the effects of air pollution (e.g., smog, particulate matter, greenhouse gases) on human health and the environment.

Full marks: 25 **Lectures 50**

Unit 1: Introduction **(02 Lectures)**

Definition of pollution; pollutants; classification of pollutants.

Unit 2: Air pollution **(06 Lectures)**

Ambient air quality: monitoring and standards (National Ambient Air Quality Standards of India); air quality index; sources and types of pollutants (primary and secondary); smog (case study); effects of different pollutants on human health (NO_x, SO_x, PM, CO, CO_2, hydrocarbons and VOCs) and control measures; indoor air pollution: sources and effects on human health.

Unit 3: Water pollution **(06 Lectures)**

Sources of surface and ground water pollution; water quality parameters and standards; organic waste and water pollution; eutrophication; COD, BOD, DO; effect of water contaminants on human health (nitrate, fluoride, arsenic, chlorine, cadmium, mercury, pesticides); water borne diseases; concept and working of effluent treatment plants (ETPs).

Unit 4: Soil pollution **(05 Lectures)**

Causes of soil pollution and degradation; effect of soil pollution on environment, vegetation and other life forms; control strategies.

Unit 5: Noise pollution **(05 Lectures)**

Noise pollution – sources; frequency, intensity and permissible ambient noise levels; effects on communication, impacts on life forms and humans - working efficiency, physical and mental health; control measures.

Unit 6: Radioactive and thermal pollution **(05 Lectures)**

Radioactive material and sources of radioactive pollution; effect of radiation on human health (somatic and genetic effects); thermal pollution and its effects.

Unit 7: Marine pollution (05 Lectures)

Marine resources and their importance; sources of marine pollution; oil spill and its effects; coral reefs and their demise; coastal area management; existing challenges and management techniques (planning, construction, environmental monitoring of coastal zones).

Unit 8: Chemistry of environmental pollutants (08 Lectures)

Solubility of pollutants (hydrophilic and lipophilic pollutants), concept of biotransformation and bioaccumulation, concept of radioactivity, radioactive decay and half of pollutants; organometallic compounds, acid mine drainage.

Unit 9: Pollution control (08 Lectures)

Activated Sludge Process (ASP) – Trickling Filters – oxidation ponds, fluidized bed reactors, membrane bioreactor neutralization, ETP sludge management; digesters, up flow anaerobic sludge blanket reactor, fixed film reactors, sequencing batch reactors, hybrid reactors, bio scrubbers, bio trickling filters; regulatory framework for pollution monitoring and control; case study: implementation of CNG.

Practical:

Marks: 15

A) Identification and listing of different types of water and soil pollutants in the locality.

B) Visit and report to study the functioning of water treatment/sewage treatment plant.

C) LC_{50} calculation by probit analysis with data provided (theoretical).

Suggested Readings

1. Gurjar, B.R., Molina, L.T. & Ojha C.S.P. 2010. *Air Pollution: Health and Environmental Impacts*. CRC Press, Taylor & Francis.
2. Hester, R.E. & Harrison, R.M. 1998. *Air Pollution and Health*. The Royal Society of Chemistry, UK.
3. Park, K. 2015. *Park's Textbook of Preventive and Social Medicine* (23rdedition). Banarsidas Bhanot Publishers.
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