COURSES OF STUDIES

FOR

THREE YEAR BACHELOR DEGREE COURSE IN

ENVIRONMENTAL SCIENCE HONOURS

DEPARTMENT OF ENVIRONMENTAL SCIENCE

Choice Based Credit System (CBCS)

First & Second Semester Examination–2023-24

Third & Fourth Semester Examination–2024-25

Fifth & Sixth Semester Examination – 2025-26

GOVERNMENT AUTONOMOUS COLLEGE, PHULBANI, KANDHAMAL-762001

DEPARTMENT OF ENVIRONMENTAL SCIENCE

Vision :

Empowering and emancipating students through an understanding of the environment, sustainability and related ethical issues.

Mission :

Our mission is to develop environmentally conscious citizens who are able to appreciate the environment in its totality. We strive to equip our students with motivation, attitude, sound knowledge, commitment and skills to actively participate, at various levels, in sustainably managing environmental issues.

PREAMBLE

The course curriculum for undergraduate studies under choice based credit system (CBCS) for B.Sc. in Environmental Science (Hons.) is framed in this document. This exercise is a step forward to implement nationwide curriculum restructuring initiative by the National Education Policy-2020. Many formal and informal meetings were held with a number of colleagues from the universities and colleges, who helped with crucial inputs as to the content of the course. This curriculum is a fresh exercise, but also represents a continuous effort of deliberations with the University and College teachers. In view of future implementation of National Education Policy-2020, this course curriculum for undergraduate studies under Choice Based Credit System (CBCS), the main objective of framing this curriculum of B.Sc. (Hons.) in Environmental Science is to impart the students a holistic understanding of the subject giving substantial weightage to the core contents, skill, value-based and ability enhancement. The syllabus has given due importance on the main streams of the body of knowledge on 'Environment' with due recognition of its wide spectrum. The ultimate goal of the syllabus is to enable the students to have an in-depth knowledge on the subject and enhance their scope of employment at every level of exit. Adequate emphasis has been given on the new and emerging techniques and understanding of the subject under the changing regime and global context. There is need to strengthen the students to understand essential aspects of Environmental Science in diverse subject areas such as ecology, environmental chemistry, environmental pollution, environmental geo-science, atmospheric sciences, biodiversity, natural resources management, global warming, climate change and waste management. The curriculum lays focus on creating new knowledge, acquiring new skills and capabilities in Environmental Science producing an intelligent human resource serving the Environment and society, focusing on problem solving critical thinking, teamwork and collaboration. There is also an additional emphasis in providing opportunities to understand the integration of modern disciplines such as environmental modeling, geographical information systems and remote sensing, environmental sustainability, corporate governance and their applications to environmental sciences. Students would be encouraged to go beyond the classroom and conduct active action-research, research projects, technology based learning and internships in industry/private/government/manufacturing and service sectors based on suitability. Lectures and classroom sessions are accompanied with on-field visits, industrial visits, seminars, laboratory experiments and in-plant training. Educational visits are an integral part of teaching Environmental Science. These interventions are compulsory and essential aspects of the curriculum. There are optional subject that can be chosen by the students as per their desire and their professional choices. It is hoped that a student with a three years B.Sc. Environmental Science (Hons.) degree, after having the rigor of the courses outlined here, will feel adequately equipped to meet the challenges of career development. At the same time, there is sufficient content for those who wish to continue academic life at the University beyond the under-graduate level. Due care has been taken to maintain necessary

academic wholesomeness and depth in the course content so that the learning out comes from these courses will lead to intellectual growth of a student. There is a demand for the subject in our country and as Educationists we have a societal obligation to meet such aspirations of the youths. It is equally expected that Environmental Science graduates will significantly contribute to the vision of' Zero Defect, Zero Effect' policy initiative of Government of India. The credits will be distributed as 14 papers constituting Core Courses, 4 papers of Discipline Specific Elective, 4 papers comprising Generic Elective Courses, 3 papers of Ability Enhancement Courses, comprising of 1 language, 2 Skill based and 8 Value based as Skill Enhancement Courses, and 1 Research Project cum Dissertation. Courses on Environmental Science are included as per the earlier UGC directives.

UGC guidelines are as follows :

1. To ensure the interdisciplinary spirit of the proposed curriculum, teaching must be carried out by the faculty with M.Sc. in Environmental Science and or Ph.D. Degree in the 'Environmental Science' subject. A candidate who is qualified with UGC-NET/ICAR-NET in the area of Environmental Science will be well-equipped to teach this curriculum.

2. Further, the existing number of UGC NET Fellowships in the field of Environmental Sciences is highly inadequate; it is proposed to increase the number of Fellowships in this area. An Environmental Science programme at the undergraduate level will be successful only when independent Department of Environmental Science is established at under-graduate colleges. It is important to avoid existing problem, soft co-ordination in teaching carried out through participatory approach. NEP-2020 committee may like to pursue the matter with Universities/Colleges and take necessary steps in this direction.

Program Educational Objectives (PEOs): B.Sc. (H.) Environmental Science

PEO 1 : Investigate the complexities of the natural environment and our relationship with it.

PEO 2 : Explore the problems we face in understanding our natural environment and sustainable development.

PEO 3 : Develop scientific, interpretive, innovative and creative thinking skills to manage global, national and local environmental problems.

PEO 4 : Learn to reduced carbon footprint through creative and field research techniques.

PEO 5 : Use of survey methods, biodiversity assessment, emission inventory etc. by using primary data and *in Silico* tools and/ or geo informatics to study environmental change.

Programme Outcomes

By the end of the Programme the students will be able to develop:

PO 1 : Multidisciplinary knowledge related to catering to *environmental sustainability*

PO 2 : Systemic and *critical thinking* with reference to environment-people-economic development attributes

PO 3 : Problem identification *skills and sustainable* solution provisioning

PO 4 : *Self-directed learning* efficiencies leading to a productive lifelong learning process to maintain a green life style.

PO 5 : Research related skills such as review of literature, *Reflective thinking*, design of experiments, assignment, projects, *social interaction*, report writing and prepare target specific communication packages

Programme Specific Outcomes

PSO 1 : To develop competency in understanding the interrelatedness of the divisions of the Environmental Science.

PSO 2 : To instill knowledge of the divisions of Environment and development, enabling students to be employed in various positions in the academia, industry and government and non-government institutions as skilled manpower.

PSO 3 : To motivate and inspire to acquire contemporary understanding and skills leading to environmental issue identification.

PSO 4 : To inculcate creativity and innovative spirit in the domain of human-environment interface leading to vocation / entrepreneurial opportunities

PSO 5 : The learners will be able to become effective scientific communicators/collaborators in multidisciplinary teams providing technical leadership to engage with the challenging environmental problems of local, national and global nature.

SYLLABI FOR CBCS COURSE

Sem.	CORE COURESE (14)	Ability Enhancement Compulsory Course(AECC) (2)	Ability Enhancement Elective Course (AEEC) (2) (Skill Based)	Elective: Discipline Specific DSE (4)	Elective: Generic (GE) (4)
I	C-I	AECC-I			GE-IA
	C-II	AECC-III (EV-I)			
II	C-III	AECC-II			GE-IB
	C-IV	AECC-III (EV-II)			
III	C-V	AECC-III (EV-III)	SEC-I (QLT)		GE-IIA
	C-VI				
	C-VII				
IV	C-VIII	AECC-III (EV-IV)	SEC-II (CE)		GE-IIB
	C-IX				
	C-X				
V	C-XI	AECC-III (EV-V)		DSE-I	
	C-XII			DSE-II	
VI	C-XIII	AECC-III (EV-VI)		DSE-III	
	C-XIV			DSE-IV (OR) PROJECT	

DISTRIBUTION OF MARKS

Paper with Practical	
Mid Semester (15 Marks)	
Two questions to be answered carrying 1 mark each	2X1 mark = 2 marks
Two questions to be answered carrying 1.5 marks each	2X1.5 marks = 3 marks
Two questions to be answered carrying 2 marks each	2X2 marks = 4 marks
One question to be answered carrying 6 marks each	1X6 marks = 6 marks
End Semester (60 Marks)	
Eight questions to be answered carrying 1 mark each	8X1 mark = 8 marks
Eight questions to be answered carrying 1.5 marks each	8X1.5 marks = 12 marks
Eight questions to be answered carrying 2 marks each	8X2 marks = 16 marks
Four questions to be answered carrying 6 marks each	4X6 marks = 24 marks
Paper without Practical	
Mid Semester (20 Marks)	
Three questions to be answered carrying 1 mark each	3X1 mark = 3 marks
Two questions to be answered carrying 2 marks each	2X2 marks = 4 marks
Two questions to be answered carrying 3 marks each	2X3 marks = 6 marks
One question to be answered carrying 7 marks each	1X7 marks = 7 marks
End Semester (80 Marks)	
Twelve questions to be answered carrying 1 mark each	12X1 mark = 12 marks
Eight questions to be answered carrying 2 marks each	8X2 marks = 16 marks
Eight questions to be answered carrying 3 marks each	8X3 marks = 24 marks
Four questions to be answered carrying 7 marks each	4X7 marks = 28 marks

Three-Year (6-Semester) CBCS Programme (B.Sc. Hons) Environmental Science				
Yr.	Sl. No.	**Course Structure**	**Code**	**Credit Points**
FIRST YEAR		**SEMESTER-I**		
	1	Earth and earth surface processes	C-1.1	4+2
	2	Physics and Chemistry of Environment	C-1.2	4+2
	3	Environment and Society	GE-1.3	4+2
	4	Environmental Studies & Disaster Management	AECC-1.4	4
	5	Ethics & Values (Unit-I)	AECC-1.5	1
		SEMESTER-II		
	6	Water and water resources	C-2.1	4+2
	7	Land and soil conservation and management	C-2.2	4+2
	8	Human-Wildlife Conflict and Management	GE-2.3	4+2
	9	MIL Communication – Odia / MIL (AE)/ Environmental Studies & Disaster Management (AECC)	AECC-2.4	4
	10	Ethics & Values (Unit-II)	AECC-2.5	1
SECOND YEAR		**SEMESTER-III**		
	11	Ecology and Ecosystems	C-3.1	4+2
	12	Environmental Biotechnology	C-3.2	4+2
	13	Atmosphere and global climate change	C-3.3	4+2
	14	Gender and environment	GE-3.4	4+2
	15	Quantitative & Logical Thinking	SECC-I-3.5	4
	16	Ethics & Values (Unit-III)	AECC-3.6	1
		SEMESTER-IV		
	17	Systematics and biogeography	C-4.1	4+2
	18	Urban ecosystems	C-4.2	4+2
	19	Environmental legislation and policy	C-4.3	4+2
	20	Green technologies (Theory) Green technologies (Practical/Tutorial)	GE-4.4	4+2
	21	Communicative English	SECC-II-4.5	4
	22	Ethics & Values (Unit-IV)	AECC-4.6	1
FINAL YEAR		**SEMESTER-V**		
	23	Biodiversity and conservation	C-5.1	4+2
	24	Organismal and evolutionary biology	C-5.2	4+2
	25	Energy and environment	DSE-5.3	4+2
	26	Environmental Economics (Practical/Tutorial)	DSE-5.4	4+2
	27	Ethics & Values (Unit-V)	AECC-5.5	1
		SEMESTER-VI		
	28	Environmental pollution and human health	C-6.1	4+2
	29	Natural resource management and sustainability	C-6.2	4+2
	30	Hazards and Disaster Risk Assessment	DSE-6.3	4+2
	31	Solid waste management (Theory/Practical)	DSE-6.4	4+2
		Or, Project-cum-Dissertation	DSE-6.4	6
	32	Ethics & Values (Unit-VI)	AECC-6.5	1

COURSE STRUCTURE OF UG ENVIRONMENTAL SCIENCE HONOURS

SEM.	COURSE	COURSE NAME	CREDITS	MARKS
I	AECC-I	Environmental Studies and Disaster Management	04	100
	AECC-III	Ethics and Values (Unit-I)	01	25
	C-I (Theory) C-I (Practical/ Assignment)	Earth and earth surface processes	04 02	75 25
	C-II(Theory) C-II (Practical)	Physics and chemistry of Environment	04 02	75 25
	GE-I	Environment and Society	06	100
II				
	AECC-III	Ethics and Values (Unit-II)	01	25
	C-III(Theory) C-III(Practical)	Water and water resources	04 02	75 25
	C-IV(Theory) C-IV (Practical)	Land and soil conservation and management	04 02	75 25
	GE-II	Human-Wildlife Conflict and Management	06	100
III	AECC-III	Ethics and Values (Unit-III)	01	25
	C-V (Theory) C-V(Practical)	Ecology and ecosystems	04 02	75 25
	C-VI(Theory) C-VI (Practical)	Environmental biotechnology	04 02	75 25
	C-VII(Theory) C-VII (Practical)	Atmosphere and global climate change	04 02	75 25
	GE-III	Gender and environment	06	100
	SEC-I	QLT	04	100
IV	AECC-III	Ethics and Values (Unit-IV)	01	25
	C-VIII(Theory) C-VIII (Practical)	Systematics and biogeography	04 02	75 25
	C-IX(Theory) C-IX (Practical)	Urban ecosystems	04 02	75 25
	C-X	Environmental legislation and policy	06	100
	GE-IV(Theory) GE-IV(Practical)	Green technologies (Theory) Green technologies (Practical/Tutorial)	04 02	75 25
	SEC-II	CE	04	100
V	AECC-III	Ethics and Values (Unit-V)	01	25
	C-XI(Theory) C-XI (Practical)	Biodiversity and conservation	04 02	75 25
	C-XII(Theory) C-XII (Practical)	Organismal and evolutionary biology	04 02	75 25
	DSE-I	Energy and environment	06	100
	DSE-II(Theory) DSE-II(Practical)	Environmental Economics (Practical/Tutorial)	04 02	75 25

VI	AECC-III	Ethics and Values (Unit-VI)	01	25
	C-XIII(Theory) C-XIII (Practical)	Environmental pollution and human health	04 02	75 25
	C-XIV	Natural resource management and sustainability	06	100
	DSE-III(Theory) DSE-III (Practical)	Hazards and Disaster Risk Assessment	04 02	75 25
	DSE-IV(Theory) DSE-IV (Practical)	Solid waste management	04 02	75 25
	(OR)			
	DSE-IV	Project-cum-Dissertation	06	100*

Discipline Specific Elective Papers: (Credit:06 each) (4 papers to be selected by students of Environmental Science Honours): DSE I-IV

1. Energy and environment
2. Environmental economics
3. Hazards and Disaster Risk Assessment
4. Solid waste management
5. *Dissertation on Solid waste management/Environmental Pollution (can be opted as alternative of DSE-IV only and of 6 credits. **Dissertation content: 50, Seminar: 30, Viva Voce: 20)**

Notes:

- C- Core Course
- GE- Generic Elective Course
- DSE- Discipline Specific Elective Course
- AECC- Ability Enhancement Compulsory Course
- SEC- Skill Enhancement Course (Skill Based)
- For a 6 credit course, the total teaching hours are: Minimum- 50 Hours, Maximum- 65 Hours

ENVIRONMENTAL SCIENCE HONOURS

HONOURS PAPERS:

Core Paper–14 papers
Discipline Specific Elective –4 papers
Generic Elective for non Environmental Science students– 4 papers.
Incase University offers 2 subjects as GE, then papers 2 and 4 will be the GE paper.

SEMESTER-I

C-1.1 : EARTH AND EARTH SURFACE PROCESSES

Full Marks: 100
Mid Sem 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

Objective: This course introduces basic structure and composition of the Earth and various surface processes and their impact on living systems.

UNIT 1: Origin of Earth and System Processes

Solar system formation and planetary differentiation; formation of the Earth: formation and composition of core, mantle, crust; chemical composition of Earth; geological times cale and major changes on the Earth's surface; Holocene and the emergence of humans. Concept of plate tectonics and continental drift theory, continental collision and formation of the Himalaya; ocean floor spreading; mantle convection and, major plates; earthquakes; volcanic activities; orogeny; isostasy; gravitational and magnetic fields of the earth; paleontological evidences of plate tectonics.

UNIT 2: Minerals and Rocks

Minerals and important rock forming minerals; rock cycle: lithification and metamorphism; Three rock laws; rock structure, igneous, sedimentary and metamorphic rocks; weathering: physical, biogeochemical processes; erosion: physical processes of erosion, factors affecting erosion; agents of erosion: rivers and streams, glacial and aeolian transportation and deposition of sediments by running water, wind and glaciers.

UNIT 3: Earth Surface Processes

Atmosphere: evolution of earth's atmosphere, composition of atmosphere, physical and optical properties, circulation; interfaces: atmosphere–ocean interface, atmosphere–land interface, ocean–land interface; land surface processes: fluvial and glacial processes, rivers and geomorphology; types of glaciers, glacier dynamics, erosional and depositional processes and glaciated landscapes; coastal processes.

UNIT 4: Importance of Being a Mountain

Formation of Peninsular Indian mountain systems - Western and Eastern Ghats, Vindhyas, Aravallis, etc. Formation of the Himalaya; development of glaciers, perennial river systems and evolution of monsoon in Indian subcontinent; formation of Indo-Gangetic Plains, arrival of humans; evolution of Indus Valley civilization; progression of agriculture in the Indian subcontinent in Holocene; withdrawing monsoon and lessons to draw.

Course Outcomes:

CO1: This paper enlightens and trained students about different aspects of origin and different processes of Earth surface along with different mineral composition and a brief account on mountains.

CO 2 : Students will be able to Analyze formation of Solar System, Earth, Atmosphere & Hydrosphere through study of Solar System and history of Earth.

CO 3 : Students will be able to Analyze role of Plate Tectonics in Various Earth Surface Processes.

CO 4 : Create in student's ability to understand about changes in Earth's history with time.

CO 5 : Students will be able to Evaluate the role of different types of Rocks in Rock Cycle and significance of Weathering and Erosion over Earth Surface.

CO 6 : Students will Evaluate the role of Atmosphere - Ocean, Atmosphere- Land & Ocean-Land Interface in Earth

Practical/Assignment : Based on the theory/fieldwork.

1. Identification properties of Minerals.
2. Description of major rock forming Minerals.
3. Identification properties of Rocks
4. Collection of different types of rocks
5. Collection of different sized weathering product of soil.
6. Description of Rocks.
7. Identification and description of major mountain of India.
8. Western Ghats and Indian Monsoon
9. Role of Arravalies in That Desert formation
10. Structure and impact of the Himalayas to Indian climate systems

Text Books:

- Keller, E.A.2011. *Introduction to Environmental Geology* (5thedition). Pearson Prentice Hall.
- Krishnan, M.S. 1982. *Geology of India and Burma*. CBS Publishers & Distributors.

Reference Books:

- Bridge, J. & Demicco, R. 2008. *Earth Surface Processes, Land forms and Sediment deposits*. Cambridge University Press.
- Duff, P.M.D. and Duff, D.(Eds.).1993.*Holmes' Principles of Physical Geology*. Taylor & Francis.
- Gupta, A.K., Anderson, D.M., & Over peck, J.T.2003. Abrupt changes in the Asian southwest monsoon during the Holocene and their links to the North

Atlantic Ocean. *Nature* 421: 354-357.

- Gupta, A.K., Anderson, D.M., Pandey, D.N., & Singhvi, A.K. 2006. Adaptation and human migration, and evidence of agriculture coincident with changes in the Indian summer monsoon during the Holocene. *Current Science* 90: 1082-1090.
- Leeder, M., & Arlucea, M.P. 2005. *Physical Processes in Earth and Environmental Sciences.* Blackwell Publishing.
- Pelletier, J.D. 2008. *Quantitative Modeling of Earth Surface Processes* (Vol.304). Cambridge: Cambridge University Press. Chicago.

C-1.2 : PHYSICS AND CHEMISTRY OF ENVIRONMENT

Full Marks: 100
Mid Sem 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

Objective: This course build on conceptual understanding of students on basic principles behind various environmental processes.

UNIT 1: Fundamentals of Environmental Physics

Basic concepts of light and matter; quantum mechanics (relation between energy, wavelength and frequency), black body radiation, Kirchhoff's law, Stephan-Boltzmann equation, Wein's Displacement law, spectro-photometric concepts: absorption and transmission of light, Beer–Lambert law, scattering flight, Rayleig hand Miescattering; photoelectric effect and solar photovoltaic cells. Basic concepts of pressure, force, work and energy; types of forces and their relation (pressure gradient, viscous, Coriolis, gravitational, centripetal, and centrifugal force).

UNIT 2: Movement of Pollutants in Environment

Concepts of diffusion and dispersion, point and area source pollutants, pollutant dispersal; Gaussian plume model, hydraulic potential, Darcy's equation, types of flow, turbulence. Concept of heat transfer, conduction, convection; concept of temperature, lapse rate (dry and moist adiabatic); mixing heights, laws of thermodynamics; concept of heat and work, Carnot engine, transmission of electrical power, efficiency of turbines, wind mills and hydroelectric power plants.

UNIT 3: Fundamentals of Environmental Chemistry

Atomic structure, electronic configuration, periodic properties of elements; types of chemical bonds; mole concept, molarity and normality; quantitative volumetric analysis. Thermodynamic systems; acid-base theories and salts, solubility products; redox reactions; concepts of pH and pE, concept of buffer, Henderson-Hasselbalch equation; electrochemistry, Nernst equation, electrochemical cells. Basic concepts of organic chemistry, hydrocarbons, aliphatic and aromatic compounds, polarity of the functional groups, synthesis of xenobiotic compounds like pesticides and dyes, synthetic polymers.

UNIT 4: Air, Water and Soil Chemistry

Structure and composition of atmosphere; photochemical reactions in atmosphere; smog: classical smog and photochemical smog, aerosols: PM 10, PM 2.5; chemistry of acid rain, case studies; ozone chemistry and ozone layer depletion, role of CFCs in ozone depletion. Physico- chemical properties of water; alkalinity and acidity of water, hardness of water, solubility of gases in water, metal complex formation and chelation; heavy metals in water. Soil composition; relation between organic carbon and organic matter, inorganic and organic components in soil; soil humus; cation exchange reactions in soil; NPK in soil.

Course Outcomes :

CO 1 : Develop in depth knowledge about estimation of various Water Quality Parameters.
CO 2 : Develop practical knowledge on Measurement of soil parameters.
CO 3 : Gain knowledge about Identification of Minerals
CO 4 : Gain knowledge about Identification of Rocks
CO 5 : Develop knowledge on Preparation of Herbarium and its Documentation.

Practical's: Based on the theory.

1. Sampling technique of water
2. Determination of pH – pH metric method
3. Determination of Electrical Conductance – Conductivity meter method
4. Estimation of Turbidity – Nephelometric method
5. TS, TSS & TDS – Gravimetric and Filtration method 6. Estimation of Acidity – Alkalimetric method / CO2 – NaOH titration method
6. Estimation of Alkalinity – Acidimetric method
7. Estimation of Hardness – EDTA Complexometric method
8. Estimation of Chlorides – Argentometric method 10. Estimation of Dissolved Oxygen – Modified Winkler's method
9. Estimation of Nitrates – Phenoldisulfonic Acid method
10. Estimation of Fluorides – Fluoride meter method/SPADNS Reagent method
11. Estimation of Sulphates – Barium chloride method

Text Books:

- Forinash, K. 2010. *Foundation of Environmental Physics*. Island Press.
- Pani, B.2007. *Textbook of Environmental Chemistry*. IK international Publishing House.

Reference Books:

- Beard, J.M. 2013. *Environmental Chemistry in Society* (2nd edition). CRC Press.
- Boeker, E. & Grondelle, R. 2011. *Environmental Physics: Sustainable Energyand Climate Change*. Wiley.
- Connell, D.W. 2005. *Basic Concepts of Environmental Chemistry* (2nd edition).CRC Press.
- Girard, J.2013. *Principles of Environmental Chemistry* (3rd edition). Jones & Bartlett.
- Harnung, S.E. & Johns on, M.S.2012. *Chemistry and the Environment*. Cambridge University Press.
- Hites, R.A.2012. *Elements of Environmental Chemistry* (2nd edition).Wiley & Sons.
- Manhan, S.E. 2000. *Fundamentals of Environmental Chemistry*.CRC Press.

Generic Elective Paper II

GE-1.3 : ENVIRONMENT AND SOCIETY

Full Marks: 100
Mid Sem 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

Objective: The course examines the relationship between the environment and society enabling the students to understand and appreciate the role played by environment, society, and, their interface in shaping environmental decisions. The students will be enabled to thinkcritically on environmental issues. Tutorials are basically MCQ type or Quiz.

UNIT 1: Development-environment conflict

Social and cultural construction of 'environment'; environmental thought from historical and contemporary perspective in light of the concepts of Gross Net Happiness and Aldo Leopold's Land Ethic. Developmental issues and related impacts such as ecological degradation; environmental pollution; development-induced displacement, resettlement, and rehabilitation: problems, concerns, and compensative mechanisms; discussion on Project Affected People (PAPs).

UNIT 2: Urbanization and environment

Production and consumption oriented approaches to environmental issues in Indian as well as global context; impact of industry and technology on environment; urban sprawl, traffic congestion and social-economic problems; conflict between economic and environmental interests.

UNIT 3: Environment, social in equalities and regulatory framework

Inequalities of race, class, gender, region, and nation-state in access to healthy and safe environments; history and politics surrounding environmental, ecological and social justice; environmental ethics, issues and possible solutions.

Regulatory framework: Brief account of Forest Conservation Act 1980 1988; Forest Dwellers Act2008; Land AcquisitionAct1894, 2007, 2011, 2012; Land Acquisition Rehabilitation and Resettlement Act 2013.

UNIT 4: Community participation

State, corporate, civil society, community, and individual-level initiatives to ensure sustainable development; case studies of environmental movements (Appiko Movement, Chipko Movement, Narmada Bachao Andolan); corporate responsibility movement; appropriate technology movement; environmental groups and movements, citizen groups; role played by NGOs; environmental education and awareness.

Outcomes: This paper emphasizes on various aspects of conflict between development and environment, urbanization and environment and how community participation affects these conflicts on a social platform.

Practical: Based on the theory/field work.

Text Books:

- Elliot, D.2003. *Energy, Society and Environment, Technology for a Sustainable Future*. Routledge Press.

Reference Books:

- Chokkan, K.B., Pandya, H. & Raghunathan, H. (eds). 2004.*Understanding Environment*. Sagar Publication India Pvt. Ltd., New Delhi.
- Guha, R.1989. *Ecological change and peasantresistancein the Himalaya*. Unquiet Woods, Oxford University Press, Delhi.
- Leopold,A.1949.*TheLandEthic*.pp.201-214.Chicago, USA.
- National Research Council (NRC).1996. *Linking Science and Technology to Society's Environmental Goals*. National Academy Press.
- Pandit, M.K. 2013. Chipko: Failure of a Successful Conservation Movement. In: Sodhi, N.S., Gibson, L. & Raven, P.H. *Conservation Biology: Voices from the Tropics.* pp.126-
  127. Wiley-Blackwell, Oxford, UK.

AECC-1.4 : ENVIRONMENTAL STUDIES & DISASTER MANAGEMENT

Full Marks – 100
Mid Sem – 20/1 hr
End Sem – 80/3 hrs

UNIT – I (Environment)

The Environment: The Atmosphere, Lithosphere, Hydrosphere, Biosphere Ecosystem : Energy flow in the ecosystem

Biogeochemical Cycle : Water Cycle, Carbon Cycle, Nitrogen Cycle

Pollution: Water Pollution, Air Pollution, Soil Pollution, Radiation Pollution, Industrial Pollution, Light Pollution, Sound Pollution

Environmental Laws : Water Act 1974, Air Act 1981, The Wildlife Protection Act 1972, The Environment Protection Act 1986, The Forest Conservation Act 1980

UNIT – II (Climate Change & Sustainable Development)

Population Ecology: Individuals, Species, Population, Community Human Population Growth, Population Control Methods Urbanization and its effects on Society

Climate Change : Causes, effect, Global Warming, Carbon footprint and environmental protection

Steps taken towards sustainable development : Ban of single-use plastics, Automobile Scrapping Policy, Promotion of Electrical Vehicles

Brief idea on Sustainable Development : Goals (SDGs), Agenda 21 of Rio Earth Summit

UNIT – III (Disaster Management)

Disaster Management : Types of disasters (Natural and Man-made) and their causes and effect

Vulnerability Assessment and Risk Analysis : Vulnerability to various disasters (Flood, Cyclone, Earthquake, Heat waves and Lightning)

Institutional Framework : Institutional arrangements for disaster management (National Disaster Management Authority (NDMA), State Disaster Management Authority (SDMA), District Disaster Management Authority (DDMA), National Disaster Response Force (NDRF) and Odisha Disaster Rapid Action Force (ODRAF) Preparedness Measures : Disaster Management Cycle, Early warning System, Pre-Disaster and Post-Disaster Preparedness, Strengthening of SDMA and DDMA, Community Preparedness, Stakeholder participation, Corporate Social Responsibility (CSR)

Survival Skills : Survival Skills adopted during and after disaster (Flood, Fire, Earthquake, Cyclone, Lightening)

UNIT – IV

Brief idea on Epidemics and Pandemics

Non-communicable diseases with special reference to Cardiovascular diseases, Cancer, Diabetes, Hypertension and Obesity and their prevention

Communicable diseases with special reference to Covid-19, Flu, Hepatitis, AIDS and Tuberculosis and their transmission

Dynamics of Disease Transmission : Mode of transmission (Direct/Indirect), Events after infection: Immunity (Active vrs Passive, Innate vrs Acquired, Herd Immunity), Incubation Period

Prevention of Epidemics/Pandemics Diseases : Preventing Measures (Quarantine, Sanitization, Personal Protective measures such as hand washing and use of protective devices, Vaccination); Control Measures (Surveillance, Isolation, Contact Tracing)

Life Style management : Diet, Physical Exercise, Yoga and sleeping habit

Role of Different Sectors in Managing Health Disaster : Role of Government (Centre and State), Community, Civil Society, Student mass, NGOs

Books Recommended:

- Asthana DK and Asthana M : A Text Book of Environmental Studies, S. Chand, New Delhi.
- Bharucha E : A Text Book of Environmental Studies, New Delhi, UGC.
- Dash MC and Mishra PC : Man and Environment, McMillan, London.
- Disaster Management and Mitigation Plan, 2013 of Dept. of Health & Family Welfare, Govt. of Odisha*
- Mishra DD : *Fundamental Concept in Environmental Studies*, S. Chand, New Delhi.
- National Policy on Disaster Management, 2009*
- National Disaster Management Plan, 2019*
- Odeem EP, *Fundamentals of Ecology*, Natraj Publications.
- State Disaster Management Plan, 2019 of Government of Odisha*
- Standard Operating Procedure (SOP) issued by Govt. of India and Govt. of Odisha on Public Health Managements in the websites www.mohfw.gov.in and health.odisha.gov.in*
- The Disaster Mangement Act. 2005 of Government of India*

[Note : Star (*) marked Reference, published by the State as well as Central Government are available in the open sources]

AECC-1.5 (EV-I) : ETHICS & VALUES

UNIT-I : Issues Relating to Women

Full Marks – 25
End Sem – 25/1 hr

General introduction on Ethics and Values, Gender equality as an essential precursor to social progress, the present scenario, Desirable gender related values

Women and Family:

Pre-natal sex selection, Gendered practices in the family, Gender based division of labour in the family, Marriage and women, Marriage and women's consent, Child marriage, Practice of dowry, Women and family violence

Women and Work:

Women's work: The Invisible hands, Exploitation of women at work, Gender Stereotyping at work, Glass Ceiling, Women and pay gap, Sexual Harassment of women at work, Working women and role conflict

Women, Community and Society:

Violence against women in public spaces, Gender sensitive language and communication, Gendered language, Sexist Language, Gender neutral language, Women and property Rights, Women's property Rights in Indian Laws, The functionality of Women's Property Rights

SEMESTER-II

C-2.1 : WATER AND WATER RESOURCES

Full Marks: 100
Mid Sem 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

Objective: This course develop knowledge introduces students to the hydrological cycle, properties of water, physicochemical and biological water quality assessment and indices, types of water resources, their use and management.

UNIT 1: Properties of water

Physical: temperature, colour, odour, total dissolved solids and total suspended solids; hydrologicalcycle; precipitation, runoff,infiltration,evaporation,evapo-transpiration; Chemical: major inorganic and organic constituents, dissolved gases, DO, COD, BOD,

acidity and alkalinity, electrical conductivity, sodium adsorption ratio; Biological: phytoplankton, phytobenthos, zooplankton, macro-invertebrates and microbes.

UNIT 2: Surface and subsurface water

Introduction to surface and ground water; surface and ground water pollution; water table; vertical distribution of water; formation and properties of aquifers; techniques for ground water recharge; river structure and patterns; watershed and drainage basins; importance of watershed and watershed management; rain water harvesting in urban settings. Marine resources; commercial use of marine resources; threats to marine ecosystems and resources; marine ecosystem and resource management (planning approach, construction techniques and monitoring of coastal zones).

UNIT 3: Wetlands and their management

Definition of a wetland; types of wetlands (fresh water and marine); ecological significance of wetlands; threats to wetlands; wetland conservation and management; Ramsar Convention, 1971; major wetlands of India, National River linking plan: ecological and economic impacts.

UNIT 4: Water resources, conflicts, laws and treaties

Water resources (oceans, rivers, lakes and wetlands) and types of water ; Overexploitation of surface and ground water resources; water quality standards in India; role of state in water resources management.
Water resources and conflicts on its sharing, case studies on Kaveri and Krishna river water disputes; Multipurpose river valley projects in India and their environmental and social impacts; case studies of dams - Narmada and Tehri dam issues; International agreements to resolve these conflicts. Water Act 1974; Ganges water treaty; Teesta water treaty.

Course Outcomes:
CO 1 : Develop in depth knowledge about estimation of various Water Quality Parameters
CO 2 : Develop practical knowledge on Measurement of soil parameters.
CO 3 : Gain knowledge about Identification of Minerals
CO 4 : Gain knowledge about Identification of Rocks
CO 5 : Develop knowledge on Preparation of Herbarium and its Documentation.

Practical/Assignment : Based on the theory.

1. Estimation of Nitrates – Phenoldisulfonic Acid method
2. Estimation of Fluorides – Fluoride meter method/SPADNS Reagent method
3. Estimation of Sulphates – Barium chloride method
4. Determination of Density, Surface Tension and Viscosity of water and other liquid samples
5. Determination of biochemical oxygen demand of water samples.
6. Collection and study of different types of planktons in different natural water samples
7. Determination of pH of ground water sample
8. Determination of EC of ground water sample
9. Preparation of assignment and seminar on various types of water conflicts, environmental movements and policy frameworks.

Text Books:

- Mays, L.W.2006. *Water Resources Sustainability*. The McGraw-Hill Publications.

Reference Books:

- Bansil, P.C.2004. *Water Management in India*. Concept Publishing Company, India.
- Brebbia, C.A. 2013. *Water Resources Management VII*. WIT Press.
- CEA .2011. *Water Resources and Power Maps of India*. Central Board of Irrigation & Power.
- Grumbine, R.E. & Pandit, M.K. 2013.Threats from India's Himalaya dams. *Science* **339**: 36- 37.
- Loucks, D.P., Stedinger, J.R. & Haith, D.A. 1981. *Water Resource Systems Planning and Analysis*. Englewood Cliffs, NJ, Prentice Hall.
- Schward & Zhang, 2003. *Fundamentals of Groundwater*. John Willey and Sons.
- Souvorov, A.V. 1999. *Marine Ecologonomics: The Ecology and Economics of Marine Natural Resource Management*. Elsevier Publications.
- Vickers, A.2001. *Handbook of Water Use and Conservation*. Water Plow Press.

C-2.2 : LAND AND SOIL CONSERVATION AND MANAGEMENT

Full Marks: 100
Mid Sem 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

Objective: This course introduces students to the fundamentals of land and soil degradation.

UNIT 1: Fundamentals of soil science

Land as a resource, ecological and economic importance of soil; Soil formation; classification of soil; soil architecture; physical properties of soil; soil texture; soil water holding capacity; soil temperature; soil colloids; soil acidity and alkalinity; soil salinity and sodicity; soil organic matter; micronutrients of soil; nitrogen, sulphur, potassium and phosphorus economy of soil; soil biodiversity; soil taxonomy maps.

UNIT 2: Soil degradation-causes

Types and causes of soil degradation; Soil resistance and resilience; nature and types of soil erosion; non-erosive and erosive soil degradation; losses of soil moisture and its regulation; nutrient depletion; soil pollution due to mining and mineral extraction, impact soil degradationon agriculture and food security; industrial and urban development, toxic organic chemicals, and organic contaminants in soils; fertilizers and fertilizer management; recycling of soil nutrients.

UNIT 3: Land use changes and land degradation

Land resources: types and evaluation; biological and physical phenomena in land degradation; visual indicators of land degradation; drivers of land degradationdeforestation, desertification;habitatloss,lossofbiodiversity;rangelanddegradation;landsalinization;human population pressure, poverty, socio-economic and institutional factors; drivers of land use and land cover change in major geographic zones and biodiverse regions with particular reference to the Himalaya and the Western Ghats.

UNIT 4: Land degradation and its control

Economic valuation of land degradation; onsiteand offsitecostsof land degradation; loss of ecosystem services; effects on nutrient cycles; future effects of soil degradation; emerging threats of land degradation to developing countries Sustainable land use planning; role of databases and data analysis in land use planning control and management; land tenure and land policy; legal, institutional and sociological factors; integrating land degradation assessment into conservation.

Course Outcomes :

CO 1 : Develop in depth knowledge about estimation of various Water Quality Parameters
CO 2 : Develop practical knowledge on Measurement of soil parameters.
CO 3 : Gain knowledge about Identification of Minerals
CO 4 : Gain knowledge about Identification of Rocks
CO 5 : Develop knowledge on Preparation of Herbarium and its Documentation.

Practicals: Based on the theory/ fieldwork.

1. Isolation of Fungi from Soils – Pour Plate method.
2. Estimation of Coliform Group of Bacteria – MPN Technique.
3. Estimation of Coliform Group of Bacteria – MF Technique.
4. Estimation of soil respiration by alkali absorption
5. Estimation of evolution of CO_2 from soil with respect to pesticides.
6. Determination of evolution of CO_2 from the soil with respect to heavy metals.
7. Determination of pH of soil samples.
8. Determination of EC of soil samples.
9. Determination of soil porosity/percentage pore space
10. Determination of bulk density of soil.
11. Determination of texture of soil.
12. Estimation of Alkali or Alkaline Earth metals of soil samples.
13. Estimation of heavy metals in soil samples.
14. Study on composting process of biodegradable solid waste.
15. Assignment and Seminar on various types of soil degradation processes: cause and control methods.

Text Books:

- Brady,N.C.&Well,R.R.2007.*The Nature and Properties of Soils* (13th edition), Pearson Education Inc.

Reference Books:

- Gadgil, M. 1993. Biodiversity and India's degraded lands. *Ambio***22:**167-172.

- Johnson, D.L. 2006. *Land Degradation* (2ndedition). Rowman & Little field Publishers.
- Marsh, W. M. & Dozier, J. 1983. *Landscape Planning: Environmental Applications*. John Wiley and Sons.
- Oldeman, L. R. 1994. The global extent of soil degradation. *Soil resilience and sustainable land use*, *9*. (http://library.wur.nl/isric/fulltext/isricu_i26803_001.pdf).
- Pandit, M.K. et. al. 2007. Unreported yet massive deforestation driving loss of endemic biodiversity in Indian Himalaya. *Biodiversity Conservation* **16**: 153-163.
- Pandit, M.K. & Kumar, V.2013.Land use and conservation challenges in Himalaya: Past, present and future. In: Sodhi, N.S., Gibson, L. & Raven, P.H. *Conservation Biology: Voices from the Tropics.* pp. 123-133. Wiley-Blackwell, Oxford, UK (file:///Users/mkpandit/Downloads/Raven%20et%20al.%202013.%20CB%20Voices%20from%20Tropics%20(2).pdf).
- Peterson, G. D., Cumming, G. S. & Carpenter, S. R. 2003. Scenario planning: a tool for conservation in an uncertain world. *Conservation Biology* 17: 358-366.
- Scherr, S. J. 1999. *Soil degradation: A threat to developing-country food security by 2020?* (Vol. 27). International Food Policy Research Institute.

Generic Elective Paper III

GE-2.3 : HUMAN-WILD LIFE CONFLICT AND MANAGEMENT

Full Marks: 100
Mid Sem 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

Objective: This paper deals with the conflicts that have arisen as a result of shrinkage of wildlife habitats and the same being shared by human communities. It raises questions about the moral obligations of humans, need for conservation, and social impacts of conflicts. The paper aims at introducing the students to the scientific and social perspective of conservation.

Unit 1: Evolution of the concept of wildlife management

Journey of mankind from predator to conservator; prehistoric association betweenwildlifeandhumans:recordsfromBhimbetkawallpaintings;conservationofwildlifeint hereign of king Ashoka: excerpts from rock edicts; Bishnoi community; understanding wildlife management, conservation and policies regarding protected areas in 21st century; positive values provided by wildlife conservation (monetary, recreational, scientific and ecological benefits). What is the role of government, wildlife biologists and social scientists, concept of deep and shallow ecology.

Unit 2: Wild life conservation laws in India

Needofenvironmentalmanagement;wildlifeconservation:moralobligation?philosoph y of wildlife management; Types of protected areas (Wildlife Sanctuaries, National Parks, Biosphere Reserves); IUCN categories of protected areas, Natural World Heritage sites; concept ofcoreandbufferareainaprotectedrange,briefintroductiontoWildlifeProtectionActof

1972, Forest act 1927, Environmental Protection Act 1986, and Forest conservation Act 1920; introduction of Tiger task force, Status of current protected areas in India.

Unit 3: Socio-economic and legal basis of conflicts

Concepts of development and encroachment, who is the intruders: human or animal? Impact of conflict on humans and wildlife, impact of habitat fragmentation, social inequality in terms of forest conservation: forest produce as a need vs. forest exploitation, introduction to tribal rights in India, demographic profile of tribes in India, importance of forest produce to tribal populations, Forest dwellers (Recognition of forest right) Act, 2006. Insight into the important wildlife conflicts: Keoladeo National park conflict of Bharatpur, Human and elephant conflicts of Kerala, Fisherman and tiger conflict of Sundarbans forest, shifting cultivation in North east India.

Unit 4: Human wild life coexistence

Symbiotic relationship between tribals and forest, forest and development, focus on the inclusive growth of tribes: community participation in forest management, case study of Chipko movement, sacred groves forests, India's Bishnoi community and their conservation practices; ecologicaleconomicwelfareanddevelopment:conservationofindigenousculture andtraditions, role of international organizations: Man and biosphere programmes; concept of conservation reserves and community reserves, importance of wildlife corridors in minimizing the conflicts and conservation.

Outcomes: This paper helps students understand the origin and evolution of the concept of wildlife management. It also focuses on various legal based conflicts arising from human and wild life interaction.

Practical: Based on the theory.

Text Books:

- Wood roffe, R.2005.*People and Wildlife: Conflict and Coexistence*. Cambridge.
- Wood roffe, R.,Thirgood, S., & Rabinowitz, A.2005. *People and Wildlife,Conflictor Coexistence?* (No. 9). Cambridge University Press.

Reference Books:

- Conover, M. 2001. *Resolving Human Wildlife Conflicts*, CRC Press.
- Dickman, A. J. 2010. Complexities of conflict: the importance of considering social factorsforeffectivelyresolvinghuman–wildlifeconflict.*AnimalConservation***13:**458-466.
- Messmer, T.A. 2000.The emergence of human–wild life conflict management: Turning challenges into opportunities. *International Biodeterioration & Biodegradation* 45: 97- 102.
- Paty, C. 2007. *Forest Governmen and Tribe*. Concept Publishing Company.
- Treves, A. & Karanth, K. U. 2003. Human-carnivore conflict and perspectives on carnivore management worldwide. *Conservation Biology* **17**: 1491-1499.

AECC – 2.4 : MIL COMMUNICATIONS – ODIA
(ଯୋଗାଯୋଗ ଅନୁବିଧି, ରୀତି ଓ ମାଧ୍ୟମ)

Full Marks – 100
Mid Sem – 20/1hr
End Sem – 80/3 hrs

ଏକକ /ୟୁନିଟ୍ – ୧ :

୧ମ ଯୋଗାଯୋଗର ପରିଭାଷା, ଅନୁବିଧି, ପରିସର ଓ ପ୍ରକାରଭେଦ

୨ୟ ଏକକ / ୟୁନିଟ୍ – ୨ :

ସାକ୍ଷାତକାର, ଭାଷଣ କଳା

୩ୟ ଏକକ / ୟୁନିଟ୍ – ୩ :

ସମ୍ବାଦର ପରିଭାଷା ଓ ସମ୍ବାଦ ପ୍ରସ୍ତୁତି

୪ର୍ଥ ଏକକ / ୟୁନିଟ୍ – ୪ :

ଓଡ଼ିଆ ଭାଷାର ବର୍ଣ୍ଣମାଳା, ବର୍ଣ୍ଣାଶୁଦ୍ଧିର ନିରାକରଣ । (ବନାନ ତ୍ରୁଟି - ସାଦୃଶ୍ୟଜନିତ ଅଶୁଦ୍ଧି, ଲିଙ୍ଗଗତ ଅଶୁଦ୍ଧି, ସନ୍ଧିଗତ ଅଶୁଦ୍ଧି, ସମାସଗତ ଅଶୁଦ୍ଧି, ବଚନ ଓ ବିଭକ୍ତିଗତ ଅଶୁଦ୍ଧି, ବାକ୍ୟ ବିଧିଜନିତ ଅଶୁଦ୍ଧି, ସମାର୍ଥବୋଧକ ଶବ୍ଦାଶୁଦ୍ଧି, ପ୍ରତ୍ୟୟ ଜନିତ ଅଶୁଦ୍ଧି, ଶବ୍ଦ ସଂଯୋଗାତ୍ମକ ଓ ସ୍ୱରସଙ୍ଗତି ଜନିତ ଅଶୁଦ୍ଧି)

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ :

୧. ଯୋଗାଯୋଗ ମୂଳକ ମାତୃଭାଷା (ଓଡ଼ିଆ) - ସାମଲ ବିରଞ୍ଚି ନାରାୟଣ, ସତ୍ୟନାରାୟଣ ବୁକ ଷ୍ଟୋର, କଟକ

୨. ସଂଯୋଗ ଅନୁବିଧି - ସନ୍ତୋଷ କୁମାର ତ୍ରିପାଠୀ, ନାଳନ୍ଦା, କଟକ

୩. ଭାଷଣ କଳା ଓ ଅନ୍ୟାନ୍ୟ ପ୍ରସଙ୍ଗ - କୃଷ୍ଣଚନ୍ଦ୍ର ପ୍ରଧାନ, ସତ୍ୟନାରାୟଣ ବୁକ୍ ଷ୍ଟୋର,କଟକ

୪. ପ୍ରାୟୋଗିକ ଓଡ଼ିଆ ଭାଷା – ଓଡ଼ିଶା ରାଜ୍ୟପାଠ୍ୟ ପୁସ୍ତକ ପ୍ରଣୟନ ଓ ପ୍ରକାଶନ ସଂସ୍ଥା, ଭୁବନେଶ୍ୱର

୫. ସମ୍ବାଦ ଓ ସାମ୍ବାଦିକତା – ଚନ୍ଦ୍ରଶେଖର ମହାପାତ୍ର, ଓଡ଼ିଶା ରାଜ୍ୟ ପାଠ୍ୟପୁସ୍ତକ ପ୍ରଣୟନ ଓ ପ୍ରକାଶନ ସଂସ୍ଥା, ଭୁବନେଶ୍ୱର

୬. ନିର୍ଭୁଲ ଲେଖାର ମୂଳସୂତ୍ର - ନୀଳାଦ୍ରିଭୂଷଣ ହରିଚନ୍ଦନ, ପି.ସି.ଆର ପବ୍ଲିକେସନ, ଭୁବନେଶ୍ୱର

୭. ସର୍ବସାର ବ୍ୟାକରଣ - ନାରାୟଣ ମହାପାତ୍ର ଓ ଶ୍ରୀଧର ଦାସ, ନିୟୁ ଷ୍ଟୁଡେଣ୍ଟସ୍ ଷ୍ଟୋର, କଟକ

ମୂଲ୍ୟ ବିଭାଜନ ପଦ୍ଧତି : (ସବୁଥିରୁ ବିକଳ୍ପ ପଢ଼ିବ)

(କ) ପତ୍ରର ମୋଟ ନମ୍ବର – ୧୦୦

(ଖ) ଆନ୍ତଃପରୀକ୍ଷା – ୨୦ ଓ ମୁଖ୍ୟ ପରୀକ୍ଷା – ୮୦

(ଗ) ନିର୍ଦ୍ଧାରିତ ପାଠ୍ୟର ସବୁ ଏକକ(ୟୁନିଟ୍)ରୁ ବିକଳ୍ପସହ ଦୁଇଟି ଲେଖାଏଁ ମୋଟ ୮ଟି ୧୫ନମ୍ବର ବିଶିଷ୍ଟ ଦୀର୍ଘ ପ୍ରଶ୍ନ ପଡିବ । ବିଦ୍ୟାର୍ଥୀଙ୍କୁ ୪ଟି ପ୍ରଶ୍ନର ଉତ୍ତର ଦେବାକୁ ହେବ । (୧୫ x ୪ = ୬୦)

(ଘ) ନିର୍ଦ୍ଧାରିତ ପାଠ୍ୟର ସବୁ ଏକକରୁ ୧୨ଟି ଅତିସଂକ୍ଷିପ୍ତ ପ୍ରଶ୍ନ ପଡ଼ିବ । ସେଥିରୁ ୧୦ଟି ପ୍ରଶ୍ନର ଉତ୍ତର ଦେବାକୁ ହେବ ।
(୧୦ x ୨ = ୨୦)

AECC-2.5 (EV-II) : ETHICS & VALUES

UNIT-II : Values and Good Citizenship

Full Marks – 25
End Sem – 25/1 hr

2.1 Indian Constitution:

Salient Values of Preamble : Sovereign, Socialist, Secular, Democratic, Republic, Justice, Liberty, Equality and Fraternity

2.2 Patriotism:

Patriotic value and ingredients of nation building, Concept of Good citizenship, Emotional connection with the country, Duties of citizens and Qualities of good citizens

2.3 Volunteerism:

Concept of facets of Volunteerism and Leadership, Building a better society through Volunteerism, Blood Donation, Social Work, Helping the Aged, Environmental Protection

2.4 Work Ethics:

Punctuality, Cleanliness, Law abidingness, Rational Thinking and Scientific Temper

SEMESTER-III

C-3.1 : ECOLOGY AND ECOSYSTEMS

Full Marks: 100
Mid Sem 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

Objective: This course enable the students about basic understanding of ecology, ecosystem and its structural and functional aspects.

UNIT 1: General concepts of Ecology

Basic concepts and definitions: ecology, ecosystems, resistance and resilience; autecology; synecology; major terrestrial biomes, Biogeochemical cycles and sedimentary cycle, role of mycorrhizae; decomposition and nutrient release; nutrient use efficiency; nutrient budget; nutrient conservation strategies. Ecological amplitude; Liebig's Law of the Minimum; Shelford's Law of Tolerance; phenotypic plasticity; ecotypes; ecoclines; acclimation; thermoregulation; strategies of adaptation in plants and animals.

UNIT 2: Ecology of populations

Concept of population and meta-population; r- and K-selection; characteristics of population: density, dispersion, natality, mortality, life tables, survivorship curves, age structure; population growth: geometric, exponential, logistic, density-dependent; limits to population growth; deterministic and stochastic models of population dynamics; rudreal,

competitive and stress-tolerance strategies.

UNIT 3: Ecology of communities

Discrete versus continuum community view; community structure and organization: physiognomy, sociability, species associations, periodicity, biomass, stability, keystone species, ecotone and edge effect; species interactions: mutualism, symbiotic relationships, commensalism, amensalism, protocooperation, predation, competition, parasitism, mimicry, herbivory; ecological succession: primary and secondary successions, models and types of successions, climax community concepts, examples of succession. ecological niche; types of niche: Eltonian niche, Hutchinsonian niche, fundamental niche, realized niche;, impacts of biological invasion on ecosystem and communities, case studies.

UNIT 4: Ecosystem ecology

Types of ecosystem: forest, grassland, lentic, lotic, estuarine, marine, desert, wetlands; ecosystem structure and function; abiotic and biotic components of ecosystem; ecosystem boundary; ecosystem function; ecosystemmetabolism; primary production andmodelsofenergy flow; secondary production and trophic efficiency; ecosystem connections: food chain, foodweb; detritus pathway of energy flow and decomposition processes; ecological efficiencies; ecological pyramids: pyramids of number, biomass, and energy, ecosystem input of nutrients; biotic accumulation; ecosystem losses; nutrient supply and uptake.

Course Outcomes:

CO 1 : Have an enhanced knowledge of an ecology.
CO 2 : Be able to make connections and interrelations between various disciplines in the environment.
CO 3 : Be able to explain the structure and impact of biogeochemical cycles.
CO 4 : Be able to Illustrate abiotic/biotic interactions and symbiotic relationships.
CO 5 : Be able to describe ecological and statistical techniques and approaches used in the study of environmental biology.

Practicals/Assignment: Based on the theory.

1. Sampling technique of phytoplankton
2. Determination of organic pollution – Carlson's Trophic State index
3. Estimation of primary productivity of a pond – Light and Dark bottle method
4. Estimation of primary productivity of terrestrial vegetation – Chlorophyll method
5. Estimation of primary productivity of grasses – Harvest method
6. Study of plant community – Individual count method/Quadrat method
7. Study of animal community – Line transect method
8. Determination of species diversity indices –Simpson and Shannon's Wiener Index
9. Determination of aquatic species diversity of any lentic of lotic ecosystem.
10. Identification of ecological indicators
11. Assignment on study of lifecycle or growth pattern of any organism.
12. Study on habitat structure or germination pattern.
13. Estimation of primary productivity of a pond – Light and Dark bottle method

Text Books:

- Odum, E.P. 1971. *Fundamentals f Ecology*. W.B. Sounders.

Reference Books:

- Groom. B. & Jenkins. M.2000. *Global Biodiversity: Earth's Living Resources in the 21st Century.* World Conservation Press, Cambridge, UK.
- Gurevitch, J., Scheiner, S.M., & Fox, G.A.2002. *The Ecology of Plants*. Sinauer associates incorporated.
- Loreau, M.& Inchausti, P.2002. *Biodiversity and Ecosystem functioning:Synthesis and Perspectives.* Oxford University Press, Oxford, UK.
- Pandit, M.K., White, S.M. & Pocock, M.J.O. 2014. The contrasting effects of genome size, chromosome number and ploidy level on plantinvasiveness: aglobalanalysis. *New Phytologist* 203: 697-703.
- Pimentel,D.(Ed.).2011. *Biological invasions: Economic and environmental costs of alien plant, animal, and microbe species*. CRC Press.
- Singh,J.S.,Singh,S.P.&Gupta,S.R.2006.*Ecology,EnvironmentandResource Conservation.* Anamaya Publications.
- Wilson, E.O.1985. The Biological Diversity Crisis. *Bio Science* 35:700-706.

CORE PAPER-VI

C-3.2 : ENVIRONMENTAL BIOTECHNOLOGY

Full Marks: 100
Mid Sem 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

Objective: This course presents an objective view of the application of biotechnological in tackling environmental problems.

UNIT 1: Structure and Function of DNA, RNA and Protein

DNA: structural forms and their characteristics (B, A, C, D, T, Z); physical properties: UV absorption spectra, denaturation and renaturation kinetics; biological significance ofdifferent forms; Synthesis. RNA: structural forms and their characteristics. Protein: hierarchical structure, types of amino acids; posttranslational modifications and their significance; synthesis; types and their role: structural, functional (enzymes). Central dogma of biology; genetic material prokaryotes, viruses, eukaryotes and organelles; mobile DNA; chromosomal organization (euchromatin, heterochromatin - constitutive and facultative heterochromatin).

UNIT 2: Recombinant DNA Technology

Recombinant DNA: origin and current status; steps of preparation; toolkit of enzymes for manipulation of DNA: restriction enzymes, polymerases (DNA/RNA polymerases, transferase, reverse transcriptase), other DNA modifying enzymes (nucleases,

ligase, phosphatases, polynucleotide kinase); genomic and cDNA libraries: construction, screening and uses; cloning and expression vectors (plasmids, bacteriophage, phagmids, cosmids, artificial chromosomes; nucleic acid microarrays, R-DNA technology in environmental management.

UNIT 3: Ecological restoration and bioremediation

Wastewater treatment: anaerobic, aerobic process, methanogenesis, treatment schemes for waste water: dairy, distillery, tannery, sugar, antibiotic industries; solid waste treatment: sources and management (composting, vermiculture and methane production, landfill. hazardous waste treatment). Specific bioremediation technologies: land farming, biopiles, composting, bioventing, biosparging, pump and treat method, phytoremediation; remediation of degraded ecosystems; advantages and disadvantages; degradation of xenobiotics in environment, decay behavior and degradative plasmids, hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides, heavy metals degradative pathways.

UNIT 4: Ecologically safe products and processes

PGPR bacteria: biofertilizers, microbial insecticides and pesticides, bio-control of plant pathogen, Integrated pest management; development of stress tolerant plants, biofuel; miningand metal biotechnology: microbial transformation, accumulation and concentration of metals, metal leaching, extraction; exploitation of microbes in copper and uranium extraction, use of bioreactors for bioremediation.

Course Outcomes:

CO 1 : To explain the basic concepts of biotechnology
CO 2 : To define the principles of Genetic Engineering
CO 3 : To understand the techniques involve in Genetic Engineering
CO 4 : To know the application of biotechnology
CO 5 : To study the future and scope of biotechnology

Practicals/Assignment: Based on the theory.

1. Isolation of Bacteria from Water/Wastewater – Serial Dilution Technique.
2. Identification of Bacteria – Gram Staining.
3. Isolation of Fungi from Soils – Pour Plate method.
4. Identification of Fungi – Lactophenol Cotton Blue Staining.
5. Construction of bacterial growth curve – pH – Broth culture
6. Minimum Inhibitory Concentrations (MICs) of Heavy metals on bacteria – Mueller-Hinton Agar method
7. Study of Root Nodule Bacteria – Gram Staining.
8. Study of Endomycorrhiza (VAM), Coralloid roots and Lichens.
9. Estimation of Coliform Group of Bacteria – MPN Technique.
10. Estimation of Coliform Group of Bacteria – MF Technique.
11. Assignment and Seminar on recent advances in biotechnology to manage environmental pollutions as well as resource recovery techniques.

Text Books:

- Evans, G.G.&Furlong,J.2010. *Environmental Biotechnology: Theory and Application* (2nd edition). Wiley-Blackwell Publications.
- Scagg, A.H. 2005. *Environmental Biotechnology*. Oxford University Press.

Reference Books:

- Jordening, H.J. & Winter J.2005. *Environmental Biotechnology: Concepts and Applications*. John Wiley & Sons.
- Lodish, H.F., Baltimore, D., Berk, A. Zipursky, S.L. Matsudiara, P. & Darnell, J.1995.
  Molecular Cell Biology. W.H. Freeman.
- Nelson, D.L. & Cox, M.M.2013. *Lehninger's Principles of Biochemistry*. W.H. Freeman.
- Rittman, B.E. & McCarty,P.L.2001. *Environmental Biotechnology. Principles and Applications.* McGraw-Hill, New York.
- Snustad, D.P. & Simmons, M.J. 2011. *Principles of Genetics* (6th edition). John Wiley & Sons.
- Wainwright, M.1999. *An Introduction to Environmental Biotechnology*, Springer.

CORE PAPER-VII

C-3.3 : ATMOSPHERE AND GLOBAL CLIMATE CHANGE

Full Marks: 100
Mid Sem 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

Objective: This course deals with dynamics of atmospheric processes, which include its composition, meteorological phenomena, atmospheric chemistry and effects of global changes on human communities and initiatives taken at global and regional levels to combat them.

UNIT 1: Atmospheric circulation and energy balance

Movement of air masses; atmosphere and climate; air and sea interaction; southern oscillation; western disturbances; *El Nino* and *La Nina*; tropical cyclone; Indian monsoon and its development,changingmonsooninHoloceneintheIndiansubcontinent,itsimpacton agriculture and Indus valley civilization; effect of urbanization on micro climate; Asian brown clouds. Earth's energy balance; energy transfers in atmosphere; Earth's radiation budget; green house gases (GHGs); greenhouse effect; global conveyor belt.

UNIT 2: Meteorology, atmospheric stability and chemistry

Meteorological parameters (temperature, relative humidity, wind speed and direction, precipitation); atmospheric stability and mixing heights; temperature inversion; plume behavior; Gaussian plume model. Chemistry of atmospheric particles and gases; smog – types and processes; photochemical processes; ions and radicals in atmosphere; acid-base reactions in atmosphere; atmospheric water; role of hydroxyl and hydroperoxyl radicals in atmosphere.

UNIT 3: Global warming and climate change

Evolution and development of Earth's atmosphere; atmospheric structure and composition; significance of atmosphere in making the Earth, the only biosphere; Milankovitch cycles, atmospheric windows. Trends of global warming and climate change; drivers of global warming and Global Warming Potential (GWP) & climate change; impact of climate change on atmosphere, weather patterns, sea level rise, agricultural productivity and biological responses - range shift of species, CO2 fertilization and agriculture; impact on economy and spread of human diseases.

UNIT 4: Ozone layer depletion, environmental policy & agreements

Ozone layer or ozone shield; importance of ozone layer; ozone layer depletion and causes; Chapman cycle; process of spring time ozone depletion over Antarctica; ozone depleting substances (ODS); effects of ozone depletion; mitigation measures and international protocols. Environmental policy debate; International agreements; Montreal protocol 1987; Kyoto protocol 1997; Convention on Climate Change; carbon credit and carbon trading; clean development mechanism.

Course Outcomes :

CO 1 : Describe the linkage between different components of the Atmospheric system and climate change.
CO 2 : Explain the basic principles and laws global climate system.
CO 3 : Understanding climate change causes and human interactions.
CO 4 : Account for the impact of climate change on society and the role of various mitigation and adaptative measures.
CO 4 : Students able to learn effective implementation of environmental policy combating Climate Change.

Practical/Case Study/Assignment: Based on the theory.

1. Calculation of carbon footprint and offset value
2. Emission Inventory development for various local sources.
3. Atmosphere circulation model preparation.
4. Determinations and calculation of various meteorological parameters (temperature, Relative Humidity, Precipitation etc.)
5. Development of vehicular emission inventory.
6. Collection and chart preparation of ODS.
7. Seminar/Case Study/ Assignment of various effects of climate change and environmental policy debate.

Text Books:

- Hardy, J.T.2003.*Climate Change: Causes, Effects and Solutions*. John Wiley& Sons.
- Harvey, D.2000. *Climate and Global Climate Change*. Prentice Hall.

Reference Books:

- Barry,R.G.2003. *Atmosphere, Weather and Climate*. Routledge Press, UK.
- Gillespie, A. 2006. *Climate Change, Ozone Depletion and Air Pollution: Legal Commentaries with Policy and Science Considerations*. Martinus Nijh off Publishers.
- Manahan,S.E.2010. *Environmental Chemistry*. CRC Press, Taylor and Francis Group.
- Maslin, M.2014.*Climate Change: A very Short Introduction*. Oxford Publications.
- Mathez, E.A.2009. *Climate Change: The Science of Global Warming and our Energy Future*. Columbia University Press.
- Mitra, A.P., Sharma, S., Bhattacharya, S., Garg,A., Devotta, S. &Sen ,K.2004. *Climate Change and India*. Universities Press, India.
- Philander, S.G. 2012. *Encyclopedia of Global Warming and Climate Cha*nge (2nd edition). Sage Publications.

Generic Elective Paper IV

GE-3.4 : GENDER AND ENVIRONMENT

Full Marks: 100
Mid Sem 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

Objective: The paper is designed to expose students to the concept of gender in society and its relevance in the environmental context. The principal objective of the course is to enable students to examine environmental issues from a gender-sensitized perspective.

UNIT 1: Gender and society

The socially constructed 'gender' concept; Gender existence in society; gender: matriarchy and patriarchy as means of social exclusion (case studies in an Indian context);gender equity issues in rural and urban settings.

UNIT 2: Gender and the environment

Relevance of the concept in an environmental context; evolution of gender hierarchies in historical and contemporary perspective; gendered division of roles in cultural, social and economic perspective; gender inequalities.

UNIT 3: Gender, resources and the environment

Knowledge about the environment among men and women; differential dependencies on environmental resources; implications of gendered responses to environmental degradation.

UNIT 4: Gender, environmental management and future

Women's participation in environmental movements and conservation; historical and contemporary case studies; role of women in environmental education, awareness and sustainable development. Need for gender equity; Instruments for change: education, media, action groups, policy and management; equity in resource availability and consumption for a sustainable future.

Outcomes: This paper helps students understand the gender existence in society and its impact on social and environmental structure. It also focuses on impact of gender on environmental management.

Tutorial: Tutorial based course.

Text Books:

- Miller, B. 1993. *Sex and Gender Hierarchies*. Cambridge University Press

Reference Books:

- Agarwal, B. 1992. *The Gender and Environment Debate: Lessons from India*. Feminist Studies (Minnesota).
- Agarwal, B.1997. Gender, Environment and Poverty Interlinks: Regional Variations and Temporal Shifts in Rural India: 1971-1991. *World Development* **25:** 1-42.
- Agarwal, B.2001. Participatory exclusions, community forestry, and gender: An analysis for South Asia and a conceptual framework. *World Development* **29:** 1623-1648.
- Jackson,C.1993. Doing what comes naturally? Women and environment in development
  World Development **21:**1947-63.
- Krishna, S.2004. *Livelihood and Gender*. New Delhi, Sage.
- Leach, M. 2007. Earth Mothermythsandother ecofeministfables: Howastrategic notion rose and fell. *Development and Change* **38:** 67-85.
- Stein, R.(ed.).2004 .*New Perspectiveson Environmental Justice: Gender, Sexuality, and Activism*. Rutgers University Press.
- Steingraber, S.1998. *Living Downstream: AScientist's Personal Investigation of Cancer and the Environment.* New York: Vintage Books.
- Zwarteveen, M.Z.1995. *Linking women to the maincanal: Gender and irrigation management*. Gatekeeper Series 54, IIED.

SECC-II-3.5 : QUANTITATIVE AND LOGICAL THINKING

Full Marks – 100
Mid Sem – 20/1hr
End Sem – 80/3 hrs

UNIT – I :

Whole numbers, Integers, Rational and irrational numbers, Fractions, Square roots and Cube roots, Surds andIndices, Problems on Numbers, Divisibility Steps of Long Division Method for Finding Square Roots:

UNIT – II :

Basic concepts, Different formulae of Percentage, Profit and Loss, Discount, Simple interest, Ratio and Proportion,Mixture

UNIT – III :

Time and Work, Pipes and Cisterns, Basic concepts of Time, Distance and Speed; relationship among them

UNIT – IV :

Concept of Angles, Different Polygons like triangles, rectangle, square, right angled triangle, PythagoreanTheorem, Perimeter and Area of Triangles, Rectangles, Circles

UNIT – V :

Raw and Grouped Data, Bar Graphs, Pie charts, Mean, Median and Mode, Events and Sample Space, Probability

I. LOGICAL REASONING

UNIT – I :

Analogy basing on kinds of relationships, Simple Analogy; Pattern and Series of Numbers, Letters, Figures.Coding-Decoding of Numbers, Letters, Symbols (Figures), Blood relations

UNIT – II :

Logical Statements– Two premise argument, More than two premise argument using connectives

UNIT – III :

Venn Diagrams, Mirror Images, Problems on Cubes and Dices

Books Prescribed :

1. Quantitative And Logical Thinking – Odisha State Higher Education Council, Bhubaneswar

AECC-3.6 (EV-III) : ETHICS & VALUES

UNIT-III : Issues of Drug, Tobacco and Alcohol Addiction

Full Marks – 25
End Sem – 25/1 hr

3.1 Extent of the Problem:

Extent of Drug and Tobacco addiction and alcoholism in India, Myths associated with them, Health hazards associated with them and how they have become silent killers

3.2 Socio-economic impact:

Socio-economic impact of Drug and Tobacco addiction and alcoholism:

Loss of physical and mental strength, Loss of character, Loss of family ties and relationship, Loss of earning and livelihood potentials, Loss of societal respect and dignity etc

3.3 Laws to Address this Problem:

Silent features of social legislation such as NDPS Act, 1985 and COTPA Act, 2003, Mechanism and Government Schemes for prevention, deaddiction and rehabilitation

3.4 Role of Stake - holders:

Provision of Tobacco free campus and role of students, Role of students in their family and immediate surroundings, Role of NGOs and other agencies

SEMESTER-IV

CORE PAPER VIII

C-4.1 : SYSTEMATICS AND BIOGEOGRAPHY

Full Marks: 100
Mid Sem 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

Objective: This course will discuss principles and applications of classical and modern day systematic to classification of living organisms, develop understanding of historical and contemporary patterns of distributions of organisms in an era of global change and large scale human induced degradation.

UNIT 1: Concept and systematic approaches

Concept of taxa (species, genus, family, order, class, phylum, kingdom); concept of species (taxonomic, typological, biological, evolutionary, phylogenetic); categories and taxonomic hierarchy. Definition of systematic; taxonomic identification; keys; field inventory; herbarium; museum; botanical gardens; taxonomic literature; nomenclature; evidence from anatomy, palynology, ultrastructure, cytology, phyto-chemistry, numerical and molecular methods; taxonomy databases.

UNIT 2: Taxonomic hierarchy, Nomenclature & Systems of classification

Principles and rules (International Code of Botanical and Zoological Nomenclature); ranks and names; types and typification; author citation; valid publication; rejection of names; principle of priority and its limitations; names of hybrids; classification systems of Bentham and Hooker; Angiosperm Phylogeny Group (APG III) classification. Operational Taxonomic Units; DNA barcoding; phylogenetic tree (rooted, unrooted, ultrametric trees).

UNIT 3: Biogeography, Speciation and extinction

Genes as unit of evolutionary change; mutation; genetic drift; gene flow; natural selection;geographicandecologicalvariation;biogeographicalrules–Gloger'srule, Bergmann's rule, Allen's rule, Geist rule; biogeographical realms and their fauna; endemic,

rare, exotic, and cosmopolitan species.

Types and processes of speciation – allopatric, parapatric, sympatric; ecological diversification; adaptive radiation, convergent and parallel evolution; dispersal and immigration; means of dispersal and barriers to dispersal; extinction.

UNIT 4: Historical, ecological & conservation biogeography

Paleo-records of diversity and diversification; role in biogeographic patterns – past and present; biogeographical dynamics of climate change and Ice Age. Species' habitats; environment and niche concepts; biotic and abiotic determinants of communities; species-area relationships; concept of rarity and commonness; Island Biogeography theory; Equilibrium Theory of Ishland Biogeography. Application of biogeographical rules in design of protectedarea and biosphere reserves.

Outcomes: This paper helps the students to better understand the concept of Taxonomic hierarchy, Nomenclature & Systems of classification. It also provides students the knowledge regarding biogeography, its speciation, extinction and its conservation by various methods.

CO 1 : Concept and understanding of taxa and species CO_2
CO 2 : Knowledge development regarding principles and rules of biological nomenclature system.
CO 3 : Study on biogeography, speciation and extinction.
CO 4 : Application of various conservation method of biodiversity.

Practical/Biodiversity Assessment: Based on the theory.

1. Community analysis of grassland or forest ecosystem.
2. Herbarium preparation for various plant species.
3. Identification of plants and animals.
4. Determinations of diversity index, dominance index, and IVI score of any eco system.
5. Lien transect method to predict vegetation pattern and successional stages (Sere) of forest ecosystem.
6. Assignment on green audit report of campus with respect to biodiversity.
7. Seminar pertaining to theory paper.

Text Books:

- Mani,M.S.1974. *Ecology and Biogeography in India*. Dr. W Junk Publishers., The Hague.
- Williams, D.M., Ebach, M.C. 2008. *Foundations of Systematics and Biogeography*. Springer.

Reference Books:

- Lomolino,M.V.,Riddle,B.R.,Whittaker,R.J.&Brown,J.H.2010.*Biogeography*(4th edition). Sinauer Associates, Sunderland.
- Singh,G.2012.*PlantSystematics:TheoryandPractice*(3rdedition).Oxford&IBHPvt. Ltd., New Delhi.
- Wheeler,Q.D.&MeierR.2000.*SpeciesConceptsandPhylogeneticTheory:ADebate.*

Columbia UniversityPress,NewYork.
- Wilkins,J.S.2009.*Species:AHistoryoftheIdea*(Vol.1).UniversityofCalifornia Press.

CORE PAPER IX

C-4.2 : URBAN ECOSYSTEMS

Full Marks: 100
Mid Sem 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

Objective: This course is designed to enable the students to examine the existing environmental issues, conflicts and their potential role in urban development. It also focuses on key challenges posed by increasing development to far-reaching goal of sustainability in urban areas.

UNIT 1: Environment in an Urban Setting

Introduction to urbanization; urban sprawl and associated environmental issues. Man as the driver of urban ecosystem; commoditization of nature; metros, cities and towns as sources and sinks of resources; resource consumption and its social, cultural, economic and ecological perspectives; urban transformation; increasing challenges posed by modernity for the environment; urban pollution (air, water, soil).

UNIT 2: Urban dwelling

Housing scenario across a range of large-medium-small cities; poverty and slums in an urban context; Town planning Acts and their environmental aspects; energy consumption and waste disposal as well as accumulation; environmental costs of urban infrastructure, urban settings as loci of sustainability; challenges associated with sustainability and urban future.

UNIT 3: Natural spaces in a city

Concept of 'controlled nature'; scope, importance and threats to nature in the city; organization and planning of green spaces such as parks, gardens and public spaces; concept of green belts; urban natural forest ecosystem as green lungs.

UNIT 4: Planning and environmental management

Urban planning and its environmental aspects from historical and contemporary perspectives; benefits of environmental management; introduction to green buildings; urban governance; political complexity of applying ecological science to urban policy and planning, smart cities, management of urban environment; alternative resources; policy and management decisions.

Course Outcomes :

CO 1 : Demonstrate an entry level competence in understanding the ecological dynamics and their influence on urban ecosystem.
CO 2 : Demonstrate the ability to carry out environmental analysis in field conditions/laboratories and make appropriate judgment on growing Indian cities.
CO 3 : Ability to understand and appreciate the role of ecology and system dynamics in specific habitats/agro-ecosystems.
CO 4 : Be able to understand the demands and function in environmental management.

Practical/Seminar/Pilot Project: Based on the theory.

1. Study on urban pollution viz. air, noise, water and soil.
2. Study on Sewerage Waste Management in urban setting.
3. Preparation of solid waste inventory and generation pattern
4. Management of biodegradable solid waste such as composting, vermiconposting, land filling etc.
5. Debate on Urban Heat Island and its impact on urbanites.
6. Various schemes of government and its implementation in environmental management (GRIHA rating/Septage Management/Swachh Bharat Abhijan/Municipal Waste Management/ Biomedical Waste management)
7. Alternate source of energy and application in meeting energy need of cities (Green Energy).
8. Bharat Stage norms and promotion of Flexi fuel, CNG and Electronic Vehicle on vehicular air pollution.
9. To study the impact of Socio-Cultural behavior/practices of Urban people on environmental management.

Text Books:

- Gaston, K.J. 2010.*Urban Ecology*. Cambridge University Press, New York.
- Richter, M. & Weiland, U.(ed.).2012. *Applied Urban Ecology*. Wiley-Blackwell, UK.

Reference Books:

- D'Monte, Darryl. 1985. *Industry versus Environment Temples or Tombs*. Three Controversies, Delhi, CSE.
- Ernstson, H. 2011. *Re-translating nature in post-apartheid Cape Town: The material semiotics of people and plants at Bottom Road*. In: Heeks, R., (Ed.) Conference on "Understanding Development through Actor-Network Theory", LondonSchoolof Economics, 30 June, London.
- Grimm, N.B., Faeth, S.H., etal.2008. Global Change and the Ecology of Cities. *Science* **319**:756-760.
- Hinchliffe, S. & Whatmore, S.2006. Livingcities: Towards a politics of conviviality. *Scienceas Culture***15**:123–138.
- McIntyre, N.E. 2000. Urban ecology as an interdisciplinary field: differences in the use of 'urban' between the social and natural sciences. *Urban Ecosystems* **4**: 5-24.
- Montgomery, M.R.2009.Urban Transformation of the developing world. *Science* **319:** 761-764.

CORE PAPER X

C-4.3 : ENVIRONMENTAL LEGISLATION AND POLICY

Full Marks: 100
Mid Sem 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

Objective: This paper introduces students to the legal structure of India and fundamentals of environmental legislation and policy making. Each unit will help the students to develop basic concepts of environmental legislation and policy making in India and around the world.

UNIT 1: Legislation system in India

Constitution of India; fundamental rights; fundamental duties; Union of India; union list, state list, concurrent list; legislature; state assemblies; judiciary; panchayats and municipal bodies; National Green Tribunal. Legal definitions (environmental pollution, natural resource, biodiversity, forest, sustainable development); Article 48A (The protection and improvement of environment and safeguarding of forests and wildlife); Article 51 A (Fundamental duties).

UNIT 2: Environmental legislation: History and policy

Ancient period: worship of water, air, trees; Mauryan period: Kautilya'sArthashastra, Yajnavalkyasmriti and Charaksamhita; Medieval period: forests as woodland and hunting resources during Mughal reign; British India: Indian Penal Code 1860,Forest Act 1865, Fisheries Act 1897; Independent India: Van Mahotsava 1950, National Forest Policy 1952, Orissa River pollution and prevention Act 1953.

UNIT 3: Legislative Instruments

The Indian Forest Act 1927; The Wildlife (Protection) Act 1972; The Water (Prevention and Control of Pollution) Act 1974; The Forests (Conservation) Act 1980; The Air (Prevention and Control of Pollution) Act 1981; The Environment (Protection) Act 1986; Motor Vehicle Act 1988; The Public Liability Insurance Act 1991; Noise Pollution (Regulation and Control) Rules 2000; The Biological Diversity Act 2002; The Schedule Tribes and other Traditional Dwellers (Recognition of Forests Rights) Act 2006; The National Green Tribunal Act 2010; scheme and labeling of environment friendly products, Ecomarks.

UNIT 4: International laws and policy and Case studies in India

Stockholm Conference 1972; United Nations Conference on Environment and Development 1992; Rio de Janeiro (Rio Declaration, Agenda 21); Convention on Biological Diversity, Montreal Protocol 1987; Kyoto Protocol 1997; Copenhagen and Paris summits.

Role of Ministry of Environment, Forests & Climate; role of central and state pollution control boards. National Green Tribunal: Ganga Tanneries Case: M.C. Mehta vs. Union of India 1988.

Course Outcomes :

CO1 Get basic knowledge of environmental policies, its relevance, and various principles.
CO2. Understand various acts and legislation in place and suggest solutions of the gaps in the existing policies and legislation.
CO3. Know about international treaties and conventions
CO4. Know the significance of various historical environmental movements

Tutorial/Case study: Tutorial and case study based.

1. Case study or assignment on major Environmental Movements viz. Narmada Bacho Andolan, Chipko Movement, Jal Satyagrah, Pullavorum Dam Project, Gandhamardan Mining Issues. POSCO Industrial project (Paradeep), Namami Ganges programme.
2. Case study or assignment on Major environmental Disasters viz. Shri Ram Food and Fertilizers Case / Oleum Gas Leakage Case, Bhopal Gas Tragedy, Chernobyl Nuclear Disaster (1986), Sevaso Disaster (1976), Minamata Disaster, Fukusima Daiichi Nuclear Disaster (2011)

Text Books:

- Divan, S. & Rosencranz, A. 2001. *Environmental Law and Policy in India*. Oxford University Press.
- Venkat, A.2011. *Environmental Law and Policy*. PHIL earning Private Ltd.

Reference Books:

- Abraham, C.M. 1999. *Environmental Jurisprudence in India*. Kluwer Law International.
- Agarwal, V.K. 2005.Environmental Laws in India: Challenges for Enforcement. *Bulletin of the National Institute of Ecology* 15: 227-238.
- Divan, S. & Rosencranz, A. 2002. *Environmental Law and Policy in India: Cases, Materials and Statues* (2nd edition). Oxford University Press.
- Gupta, K.R. 2006. *Environmental Legislation in India*. Atlantic Publishers and Distributors.
- Leelakrishnan, P. 2008. *Environmental Law in India* (3rd edition). LexisNexis India. Naseem, M.2011. *Environmental Law in India Mohammad*. Kluwer Law International

Generic Elective Paper IV

GE-4.4 : GREEN TECHNOLOGIES

Full Marks: 100
Mid Sem 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

Objective: This paper introduces students to the concept of green technology, its goals and advantages. It also highlights potential role of green technologies in realizing the goal of sustainable development and focuses on community participation to tap the economic benefits associated with switching to green technologies.

UNIT 1: Green technologies: concept

Definition and concepts: green technology, green energy, green economy, and green chemistry; sustainable consumption of resources; individual and community level participation, energy conservation; encouraged use of public transport instead of private transport. successful green technologies: wind turbines, solar panels; 3 R's of green technology: recycle, renew and reduce; paradigm shift from 'cradle to grave' approach. Agenda of green development; reduction of ecological footprint; role of green technologies towards a sustainable future; major challenges and their resolution for implementation of green technologies.

UNIT 2: **Green infrastructure, planning and economy**

Green buildings; history of green buildings, need and relevance of green buildings over conventional buildings, outlined examples of green buildings; LEED certified building; Eco- mark certification, Green planning: role of governmental bodies, land use planning, concept of green cities, waste reduction and recycling in cities, 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 3: Applications of green technologies

Increase in energy efficiency: cogeneration, motor system optimization, oxy-fuel firing, isothermal melting process, energy efficient fume hoods. Green House Gas (GHG) emissions reduction: carbon capture and storage (CCS) technologies, purchase and use of carbon offsets, methane emissions reduction and/or reuse. 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 4: **Green chemistry and future**

Introduction to green chemistry; principles and recognition of green criteria in chemistry; biodegradable and bio-accumulative products in environment; green

nanotechnology; reagents, reactions and technologies that should be and realistically could be replaced by green alternatives; photodegradable plastic bags, green practices to conserve natural resources (organic agriculture, agroforestry, reducing paper usage and consumption, etc.); emphasis on waste reduction instead of recycling, emphasis on innovation for green future; role of advancement in science in developing environmental friendly technologies.

Course Outcomes:

CO 1 : Knowledge on importance and significance of green technology
CO 2 : Knowledge on development and application of innovative technologies in conversion natural forms energy to economically and environment friendly forms
CO 3 : Ability to develop, fabricate and utilize eco-friendly and cost-effective products in a variety of applications, and green design in building and infrastructure
CO 4 : Ability to understand the role of green technology in resource generation, employment and improvement of livelihood standards
CO 5 : Knowledge of various environmental monitoring and assessment tools, and industrial safety and hazard analysis

Practical/Project: field based study.

Text Books:

- Anastas, P.T. &Warner, J.C.1998.*Green Chemistry: Theory & Practice*. Oxford University Press.
- Arceivala, S.L. 2014. *Green Technologies: For a Better Future*. Mc-Graw Hill Publications.

Reference Books:

- Baker, S. 2006. *Sustainable Development*. Routledge Press.
- Hrubovcak, J., Vasavada, U. & Aldy, J. E. 1999. *Green technologies for a more sustainable agricultu e* (No.33721). United States Department of Agriculture, Economic Research Service.
- Than gavel, P. & Sridevi, G. 2015. *Environmental Sustainability: Role of Green Technologies*. Springer Publications.
- Woolley, T. & Kimmins, S.2002. *Green Building Handbook* (Volume1and2).Spon Press.

SECC-I-4.5 : COMMUNICATIVE ENGLISH

(Enriching Linguistic Knowledge & Communication Proficiency)

Full Marks – 100
Mid Sem – 20/1hr
End Sem – 80/3 hrs

UNIT-I : BUSINESS COMMUNICATION AND GRAMMAR

Why English Communication is Essential and How to Improve the Skill? Introduction to Voice and Accent, Why do we have such different accents?, Accent Training-Consequences, Voice and accent in the Enterprise Industry, Globally Comprehensible Accent, Introduction to Phonetics, International Phonetic Alphabet

Consonant Sounds Vowels Diphthongs
A Few Phonic Rules Word Stress: Syllables
Intonation : Intonation and Stress
Pacing and Chunking : Common Patterns of Pacing, Importance of Chunking Fluency
Indianisms : Errors relating to Grammar, Vocabulary

UNIT-II : GRAMMAR

English: Spoken Versus Written Communication
Nouns : Kinds of Nouns, Activity 3: Noun Ping-pong, Nouns-Number, Noun-Gender, Countable and Uncountable Nouns
Pronouns : Reflexive Pronouns, Relative Pronouns, Demonstrative Pronouns, Interrogative Pronouns, Indefinite pronouns, Activity 4: Sentence Auction
Adjectives : Activity 5 : Picture perfect, Positioning of adjectives, Comparative Degrees of Adjectives, Order of Adjectives
Adverbs : Kinds of Adverb, Degree of Comparison, Word Order with Adverbs, Activity 6: Relay Race Prepositions : Activity 7: Treasure Hunt, Activity 8: Route Map, Prepositions with Adjectives, Nouns and Verbs
Conjunctions : Coordinating conjunctions, Subordinating Conjunctions, Correlative Conjunctions, Connecting Adverbs, Activity 9: The Socks Story
Verbs : Verb Classification, List of irregular verbs, Activity 10: Word Search
Subject and verb agreement, Activity 11: Tossed Word Salad, Activity 12: The Sentence Pageant Determiners and Modifiers : Kinds of determiners, The Definite and the Indefinite Article, Definite Article: The, Activity 13: Proof Reading
Tenses : Reference Table, Present Tense, Activity 14: Instruction Manual, Activity 15: Commentary, Past Tense, Activity 16: The Chain List, Activity 17: Transcription, Future Tense, Activity 18: This Week for You, Activity 19: Verb Grand Prix
Punctuation : Forms of Punctuation

UNIT-III : READING COMPREHENSION

Reading – A 7 Step Process, Techniques to enhance students' reading skills, Types of reading skills, Skimming, Scanning, Extensive reading, Intensive reading, Three levels of Reading, Improving your reading speed, Reading Comprehension Practice Exercises

Text Books:

1. Communicative English – Odisha State Higher Education Council, Bhubaneswar

AECC-4.6 (EV-IV) : ETHICS & VALUES

UNIT-IV : Ethical Values for Student Life

Full Marks – 25
End Sem – 25/1 hr

4.1 Meaning and Objective of Education :

Knowledge is power and quest for knowledge is the real meaning of education, not quest for Degree and qualifications; Real education builds character : Difference between Academic Qualification and Ability, Academic failure could be failure within the classroom, but not outside (i.e. Failed in exam, passed in life!)

4.2 Challenges for Ethical Practices in Institutions of Higher Education:
Ragging, Suicide and Need for Educational Counseling, Violence vs. Peaceful Protest, Conflict resolution, Plagiarism and violation of Intellectual property Rights, Cheating in Examination and other Fraudulent Practices

4.3 Inter personal Relation and Community Life in HEI :
Green Preacher and conservation of Energy, Community Life in Campus including Hostels, Local Common area, Inter personal relations (Students-Teacher, Students-Student and Man-Woman, Positivie Friendship)

4.4 Ethical Leadership in Academic Institution :
Concept and Traits of Leadership to Provide solution, everyone has Leadership Role (not limited to position), Concept of Ethical leadership, Scope of Leadership in college and Universities for Students, Teachers and Administrators, Importance of Co-curricular and extra-curricular activities.

SEMESTER-V

CORE PAPER XI

C-5.1 : BIODIVERSITY AND CONSERVATION

Full Marks: 100
Mid Sem 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

Objective: This course is aimed at helping students to understand and appreciate various concepts and issues concerning biodiversity and conservation at local, regional and global levels. The course will attempt at encouraging students to appreciate the paradigm "think globally, act locally" for a sustainable common future of humankind.

UNIT 1: Levels of Organization, Biodiversity Patterns & Estimation

Organic evolution through geographic time scale; species concept – what's in a name?, how many species are there on earth? Spatial patterns: latitudinal and altitudinal trends in biodiversity; temporal patterns fluctuations in biodiversity patterns; importance of biodiversity patterns in conservation. Sampling strategies and surveys: phyto-sociological analysis, biomass estimation; community diversity estimation: alpha, beta and gamma diversity.

UNIT 2: Importance of Biodiversity

Economic values – medicinal plants, drugs, fisheries and livelihoods; ecological services – primary productivity, role in hydrological cycle, biogeochemical cycling; ecosystem services – purification of water and air, nutrient cycling, climate control, pest control, pollination, and formation and protection of soil; social, aesthetic, consumptive,

and ethical values of biodiversity.

UNIT 3: Threats to Biodiversity

Natural and anthropogenic disturbances; habitat loss, habitat degradation, and habitat fragmentation; climate change; pollution; hunting; over-exploitation; deforestation; hydropower development; invasive species; land use changes; overgrazing; man wildlife conflicts; consequences of biodiversity loss; Intermediate Disturbance Hypothesis.

UNIT 4: Conservation of Biodiversity

In situ conservation (Biosphere Reserves, National Parks, Wildlife Sanctuaries); Ex-situ conservation (botanical gardens, zoological gardens, gene banks, seed and seedling banks, pollen culture, tissue culture and DNA banks), role of local communities and traditional knowledge in conservation; biodiversity hotspots; IUCN Red List categorization – guidelines, practice and application; Red Data book; ecological restoration; afforestation; social forestry; agro forestry; joint forest management; role of remote sensing in management of natural resources. India as a mega diversity nation; National Biodiversity Action Plan.

Course Outcomes:

CO1 : To understand the importance of biodiversity.
CO2 : To analysis diversity types and indices.
CO3 : Develops knowledge on different factors for biodiversity laws.
CO4 : study various methods of biodiversity conservation.
CO5 : To learn the conservation status of species and recent developments on biodiversity.

Practical : Based on the theory.

1. Applications of GPS, Digital camera and Binoculars for biodiversity studies.
2. To study frequency of different plant species by quadrat method.
3. To study densiry of different plant species by quadrat method.
4. To find the abmdance of plant species by quadrat method.
5. To visit the field for inventorization of plant species.
6. To study the avian diversity in a visited area.
7. To study the techniques for preparation of herbarium.
8. To study the presence of animal species diversity in a visited area.
9. To study the presence of different wildlife sanctuary, biosphere reserve, national parks found all over the Odisha.
10. To study on mating behavior of certain wild animals.
11. Report on biodiversity hotspots of India
12. Estimation of primary productivity of terrestrial vegetation – Chlorophyll method
13. Estimation of primary productivity of grasses – Harvest method
14. Study of animal community – Line transect method
15. Estimation of carbon capture and storage of trees
16. Identification of ecological indicators

Text Books:

- Gaston, KJ. & Spicer, J.I. 1998. *Biodiversity: An Introduction.* Blackwell

Science, London, UK.

- Primack, R.B. 2002. *Essentials of Conservation Biology*(3rdedition). Sinauer Associates, Sunderland, USA.

Reference Books:

- Krishnamurthy, K.V. 2004. *An Advanced Text Book of Biodiversity-Principles and Practices*. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.
- Pandit, M.K. & Grumbine R.E. 2012. Ongoing and proposedhydro power developmentin the Himalaya and its impact on terrestrial biodiversity. *Conservation Biology* **26**:1061- 1071.
- Singh, J.S. & Singh, S.P. 1987 .Forest vegetation of the Himalaya. *The Botanical Review* 53:80-192.
- Singh, J.S., Singh, S.P. & Gupta, S. 2006. *Ecology, Environment and Resource Conservation.* Anamaya Publications, New Delhi.
- Sodhi, N.S. & Ehrlich, P.R. (Eds).2010.*ConservationBiologyforAll*.OxfordUniversity Press.
- Sodhi, N.S.,Gibson, L. & Raven, P.H. 2013. *Conservation Biology: Voices from the Tropics.* Wiley-Blackwell, Oxford, UK.

CORE PAPER XII

C-5.2 : ORGANISMAL AND EVOLUTIONARY BIOLOGY

Full Marks: 100
Mid Sem 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

Objective: This paper introduces students to the fundamentals of ecology and evolutionary biology. Each unit covers vast range of topics, which will help the students to develop basic concepts of ecology and evolutionary biology**.**

UNIT 1: History of Life on Earth

Paleontology and evolutionary History; evolutionary time scale; eras, periods and epoch; major events in the evolutionary time scale; origins of unicellular and multi cellular organisms; major groups of plants and animals; stages in primate evolution including Homo.

UNIT 2: Evolution of Unicellular Life

Origin of cells and unicellular evolution and basic biological molecules; a biotic synthesis of organic monomers and polymers; Oparin-Haldane hypothesis; study of Miller; the first cell; Lamarck's concept of evolution; Darwin's Evolutionary Theory: variation, adaptation, struggle, fitness and natural selection; Mendelism; spontaneity of mutations; Bio-geographic evidence of evolution; evolution of geographic patterns of diversity.

UNIT 3: Molecular Evolution

Neutral evolution; molecular divergence and molecular clocks; molecular tools in phylogeny, classification and identification; protein and nucleotide sequence analysis; origin of new genes and proteins; gene duplication and divergence.

UNIT 4: Fundamentals of Population Genetics

Concepts of populations, gene pool, gene frequency; concepts and rate of change in gene frequency through natural selection, migration and genetic drift; adaptive radiation; isolating mechanisms; speciation (allopatric, sympatric, peripatric and parapatric); convergent evolution; sexual selection; coevolution; Hardy-Weinberg Law.

Course Outcomes:

CO1 : At the end of this course, we expect the student to have a better understanding of the different evolutionary processes that shape biodiversity.
CO2 : The course also addresses micro-evolutionary processes using quantitative genetics at the molecular level.
CO3 : In the practical section of the course, the students will learn how to use analytical tools to construct and interpret phylogenetic trees from molecular data.
CO4 : To understand the evolutionary diversification of gene/protein families.

Practical/Assignment/Model Preparation/Seminar: Based on the theory.

The students are required to reconstruct dataset (selected from a specified journal) based on Mendelian or Darwin Theory of Evolution or Hardy-Weinberg's Law in their first assignment. The students are required to come up with their own interpretations from their reconstructed phylogenies. In the second assignment, they will evaluate the molecular evolution of gene families and map the evolutionary variability on the 3D structures of proteins or they may prepare a chart or presentation on organism.

Text Books:

- Minkoff, E.C. 1983. *Evolutionary Biology*. Addison Wesley. Publishing Company.
- Nei, M. & Kumar, S. 2000. *Molecular Evolution and Phylogenetics*. Oxford University Press.

Reference Books:

- Futuyma, D.J. 2009. *Evolution* (2nd edition). Sinauer Associates.
- Gillespie, J.H. 1991. *The Causes of Molecular Evolution*. Oxford University Press.
- Graur, D. & Li, W.H.1999. *Fundamentals of Molecular Evolution* (2ndedition). Sinauer Associates.
- Kimura, M. 1984. *The Neutral Theory of Molecular Evolution*. Cambridge University Press.
- Nei, M. 1975. *Molecular Population Genetics and Evolution*. North-Holl and Publishing Company.
- Nei, M. 1987. *Molecular Evolutionary Genetics*. Columbia University Press.

· Thorne, J.L., Kishino, H., & Painter, I.S.1998. Estimating therate of evolution of the rate of molecular evolution. *Molecular Biology and Evolution* 15: 1647-1657.

CORE PAPER XIII

DSE-5.3 : ENVIRONMENTAL POLLUTION AND HUMAN HEALTH

Full Marks: 100
Mid Sem 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

Objective: This course deals with different aspects of environmental contamination, which have adverse effects on human health. It will lay emphasis on understanding mechanisms of pollutants impacting human health by developing an understanding of different types of pollutants, their sources and mitigation measures. The students will also be introduced to the concept of permissible limits.

UNIT 1: Chemistry of Environmental Pollutants

Definition of pollution; pollutants; classification of pollutants; solubility of pollutants (hydrophilic and lipophilic pollutants), transfer of pollutants within different mediums, role of chelating agents in transferring pollutants, concept of biotransformation and bioaccumulation, concept of radioactivity, radioactive decay and half-life of pollutants, organometallic compounds, acid mine drainage, causes of soil pollution and degradation; effect of soil pollution on environment, control strategies.

UNIT 2: Air Pollution

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 (NOx, SOx, PM, CO, CO_2, hydrocarbons and VOCs) and control measures; indoor air pollution: sources and effects on human health. Noise pollution: sources and permissible ambient noise levels; effect on communication, impacts on life forms and humans, control measures, Radioactive material and sources of radioactive pollution.

UNIT 3: Fresh Water and Marine Pollution

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). 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), thermal pollution and its effects.

UNIT 4: Pollution Control

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, bioscrubbers, biotrickling filters; regulatory framework for pollution monitoring and control; case study: Ganga Action Plan; Yamuna Action Plan; implementation of CNG in NCT of Delhi.

Course Outcomes:

CO 1 : Understanding of the essential concepts of environmental pollution, classification, and its sources.
CO 2 : To gain clear concepts over air and water pollution and its impacts.
CO 3 : Concept of noise, radioactive, and thermal pollution causes and effects.
CO 4 : Understanding standards of the pollution level and its management as well as the impact on human health.

Practical: Based on the theory.

1. Determine water quality of a given location using rapid pollution monitoring kits
2. Assess air quality index (AQI) of any location using real-time air quality parameters
3. Determine magnitude of solid waste generated in a home/college on a monthly basis
4. Develop and maintain compost/vermicompost using biodegradable waste in the College
5. Identify suitability of given water samples for various purposes using given kits
6. Prepare water audit report of the college/house/locality/colony.
7. Map solid and liquid discharge of the college/colony and develop a management plan (show it using schematic diagram, and photographs.
8. Repurpose waste for economic and environmental benefits in your college/near by area/colony (submit a small video).
9. Analyze river-society-economy nexus based on primary or secondary data (use quantitative data, and show it using photographs on a poster).

Text Books:

- Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2006. *Environmental and Pollution Science*. Elsevier Academic Press.
- Purohit, S.S. & Ranjan, R. 2007. *Ecology, Environment & Pollution*. Agrobios Publications.

Reference Books:

- Gurjar, B.R., Molina, L.T. & Ojha C.S.P. 2010. *Air Pollution: Health and Environmental Impacts*. CRC Press, Taylor & Francis.
- Hester, R.E. & Harrison, R.M. 1998. *Air Pollution and Health*. The Royal Society

of Chemistry, UK.

- Park, K.2015. *Park's Text book of Preventive and Social Medicine* (23rd edition). Banarsi das Bhanot Publishers.
- Vesilind, P. J., Peirce, J.J., & Weiner R.F. 1990. *Environmental Pollution and Control*. Butterworth-Heinemann, USA.

CORE PAPER XIV

DSE-5.4 : NATURAL RESOURCE MANAGEMENT AND SUSTAINABILITY

Full Marks: 100
Mid Sem 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

Objective: This paper takes an objective view of the nature of Earth's resources, their generation, extraction and impact of human activities on earth's environment. The students are expected to understand effective management strategies. It aims to provide an idea of effective management strategies and a critical insight of the major sustainability issues.

UNIT 1: Natural resources and conservation

Resource and resource degradation; resource conservation; resource availability and factors influencing its availability; marine resources; energy resources; mineral resources; ecological, social and economic dimension of resource management, forest management strategies, strategies of water conservation; rain water harvesting; soil resources: importance of soil, soil conservation strategies; food resources: world food problem, green revolution.

UNIT 2: Mineral resources

Mineral resources and the rock cycle; identified resources; undiscovered resources; reserves; types of mining: surface, subsurface, open-pit, dredging, strip; reserve-to-production ratio; global consumption patterns of mineral resources techniques to increase mineral resource supplies; ocean mining for mineral resources; environmental effects of extracting and using mineral resources.

UNIT 3: Non-renewable and renewable energy resources

Oil: formation, exploration, oil shale, natural gas: exploration, liquefied petroleum gas, compressed natural gas; coal: reserves, coal gasification; environmental impacts of non renewable energy consumption; future energy options and challenges. Energy efficiency; life cycle cost; cogeneration; solar energy: technology, advantages, passive and active solar heating system, solar thermal systems, solar cells, JNN solar mission; benefits of hydropower development; nuclear fission reactors, pros and cons of nuclear power, storage of radioactive waste, radioactive contamination; tidal energy; wave energy; ocean thermal

energy conversion (OTEC); geothermal energy; energy from biomass; bio-diesel.

UNIT 4: Resource management

Approaches in resource management: ecological approach; economic approach; ethnological approach; implications of the approaches; integrated resource management strategies; concept of sustainability science: different approach towards sustainable development and its different constituents; sustainability of society, resources and framework; sustainable energy strategy; principles of energy conservation; Indian renewable energy programme.

Course Outcomes:

CO1 Be able to Protection of Natural Resources.
CO2 Responsible Use of Natural Resources.
CO3 To Promote energy conservation through efficient land use planning and building design through energy conservation.
CO4 Students are able to understand the benefits of sustainable use of Natural Resources.
CO5 Students are able to encourage conservation of natural resources, the city should work towards ensuring that users are charged for the full local costs of their individual use of water, electricity and sanitary sewers. There should also be educational programs to encourage conservation of natural resources.

Tutorials/Seminar: Based on the theory.

1. Isolation of Bacteria from Water/Wastewater – Serial Dilution Technique.
2. Identification of Bacteria – Gram Staining.
3. Isolation of Fungi from Soils – Pour Plate method.
4. Identification of Fungi – Lactophenol Cotton Blue Staining.
5. Construction of bacterial growth curve – pH – Broth culture
6. Minimum Inhibitory Concentrations (MICs) of Heavy metals on bacteria – Mueller-Hinton Agar method
7. Study of Root Nodule Bacteria – Gram Staining.
8. Study of Endomycorrhiza (VAM), Coralloid roots and Lichens.
9. Estimation of Coliform Group of Bacteria – MPN Technique.
10. Estimation of Coliform Group of Bacteria – MF Technique.

Text Books:

- Owen, O.S, Chiras, D.D, & Reganold,J.P.1998. *Natural Resource Conservation– Management for Sustainable Future* (7th edition). Prentice Hall.

Reference Books:

- Craig, J.R., Vaughan. D.J. & Skinner. B.J. 1996. *Resources of the Earth: Origin, Use, and Environmental Impacts* (2nd edition). Prentice Hall, New Jersey.
- Freeman, A.M. 2001. *Measures of value and Resources: Resources for the Future*. Washington DC.
- Freeman, A.M. 2003. *Millennium Ecosystem Assessment: Conceptual Framework*. Island Press.
- Ginley, D.S. & Cahen, D.2011. *Fundamentals of Materials for*

Energy and Environmental Sustainability. Cambridge University Press.
- Klee, G.A. 1991. *Conservation of Natural Resources*. Prentice Hall Publication.
- Miller, T.G. 2012. *Environmental Science*. Wadsworth Publishing Co.
- Ramade, F. 1984. *Ecology of Natural Resources*. John Wiley & Sons Ltd.
- Tiwari, G.N. & Ghosal. M.K. 2005. *Renewable Energy Resources: Basic Principles and Application*. Narosa Publishing House.

AECC-5.5 (EV-V) : ETHICS & VALUES

UNIT-V : Vulnerable Sections of Society: Understanding their Issues

Full Marks – 25
End Sem – 25/1 hr

5.1 Issues Relating to Children:
Nutrition and health, Child Exploitation : Child labour, Trafficking, Sexual exploitation

5.2 Issues Relating to Elderly Persons:
Abuse of Elders, Financial Insecurity, Loneliness and Social Insecurity, Health Care Issues, Needs for a Happy and Dignified Ageing

5.3 Issues Relatng to Persons with disability:
Rights of PWD, affirmative action, Prevention of discrimination, providing equal opportunity, various scheme for empowering PWD and social justice for PWD

5.4 Issues Relating to Third Gender:
Understanding the Third Gender, Social justice for them, Removal of discrimination, Affirmative action and Acceptance of diversity of gender

SEMESTER-VI

Discipline Specific Elective Paper I

C-6.1 : ENERGY AND ENVIRONMENT

Full Marks: 100
Mid Sem 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

Objective: This course aims to provide students with a broad understanding of the existing energy resources, issues related to energy and the environment, challenges and possible paths to sustainable energy generation and use.

UNIT 1: Energy, Demand and Energy resources

Defining energy; forms and importance; fossil fuels, advent of nuclear energy, global energy resources; renewable and non-renewable resources: distribution and

availability; future technologies for capturing and integrating these resources into our energy infrastructure; energy- use scenarios in rural and urban setups; energy conservation. Global energy demand: historical and current perspective; energy demand and use in domestic, industrial, agriculture and transportation sector; energy subsidies and environmental costs.

UNIT 2: Energy, environment and society

Nature, scope and analysis of local and global impacts of energy use on the environment; fossil fuel burning and related issues of air pollution, greenhouse effect, global warming and, urban heat island effect; nuclear energy and related issues such as radioactive waste, spent fuel; social inequalities related to energy production, distribution, and use.

UNIT 3: Energy, ecology and the environment

Energy production as driver of environmental change; energy production, transformation and utilization associated environmental impacts (Chernobyl and Fukushima nuclear accidents, construction of dams, environmental pollution); energy over-consumption and its impact on the environment, economy, and global change.

UNIT 4: Politics of energy policy and our energy future

Political choices in energy policy globally and in the Indian context; domestic and international energy policy; energy diplomacy and bilateral ties of India with her neighbors. Current and future energy use patterns in the world and in India; alternative sources as green energy (bio fuels, wind energy, solar energy, geothermal energy; ocean energy; nuclear energy); need for energy efficiency; energy conservation and sustainability.

Course Outcome:

CO1: Students would be able to exhibit an ability to integrate major factors affecting the Earth's energy resources, environment, and climate change.

CO2 : The students would be able to demonstrate expertise in energy supply and demand. Understanding technologies for sustainable energy usage.

CO3 : Conservation of energy, alternate energy efficiency, security and their association with environmental effects in a global and societal context.

CO4 : The students would exhibit innovative and creative solutions to energy and environmental problems through projects.

Tutorials/Seminar: Tutorial-based.

Text Books:

- Elliott, D. 1997. *Sustainable Technology. Energy, Society and Environment* (Chapter 3). New York, Routledge Press.

Reference Books:

- McKibben,B.2012.*GlobalWarming'sTerrifying New Math*, Rolling Stone

- Magazine. Craig. J.R., Vaughan, D.J.,Skinner.B.J.1996. *Resources of the Earth: Origin, use, and environmental impact* (2nd edition). Prentice Hall, New Jersey.
- Rowlands, I.H. 2009. *Renewable Electricity: The Prospects for Innovation and Integration in Provincial Policies* in Debora L. Van Nijnatten and Robert Boardman (eds), Canadian Environmental Policy and Politics: Prospects for Leadership and Innovation, Third Edition. Oxford University Press, pp. 167-82.
- Oliver, J. 2013. Dispelling the Myths about Canada's Energy Future, Policy: Canadian Politics and Public Policy, June-July.
- Mallon, K. 2006. *Myths, Pitfalls and Oversights, Renewable Energy Policy and Politics: A Handbook for Decision-Making*. Earth Scan.

Discipline Specific Elective Paper II

C-6.2 : ENVIRONMENTAL ECONOMICS

Full Marks: 100
Mid Sem 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

Objective: This paper introduces students to the fundamentals of environmental economics. It covers some basic concepts of economics to familiarize students with absence of market, demand and supply in nature. Each unit covers a range of topics, which will help students develop modern concepts of environmental economics and its importance in conservation of biodiversity and ecosystems through understanding of economic costs associated with these.

UNIT 1: Environmental economics

Main characteristics of environmental goods; marginal analysis; markets and market failure; social benefit, costs and welfare functions; meaning and types of environmental values; measures of economic values; tangible and intangible benefits; Pareto principle or criterion; Hardin's Thesis of' The Tragedy of Commons' ;prisoner's dilemma a game; methods of a batement of externalities; social cost benefit analysis; cost-effectiveness analysis.

UNIT 2: Economic solutions to environmental problems

Social costs and benefits of environmental programmes: marginal social benefit of abatement, marginal social cost of abatement; pollution control: policies for controlling air and water pollution, disposal of toxic and hazardous waste- standards vs. emissions charges, environmental subsidies, modelling and emission charges; polluter pay principles; pollution permit trading system.

UNIT 3: Natural resource economics

Economics of non-renewable resources; economics of fuels and minerals; Hotelling's rule and extensions; taxation; economics of renewable resources; economics of water use, management of fisheries and forests; introduction to natural resource accounting.

UNIT 4: Tools for environmental economic policy

Growth and environment; environmental audit and accounting, Kuznets curve, environmental risk analysis, assessing benefits and cost for environmental decision making; cost benefit analysis and valuation: discounting, principles of Cost-Benefit Analysis, estimation of costs and benefits, techniques of valuation, adjusting and comparing environmental benefits and costs.

Course Outcome:

CO 1 : Discuss the environmental issues in relation to the theory of externalities, public goods, and welfare.

CO 2 : Illustrate and examine economic principles concerning the choice of instruments for controlling pollution and the relative strength and weaknesses of environmental policies based on command-and-control vis-à-vis market-based instruments.

CO 3 : Discuss various approaches and methods developed for valuing environmental goods and services.

CO 4 : Examine issues in the contemporary environmental discourse from an economists' point of view.

Practical/Tutorial/Seminar: Tutorials, analysis and exercise based.

1. The assessment pattern would consist of a mid-semester exam (30%), end-semester examination (35%), term paper and class presentations (35%).
2. The mid-semester would be subjective in nature and would aim to test the students for their application of microeconomics principles to environmental economics.
3. The end-semester examination would examine the students for their understanding of methods and approaches taught and their application to the range of environmental issues.
4. In term paper and class presentations, the underlying emphasis would be on developing the attitude of independent thinking on contemporary environmental issues and critical evaluation of public policy for addressing environmental problems.
5. Presentation on carbon credit, carbon business and share market, green economy, ICC business charter for sustainable development, CSR and environmental responsibility.

Text Books:

- Hanley, N., Shogren, J.F., & White, B.2007. *Environmental Economics: In Theory and Practice*. Palgrave Macmillan.
- Kolstad, C.D. 2010. *Environmental Economic*s. Oxford University Press.

Reference Books:

- Arrow,K.,Bolin,B.,Costanza,R.,Dasgupta,P.,Folke,C.,Holling,C.S.,Jansson,B.O., Levin, S., Maler, K.G., Perrings, C., Pimentel, D. 1995. Economic growth, carrying capacity, and the environment. *Ecological Economics* **15**: 91-95.
- Perman, R.2003. *Natural Resource and Environmental Economics*. Pearson Education.
- Singh, K. & Shishodia, A.2007. *Environmental Economics: Theory and*

Applications. Sage Publications.
- Thomas, J.M. & Callan, S.J.2007. *Environmental Economics*. Thomson LearningInc.
- Tietenberg, T.2004 .*Environmental and Natural Resource Economics* (6th Edition). Pearson Education Pvt. Ltd.
- Tietenberg, T.H. & Lewis, L. 2010. *Environmental Economics and Policy*. Addison- Wesley.
- Turner, R.K., Pearce, D., & Bateman, I.1994. *Environmental Economics: An Elementary Introduction*. Harvester Wheatsheaf.

Discipline Specific Elective Paper III
DSE-6.3 : HAZARDS AND DISASTER RISK ASSESSMENT

Full Marks: 100
Mid Sem 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

Objective: This paper introduces the students to various aspects of environmental hazards, their causes, classifications, and impacts. It also focuses on the management strategies and governmental action plan to mitigate and prepare for such hazards.

UNIT 1: Natural hazards

Hydrological, atmospheric & geological hazards; earthquake: seismic waves, epicenter; volcanoes: causes of volcanism, geographic distribution; floods: types and nature, frequency of flooding; landslides: causes and types of landslides, land slide analysis; drought: types of drought- meteorological, agricultural, hydrological, and famine; Glacial Lake Outburst Floods (GLOF); tornadoes, cyclone & hurricanes; tsunamis: causes and location of tsunamis; coastal erosion, sea level changes and its impact on coastal areas and coastal zone management.

UNIT 2 : Anthropogenic hazards

Impacts of anthropogenic activities such as rapid urbanization, injudicious ground water extraction, sand mining from river bank, deforestation, mangroves destruction; role of construction along river banks in elevating flood hazard; disturbing flood plains. deforestation and landslide hazards associated with it; large scale developmental projects, like dams and nuclear reactors in hazard prone zones; nature and impact of accidents, wildfires and biophysical hazards. Case studies of Bhopal, Minamata and Chernobyl disaster.

UNIT 3 : Risk and vulnerability assessment

Concept of risk and vulnerability; two components of risk: likelihood and consequences, qualitative likelihood measurement index; categories of consequences (direct losses, indirect losses, tangible losses, and intangible losses); application of geoinformatics in hazard, risk & vulnerability assessment. Concept of mitigation; types of mitigation: use of technologies in mitigations such as barrier, deflection and retention systems; importance of planning, exercise, and training in preparedness; role of public and

media in hazard preparedness.

UNIT 4 : Disaster management in India

Lessons from the pastconsidering the examples of Bhujearthquake, tsunamidisaster, and Bhopal tragedy; National Disaster Management Framework, national response mechanism, role of government bodies such as NDMC and IMD; role of armed forces and media in disaster management; role of space technology in disaster management; case study of efficient disaster management during cyclone '*Phailin*' in 2013.

Course Outcome:

CO 1 : Explain various types of Environmental disasters and responsible factors.
CO 2 : Interpret and discriminate different stages of disaster management planning and utility tools in every stage.
CO 3 : Understand the administrative structure of disaster management in India and know the ethical and humanitarian values.
CO 4 : Apply advanced techniques in disaster management and disaster risk reduction.

Practical/Case Studies/Assignment: Based on the theory.

1. Case study on important natural disaster like Nuclear Disaster, Cyclone, Land slide, Heat wave, Earth Quake, Forest Fire, Volcanic Activities, Tsunami, Thunder Storm, Drought.
2. Major Global Disastesr : London Smog, Los Angels Smog, Polar Vortex Chernobyl Nuclear Disaster, Fukushima Daichii Nuclear Disaster etc.
3. Nation Disasters : Bhuj Earthquake, Tamil Nadu/ Andaman Nicobor Tsunami, Maharastra Flood, New Delhi Air Pollution
4. Local Disasters : Odisha Super Cyclone (1999), Foni (2019), Land Slides (Kandhamal)

Text Books:

- Schneid, T. D. & Collins, L.2001. *Disaster Management and Preparedness*. Lewis Publishers, New York, NY.

Reference Books:

- CoppolaD. P.2007. *Introduction to International Disaster Management*. Butter worth Heinemann.
- Cutter, S.L. 2012. *Hazards Vulnerability and Environmental Justice*. Earth Scan, Routledge Press.
- Keller, E.A.1996. *Introduction to Environmental Geology*. Prentice Hall, Upper Saddle River, New Jersey.
- Pine, J.C. 2009. *Natural Hazards Analysis: Reducing the Impact of Disasters*. CRC Press, Taylor and Francis Group.
- Smith, K.2001.*Environmental Hazards: Assessing Risk and Reducing Disaster*. Routledge Press.
- Wallace, J.M. & Hobbs, P.V.1977. *Atmospheric Science: An Introductory Survey*. Academic Press, New York.
- Wasson, R.J., Sundriyal, Y.P., Chaudhary, S., Jaiswal, M.K., Morthekai, P., Sati, S.P. & Juyal, N.2013. A1000-yearhistoryoflargefloodsintheupperGangacatchment, central Himalaya, India. *Quaternary Science Reviews* **77**: 156–166.

Discipline Specific Elective Paper IV

DSE-6.4 : SOLID WASTE MANAGEMENT

Full Marks: 100
Mid Sem 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

Objective: Every human activity ends up in the generation of unwanted waste product. This paper throws light on the current scenario of solid waste generation and problem in its handling and management. It also deals with the different governmental policies that explain proper transportation, handling and disposal of solid waste to minimize its effect on environment.

UNIT 1: Solid & industrial waste management

Sources and generation of solid waste, their classification and chemical composition; characterizationofmunicipalsolidwaste;hazardouswasteandbiomedicalwaste;impactofsolid waste on environment, human and plant health; different techniques used in collection, storage, transportation and disposal of solid waste (municipal, hazardous and biomedical waste); landfill; thermal treatment (pyrolysis and incineration) of waste material; stack emission control and emission monitoring; effluent treatment plant and sewage treatment plant.

UNIT 2: Resource Recovery

4R- reduce, reuse, recycle and recover; biological processing - composting, anaerobic digestion, aerobic treatment; reductive dehalogenation; mechanical biological treatment; green techniques for waste treatment. Concept of waste-to-energy (WTE), energy recovery from waste; refuse derived fuel (RDF); different WTE processes: combustion, pyrolysis, landfill gas (LFG) recovery; anaerobic digestion; gasification

UNIT 3: Integrated waste management

Concept of Integrated waste management; waste management hierarchy; methods and importance of Integrated waste management. Cradle-to-grave approach; lifecycle inventory of solid waste; role of life cycle assessment (LCA) in waste management; advantage and limitation of LCA; case study on LCA of a product.

UNIT 4: Policies for solid waste management

Municipal Solid Wastes (Management and Handling) Rules 2000; Hazardous Wastes Management and Handling Rules 1989; Bio-Medical Waste (Management and Handling) Rules 1998; Eco-friendly or green products.

Course Outcomes :

CO 1 Understand the characteristic of wastes and the systems, and processes of waste management.
CO 2 Identify the case specific issues related to pollution potentials of solid wastes
CO 3 Address solid waste management practices through a cradle-to-grave approach
CO 4 Apply understanding to generate recourses from wastes
CO 5 Make appropriate decisions through application of waste management principles

Practical: Based on the theory and field-based.

Text Books:

- Bagchi, A. 2004. *Design of Landfills and Integrated Solid Waste Management*. John Wiley & Sons.

Reference Books:

- Asnani, P.U. 2006. Solid waste management. *India Infrastructure Report 570.*
- Blackman,W.C. 2001. *Basic Hazardous Waste Management*.CRC Press.
- Mc Dougall, F.R.,White, P.R., Franke, M., & Hindle, P.2008. *Integrated Solid Waste Management: A Life Cycle Inventory*. John Wiley & Sons.
- USEPA. 1999. *Guide for Industrial Waste Management*. Washington D.C.
- White, P.R., Franke, M. &HindleP.1995. *Integrated Solid waste Management: A Lifecycle Inventory*. Blackie Academic & Professionals.
- Zhu, D., Asnani, P.U., Zurbrugg, C., Anapolsky, S. & Mani, S. 2008. *Improving Municipal Solid waste Management in India.* The World Bank, Washington D.C.

Discipline Specific Elective Paper IV

Dissertation/Research Project
DISSERTATION ON SOLID WASTE MANAGEMENT / ENVIRONMENTAL POLLUTIONS

Full Marks: 100
Mid Sem 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

Regulation for the dissertation/project in DSE IV (Hons) Paper

The Project Paper (DSE-IV) Full Mark-100is composed of

a) Identification of Problem - 05marks
b) Review of Literature - 10marks
c) Methodology - 15marks
d) Analysis - 15marks
e) Findings - 15marks
f) Presentation - 10 marks
g) Viva-Voce - 30 marks

Pass Mark-40 out of 100

The Project Paper will not have Mid Semester Examination. The project paper will be evaluated both by External and Internal Examiners. Submission of Project will carry 60 marks and Presentation and Viva-voce will carry 40 marks. Preferably students are advised to present the paper Power Point presentation method. Viva will be conducted through on the topic in the presence of external and internal examiners.

The student may choose any on one Unit/ Topic given in the syllabus in DSE-IVash is/her Project. Where to picis not given in the syllabus, the concerned teachers will choose any one of the Unit/Topic of study may select as project for the students.

Remuneration to the Examiner (External/ internal) is Rs.20/- each per project Fee of Rs.50/- shall be collected from each Hons. Student at the time of Readmission to +3 III rd Year at the college level and the collected amount will be deposited in the examination account of respective colleges. The Remuneration for External & Internal may please be met from that amount.

Evaluation of project by both the examiners shall be completed before the commencement of 6th Semester Examination and the marks be uploaded through UUEMS.

AECC-6.5 : (EV-VI) : ETHICS & VALUES

UNIT-VI : Environmental & Techno Ethics

Full Marks – 25
End Sem – 25/1 hr

6.1 Environmental Ethics:

Types of Ecological Values, Environmental Values & Valuing Nature, Equitable use of

Resources, Role of Individual in the conservation of resources for future generation, Bio-Ethics-Genetic manipulation in plants and animals for benefits of society and cruelty against animal.

6.2 Promotion of Green Technology:

Goal of Green Technology: Reduce recycling, **Renew** (removal of chemicals), **Refuse** and **Responsibility**.

Green Technology in relation to :- Energy and Construction.

6.3 Ethics and Technology:

Ethics and Technology with reference to Science, gadget, machine etc. and interaction with each other,

Agricultural, Industrial, Digital, Globalized Age etc

6.4 Judicious Use of Technology:

Judicious use of Mobile Phones, Electrical machines, Plastics, Television, Computers and their harmful effects

Ethics and Use of Digital Technology: Cyber ethics- Crimes and Ethical hacking,

Ethics of social media: WhatsApp, Facebook, Twitter and others

ASSIGNMENT/PILOT PROJECT/CASE STUDY/SEMINAR

Full Marks: 25
End Sem Practical – 25/3 hrs

Regulation for the Assignment/project Hons. core Paper

The Project Paper (Full Mark-25) is composed of

a) Identification of Problem/Objective - 02marks
b) Review of Literature - 03marks
c) Data Mining/Meta-data Analysis - 10 marks
d) Discussion & Summary - 05marks
e) Presentation - 05 marks

Pass Mark-13 out of 25

The Project Paper will not have Mid Semester Examination. The project paper will be evaluated by Internal Examiners. Preferably students are advised to present the paper Power Point presentation method. Viva will be conducted through on the topic in the presence of internal examiners. The student may choose any on one Unit/ Topic given in the syllabus in the core paper syllabus. The concerned teachers will choose any one of the Unit/Topic of study may select as project for the students as per the syllabus.