

Proposed syllabus and Scheme of Examination

For

B.Sc. (Honors) Environmental Science

Submitted

to

KAZI NAZRUL UNIVERSITY

Under

Choice Based Credit System

June 2016

Outline of Choice Based Credit System:

1. **Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

2. **Elective Course:** Generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

2.1 **Discipline Specific Elective (DSE) Course:** Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective.

2.2 **Dissertation/Project:** An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.

2.3 **Generic Elective (GE) Course:** An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.

P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

3. **Ability Enhancement Courses (AEC):** The Ability Enhancement (AE) Courses may be of two kinds: Ability Enhancement Compulsory Courses (AECC) and Skill Enhancement Courses (SEC). "AECC" courses are the courses based upon the content that leads to Knowledge enhancement; i. Environmental Science and ii. English/MIL Communication. These are mandatory for all disciplines. SEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.

3.1 Ability Enhancement Compulsory Courses (AECC): Environmental Science, English Communication/MIL Communication. 3.2 Skill Enhancement Courses (SEC): These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge.

Department of Environmental Science, Kazi Nazrul University, Asansol
Curriculum For B.Sc. Honours in Environmental Science [Choice Based Credit System]

Semester-I

Sr. No.	Name of the Subject	Nature	Code	Teaching Scheme in hour per week			credit
				L	T	P	
1	Fundamentals of Environment	Core Course-I	HENV-CCT-101	5	1	0	6
2	Environmental Biology	Core Course-II	HENV-CCT-102	5	1	0	6
3	Fundamental Environmental Practical	Core Course-III Practical	HENV-CCP-103	0	0	4	4
4	GE-I	GE					4
5	GE-I Lab/Tutorial	GE					2
6	Environmental Studies						2
							Total Credit =24

Semester-II

Sr. No.	Name of the Subject	Nature	Code	Teaching Scheme in hour per week			credit
				L	T	P	
1	Environmental Chemistry	Core Course-IV	HENV-CCT-201	5	1	0	6
2	Environmental Physics	Core Course-V	HENV-CCT-202	5	1	0	6
3	Practical	Core Course-VI Practical	HENV-CCP-203	0	0	4	4
4	GE-II	GE					4
5	GE-II Lab/Tutorial	GE					2
6	Eng/MIL						2
							Total Credit =24

Semester-III

Sr. No.	Name of the Subject	Nature	Code	Teaching Scheme in hour per week			credit
				L	T	P	
1	Environmental Pollution - I	Core Course-VII	HENV-CCT-301	4	0	0	4
2	Environmental Pollution – II & Monitoring Techniques	Core Course-VIII	HENV-CCT-302	4	0	0	4
3	Practical	Core Course-IX Practical	HENV-CCP-303	0	0	4	4
4	GE-III	GE					4
5	GE-III Lab/Tutorial	GE					2
6	SEC-I	AEEC-I					2
							Total Credit =20

Semester-IV							
Sr. No.	Name of the Subject	Nature	Code	Teaching Scheme in hour per week			credit
				L	T	P	
1	Environmental Resources	Core Course-X	HENV-CCT-401	4	0	0	4
2	Environmental Biotechnology & Economics	Core Course-XI	HENV-CCT-402	4	0	0	4
3	Practical	Core Course-XII Practical	HENV-CCP-403	0	0	4	4
7	GE-IV	Theory		4	0	0	4
8	GE-IV	Lab/Practical/ Tutorial		0	0	2	2
9	SEC-II	Skill Enhancement Course-II		4	0	0	4
Total Credit = 24							

Semester-V							
Sr. No.	Name of the Subject	Nature	Code	Teaching Scheme in hour per week			credit
				L	T	P	
1	Earth Sciences	Core Course-XIII	HENV-CCT-501	4	0	0	4
2	Environmental Management	Core Course-XIV	HENV-CCT-502	4	0	0	4
3	Practical	Core Course-XV Practical	HENV-CCP-503	0	0	4	4
5	DSE -I	DSE-I					4
6	DSE –I / Lab Tutorial	DSE-I					2
7	DSE -II	DSE-II					4
8	DSE –II Lab/ Lab Tutorial	DSE-II					2
Total Credit = 24							

Semester-VI							
Sr. No.	Name of the Subject	Nature	Code	Teaching Scheme in hour per week			credit
				L	T	P	
1	Environmental Laws, Policy and EIA	Core Course-XVI	HENV-CCT-601	4	0	0	4
2	Environmental Health & Stress Physiology	Core Course-XVII	HENV-CCT-602	4	0	0	4
3	Practical	Core Course- XVIII Practical	HENV-CCP-603	0	0	4	4
5	DSE -III	DSE-III					4
6	DSE –III / Lab Tutorial	DSE-III					2
7	DSE -IV	DSE-IV					4
8	DSE –IV Lab/ Lab Tutorial	DSE-IV					2
Total Credit =24							

Total credits: 140

Core Course

Sr. No.	Semester	Name of the Subject	Teaching Scheme in hour per week			Credit
			L	T	P	
1	I	Fundamentals of Environment	5	1	0	6
2	I	Environmental Biology	5	1	0	6
3	I	Practical	0	0	4	4
4	II	Environmental Chemistry	5	1	0	6
5	II	Environmental Physics	5	1	0	6
6	II	Practical	0	0	4	4
7	III	Environmental Pollution-I	4	0	0	4
8	III	Environmental Pollution-II & Monitoring Techniques	4	0	0	4
9	III	Practical	0	0	4	4
10	IV	Environmental Resources	4	0	0	4
11	IV	Environmental Biotechnology & Economics	4	0	0	4
12	IV	Practical	0	0	4	4
13	V	Earth Sciences	4	0	0	4
14	V	Environmental Management	4	0	0	4
15	V	Practical	0	0	4	4
16	VI	Environmental Laws, Policy & EIA	4	0	0	4
		Health & Stress Physiology				
17	VI	Environmental Health & Stress Physiology	4	0	0	4
18	VI	Practical	0	0	4	4
		Credits				80

AECC –Ability Enhancement Compulsory Courses: English/Modern Indian Language/EVS

AECC –Ability Enhancement Elective Courses [Skill Enhancement Course (SEC)]

[Two papers are to be taken and each paper will be of 2 credits]*₁

1. Skill in Experimental Methods 2. Circuit Theory and Network Skills 3. Numerical Methods and Programming Skills 4. Technical Drawing Skills.

Discipline Specific Electives (DSE)

[Four papers are to be taken and each paper will be of 6 credits]

1. Fundamentals of Environment 2. Environmental Biology 3. Environmental Chemistry
4. Environmental Physics 5. Environmental Pollution-I 6. Environmental Pollution-II & Monitoring Techniques
7. Environmental Resources 8. Environmental Biotechnology & Economics

Interdisciplinary/ Generic Elective (G.E.) from other Department

[Four papers are to be taken and each paper will be of 6 credits]

Note: Papers are to be taken from the following disciplines. (At least two papers are to be taken from Chemistry)

1. Chemistry 2. Botany, 3. Environmental Science
4. Any relevant course from B.A./B. Sc. Program.

Interdisciplinary/Generic Elective (G.E.) for Other Departments

Sr. No.	Semester	Name of the Subject	Teaching Scheme in hour per week			Credit
			L	T	P	
1	I	Fundamentals of Environment	5	1	0	6
2	I	Environmental Biology	4	0	4	6
3	II	Environmental Chemistry	5	1	0	6
4	II	Environmental Physics	4	0	4	6
5	III	Environmental Pollution-I	4	0	0	6
6	III	Environmental Pollution-I & Monitoring Techniques	4	0	4	6
7	IV	Environmental Resources	4	0	0	6
8	IV	Environmental Biotechnology & Economics	4	0	4	6

SEM- I
HENV-CCT-101
Fundamentals of Environment

Lectures - 55

- I. Concept of Environment: Concept, ideas, and types and components of environment; Objectives, nature and scope of the subject; Man-environment relationships; Environmental awareness – Earth Summits, recent Conventions on climate change 12
- II. Environmental Education: Goals of environmental education; Environmental education at primary, secondary and tertiary level; Green politics; Models for future environmental education; Environmental movements – The Chipko movement, Silent Valley movement, *Narmado Bachao Andalon*, Tehri Dam Conflict 15
- III. Cell and Genetics:
- Cell: Fundamental units of life, ultrastructure and functions of plasma membrane, cellular organelles, *e.g.*, Mitochondria, Ribosome, Golgi body, Chloroplast, Endoplasmic reticulum, Nucleus, Chromosome; Mitotic and meiotic stages of cell division 14
- Fundamentals of genetics: Mendel's Law of inheritance and gene interaction; Darwinism and Modern Synthetic Theory of evolution; Concept on speciation; Hardy Weinberg Equilibrium; Genetic drift 14

SEM – I
HENV-CCT-102
Environmental Biology

Lectures - 55

- I. Taxonomy: Definition of taxonomy, systematic and classification; Morphological and taxonomical studies of flora and fauna 12
- II. Concepts of Ecology: Subdivisions and developmental phases of ecology; Ecological classification (hydrophytes, xerophytes, halophytes, mesophytes, lithophytes, chasmophytes, epiphytes) and their morphological, physiological and biochemical adaptation; Ecological factors - climatic, edaphic, physiographic and biotic; Limiting factor & Shelford's Law 13
- III. Concepts of Ecosystem and Biomes: Structural and functional aspects of major ecosystems (with special reference to freshwater, mangrove and desert); Ecological pyramids, food chain and food webs; Predation, competition, symbiosis, defensive mechanism, resilience and stability; Biomes: Concept, characteristics of biome types, *viz.*, Grass lands, Tropical Rain Forests and Tundra 15
- IV. Biotic Community: Basic ideas on population in relation to ecology; Basic ideas on ecotone and edge effect, habitat and ecological niche, ecotypes, ecophene, ecological indicators; Elementary idea on biogeochemical cycles (*viz.*, N, C, S, P) 15

SEM - I
HENV-CCP-103

Time: 3 hours

<u>Description of Items</u>	<u>Distribution of Marks</u>
1) One Major experiment	15
2) Identification with reasons	10
3) Laboratory Note Book	05
4) <i>Viva-voce</i>	10

Practical Courses

1) Major Experiments

- a) Cytological preparation of mitotic stages from onion root tips (*Allium cepa*)
- b) Cytological preparation of meiotic stages from grasshopper testis

2) Identification with reasons (at least one from each A & B must be set during examination)
Study on Aquatic organisms (Microfauna and Microflora)

A) Study of Microfauna viz., *Brachionus*, *Keratella*, *Cyclops*, *Cypris*, *Diaptomus*, Nauplius larva, *Bosmina*, *Moina*, *Eubranchipus*

B) Study of Microflora viz., *Spirogyra*, *Zygnema*, *Pistia*, *Eichhornia*, *Hydrilla*, *Ceratophyllum*, *Ipomoea*, *Azolla*, *Lemna* (minor and major), *Limnophilia*, *Marselia*, *Nymphae*, *Nelumbo*.

3) Laboratory Note Book containing all practical experiments, Identifications

4) *Viva-voce*

SEM-II
HENV-CCT-201
Environmental Chemistry

Lectures - 55

I. Fundamental Concepts of General Chemistry: Molecular weight, equivalent weight, molarity, normality, valency, oxidation state and bonding, oxidation and reduction reactions; Metals and nonmetals; Aromatic and aliphatic organic compounds; Saturated and unsaturated hydrocarbons; Free radicals; Catalytic process	12
II. Fundamentals of Biochemistry: Elementary ideas on carbohydrates, proteins, lipids and enzymes; Idea on structure of macro-molecules--DNA and RNA, and Chlorophyll	10
III Chemical Equilibrium and Kinetics (Fundamentals): Stoichiometry, chemical equilibrium, chemical potential; Acid-base reactions (acidity, alkalinity, buffers and buffer capacity)	08
IV. Aquatic Chemistry: Principles of sedimentation, coagulation, precipitation; Concept of solubility product; Filtration and adsorption processes	07
V. Atmospheric Chemistry: Composition and Structure of the atmosphere; Properties of atmospheric gases, aerosols, SPM; Photochemical reactions in the atmosphere (photochemical smog)	10
VI. Green chemistry: Concept, principles, applications of green chemistry, <i>e.g.</i> , use of CO ₂ , H ₂ O ₂ , TiO ₂ ; Green technology in waste management	08

SEM - II
HENV-CCT- 202
Environmental Physics

Lectures - 55

I. Fundamental Mathematics: Variation, theory of indices; Arithmetic and geometric progression; Theory of quadratic equation, logarithm, integration by parts; Introduction to matrix and determinant; Linear differential equation	17
II. Dynamic Meteorology: First and second law of thermodynamics, entropy, enthalpy, heat transfer processes; Diffusion and transport of pollutants in air	18
III. Biophysics: Free energy; Bioenergetics of coupled reactions; High energy phosphates-central role in energy capture and transfer; Energy yield, coupling factor theory, membrane transport, active transport, ATP driven active transport, ion driven active transport; Diffusion, diffusion pressure of liquids, importance of diffusion in plants; Osmosis, osmotic pressure, plant cell as osmotic system and relationship with turgor pressure, wall pressure and osmotic pressure; Water potential concept-components of water potential - i) Matric potential, ii) Solute potential, iii) Pressure potential; Osmotic relation in three physical states (ψ , ψ_s , ψ_p); Water potential changes in plasmolysis and deplasmolysis, imbibitions	20

SEM - II
HENV-CCP-203

Time: 3 hours

Full marks: 50 (40+10)

Description of Items	Distribution of Marks
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1) One Major experiment	15
2) One Minor experiment	10
3) Laboratory Note Book	05
4) <i>Viva-voce</i>	10

1) Major experiments

- a) Estimation of protein, sugar from plant tissues
- b) Estimation of chlorophyll from green leaves

2) Minor experiment

- a) Introduction of Computer programmes (Microsoft Word, Power point presentation, EXCEL)
- b) Measurement of dust fall

3) Laboratory Note Book containing all practical experiments, Computer

4) *Viva-voce*

SEM-III
HENV-CCT-301
Environmental Pollution-I

Time: 2 hours

Full marks: 50 (40+10)
Lectures - 45

I. Understanding Pollution (Fundamentals): Pollution, poverty, and population	03
II. Air Pollution: Air pollutants—sources and effects of primary and secondary pollutants, particulate matters, HAPs (hazardous air pollutants), indoor pollutants; <i>El Nino</i> phenomenon, Global climate change	15
III. Water Pollution: Sources-direct and indirect sources and their impact on water bodies, <i>viz.</i> , marine, coastal, wetlands, groundwater	07
IV. Soil Pollution: Sources, types and effects of soil pollution	05
V. Thermal pollution: Definition, nature of pollutants, environmental effects of coal ash	03
VI. Marine pollution: Sources and nature, status of coastal and estuarine pollution in India, effects on aquatic biota	07
VII. Vehicular pollution: Characteristics of automobile emissions, effects of automobile pollutants	05

SEM-III
HENV-CCT-302
Environmental Pollution-II & Monitoring Techniques

Time: 2 hours

Full marks: 50 (40+10)
Lectures - 45

I. Natural Hazards: Basic concept of natural hazards, <i>e.g.</i> , flood, earthquake and landslide in Indian context	05
II. Noise Pollution: General features, sources and classification; Effects of sound pollution	05
III. Radiation Pollution: Man-made radiation; Radiation hazards, nuclear accidents	03
IV. Pesticide Pollution: Sources, categories; Pesticidal effects in water; Elementary idea on IPM	05
V. Metal pollution: Metals in soil, food and water; Elementary idea on metal pollution (<i>e.g.</i> , Lead, Cadmium)	05
VI. Analytical techniques & tools: Sampling, preservation and storage techniques; Principle, application and limitations of titrimetry, gravimetry and potentiometry; Ultrasound characteristics & Environmental applications of acoustic RADAR, LASER radiation	12
Bacteriological examination of water (IS: 1622 – 1981) with special reference to standard plate count and test for coliforms	05
Data collection and representation techniques: Concept of sampling, mean, median, mode, frequency distribution, standard error and deviation	05

SEM - III
HENV-CCP-303

Time: 3 hours

Full marks: 50 (40+10)

Description of Items	Distribution of Marks
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1) One Major experiment	15
2) One Minor experiment	10
3) Laboratory Note Book	05
4) <i>Viva-voce</i>	10

Practical Courses

1) Major Experiments

- a) Estimation of water parameters—DO, Free and Combined CO₂, Hardness, Alkalinity, Acidity, Chloride, TSS, TDS
- b) Statistical problems (calculation of mean, standard error and deviation from supplied data)

2) Minor Experiments

- a) Colony counting
- b) Preparation of basic liquid medium (e.g., Nutrient broth or Mc Conkey Broth)/Solid medium (Nutrient agar or Mc Conkey agar)/Media for culture of bacteria

3) Laboratory Note Book containing all practical experiments

4) *Viva-voce*

SEM-IV
HENV-CCT-401
Environmental Resources

Time: 2 hours

Full marks: 50 (40+10)
Lectures - 45

I. Natural resources: Current status of Water, Land, Forest, Minerals resources	05
II. Energy resources: Classification, conventional, non-conventional, renewable, non-renewable	05
III. Fossil fuels: Coal (composition, origin and classification); Petroleum (origin, mining, chemical composition, classification); Natural gas (concept on LNG, CNG, LPG); Oil (origin, utilization)	12
IV. Renewable resources: Solar energy (PV cells, PG cells); Geothermal energy (origin, utilization); Ocean energy; Biomass energy; Hydroelectricity	08
V. Conservation of natural resources; Present trend and future energy resources	05
VI. Biological wealth: Value of wild species; Sources of agriculture, forestry, aquaculture; Biodiversity – Concept, value; Decline and reasons of consequences of losing biodiversity; Mega-diversity Hotspots, hotspots of biodiversity, Red Data Book; Conservation of biodiversity (International & national)	10

SEM-IV
HENV-CCT-402
Environmental Biotechnology and Economics

Time: 2 hours

Full marks: 50 (40+10)
Lectures - 45

I. Bacterial morphology: Shape, size, structure and function of bacterial cell membrane, cell wall, capsule, flagella	06
II. Virology: Descriptive properties of virus: Morphology and structure of bacteriophages	05
III. Microbes of different environment; Contamination and microbial spoilage of food	03
IV. Biotechnological approaches: Definition, types, applications and advantages of biofertilisers, biopesticides, biofuels	10
V. Principles of genetic engineering	03
VI. Environmental Economics: Concept, scope and interrelation; Concept of supply and demand; Ecological economics; Environmental indicators-sustainable accounting; Environmental Kuznets's Curve; Economics of pollution control; Cost: Benefit analysis	10
VII. Environmental Accounting and Auditing: Environmental accounting--objectives, financial accounting, social accounting; Overview on environmental audit programmes in India; ICC basic steps of an environmental audit; Life cycle assessment	08

SEM - IV
HENV-CCP-403

Time: 3 hours

Full marks: 50 (40+10)

Description of Items	Distribution of Marks
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1) One Major experiment	15
2) Preparation of biodiversity registers	10
3) Laboratory Note book	05
4) <i>Viva-voce</i>	10

1. Major Experiments

- a) Quantitative characters of plant community, density, frequency, dominance
- b) Staining and counting of zooplankton

2. Preparation of biodiversity registers

- a) Study on local flora and fauna (report)
- b) Biodiversity of locality

3) Laboratory Note Book containing all practical experiments, Identifications

4) *Viva-voce*

SEM - V
HENV-CCT-501
Earth Sciences

Time: 2 hours

Full marks: 50 (40+10)
Lectures - 45

- I. Earth Processes: Origin and evolution of earth; Geological time scale; Major rock types, rock cycle; Continental drift; Big Bang Theory 08
- II. Climatology: Elements of climates; Spatial and temporal patterns of climate; Climate parameters in India and climatic classification (Koppen's classification) 07
- III. Earth Resources: Mineral resources--classification, Indian occurrences; Water resources (surface and groundwater)--hydrological cycles, geological formation as aquifers, types of aquifers 10
- IV. Soil: Weathering processes and soil formation; Soil profile development; Basic concept of physical, chemical and mineralogical composition of soil 07
- V. Elementary Idea of Remote Sensing: Definition, source of energy, energy interactions with the atmosphere and Earth's surface materials; Remote sensing platforms; Types of satellites; Latest Indian operating satellites and their utilities; Advantages and limitations of remote sensing 13

SEM - V
HENV-CCT- 502
Environmental Management

Time: 2 hours

Full marks: 50 (40+10)
Lectures - 45

- I. Principles of Management: Definition and concept on environmental management; Environmental quality measurement (ISO 14000), Environmental management system; Implication of Agenda-21; Functions of management--forecasting, planning, organizing, motivating, coordinating, controlling, and communicating, leadership, directing, and decision making 15
- II. National Committee on Environment Planning and Coordination, and its function in India; Energy management in industries 10
- III. Management of air pollution, water pollution, noise pollution in respect to Indian scenario; Ganga Action Plan (GAP), Yamuna Action Plan (YAP) 08
- IV. Integrated system for waste management: Municipal Solid Wastes (MSW); Biomedical wastes; Plastic wastes; Hazardous wastes; Radioactive waste; Biosafety Protocol 12

SEM - V
HENV-CCP-503

Time: 3 hours

Full marks: 50 (40+10)

<u>Description of Items</u>	<u>Distribution of Marks</u>
1) One Major experiment	10
2) Identification with reasons	10
3) Laboratory Note book	05
4) <i>Viva-voce</i>	10
1) Major experiments	
a) Estimation of soil parameters—Texture, Temperature, Organic carbon, Colour, Density, Porosity, Conductivity, pH	
2) Identification with reasons	
a) Visual interpretation of satellite imagery	
b) Hand specimen identification of common rocks (Granite, Sandstone, Schist) and Minerals (Quartz, k-Feldspar, Muscovite)	
3) Laboratory Note Book containing all practical experiments, Identifications	
4) <i>Viva-voce</i>	

SEM-VI
HENV-CCT-601
Environmental Laws, Policy and EIA

Time: 2 hours

Full marks: 50 (40+10)
Lectures – 45

- I. Laws and Policies: Basic concept on law, rules, act, treaty; Public Policy and PILs; Environmental provisions in the Indian Constitution; Powers and Functions of Govt. Agencies for pollution control (CPCB & SPCB); Objectives & Principles of The Environment Protection Act, 1986, The Air (Prevention and Control of Pollution) Act, 1981, The Water (Prevention and Control of Pollution) Act, 1974, The Noise Pollution (Regulation and Control) Act, 2000, The Wild Life (Protection) Act, 1972, The Forest (Conservation) Act, 1980, The National Green Tribunal Act, 2010, The Biological Diversity Act, 2002 30
- II. Environmental Impact Assessment: Environmental Impact Assessment--goals of impact assessment, evolution of impact assessment, ecological impact assessment; Hazard and risk assessment; Technology assessment; Environmental inventory; Public involvement with impact assessment; Techniques and methods of EIA 15

SEM VI
HENV-CCT-602
Environmental Health & Stress Physiology

Time: 2 hours

Full marks: 50 (40+10)
Lectures - 45

- I. Environmental Health: Concept of health and disease; Principles of epidemiology and epidemiological methods, aims of epidemiology 10
- II. Diseases: Some communicable diseases--small pox, viral hepatitis, dengue, plague, Leishmaniasis; Non-communicable diseases--cardiovascular, diabetes; Immunology-elementary ideas about antigens and antibody; Allergy 15
- III. Health Programs: Health Programs in India; Demography and family planning; Nutrition and health; Health education; World health report 10
- IV. Environmental Stress Physiology: Concept and fundamentals; Photoinhibition and photoacclimation; Stress-agents like temperature, oxygen, salinity on plants 10

SEM - VI
HENV-CCP-603

Time: 3 hours

Full marks: 50 (40+10)

<u>Description of Items</u>	<u>Distribution of Marks</u>
1) One Practical demonstration	15
2) Submission of Field Report including submission of samples (flora, fauna, rocks, minerals, etc.)	10
3) Laboratory Note Book	05
4) <i>Viva - voce</i>	10

Practical Courses

1) Practical demonstration

a) Demonstration of practical procedures: Measurement of Noise, Primary productivity, BOD/COD, Process of rain water harvesting

2) Submission of Field Report

a) Educational tour/Local field visit (related to Industry/Mining/Forestry/Mountainous region/Ocean/Coastal) and Submission of collected samples (flora, fauna, rocks, and minerals)
[Local Field visit may include - a) Flora and fauna of the localities, b) Study of soil types, c) Description and identification of plant species *etc.*, along with submission of samples (flora, fauna, rocks, minerals, *etc.*)]

3) Laboratory Note Book containing all practical demonstrations

4) *Viva-voce*

Suggested Books

I

1. Environmental Science: S.C. Santra , New Central Book Agency
2. Pollution Prevention: Fundamentals and Practice Int. Ed.-2000, Paul L. Bishop, Mc Graw Hill
3. A text book of Environmental Chemistry and Pollution Control: S.S.Dara., S.Chand & Company Ltd.
4. Ecology and Environment: P.D. Sharma, Rastogi Publication.
5. Fundamental of Ecology: E.P.Odum.,W.B.Sauders Company,USA
6. Fundamentals of Microbiology and Immunology: Banerjee and Banerjee; New Central Book Agency (P) Ltd.
7. Microbiology: Prescott, Harley and Klein; Mc Graw Hill Publisher
8. Microbiology: Pelzar, M.J.,Chan, E.C.S. and Kreig, N.R., Mc Graw-Hill Publishing Company
9. Wastewater Microbiology; Bitton, G.,John Wiley, NY
10. Environmental Chemistry: A.K.De, New age(p) Ltd.
11. Chemistry for Environmental Engineering : Clair N Sawyer, Perry L. Mccarthy & Gene F. Parkin., Mc Graw - Hill Inc.
12. Standard Methods for the Examination of Water and Wastewater 20th eds. ; Lenore, S.Clesceri, Arnold E.Greenberg, Andrew D. Eaton; American Public Health Association
13. Clean technology, Johansson, A., Lewis Publishers.
14. Zero Pollution Industry, Nemerow, N.L. Wiley Intersciences
15. Industrial Pollution Prevention Handbook, Freeman, H.M., McGraw Hill
16. Environmental Impact Assessment, Canter, L. McGraw Hill
17. The Economic Approach to Environmental & Natural Resources, James R. Kahn., George Proval
18. Economics of Environment, Dorfman and Dorfmann
19. Hazardous Waste Management, M.D.Lagrega et al., McGraw Hill
20. Landfill Waste Pollution and Control, Kenneth Westlake., Albion Publishing
21. Hazardous waste Management, Wentz, C.A., McGraw Hill
22. Biology of Wastewater Treatment, Oxford Gray, N.F., University
23. Biophysics; G. R. Chatwal, Himalaya Publishing House
24. Biochemistry: U. Satyanarayana; Books and Allied (P) Ltd.
25. Lehninger Principles of Biochemistry: D. Nelson and M. Cox. Low Price Edition
26. Principles of Industrial Analysis. Skoog , Holler; Nieman. Harbourt Asia Pte Ltd. Publisher International Company
27. Textbook of quantitative chemical analysis. G.H.Jeffery, J.Bassett, J.Mentham, R.C.Denny. Longman Scientific Technical. John Wiley and Sons.
28. Biochemistry. Debajyoti Das. Academic Publisher, Kol-73
29. Higher Mathematical Science. Baishnab and Ghatak; Publishing Syndicate, Mahtma Gandhi Road; Kol - 9

II

1. Agrawal, Sikdar and Deb (2002): A Text book of Environment; MacMillan
2. Fischer (1984): Resources and Environment Economics, CUP
3. Dasgupta (1982): The Control of Resources; Basil Blackwell
4. Georgeacus-Roger (1971): The Entropy Law and Economic Process; HUP
5. Concard and Clerk (1987): Natural Resources Economics; CUP
6. Pearce and Turner (1991): The Economics of Natural Resource and Environment, Harvester & Wheatsheaf
7. Dasgupta and Heal (1979): Economic Theory of Exhaustible Resources; CUP
8. Kneese & Sweeny (1993): Handbook of natural Resource and Energy Economics/3 Volumes; North-Holland
9. Crooper & Dates (1992): Environmental Economics: A survey/OEL
10. Dorfman & Dorfman (1994): Economics of Environment/3
11. Parikh (1993): Natural Resources Accounting: A Framework for India
12. Botkin & Keller (1998): Environmental Science: Earth as a Living Planet; John Wiley & Sons
13. Barrow (1997): Environmental and Social Impact Assessment: An Introduction, John Wiley & Sons
14. Canter (1996): Environmental Impact Assessment; McGraw-Hill, Inc
15. Charles D Kolstad (2000): Environmental Economics, Oxford University Press
16. Park (2005): Preventive and Social Medicine; M/S Banarsids Bhanot
17. Kolstad (2000): Environmental Economics; OUP