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BENGALURU CITY UNIVERSITY

SYLLABUS For B.Sc. ENVIRONMENTAL SCIENCE
(I to VI Semester)

CHOICE BASED CREDIT SYSTEM

2020-2021

BENGALURU CENTRAL UNIVERSITY

DEPARTMENT OF ENVIRONMENTAL SCIENCE

Regulations, scheme of study and examination for B.Sc. Environmental Science

Semester scheme

I Objectives

- Awareness of public health hazards posed by our environment, including physical features such as global warming, chemical features such as automobile emissions, contaminants in drinking water, and biological features such as putrefying organic matter.
- Impact of governmental policies and urbanization on degradation of the environment
- Education, public- private partnership, corporate social responsibility (CSR) and change in management as way forward towards improving the Public Health thresholds.
- Educating the students on environmental policies with respect to water, air, forest and wildlife of the country.

II Eligibility for Admission

The eligibility condition for admission to B.sc environmental science shall be 10+2 or equivalent, in science stream with biology as one of the subject with a minimum of 35%.

III Duration of the Course

Duration of the undergraduate programmes shall extend over six semesters (three academic years).

IV Medium of Instruction

The medium of instruction and shall be in English

V Class room Attendance

A student shall be considered to have satisfied the requirement of attendance for the semester, if He or She has attended not less than 75% in aggregate of the number of working periods in each of the semesters.

VI Teaching and Evaluation

M.SC environmental science graduates those who have completed from recognized university regular candidates preferably with NET/KSET/ Ph.D are eligible to teach and take up the evaluation work.

VII Record Maintenance and Submission

- Every college is required to establish a dedicated environmental science lab for the purpose of conducting practical

- In every semester, the student should maintain a practical record book. This record book has to be submitted to the faculty for evaluation before the end of each semester.

VIII Scheme of Examination

- There shall be a University examination at the end of each semester. The maximum marks for the University examination in each paper shall be 70/100
- Out of the 30 marks of internal assessment, 15 marks for assignment(including field visit report) 10 marks as for internal assessment based on test..05 marks based on attendance
- The field visit to be conducted every semester for practical exposure and marks for the same to be awarded based in the report

IX Minimum for a Pass

Candidates who have obtained a minimum of 35% marks in the University examination (i.e 25 marks out of 70 marks of theory examination) and 40 % in aggregate (i.e total of University examination and internal assessment marks in each subject shall be eligible for a pass or exemption in that subject.

X Carry over: A candidate who fails in a lower semester examination may go to the higher semester

XI Classification of Successful Candidates: CLASSES & GRADES Each semester result shall be declared in terms of Classes on the basis of Percentage of Aggregate Marks scored and in terms of grading system based on the marks scored. The results of successful candidates at the end of IV, VI and X semesters shall be classified on the basis of aggregate percentage of marks obtained in all the three, six semester the Aggregate or Cumulative Grade Point Average (CGPA) for award of i) Advance Diploma in Arts, Science and Commerce ii) Bachelors Degree in Arts, Science and Commerce iii) Integrated Masters Degree in Arts, Science and Commerce An eight point letter / alpha – sign grade as described below shall be adopted.

Table I: Conversion of Percentage of Marks into Grade Points in a Paper

%Marks in a paper/practical	Grade Point (GP)
96-100	10
91-95	9.5
86-90	9.0
81-85	8.5
76-80	8.0
71-75	7.5
66-70	7.0
61-65	6.5
56-60	6.0
51-55	5.5
46-50	5.0
41-45	4.5
40	4.0
Below 40	0

1. The Semester Grade Point Average (SGPA) shall be computed by dividing the sum of the Credit Points (CP) of all the subjects of study by the maximum credits for the semester. The CP are in

turn calculated as the product of the grade points earned in the paper and the credits assigned to that paper.

2. The details are given in Appendix B. Appendix B gives a summary of marks and credits assigned to different subjects of study in Bachelor Degree programmes in all the semesters. In these tables, 100(2), indicates the maximum total mark in a subject of study is 100, while the credit assigned is 2. These tables are followed with illustrations of computing semester grade point averages (SGPA) and aggregate or cumulative grade point averages (CGPA).
3. The Aggregate or Cumulative SGPA (CGPA) at the end of the fourth, sixth and ten semesters shall be calculated as the weighted average of the semester grade point averages. The CGPA is obtained by dividing the total of semester credit weightages by the maximum credits for the programme.
4. A candidate shall be declared to have passed the UG program if he/she secures at least an aggregate SGPA/CGPA of 4.0 (or Course Alpha-Sign Grade P

Table II: Final Result / Grades Description

Semester / Program % of Marks	Semester GPA / Program CGPA	Alpha-Sign / Letter Grade	Result / Class Description
90.0-100	9.00-10.00	O (Outstanding)	Outstanding
80.0-<90.0	8.00-<9.0	A+ (Excellent)	First Class Exemplary
70.0-<80.0	7.00-<8.00	A (Very Good)	First Class Distinction
60.0-<70.0	6.00-<7.00	B+ (Good)	First Class
55.0-<60.0	5.50-<6.00	B(Above Average)	Average) High Second Class
50.0-<55.0	5.00-<5.50	C (Average)	Second Class
40.0-<50.0	4.00-<5.00	P (Pass)	Pass Class
Below 40	Below 4.00	F (Fail)	Fail/Reappear
Absent	0	**Absent**	

- The candidates who pass all the semester examinations in the first attempts in three / Five Academic Years or Six / Ten Semesters are eligible for ranks provided they secure above 60% marks or at least an Alpha-Sign Grade B+.
- The results of the candidates who have passed the VI/X semester examination but not passed the lower semester examinations shall be declared as NCL (Not Completed Lower semester examinations). Such candidates shall be eligible for the degree only after completion of all the lower semester examinations.
- A candidate who passes the semester examinations in parts is eligible for only class and not for ranking.

BENGALURU CENTRAL UNIVERSITY
DEPARTMENT OF ENVIRONMENTAL SCIENCE
CHOICE BASED CREDIT SYSTEM (SEMESTER SCHEME)
SYLLABUS OF B.Sc. ENVIRONMENTAL SCIENCE

Structure of the Course

Subject code	Title of the paper	Teaching hours /week	Examination duration Hrs	Internal assessment Marks	Exam marks	Total	Credits
I semester							
ENV 101	Divisions of the environment	4	3	30	70	100	2
ENV 102	Practical	3	3	15	35	50	1
II semester							
ENV 201	Environmental Biology	4	3	30	70	100	2
ENV 202	Practical	3	3	15	35	50	1
III semester							
ENV 301	Environmental chemistry and Earth science	4	3	30	70	100	2
ENV 302	Practical	3	3	15	35	50	1
IV semester							
ENV 401	Natural Resources and Management	4	3	30	70	100	2
ENV 402	Practical	3	3	15	35	50	1
V semester							
ENV 501	Environmental pollution	4	3	30	70	100	2
ENV 502	Natural disaster and environmental issues	4	3	30	70	100	2
ENV 503	Practical	3	3	15	35	50	1
ENV504	Practical with field visit	3	3	15	35	50	1
VI semester							
ENV 601	GIS & Remote sensing, Statistics	4	3	30	70	100	2
ENV 602	Environmental management and sustainable development	4	3	30	70	100	2
ENV 603	Practical	3	3	15	35	50	1
ENV 604	Dissertation	3	3	15	35	50	1

SEMESTER – I

ENV 101 -Division of Environment

2 Credits/Week = 4hrs/Week, 52hrs/semester – 70 Marks

Unit 1 7 hours

Environmental Science – Definition, scope and importance Environmental Science ,Factors – Biotic and Abiotic factors- types, Divisions of the environment and their interactions – atmosphere, hydrosphere, lithosphere and biosphere.

Unit 2: 10 Hours

Atmosphere – Chemical composition and thermal structure; heat budget and earth's albedo. Weather and climate,Weather Elements – atmospheric pressure, temperature, relative humidity, precipitation, wind; Major climatic zones of the world, Agro-climatic zones of India.

Unit 3: 10 Hours

Hydrospere– Definition, Importance and characteristics. Lentic and Lotic systems – Ice-caps, oceans, rivers, lakes, pond and ground water; Hydrologic cycle. Human usage of surface and Ground water; Water as a resource and its availability, types ofaquifers and springs. Ground water potential. Water Budget.

Uni4: 15 Hours

Lithosphere – Definition, structure and scope – internal structure of earth; Different kinds of minerals and rocks – Igneous, metamorphic and sedimentary – formation and types; Major landforms, Soil – formation, soil profile and classification. Physical, chemical, mineralogical and biological properties of soil. Soil Biota.

Unit5: 10 Hours

Biosphere – Definition and extent, Biomes – types, characteristics, diversity and density – Tundra, Taiga, Temperature and Deciduous forest, Grassland, Desert, Tropical rain forest; A brief introduction to biogeography; India's biogeography.

ENV 102 PRACTICALS

1 Credits/Week = 3hrs/Week-35 Marks

1. Measurement of Max. and min. temperature, humidity and pressure, wind speed and direction
2. Sampling technique of water
3. Determination Of EC-conductivity method
4. Estimation of turbidity –nephelometric method
5. TS,TSS, and TDS-gravimetric and filteration method
6. Estimation of hardness
7. Estimation of chlorides
8. Measurement methods of precipitation and solar radiation.
9. A study of physiographic of aquatic systems.
10. A study of topography of terrestrial system using maps and topo-sheets.

References

1. Fundamentals of Environmental Science: G.S. Dhaliwal, G.S. Sangha and P.K. Raina, Kalyani Publication
2. Environmental Science (6TH ED) (1997): Jr. G.T. Miller, Wadsworth Pub. Co. Environmental Science (8th Edition) (2010) : Daniel D. Chiras, Jones &Barlett Ltd.
3. Barry, G.R. and Chorley, J.R. 2003. Atmosphere, Weather and Climate. Routledge, London.
4. Critchfield, H.J. 1995. General Climatology. Printice Hall of India.
5. Daji, J.A. 1988. Textbook of Soil Science. Media Promoters and Publishers.
6. Goldman, C.R. and Horne, A.J. 1983. Limnology. Mc Graw Hill.
7. Lutgens, F.K. and Tarbuck, E.J. 1982. Atmosphere – Introduction to Meteorology. Prentice Hall Inc.
8. Menon, P.A. 1989. Our Weather. National Book Trust.
9. Miller, Jr. G.T. 1994. Living in the Environment: Principles, Connections and Solutions. Wadsworth Publishing Co.
10. Nair, B.N. and Thampy, D.M. 1980. Marine Ecology. Macmillan Co. of India.
11. Rai, M.M. 1981. Principles of Soil Science. Macmillan Co. of India.

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Semester II

ENV 201- Environmental Biology

2 Credits/Week = 4hrs/Week, 52hrs/semester – 70 Marks

Unit 1: 4 Hours

Levels of organatisation ,Ecology,Divisions of ecology, approaches in studying ecology, auto ecology and synecology, structure and functio,Biogeochemical cycles-types-carbon, nitrogen, phosphorus and sulphur cycles-anthropogenic influences on these cycles

Unit 2: 12 Hours

Ecosystems- Characteristics of ecosystems – Structure of the ecosystems –Functions of ecosystem- food chain-herbivorous and detritus food chains and food web- bio-magnification:Energy flow in an ecosystem, Study of pond and crop land ecosystems ;homeostatic and feed back mechanisms.

Major Ecosystems: types, structure and composition salient features – Forest ecosystem, Grassland ecosystem, Wetland ecosystem and Agro-ecosystem.

Unit 3: 12 hours

Community Ecology; Characteristics of a Community; ecology succession –Primary and secondary succession, Natural and man influenced succession, -Hydrarch and Xerarch – Climax vegetation and their theories; Ecotone and Edge effect: Ecological equivalents; Ecotypes and Ecophene; Ecological indicators Migration – emigration, Population Ecology: Natality, Mortality, age distribution, growth curves. Human population and its impact on environment.

Unit4: 12 Hours

Evolution ;Definition- Darwin's postulates –Natural selection-types-Industrial Melanism-Pesticide resistance. Co-evolution; Mimicry – Batesian and Mullerian mimicry, warning coloration Effect of climate (light,Temperature, Wind and water), Edaphic ,Topographic and Biotic factors on plants ; Effect of light ,Temperature water and soil on animals.

Unit:5 12 hours

Environmental microbiology and biotechnology-bioloeaching, bioremediation of various pollutants like DDT, heavy metals, surfactants, oil slicks from water and soil, determination of potability of water by MPN method, Biofertilizers and Biopesticides

ENV -202 Practicals 35 Marks

1 Credits/Week= 3hrs/ Week,

1. Study of vegetation sampling methods – Quadrat and transects
2. Estimation of frequency, density and abundance of species by quadrat/plot method.
3. Estimation of productivity of water bodies by Gaarder-gran method.

4. Estimation of productivity of crop plants by harvest method.
5. Determination of leaf area by graphical method.
6. Estimation of terrestrial productivity – Chlorophyll method.
7. Quantitative estimation of planktons and zooplanktons–Sedgwick – Rafter method.
8. Isolation of bacteria from water /wastewater using serial dilution method
9. Estimation of coliform bacteria- MPN technique and MF technique
10. Identification of Ecological Indicators.

References

1. Fundamentals of Ecology: E.P. Odum
2. Aquatic Ecosystems: Kumar, A P H Pubh
3. Renewable Energy – Environment and Development: M.Dayal; Konark Pub. Pvt.Ltd
4. Sapru R.K. 1987. Environment Management in India. Vol.I& II. Ashish Pub. House.
5. Agarwal & Rana S.V.S 1985. Environment & Natural resources, society of Biosciences.
6. Sharma V.K. 1985. Water resources planning and management, Himalaya Pub. House.
7. Raymond F. Dasmann 1984. Environmental Conservation. 5th Ed., John Wiley & sons.
8. Mathur H.S. 1981 Environmental resources. The crisis of development, RBSA Publishers
9. Agarwal, V.G.1985. Forests in India. Oxford and IBH, New Delhi.
10. Singh,B. 1992. Social forestry for rural development Anmol publication, New Delhi.
11. Wenger, K.E. 1984. Forestry Handbook. Jhon Wiley and sons. New York.
12. Nalini, K.S. 1993. Environmental resources and management. Anmol publishers.
13. Aradhana, P.S. 1991. Environmental management. Rajat publishers.
14. Boyle 1994. Renewable energy resources.
15. Singh, G. 1996. Manual of soil and water conservation practices.
16. Raymond F. Dasmann 1984. Environmental conservation, 5th eds. John wiley& Sons.
17. Shrikander.P and Varade S.R. 1991. Ecology of water and land management vol 1 & 11, Chugh publishers.

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SEMESTER III

ENV 301- Environmental Chemistry and Earth science

2 Credits/Week = 4hrs/Week, 52hrs/semester – 70 Marks

Unit:1 8 hours

Atmospheric Chemistry: Chemical composition of air, Classification of elements, chemical speciation. Particles, ions and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matter. Thermo-chemical and photochemical reactions in the atmosphere. CFC's and Ozone chemistry, chemistry of air pollutants, photochemical smog

Unit:2 12 hours

Water chemistry: properties of water, water pollutants- types sources heavy metals metalloids-organic, biological and radioactive- types of reactions in various water bodies including marine environment, Cationic, Anionic and non-ionic detergents, modified detergents.

Chemistry of some Heavy Metals-Chemistry of Pb, Hg, Cd and As-Physical and chemical properties,Behavior of these heavy metals and their Compounds ,Human exposure absorption and influence

Unit:3 10 hours

Soil Chemistry: Soil profile, distribution of inorganic and organic components in soil, Chemical properties of Soil - Saline, Acidic and Alkaline soils. Major micro and macro nutrients of soil, Nutrient Pathways - Nitrogen, Phosphorus and Potassium pathways in the soil.

Unit :4 10 hours

Environmental Analysis- Solution concentration (Normality, Molarity,Molality, ppm, Equivalent weight etc.) Titrimetric methods, Instrumentation, Principle and working of pH meter and conductivity meter. Colorimetry, Spectrometry, UV-Vis and IR Spectrophotometer and AAS. Nephelometry, Flame Spectrometry and fluorimetry; Chromatographic techniques: Paper, Thin Layer, GC and Gas – Liquid Chromatography, HPLC, X-ray florescence, X-ray diffraction, Electrophoresis.

Unit :5 12 hours

Earth's Materials – Minerals and their definition. Distribution and abundance of elements in the major units of earth, Geochemical features, Formation and classification of Rocks. Folds, faults, dykes and other geological formations and their environmental significance. Geographical classification and zones of Environment. Energy budget of the earth. Earth's thermal environment and seasons. General relationship between landscapes, biomes and climate. Climate of India.

ENV 302 practical
Credits/Week= 3hrs/ Week

1. Mineralogy – Identification of common rock forming minerals.
2. Petrology – Identification of major rock types – Igneous, Metamorphic and Sedimentary.
3. Determination of Alkalinity from water.
4. Estimation of Sulphates in water sample.
5. Estimation of nitrates in water sample.
6. Estimation of fluorides in water sample.
7. Estimation of particulate matter, sulphur dioxide and oxides of nitrogen in ambient air.
8. Visit to research institutes and study of instruments like GC,HPLC, AAS,
9. Visit to meteorological and air monitoring stations

Reference Books:

1. Sharma B.K and Kaur H. (1995). Environmental Chemistry, I Ed., Goel Publishing House.
2. De A.K (1989). Environmental Chemistry, II Ed., Wiley Eastern Limited.
3.Sawyer C.N, Mc Carty P.L and Perking G.F. (1994). Chemistry for Environmental Engineering, IIEd, Mc Graw- Hill.
4. Bailey, R.A. (1978). Chemistry of the Environment, Academic Press.
5. Tyagi O.D. and Mehra M. (1990). Text Book of Environmental Chemistry, I Ed., Anmol Publications.
6. Charles R. Goldman and Alexander J. Horene. (1983). Limnology, Mc Graw- Hill.
Valdia K.S. (1987). Environmental Geology.
7 Menard H.W., W.H.Freeman and Company, San Francisco. (1969). The nature of Oceanic life, The Ocean – A Scientific American Book.
8. Reed Wicander and James S. Monroe. Essentials of Geology, Wadsworth publishing
9. Roy L. Donahue, Raymond W. Miller and John C. Shickluna. (1987). Soils – An Introduction to soils and plant growth V.Ed., Prentice-Hall of India.
10. Biswas T.D and Mukherjee S.K. (1987). Text book of Soil Science IV Ed., Mc Graw-Hill.
11. Strahler and Strahler. (1970). Environmental Geology, Wiley & Sons, New York.
12. Valdiya K.S. (1985). Environmental Geology Allied Publishers New York.
13. Carla W. Montgomery. (1989). Environmental Geology, Wm C Brown Publishers. Dubuuguo Lowa.
14. Peter T. Flawn. (1970). Environmental Geology, Harper and Row, New York.
15. Khurumi R.S. (1988). Engineering Geology, Dhanpet Rai & Sons, New Delhi.

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SEMESTER IV

ENV 401- Natural Resources and Management

2 Credits/Week = 4hrs/Week, 52hrs/semester – 70 Marks

Unit:1 12 Hours

Definition of Natural resources; Classification of natural resources basrd on utility potential. Water resources in India- Water budget of India . Dams: Types- Impact on environment – alternatives ; Floods: Causes and control Strategies ; Water conservation Strategies in India –Watershed management ; Rain Water Harvesting; River linking

Unit:2 8 Hours

Land resources in India-Agriculture : Types and cropping patterns –Range Lands-Management; Mining, Quarrying and their impacts ;Soil erpsion: causes-Types-Impacts-Control measures

Unit:3 10 Hours

Energy Resources and Conservation: Definition- Classification of energy resources; Conventional: Fossil fules , Nuclear energy and their impacts. Non-conventional : Solar, Wind, Tidal, Microhydel, Ocean Thermal energy, Geothermal.

Unit 4 10 Hours

Forest Resources: Importance of Foresty- Types of Forests-Impacts of Deforestation; Minor forest Products; Forest based Industries; Forest Fires and their control; Forest conservation : Social Forestry-Agroforestry –Sacred Groves-Joint forest Management; Chipko and Appiko Movements; Ecotourism and its impacts. Salient features of the Indian forest Act, 1927

Unit:5 12 Hours

Biodiversity : Definition –Levels of Biodiversity; values of biodiversity; Biodiversity Hotspots; Threats to Biodiversity, Strategies of Conservation and Management ;Bio-piracy; Biodiversity Bill, 2000. Wild Life: Significance- Threats and Extinction – Endangered Species-Endemic species- In-situ and Conservation –Protected areas-National parks-Sanctuaries- Biosphere Reserves –Project Tiger and project Elephant; Red data book; Role of Indian organizations, IUCN, WWF and Greenpeace in Wildlife conservation. Salient features of the Wild life Protection Act,1972

ENV 402 practical 35 Marks

1 Credits/Week= 3hrs/ Week

1. Identification of medicinal plants of Karnataka.
2. Identification of endangered flora and fauna of India.
3. Introduction of Mapping&Properties of Maps and Direction and Scale
4. Latitude & Longitude ,Grid References
5. Conventional signs and symbols
6. Representation of Relief.
7. Study of Drainage Pattern and settlement pattern.
8. Study of national parks/sanctuaries

9. Study of selected exotic species of the Indian subcontinent a) naturalized weeds b) Exotic plantation species
10. Design of solar energy trap/ Rain water harvesting.

Reference Books

1. Abbasi, S.A. and Abbasi, N. 2001. Renewable Energy Sources and their Environmental Impact. Prentice-Hall of India pvt. Ltd.
2. Agarwala, V>P 1985. Forests in India –Environmental and production Frontires. Oxford and IBH publishing Co.
3. Beck, W.S., Liem, K.F.and Simpson, G.G.1991.life-Intoduction to Biology . Harper Collins publications.
4. Goel,R.S(ED) ,. 1993 . Environmental impacts of water resources. Tata mc Graw hill publishing Co.
5. Gupta,R.K., Dabral,B.G., Homji,V.M.M. and Puri , G .S. 2000. Forest Ecology . Vol.3 Oxford and IBH publishing co.
6. Ristinen,R.A. and Kraushaar, J.J.1999. Energy and the Environment . John Wiley and Sons Inc.
7. Santra, S.C.2001. Environmental science .Ist Ed., New Central Book Agency. Kolkata .Sharma, V.K.1985. water resource Planning and Management.Himalaya publishing House. Bombay
8. Ahuja,J.S., M.J.S.,. et.al., 1993. Map Education. Survey of India.
9. Sathyanarayan swami, B.S 1985. Engineering Geology- Laboratory Manual. Eurasia publishing House pvt Ltd.

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SEMESTER V

ENV 501- Environmental Pollution and Waste Management

2 Credits/Week = 4hrs/Week, 52hrs/semester – 70 Marks

Unit1: 10 Hours

Air Pollution: Definition, causes of air pollution, classification of air pollutant–primary and secondary pollutants . Ozone, its depletion and effects; Greenhouse effect, its consequences .Meterology of Air pollution on Biosphere :Effect on human, plant and Materials. Control of Air Pollution : Settling Chambers, Inertial Separators, Cyclones, Filters, Electrostatic Precipitaors and Scrubbers.

Unit2: 12hours

Water Pollution: Sources of pollution of surface and ground water; Water pollution parameters – physical, chemical and biological; Classification of water pollutants. Effects of water pollution on water bodies and aquatic life, vegetation and human health.water quality Monitering-Units, equipment and methods. Treatment of water for drinking purposes. Water quality standards .Muncipal Wastewater treatment-Sewage treatment-Preliminary, primary, secondary,-activated sludge process and trickling filters, Tertiary treatment methods- Reverse Osmosis and ion exchange .

Unit 3: 10 Hours

Soil Pollution – Sources of soil pollution, Pollution and residual toxicity from the application of insecticides, pesticides and fertilizers; Industrial waste and heavy metal interactions with soil components. Impacts of intensive agriculture on soil – water logging and soil salinity, their causes, impacts and remedies. Sampling techniques and Soil pollution control measures. Noise pollution – Definition, sources, effects and control; Noise pollution standards for different locations. Radioactive pollution and Thermal pollution.

Unit4:

10 hours

Solid waste management: Solid waste management and Disposal: Definition- Sources-Types; On-site handling, Storage and processing-Collection- Transfer and Transportation-processing-Recovery of materials and Disposal. Plastic management Rules,2011

Unit:5

8 Hours

Hazardous waste: Types,characteristics and classification. Biomedical and E-waste in India. Management of hazardous waste . Regulations for both urban and rural sectors.

Heavy metal pollution: Causes,Effects and Control measures with reference to Lead and Mercury.Pesticide Pollution: Causes , Effects and control measures with reference to Organo-chlorine pesticide.

ENV 502 Practical 35 Marks

Credit/Week= 3hrs/ Week

1. Determination of Dissolved Oxygen
2. Estimation of Alkalinity
3. Estimation of SPM- High volume Air Sampler method
4. Estimation of SO_2- west ang Gaeke method.
5. Estimation of Iron- Phenanthroline method.
6. Estimation of Chromium – Diphenyl Carbazide method.
7. Estimation of Copper- Neocuproine method.
8. Estimation of BOD- Dilution method.
9. Estimation of COD- Dichromate Refluxion method.
10. Measurement of Noise- Noise level Meter
11. Estimation of Nitrate.

References

1. Nandini N, Sunitha N. and Sucharita Tandon, (2007), Environmental Studies, Sapna Book House, Bangalore
2. Stern A.C (1986) Air Pollution Vol.I-VII, Academic Press.
3. Parker H.W (1977). Air Pollution.
4. ChhatwalG.R.Mehra M.C Katyal T., Satake K., Mohan Katyal, Nagahiro T.(1989). Environmental Noise Pollution and its Control, I Ed., Anmol Publications.
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6. Singh H.R (1989) Animal Ecology & Environmental Biology, Shobhan Lal Nagin Chand and Co.
7. Lodge (1994). Methods of air sampling and analysis
8. R.K Trivedy and Goel P.K (1995) An Introduction to air pollution, Techno Science Publications Jaipur .
9. KudesiaV.P.(1993). Air Pollution, Pragati Prakashan, New Delhi.
10. Sharma P.F. (1995). Environmental Biology, I Ed., Rastogi and Company.
11. Mishra P.C. (1989). Soil Pollution and Soil Organisms.
12. Wilber, C.G. (1989). Biological aspects of Water pollution. Charles C. Thomas Publishers, Illinois.

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SEMESTER V

ENV 503 - Natural Disasters and Environmental Issues

2 Credits/Week = 4hrs/Week, 52hrs/semester – 70 Marks

Unit1: 10 Hours

Natural Environmental Hazards – Volcanoes, earthquake and tsunamis, flood, landslide and cyclones – types and their impact on environment. Natural hazards monitoring and management – pre and post hazard assessment and preparedness. Case studies on disaster mitigation.

Unit 2 12 Hours

Manmade Environmental Hazards: Resource exploitation and environmental problems – Mining, Oil exploration and transportation, deforestation and their impacts on environment. Hazards due to solid, liquid and gaseous pollutants from industries – effect on ecosystem and humans; Hazards due to Lead, Cadmium, Mercury and Arsenic.

Unit 3: 10 Hours

Environmental problems associated with urbanization – traffic,dust, aerosols and noise; their management; significance of urban open spaces (lung spaces, playgrounds, parks and greenbelts) and their management.

Unit 4: 12 Hours

Modernization of agriculture and its impacts. Grasslands – overgrazing and land degradation, desertification, reclamation of degraded land; Wetlands – ecological significance, human intervention on wetlands, siltation and eutrophication, reclamamation of wetland.

Unit 5: 8 Hours

Global Environment Issues: Green House effect, global warming, global dimming – causes and associated hazards, Ozone layer depletion – causes and associated hazards. Global summits, conventions and protocols on Environment – Stockholm, Rio de Janeiro, Johannesburg, Cancun, Rio+20; Kyoto protocol, Montreal protocol; COP,UNFCCC,IPCC.

ENV 504 Practical 35 Marks

Credits/Week= 3hrs/Week

1. A study of major rock forming minerals.
2. A study of Igneous, Sedimentary and Metamorphic rocks.
3. Determination of moisture content of soil.
4. Determination of water holding capacity of soil.
5. Estimation of calcium and magnesium of soil.
6. Estimation of Oxidisable Organic matter of soil.
7. Reports on earth summit held at international level
8. Case studies on natural disasters
9. Field /industrial visit

References

1. Peter Calow (Ed)(1998) Handbook of Environmental Risk Assessment and Management. Blakwell Sciences, London.
2. Quit, M.D., David Taylor and Rupert – Prudrare (Eds)(196) Environmental Impact pf Chemical Assessment and Control. The Royal Society of Chemistry, Cambridge.
3. Ricci, P.F and Rowe M.d (ed) 1985). Health and Environmental Risk Assessment PergmonApres, N.Y.
4. Cuttler,S.I (1994). Environmental Risk and Hazards, Prentice hall of India New Delhi.
5. Natural Disasters – A Guide for relief workers – JAC AdhyatmeSadhama Kendra Mehraui, New Delhi-30.1980,
6. Parasuraman S and UniKrishnan P.V. (2000) Indian Disasters report towards a policy initiative. Oxford University press.
7. Girish K. Mishra and G.C Mathur (eds)(1993). Natural Disaster reduction. Reliance Publishing House, 302/74, Ranjit Nagar, New Delhi.
8. Narendra Kumar Jain, Disaster preparedness in India. Joint Assistance centre. Adhyatma Sadhana kendramMehrauli, New Delhi-30
9. Canter L (1996) Environmental Impact Assessment. McGraw Hill.
10. Allarachand (1985) Environmental Challenges – A global survey, UDH, New Delhi.
11. Newson M.M.(1993) Managing the human impact on the nature al Environment.
12. Nanda. A.N.(1996) Environmental Education.

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SEMESTER VI

ENV 601- GIS & Remote Sensing and Statistics

2 Credits/Week = 4hrs/Week, 52hrs/semester – 70 Marks

Unit 1: 12 Hours

Satellites and their characteristics – Geo-stationary and sunsynchronous, Earth resource Satellites- Indian Space programme. Basics ofremote sensing: Definition, concepts and principle of energy interactions with environmental components. Electromagnetic spectrum, Principles of radiation; radiation transfer.

Remote Sensing; Active and Passive remote sensing. Ideal and Real remote Sensing characteristics. Fundamental of aerial photographic systems; Principle: Types of aerial cameras, aerial photos; ground coverage; radiometric characteristics, Interpretation principles and techniques and Applications of aerial photos.

Unit 2: 10 hours

Sensors and Scanners- Profiles and geometry of scanners, different types of sensors, their characteristics, Digital image processing: Basic concepts and principles; image enhancement; edge enhancement; band rationing classification-supervised and unsupervised classification. Smoothing and filtering techniques; post classification smoothing classification accuracy enhancement; data merging; scale effects.

Unit 3: 8 hours

GIS - Definitions, Components, History and Development. Concept of space and spatial data: types, characteristics, quality and sources of spatial data. Data input, verification, storage and output. Data stream, Geo-referencing and Map scale. Spatial Data Models - Raster Data Model, Vector Data Model.Database: Different formats for database.

Unit 4 : 10 hours

Application of Remote Sensing, GPS and GIS for Environmental Planning and Management: Vegetation cover, Agriculture, Surface and Ground water, Watershed, Marine resources, Coastal zones, Wild life Ecology, Mining and Quarrying; Agriculture and range land application; earthquakes and flood mapping assessment

Unit 5: 12 hours

Biostatistics :Defenition- Functions and Limitations of statistics.

Diagrammatic Representation of Data: Line Diagram –Bar diagram- Pie diagram; Graphical Representation of Data: Histogram, Frequency polygon. Sampling Techniques: Methods of sampling-Random sampling methods- Non-random Sampling methods- Sampling and Non-sampling Errors. Measures of Central Tendency: Arithmetic means, Geometric mean-Median mode. Measures of Dispersion: Range, standard Deviation and Coefficient of variation.

ENV 602 Practical 35 Marks

Credits/Week= 3hrs/Week

1. Preparation of thematic maps – A) Baseline maps B) Transportation Network and settlement maps c) Drainage maps d) Contour maps e) Slope Analysis maps f) Land-use/land-cover maps g) Wasteland maps

2. Interpretation of satellite data.
3. Land-use/land-cover classification from satellite data and toposheets.
4. Calculation of area using planimeter/grid method.
5. Comparative studies of the satellite and toposheet landuse/land cover data.
6. Delineation of drainage of a given area from satellite data.
7. Study of aerial photographs, photo interpretation for environmental studies and topographical maps.
8. Delineation of lineaments and dykes.
9. Collection of ground truth data.
10 GIS applications - advances software's of GIS- Arc GIS, ERDA
11.GIS Data analysis

Reference Books:

1. Anji Reddy M. (2000). Remote Sensing and Geographical Information Systems: An Introduction. Book Syndicate.
2. Robert G. Reeves (Ed). (1983), Manual of Remote Sensing, Johm Wiley and Sons, New York.
3. Morris M. Thomson (Ed). (1988). Manual of Photography. Tata McGraw- Hill. Publishing Co.
4. Berry. S Siegal and Allen R.Gillspie. (1987). Remote Sensing in Geology, Tata McGraw-Hill. Publishing Co.
5. Miller J.C. (1986). Photography, John wiley and Sons, New York.
6. Smith J.T. (1991). Manual of colour Photography. John Wiley and Sons, New York.
7. Leuderr D.R. (1993). Aerial Photography interpretation – Principles and Applications, McGraw – Hill.
8. Lillesand and Kiefer. (1993). Principles of Remote Sensing
9. Nag P and Kudrat M. (1998). Digital Remote Sensing. Concept Publishing Co., New Delhi.
10. Chouhan and Joshi K.N. (1996). Applied Remote Sensing and Photo interpretation.
11. Rajan M.S. (1991). Remote Sensing and GIS for Natural Resources.
12. Narayana L.R.A (1999). Remote Sensing and its application University Press (India).
13. Lillesand T.M. (1987). Remote Sensing and Image interpretation. John Wiley, Hamburg.
14. Sabins F.F and Floyd F.J.R. (1978). Remote Sensing- Principles and interpretations.
15. Burroguh P.A and Mc Donnell R.A. (1988). Principles of Geographical Information system. Oxford Univ.Press.
16. Jorgevsen S.E. (1996). Applications of ecological modeling in environmental management. Elsevier Sci. Co., London.
17. Muralikrishna I.V. (2001). Spatial Information Technology- RS and GIS. Vol.I and II BS Publications, Hyderabad.
18. Burrough P.A. (1986). Principles of GIS for Land Resource Assessment. Oxford University Press.
19. Elachi C. (1978). Introduction to Physics and Techniques of Remote sensing. John Wiley Publication New York

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SEMESTER VI

ENV 603- Environmental Management and Sustainable Development

2 Credits/Week = 4hrs/Week, 52hrs/semester – 70 Marks

Unit 1: 12 Hours

Environmental Impact Assessment (EIA): Concept of EIA, Environmental Inventory, Assessment of Physical and Biological and socio economic Environment – Various methods of EIA and their relation advantages – Adhoc, Checklist, Matrix, Networking and simulation modeling.

Unit 2: 10 Hours

Environmental Standards – Concept, Environmental protection standards; BIS, ISO, Environmental quality monitoring – ISO 14000 and its impact on developing countries. Comparison of Indian and International standards.

Unit3: 12 Hours

Climate Change: Climate change and policy frameworks – History of international climate change policies. United Nation Framework Convention on climate change (UNFCCC) – Key provisions of the UNFCCC, its structure, and different party groups under the convention - Annex I, Annex II and Non-Annex Icountries. The Kyoto protocol and its associated bodies. Overview of Conference of Parties (CoP). Main climate change negotiations evolved over the past years and highlight some key issues relevant for a future climate change regime.
Sustainable Development: Concept of sustainable development; carbon footprint, carbon trading; green buildings, clean technologies – rain water harvesting, ecofriendly lifestyles and products. Eco-labeling.

Unit4: 12 Hours

Environmental Laws: Environmental Laws and Constitutional provisions in India – Salient features – The Indian Forest Act, 1927, The Water (Prevention and Control of Pollution) Act, 1974, Air (Prevention and Control of Pollution) Act, 1981 and The Environment (Protection) Act, 1986; The Noise Pollution (Regulation & Control) Rules, 2000; Hazardous Waste (Management, Handling and Tran boundary movement) Rules, 2008; E-waste(Management & Handling) Rules 2011.

Unit5: 06 Hours

Environmental Movements: Major environmental movements – Chipko and Appiko movements, Narmada BachoAndolan, Kaiga and Kudankulam resistance, and any local specific environment issue. A brief account of the contributions of Indian environmentalists – Wangeri Maathai, MedhaPatkar, SundarlalBahuguna, SalumaradaThimmakka.

ENV 604 -Dissertation Work **35 Marks**

(Dissertation work replaces the Practical paper of VI sem)

1 Credits / Week = 3hrs/Week

- Each candidate is required to take up a dissertation work in applied aspects as a partial fulfillment of the course.
- The candidate may work either individually or in a group (Maximum of 5 students) under the supervision of a faculty member.
- Dissertation to be submitted individually towards the end of the VI semester for evaluation.

Reference

1. Karpagam (1986). Environmental Economics.
2. Murti,S. (1998). Economic Growth and Environment. RSBA Publishers.
3. John A. Hannigan (1995), Environmental Sociology: A social Constructionist Perspective; Routledge; II New Felter, London.
4. Redelift. M. and Benton T.(eds)(1994). Social theory and Global Environment, Routledge, New York.
5. Beek U. (1992). The Risk Society; London, Sage.
6. Ramachandra Guha(ed.)(1998). Social Ecology, Oxford University Press, New Delhi.
7. David. C.(1988). Environmental Economics. EarthScan,UK.
8. Edward,B.(1987). Resources Economics, Earth Scan,Ju.
9. Titemberg. (19+0). Pollution Economics. Oxford Univ. Press.UK.

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Encl 3

UNIVERSITY GRANTS COMMISSION

Ability Enhancement Compulsory Course (AECC – Environment Studies)

Unit 1 : Introduction to environmental studies

- Multidisciplinary nature of environmental studies;
- Scope and importance; Concept of sustainability and sustainable development.

(2 lectures)

Unit 2 : Ecosystems

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems :
  a) Forest ecosystem
  b) Grassland ecosystem
  c) Desert ecosystem
  d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

(6 lectures)

Unit 3 : Natural Resources : Renewable and Non-renewable Resources

- Land resources and landuse change; Land degradation, soil erosion and desertification.
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water : Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state).
- Energy resources : Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

(8 lectures)

Unit 4 : Biodiversity and Conservation

- Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots
- India as a mega-biodiversity nation; Endangered and endemic species of India
- Threats to biodiversity : Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

(8 lectures)

Unit 5 : Environmental Pollution

- Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human health risks
- Solid waste management : Control measures of urban and industrial waste.
- Pollution case studies.

(8 lectures)

Unit 6 : Environmental Policies & Practices

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture

Nandini. N
Chairperson (BOS UG) BCU.

Dr. Nandini N. M.Sc., M. Phil., Ph.D.,
Professor and Principal Investigator
Dept. of Environmental Science
Bangalore University
Jnanabharathi, Bengaluru - 560 056.

- Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

(7 lectures)

Unit 7 : Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management : floods, earthquake, cyclones and landslides.
- Environmental movements : Chipko, Silent valley, Bishnois of Rajasthan.
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

(6 lectures)

Unit 8 : Field work

- Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds and basic principles of identification.
- Study of simple ecosystems-pond, river, Delhi Ridge, etc.

(Equal to 5 lectures)

Suggested Readings:

1. Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R. 1993. *This Fissured Land: An Ecological History of India*. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999. *Global Ethics and Environment*, London, Routledge.
4. Gleick, P. H. 1993. *Water in Crisis*. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. *Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. *Science*, 339: 36-37.
7. McCully, P. 1996. *Rivers no more: the environmental effects of dams* (pp. 29-64). Zed Books.
8. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
9. Odum, E.P., Odum, H.T. & Andrews, J. 1971. *Fundamentals of Ecology*. Philadelphia: Saunders.
10. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
11. Rao, M.N. & Datta, A.K. 1987. *Waste Water Treatment*. Oxford and IBH Publishing Co. Pvt. Ltd.
12. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. *Environment*. 8th edition. John Wiley & Sons.
13. Rosencranz, A., Divan, S., & Noble, M. L. 2001. *Environmental law and policy in India. Tripathi* 1992.
14. Sengupta, R. 2003. *Ecology and economics*: An approach to sustainable development. OUP.
15. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi.
16. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. *Conservation Biology: Voices from the Tropics*. John Wiley & Sons.
17. Thapar, V. 1998. *Land of the Tiger: A Natural History of the Indian Subcontinent*.
18. Warren, C. E. 1971. *Biology and Water Pollution Control*. WB Saunders.
19. Wilson, E. O. 2006. *The Creation: An appeal to save life on earth*. New York: Norton.
20. World Commission on Environment and Development. 1987. *Our Common Future*. Oxford University Press.

g) A candidate opting for Genetics as an optional subject shall also opt for Chemistry/ Biochemistry and Botany / Zoology / Microbiology / Biotechnology / Sericulture as optional subjects.

7.4 **PART-III:**

A) Foundation, Skill Development or Interdisciplinary Courses
(Common for all Programmes):

i) Compulsory courses in the first and second semesters one in each semester

1. Constitution of India and Human Rights
2. Environment and Public Health Read as Environmental Studies.

ii) Any four skill development courses in the third, fourth, fifth and sixth semesters, one in each semester as prescribed by the concerned faculty and approved by the Academic Council. The courses may include the following:

Sem.	B.A.	B.Sc./B.C.A.	B.Com./BBA/BMS/BHM
III	Science and Society	Culture, Diversity & Society	Science and Society
IV	Life Skills /Personality Development	Life Skills / Personality Development	Life Skills / Personality Development
V	Banking & Finance / Building Mathematical Ability	Banking &Finance / Capital Market/ German / French	German / French / Sanskrit / Culture, Diversity and Society
VI	Entrepreneurship & Innovation / Computer Application &Information Technology	Entrepreneurship & Innovation / Computer Application & Information Technology	Creativity & Innovation / Value Education

iii) One soft core course or allied subject each in the seventh and eight semesters of the integrated programme or in the first and second semesters of the post-graduate programmes, and one open elective in the ninth semester of the integrated master's programmes as prescribed by the respective Board of studies and approved by the Academic council. The soft core courses may include research methodology course, one of the foreign languages such as German, French etc. and any other course prescribed by the university from time to time.

B) Co-curricular and Extension Activities

A student shall opt for one of the following activities offered in the college, in each of the first four semesters of the undergraduate programmes. The activity carries a credit each and will be internally assessed for 50 marks.

a) N.S.S. / N.C.C
b) Sports and Games
c) Physical Education or Activities related to Yoga
d) Field studies / Industry Implant Training
e) Involvement in campus publication
f) Publication of articles in news papers, magazines or other publications
g) Community work such as promotion of values of National Integration,

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