MANGALORE UNIVERSITY

DEPARTMENT OF BIOSCIENCES

SYLLABUS AND SCHEME OF EXAMINATIONS FOR TWO YEAR (FOUR SEMESTERS) M.Sc. DEGREE PROGRAMME IN ENVIRONMENTAL SCIENCE UNDER CHOICE BASED CREDIT SYSTEM (CBCS – 2016)

Preamble:

The University Grants Commission, New Delhi has directed all Universities in the Country to implement the Choice Based Credit System (CBCS Semester Scheme) in both the Undergraduate and Post-Graduate Programmes. The Higher Education Council, Government of Karnataka also considered the implementation of CBCS. Mangalore University has directed all the P.G. Board of Studies to frame the new syllabus for the P.G. Programmes as per the new regulations governing the Choice Based Credit System for the Two Year (Four Semester) Post –Graduate Programmes. The Registrar, Mangalore University has sent a letter No.: MU/ACC/CR.38/CBCS(PG)/2015-16/A2 dated 05.05.2016 to the PG BOS in Biosciences and asked the B.O.S to prepare syllabus for M.Sc. Environmental Science Programme. Accordingly the internal members of P.G. Board of Studies in Biosciences prepared draft syllabus. The syllabus is placed before the P.G. Board of Studies. The P.G. Board of Studies in Biosciences thoroughly discussed, modified and finalized the draft syllabus.

The present M.Sc. Programme (Environmental Science) under CBCS – PG Scheme has total credits 88 (Hard Core credits: 52 (59.09%), Soft Core credits: 30 (34.09%) and Open Elective credits: 06 (6.97%))

M.Sc. ENVIRONMENTAL SCIENCE
PROGRAMME CONTENTS

	Hrs/week	Credits
I SEMESTER		
HARD CORE COURSES - THEORY		
ESH401 Ecology and Biodiversity	4	4
ESH402 Environmental Meteorology and Geography	4	4
ESH403 Biological Chemistry	4	4
SOFT CORE COURSES - THEORY (Out of 2 Courses ONE to be offered)		
ESS404 Environmental Geology	3	3
ESS405 Environmental Microbiology	3	3
PRACTICAL COURSES		
ESP406 Ecology and Biodiversity Lab	4	2
ESP407 Environmental Meteorology and Geography Lab	4	2
ESP408 Biological Chemistry Lab	4	2
ESP409 Environmental Geology Lab	4	2
ESP410 Environmental Microbiology Lab	4	2
II SEMESTER		
HARD CORE COURSES - THEORY		
ESH451 Socio-Economic aspects of Environment	4	4
ESH452 Environmental Pollution	4	4
SOFT CORE COURSES - THEORY (Out of 3 Courses TWO to be offered)		
ESS453 Environmental Chemistry	3	3
ESS454 Analytical and Statistical Methods	3	3
ESS455 Environmental Health Management	3	3
PRACTICAL COURSES		
ESP456 Socio-Economic aspects of Environment Lab	4	2
ESP457 Environmental Pollution Lab	4	2
ESP458 Environmental Chemistry Lab	4	2
ESP459 Analytical and Statistical Methods Lab	4	2
ESP460 Environmental Health Management Lab	4	2
OPEN ELECTIVE COURSES (Out of 2 Courses ONE to be offered)		
ESE461 Basic science concept in Environment	3	3
ESE462 Environmental Education and Legislations	3	3

III SEMESTER

HARD CORE COURSES - THEORY

ESH501 Environmental Pollution Abatement	4	4
ESH502 Environmental Protection	4	4

SOFT CORE COURSES - THEORY (Out of 3 Courses TWO to be offered)

ESS503	Environmental Impact Assessment	3	3
ESS504	Environmental Management Tools	3	3
ESS505	Human Population and Environment	3	3

PRACTICAL COURSES

ESP506 Environmental Pollution Abatement Lab	4	2
ESP507 Environmental Protection Lab	4	2
ESP508 Environmental Impact Assessment Lab	4	2
ESP509 Environmental Management Tools Lab	4	2
ESP510 Human Population and Environment Lab	4	2

OPEN ELECTIVE COURSES (Out of 2 Courses ONE to be offered)

ESE511 Natural Resources	3	3
ESE512 Waste Management	3	3

IV SEMESTER

HARD CORE COURSES - THEORY

ESH551 Environmental Biotechnology	4	4

SOFT CORE COURSES - THEORY (Out of 2 Courses ONE to be offered)

ESS552 Environmental conservation and management	3	3
ESS553 Environmental Toxicology	3	3

PRACTICAL COURSES

ESP554 Environmental Biotechnology Lab	4	2
ESP555 Environmental conservation and management Lab	4	2
ESP556 Environmental Toxicology Lab	4	2

PROJECT WORK

ESP557 Project Work (Dissertation and Viva)	4	4

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M.Sc. ENVIRONMENTAL SCIENCE PROGRAMME

(CBCS Semester Scheme)

Scheme of Teaching and Examination

(As per the University Guidelines)

2016-17

I SEMESTER

Paper code	Paper title	Teaching Hrs/week	Exam Hrs	Marks Exams	Marks IA	Total Marks	Credits
HARD CORE COURSES - THEORY							
ESH401	Ecology and Biodiversity	4	3	70	30	100	4
ESH402	Environmental Meteorology and Geography	4	3	70	30	100	4
ESH403	Biological Chemistry	4	3	70	30	100	4
SOFT CORE COURSES – THEORY (Out of 2 Courses ONE to be offered)							
ESS404	Environmental Geology	3	3	70	30	100	3
ESS405	Environmental Microbiology	3	3	70	30		
PRACTICAL COURSES							
ESP406	Ecology and Biodiversity Lab	4	3	70	30	100	2
ESP407	Environmental Meteorology and Geography Lab	4	3	70	30	100	2
ESP408	Biological Chemistry Lab	4	3	70	30	100	2
ESP409	Environmental Geology Lab	4	3	70	30	100	2
ESP410	Environmental Microbiology Lab	4	3	70	30		
Total						**800**	**23**

II SEMESTER

Paper code	Paper title	Teaching Hrs/week	Exam Hrs	Marks Exams	Marks IA	Total Marks	Credits
HARD CORE COURSES - THEORY							
ESH451	Socio-Economic aspects of Environment	4	3	70	30	100	4
ESH452	Environmental Pollution	4	3	70	30	100	4
SOFT CORE COURSES – THEORY (Out of 3 Courses TWO to be offered)							
ESS453	Environmental Chemistry	3	3	70	30	100	3
ESS454	Analytical and Statistical Methods	3	3	70	30		
ESS455	Environmental Health Management	3	3	70	30	100	3
PRACTICAL COURSES							
ESP456	Socio-Economic aspects of Environment Lab	4	3	70	30	100	2
ESP457	Environmental Pollution Lab	4	3	70	30	100	2
ESP458	Environmental Chemistry Lab	4	3	70	30	100	2
ESP459	Analytical and Statistical Methods Lab	4	3	70	30	100	2
ESP460	Environmental Health Management Lab	4	3	70	30		
OPEN ELECTIVE COURSES (Out of 2 Courses ONE to be offered)							
ESE461	Basic science concept in Environment	3	3	70	30	100	3
ESE462	Environmental Education and Legislations	3	3	70	30		
Total						**900**	**25**

III SEMESTER

Paper code	Paper title	Teaching Hrs/week	Exam Hrs	Marks Exams	Marks IA	Total Marks	Credits
HARD CORE COURSES - THEORY							
ESH501	Environmental Pollution Abatement	4	3	70	30	100	4
ESH502	Environmental Protection	4	3	70	30	100	4
SOFT CORE COURSES – THEORY(Out of 3 Courses TWO to be offered)							
ESS503	Environmental Impact Assessment	3	3	70	30	100	3
ESS504	Environmental Management Tools	3	3	70	30	100	3
ESS505	Human Population and Environment	3	3	70	30		
PRACTICAL COURSES							
ESP506	Environmental Pollution Abatement Lab	4	3	70	30	100	2
ESP507	Environmental Protection Lab	4	3	70	30	100	2
ESP508	Environmental Impact Assessment Lab	4	3	70	30	100	2
ESP509	Environmental Management Tools Lab	4	3	70	30	100	2
ESP510	Human Population and Environment Lab	4	3	70	30		
OPEN ELECTIVE COURSES (Out of 2 Courses ONE to be offered)							
ESE511	Natural Resources	3	3	70	30	100	3
ESE512	Waste Management	3	3	70	30		
Total						**900**	**25**

IV SEMESTER

Paper code	Paper title	Teaching Hrs/week	Exam Hrs	Marks Exams	Marks IA	Total Marks	Credits
HARD CORE COURSES - THEORY							
ESH551	Environmental Biotechnology	4	3	70	30	100	4
SOFT CORE COURSES - THEORY(Out of 2 Courses ONE to be offered)							
ESS552	Environmental conservation and management	3	3	70	30	100	3
ESS553	Environmental Toxicology	3	3	70	30		
PRACTICAL COURSES							
ESP554	Environmental Biotechnology Lab	4	3	70	30	100	2
ESP555	Environmental conservation and management Lab	4	3	70	30	100	2
ESP556	Environmental Toxicology Lab	4	3	70	30		
PROJECT WORK							
ESP557	Project Work (Report/Dissertation)			70	30	100	4
Total						**500**	**15**
Grand Total						**3100**	**82+6***

IA = Internal Assessment
***** Not included for CGPA

Total Credits: 88 (82+6*)
Hard Core credit: 18 + 12 +12+10 = 52 (59.09%)
Soft Core credit: 05 + 10 + 10 +05 = 30 (34.09%)
Open Elective credit: 0 + 03 + 03 + 0 = 06 (6.97%)

NOTE:

BASIS FOR INTERNAL ASSESSMENT: Internal Assessment marks in theory papers shall be awarded on the basis of theory test (70 Marks), Objective Test (MCQs)(15 Marks), Seminars and Assignments (15 Marks). The marks obtained shall be reduced to 30. The tests may be conducted 14 weeks after the start of a Semester. Practical Internal Assessment marks shall be based on practical test and records. 60 marks for Practical test and 10 marks for Class record. The marks obtained shall be reduced to 30. The test may be conducted 14 weeks after the start of a Semester. 30 marks for project work (Report/Dissertation and Presentation/Viva).

THEORY QUESTION PAPER PATTERN: Question Papers in all the four semesters consists of three sections (Model question paper enclosed). Section I: Write short notes on any four out of six: (4x4=16 Marks) Section II: Write explanatory notes on any five out of seven: (5x6=30 Marks). Section III: Answer any two out of three: (2x12=24 Marks). Questions are to be drawn from all the units of the syllabus by giving equal weightage to all the units.

PRACTICAL QUESTION PAPER PATTERN: 60 marks for practical exam proper (Major experiment-20 marks, Minor experiments- 10+10 marks, Identify and Comment on-5x4=20marks) and 10 marks for Class record. The Project work may be conducted either in the department or any other Institution or in an Industry. Project Report/Dissertation carries 70 marks and evaluated as per regulations.

Model Question Paper

First Semester M.Sc. Degree Theory Examination, December 2016

(CBCS)

ENVIRONMENTAL SCIENCE

ES

Time: 3 Hours Max. Marks: 70

Write short notes on **any four** of the following (not exceeding **2** pages **each**): **(4x4=16)**

1. a)
   b)
   c)
   d)
   e)
   f)

Write explanatory notes on **any five** of the following (not exceeding **3** pages **each**): (**5x6=30)**

2.
3.
4.
5.
6.
7.
8.

Answer **any two** of the following (not exceeding **8** pages **each**): **(2x12=24)**

9.
10.
11.

M.Sc. ENVIRONMENTAL SCIENCE PROGRAMME

(CBCS Semester Scheme) 2016-17

SYLLABUS

I SEMESTER

HARD CORE PAPERS

ESH401 ECOLOGY AND BIODIVERSITY

UNIT I (13 hours)

Concepts of ecosystem: History, definition and characters, biotic and abiotic components of ecosystem. Energy flow, energetics, ecological efficiency, trophic relationships, food webs, productivity and carrying capacity.

UNIT II (13 hours)

Population Ecology: Growth, mortality, natality, population fluctuations, population interactions, host-parasite interaction. Population characters and demography.

Community ecology: Community structure, characters, types of communities - terrestrial, forest, grassland, dry land, deserts, wetland and aquatic - lakes, rivers, oceans.

UNIT III (13 hours)

Basics of biodiversity: Patterns of living organsims – classification and evolution; characterizing species, basics of taxonomic characterization, magnitude and distribution of biodiversity, speciation, ecology of extinction.

UNIT IV (13 hours)

Biodiversity and Bioresources: Types of Biodiversity - species diversity, ecosystem diversity, genetic diversity; biodiversity and ecology, Bioresources - terrestrial, aquatic, agricultural and forest resources.

References:

1. Clarke, G.L., 1974. Elements of Ecology, John Wiley & Sons, New York.
2. Brock, T.D. & Madigan, M.T., 1986. Biology of microorganisms; Prentice Hall, New Jersy.
3. Dadhick, L.K., 2002. Biodiversity. Strategies for Conservation. APH Publishers, New Delhi.
4. Agarwal, S.K., 2002. Biodiversity and Environment, APH Publishers, New Delhi.
5. Nagore, A.P., 2000. Biological Diversity and International Environment Law.
6. George, A., 2000. The Ecology of sea shores. CRC Press.
7. Mukerji, K.G., 1997. Red Algae, Structure, Ultrastructure and Reproduction.
8. Ashuthosh Gautham, Aquatic Environment.
9. Keddy, P.K., 2000. Wetland Ecology, Cambridge University Press.
10. Chatrath, K.J.S., Wetlands of India.
11. Mahajan, S.E., 1999. Industrial Ecology. Lewis Publishers.
12. Ambasht, R.S., 2002. Modern Trends in Ecology and Environment.

13. Lambers, H., 2002. Plant Physiological Ecology.
14. Arjun Prasad Nagore, 1996. Biological Diversity and International Environmental Law
15. Odum, E.P., 1971. Fundamentals of ecology.
16. Barbour M.D., 1980.Terrestrial Plant Ecology. The Benjamin Cummings Publication Co., California.
17. Furley, P.A. Newey , W.W., Kirby R.P. and Hoston, J Nc. G., 1983. Geography of the Biosphere - An Introduction to the Nature, Distribution and Evolution of the World's Life Zones.

ESH402 ENVIRONMENTAL METEOROLOGY AND GEOGRAPHY

UNIT I (13 hours)

Earth as a planet: Motions of the earth, seasons. Laws of thermodynamics: concept of fluid mechanics. Thermal balance: Heat production and loss, sea-surface interaction. SST, heat islands, electromagnetic spectra: solar radiation, photochemical and photosensitized reactions.

UNIT II (13 hours)

Radioactivity: Origin of radio nuclei, natural and artificial; their effects on the ecosystem; biological effect of radiation. Concepts of residence time of moisture and gaseous components.

UNIT III (13 hours)

Geographical concepts related to environment: economic geography, agro – climatic regions, industry and environment. Energy sources and consumption patterns in urban and rural areas.
Climatology: Elements and factors of climate, climatic control, climate change, continental influence on climate, urban and rural climate; artificial climates, climate policy.

UNIT IV (13 hours)

Interpretation of Weather satellite images, surface temperature measurement, cloud top height determination, rain rate and wind velocity measurement and weather prediction,
Use of microcomputers in instrumentation and in measurement systems.

References

1. Arya, S.P., 2002. Introduction to Micrometeorology 2nd Ed.
2. Bailey R.G., 2002. Ecosystem Geography
3. Beven, K., 2002. Rainfall-Runoff Modeling: The Primer.
4. Ketan Tatu, 1999. Remote sensing for Wetland monitoring & Waterfowl Habitat Management.
5. Frew, J., 1986. Geography fieldwork, Macmillan.
6. Gardiner, V. & Dackombe, R.V., 1983. Geomorphological field manual. Allen & Unwin.

7. Gilbertson, D.D., Kent, M. & Pyatt, K.B., 1985. Practical ecology for Geography and Biology: Survey, Mapping and Data Analysis. Hutchinson.
8. Goudie, A. (ed.), 1990. Geomorphological techniques. Unwin Hyman.
9. Haines – Young, R.H & Petch, J.R., 1986. Physical Geography: its nature and methods. Harper.
10. Jones, A.P., Tucker M.E. & Hart, J.K., 1999. Description and analysis of Quaternary stratigraphic field sections. Quaternary Research Association Technical Guide 7. QRA.
11. Lal, R., 1994. Soil erosion research methods, 2nd ed. Ankeny: SWCS.
12. Matthews, H.M. & Foster, I.D., 1986. Field work exercises in human and physical geography, Arnold.
13. Parsons, T. & Knight, P.G., 1995. How to do your dissertation in geography and related disciplines. Chapman & Hall.
14. Ritchie, W., Wood, M., Wright, & Tait, D., 1988. Surveying and mapping for field scientists. Longman.
15. Rogers, A., Viles, H. & Goudie, A., 1992. The student's companion to Geography. Blackwell
16. Tucker, M., 1988. Techniques in sedimentology. Blackwell.

ESH403 BIOLOGICAL CHEMISTRY

UNIT I (13 hours)

Basic concepts: Introduction to bimoleculas, classification, type; bonding in biomolecules. Structure of water - hydrophobic, hydrophilic interactions in biological systems.

UNIT II (13 hours)

Proteins; Amino acids and peptides – classification and structure and functions; synthetic polypeptides. Enzymes and coenzymes – classification structure and functions.

Nucleic acids: Elementary concepts of nucleosides, nucleotides and polynucleotides. Structure and functions of DNA and RNA.

UNIT III (13 hours)

Lipids: common classes of lipids – glycerolipids, phospholiods and sphingolipids structure and properties.

Carbohydrates: Monosaccharides, oligosaccharides and polysaccharides. Structure and functions of some important polysaccharides (starch, cellulose, glycogen, heparin, chitin, pectins, hemicellulose and chondroin).

UNIT IV (13 hours)

Membranes : Biomembrane organisation – membrane lipids, membrane bound proteins. Properties of membranes and transport mechanism. Metabolism and bioenergetics. Overview of metabolism - catabolic and anabolic process, glycolysis, citric acid cycle and oxidative phosphorylation.

References

1. Vogel, A.L., 1971. Elementary practical organic chemistry. Vol. 3 Quantitative organic analysis. Langman ELBS.
2. Frieser, L.F. 1968. Organic chemistry experiments. (D.C. Health & Co.).
3. Elmose, D.T., 1968, Peptides and proteins. Cambridge University Press.
4. Finer, L.L. 1980. Organic chemistry. Vol. I & II. Lynem (ELBS).
5. Morison, R.T., and Boyd, R.N., 1983. Organic Chemistry. McGraq Hill. Kogakusha.
6. Pigman & Horton, D., 1970. The carbohydrates. Chemistry and biochemistry, 2nd ed. Vol. IA & IB. Plenum Press, New York & London.
7. Branden, C. and Tooze, J. 1991. Introduction to Protein Structure. Garland Publishing Inc.
8. Cantor and Schimmel, 1980. Biophysical Chemistry Part I & III, WH Freeman and Co.
9. Dickerson and Geis, 1969. The structure and action of proteins. Benjamin/ Cummings Publishing.
10. Jayaraman, J., 1948. Laboratory Manual of Biochemistry.

SOFT CORE COURSES

ESS404 ENVIRONMENTAL GEOLOGY

UNIT I (13 hours)

Introduction to Environmental Geology: Components of physical environments, geospheres - atmosphere, hydrosphere, lithosphere and biosphere.

Seismology and structure of earth: Mineralogy, seismic and tectonic processes, soil formation and its conservation; biogeochemical cycles.

UNIT II (13 hours)

Geomorphology: Weathering and erosion, slopes, valleys, streams, springs, lakes, landscapes and environmental aspects of reservoir siltation; river networks; natural hazards – earthquakes, landslides and volcanoes.

Basic aspects of paleontology: Geological time scale, ice age, geology of ocean floor, waves, tides and currents and shore line processes; environmental aspects of coastal zones; sea level rise and siltation.

UNIT III (13 hours)

Ground water - origin movement and storage of ground water, factors, controlling storage and movement; wells - permanent and artisan; springs and factors controlling their location tanks - major and minor and their siltation.

References

1. Allen, J.R.L., 1977. Physical Processes of contamination. George Allen & Unwin.
2. Bateman: Economic Mineral deposits

3. Billings, M.P., Destller, L.U., 1972. Structural Geology, Prentice Hall
4. David Kieth Todd, 1980. Ground water Hydrology, II Ed. John Wiley & Sons.
5. Davis, R.A Jr. 1985. Coastal sedimentary Environments.
6. Deer Howie and Zummann, 1977. Rock forming minerals. ELBS & Longmann.
7. Garlans, G.D., 1971. Introduction to Geophysics. Toppen Publ. Co., Tokyo.
8. Hughes, C.J., 1982. Igneous Petrology
9. Lehee, F.H. 1961. Field Geology, McGraw
10. Mason, B., 1958. Principles of Geochemistry
11. Open University Series, 1982. Earth Dynamics, Open University Press.
12. Pettijonn, F.J., 1975. Sedimentary rocks
13. Rose, D.A. Introduction to Oceanography.
14. Winker, H.G.F., 1988. Petrogenesis of Metamorphic Rocks. McGraw Hill Publishers.
15. Wyllie, P.J., 1971. The dynamic earth. A text book in Geoscience, John Willem & Sons.

ESS405 ENVIRONMENTAL MICROBIOLOGY

UNIT I (13 hours)

Introduction to microbiology, historical perspectives, branches and scope of microbiology. Microbial growth, population and growth curves, sterilization and culturing techniques, factors affecting growth and death of microorganisms: temperature, pH, water activity, O-R potential, salinity, hydrostatic pressure, disinfectants, antiseptics and chemotherapeutic agents.

UNIT II (13 hours)

Microbial Ecology: Microbial symbiosis, mutualism, plant-microbe interactions (e.g. mycorrhizas), animal-microbe interactions (human, ruminants and non-ruminants). Microbes in hydrothermal vents and coral reefs.

Aquatic Microbiology: Microbes in water and methods of their estimation (e.g. MPN), drinking water standards, water-borne diseases and prevention.

UNIT III (13 hours)

Soil Microbiology: Soil microflora and methods of their estimation, role of soil microorganisms in bioconversion and decomposition. Biological nitrogen fixation (symbiotic and non-symbiotic), microbial phosphorus solubilization and their importance in soil fertility and agriculture.

Air Microbiology: Microflora of air and methods of their estimation, air-borne diseases and prevention.

References:

1. Brock, T.B. and Madigon, M.T., Biology of microorganisms, Prentice Hall.
2. Pelczar, J. and Chan, E.C.S., Element of Microbiology, Mac Graw Hill New York.

3. Schlegel, H.G., General Microbiology, Cambridge Univ. Press.
4. Rosenberg, E. and Cohen I.R., Microbial Biology, Saunders Coll. Publ.
5. Stanier, R.Y. *et al*., The Microbial World, Prentice Hall, New Delhi.
6. Atlas, R.M. and Bartha R. Benjamin, Microbial Ecology, Cummings Sci. Press, USA.
7. Cruickshank, R., Medical Microbiology. Churchill Livingstone, London.
8. Doelle, H.W., Bacterial Metabolism. Academic Press, London.
9. Nickilin *et al.,* Instant Notes in Microbiology, Via Books Pvt. Ltd., New Delhi.
10. Norris, J.R., Methods in Microbiology. Academic Press, London.
11. Adams, M.R. and Moss, M.O., Food Microbiology, Panima Publ., New Delhi.
12. Barrett, J.T., Microbiology and Immunology Concepts, Lippincott-Raven, USA.
13. Casida, L.E., Industrial Microbiology, Wiley Eastern Ltd., New Delhi.
14. Elgert, KD., Immunology, Jon Wiley and Sons, USA.
15. Subba Rao, N.S., Advances in Agricultural Microbiology, Oxford and IBH Publ., New Delhi.
16. Alexopoulous, G.J., Introductory Mycology, Wiley Eastern Limited., New Delhi.
17. Cambell, R., Microbial Ecology. Blackwell Scientific Publ., London.
18. Webster, J., Introduction to Fungi. Cambridge University Press, Cambridge.

PRACTICAL COURSES

ESP406 ECOLOGY & BIODIVERSITY LAB

1. Microscopic observations of microbes - Keys to identify microorganisms.
2. Practical exercises in identification of symbiotic organisms.
3. Study of aquatic communities – Aquatic plants and animals.
4. Study of intertidal organisms.
5. Study of mangrove vegetation.
6. Study of seaweeds.
7. Identification of bryophytes, ferns and higher plants.

ESP407 ENVIRONMENTAL METEOROLOGY AND GEOGRAPHY LAB

1. Weather data analysis (image analysis).
2. Generation of data bases - G.S. handling, scanning and digitization.
3. Exercises related to earth projections.
4. Exercises related to potential evapotranspiration.
5. Practicals related to human settlement analysis.
6. Agricultural yield estimation using satellite data.
7. Practicals on diseases of crop plants by insect.

ESP408 BIOLOGICAL CHEMISTRY LAB

1. Determination of amines and amino acids.
2. Determination of carbohydrates.
3. Qualitative tests for the identification of monosaccharides, disaccharides and polysaccharides.
4. Qualitative tests for proteins, lipids and NPN substances.
5. Precipitation reactions of proteins.
6. Spectrophotometric estimation of serum protein, blood sugar, urine creatinine, blood urea, plant phenolics and ascorbic acid.

ESP409 ENVIRONMENTAL GEOLOGY LAB

1. Study of minerals – Hand Specimens
2. Study of Rocks – Hand Specimens
3. Structural Geology – Interpretation of geological maps, solving Dip and Strike Problems
4. Sedimentology – Classification of sediments, sediment and rock fragments.
5. Sieve analysis of sediments, pipette analysis, pebble classification
6. Study of littoral drift in the field and laboratory using dye and tracer techniques
7. Drainage Basin Analysis Generation to drainage density and drainage frequency maps
8. Exercises related to water budget
9. Exercises related to Potential Evapotranspiration
10. Compute monthly water budget from the given data
11. Ground water quality – Impact and Testing.
12. Interpretation of waves, climate, tides and currents for the given data

ESP410 ENVIRONMENTAL MICROBIOLOGY LAB

1. Introduction to basic techniques and instrumentation in microbiology.
2. Simple and differential staining for morphological studies.
3. Assessment of microflora of soil, water and air.
4. Isolation of microbes using selective media.
5. Studies on symbiotic association of microorganisms.
6. Assessment of microbial quality of drinking water and milk.
7. Microbiological assays.

II SEMESTER
HARD CORE COURSES

ESH451 SOCIO-ECONOMIC ASPECTS OF ENVIRONMENT

UNIT I (13 hours)

Introduction to cultural, social, geographical and economical anthropology. Eugenics and euthenics. Rehabilitation of human population. Social and cultural differences in the perception of values of resources.

Sociology of development, common property resources, environmental movements: Role of women in environment, tribes and environment, cost of environmental protection.

UNIT II (13 hours)

Environment and sustainable development: Measuring of sustainable development, global awareness, global and national environmental issues, manpower and training programmes.

UNIT III (13 hours)

Nature and scope of environmental economics: economic planning and development related to environment; planning, decision and implementation processes; cost benefit analysis of environment, common property rights. Market for environment, valuing environment and natural resources.

UNIT IV (13 hours)

Socio-economic dimensions of environment: Sustainable development Vs environmental development; Use and non-use value of resources; valuation, risk and uncertainty of resources; share of benefits of resources; environmental values, ethics and equity. Measurement environmental degradation.

References

1. Dasgupta, P. and Heal, G.M. 1998. Economic Theory of Exhaustible Resources, Oxford University Press, New Delhi.
2. Hantey, N., 1996. Environmental Economics - Theory and Practice, Manasa Publication, New Delhi.
3. Kalpagam, M., 1992 Environmental Economics - A Textbook. Sterling, New Delh.
4. Kolstad, C.D., 1999. Environmental Economics. Oxford University Press, New Delhi.
5. Thabeeb, K., 1996. Environment Protection Law and Policy in India. Deep and Deep, New Delhi.
6. Pearce, D.W. and Turner, R.K. 1990. Economics of Natural Resources and Management, Harvester, New York.
7. Juan Martinez-Alied, 1987. Economics, Energy and Environment. Basil Blackwell.
8. Slebeht, H., 1992. Economics of Environment – Theory and Policy, Springer Verlag.
9. Hines, L.G., 1988. The Market, Energy and Environment, Allyn and Bacon, Boston.

10. Trivedi, P.R. (ed.) 1994. Sustainable Development - Global Perspective, Commonwealth, New Delhi.
11. Bermann, P. (Ed), 1995. Health sector reforms in developing countries, Marking health development sustainable, Harward University Press.
12. Sengupta, R.P., 2001. Ecology and Economics: An approach to sustainable development, Oxford University Press, New Delhi.
13. Kushwath & Vijayakimar, 2001. Economics of Protected Areas and its management
14. Nicholas Poulin, 1977. Growth without ecodisasters.
15. Lenihan, J. and Fletcher, W.W., Environment and Man.
16. Hall, D.O., Economics of Ecosystem Management.

ESH452 ENVIRONMENTAL POLLUTION

UNIT I (13 hours)

Definition of environmental pollution: Types of pollution – Air, water, land, sound. Radioactive pollution; Transfer and Transport mechanism of pollutants.

UNIT II (13 hours)

Concepts of sources of air pollution: Gases & particulates and their components. Solid wastes – Sources of waste generation and disposal, characteristics of wastes. Effects on soil, biotic community, groundwater and air.

UNIT III (13 hours)

Sources of water pollution – Domestic, municipal, industrial and agriculture. Various water bodies as sites of waste disposal and their local, national and global impact.

UNIT IV (13 hours)

Bioindicators: Overview of bioindicators – theory, practices and problems; biondicators of air, water and soil pollution. Biomonitoring of heavy metals, biomontoring of air pollution around urban and industrial sites; organisms used as indicator of population.

References

1. Diwakar Rao, P.L, 1990. Pollution control Hand book, Utility Publications Ltd., Secunderabad, India.
2. Eaton, A.D., Clesceri L.S. & Greenberg, A.E., 1995. Standard Methods for the Examination of Water and Wastewater, APHA, Washington.
3. Moriarty, F., 1975. Pollutants and animals; A factual perspective. George Allan & Unwin Ltd., London.
4. Schmitz, R.J, 1996. Introduction to water pollution biology. Asian Books Pvt. Ltd., New Delhi.
5. Trivedi, P.R. and Sudarshan, K., 1995. Global Environmental issues, Commonwealth Publications, New Delhi.

6. Vernberg *et al*., 1981. Biological monitoring of marine pollutants, Academic Press, New York.
7. George, A., 2000. The Ecology of sea shores, CRC Press.
8. Agrawal, K.C., 2002. Environmental Pollution: Causes, Effects and Controls.
9. Binoda C. Sabata, 1995. River Pollution in India.
10. Khetan S.K., 2000. Microbial Pest Control.
11. James, G.A., 1999. Ethical Perspective on Environmental issues in India.

SOFT CORE COURSES

ESS453 ENVIRONMENTAL CHEMISTRY

UNIT I (13 hours)

Environmental segment: Evolution of the atmosphere, composition & structure; hydrologic cycle; soil composition; bio-geochemical cycles (C, O, N, P, S, CO_2 etc.) Biodistribution of elements, chemical speciation.

UNIT II (13 hours)

Chemistry of atmosphere, air pollutants – sources, photo-chemical smog, green house effect, ozone depletion, acid rain (particulates - source and environment effects). Aerosols - sources, composition and environmental effect.

UNIT III (13 hours)

Chemistry of water: Ground and surface water composition, criteria and standards of water quality – organic, inorganic, radiological and microbial contaminants; Water purification for drinking and industrial process (Demineralization, desalination and reverse osmosis).

References

1. Levit, B.P., Fidlays practical physical chemistry, Longmann, London.
2. Yadav, 1989. Advanced practical physical chemistry.
3. Day, A.K. 1984. Environmental Chemistry, Willey Eastern, III Ed.
4. Faust, S.D. and Dly, O.M., 1983. Chemistry of water treatment, Butter
5. Sawyer, C.W. and McCarty P.L., 1978. Chemistry for Environmental Engineering, McGraw Hill.
6. Vogel, A.L. 1978. A text book of quantitative inorganic analysis. ELBS.
7. APHA, 1989. Standard methods for the examination of water and waste water, Washington D.C.
8. Ghosh G.K., 1999. Biopesticide and Integrated Pest Management.
9. Prabha Shastri Ranade, 2000. Industries and Environment. A study of Impact Assessment.

ESS454 ANALYTICAL AND STATISTICAL METHODS

UNIT I (13 hours)

Inorganic analytical methods: Coulometric titration – titration curves with EDTA, indicators, masking and damasking techniques. Principle, description and applications of chromatography, calorimetry, spectrophotometry, nephlometry/turbidometry, flame spectrometry, microscopy, Flourometry, X-ray fluorescence, radiometry, micrometry, AAS, GC/MS and NMR.

UNIT II (13 hours)

Introduction to basic statistics: Types of data - primary and secondary, collection of data, classification and tabulation of data. Diagrammatic and graphical representation of data – bar, pie, pictograms, histograms, frequency polygon, frequency curve and cumulative frequency curves.

Measures of central tendency - mean, median, mode; measures of dispersion – range, standard deviation, quartile deviation, mean deviation, relative measures of dispersion skewness and kurtosis, standard error, variance.

UNIT III (13 hours)

Distributions: Principles, properties and applications of binomial, poison and normal distributions. Theory of sampling, sampling distributions –'t', Chi- square, F distributions. Test of significance – 't' Test, Chi-square test, F-test. ANOVA- One way and two way classification.

Application of statistics in environment studies.

References

1. McGarigal, K., 2002. Multivariate statistics for Wildlife and Ecology Research, Springer Verlag New York.
2. Magurran, A.E., 1988, Ecological diversity and its measurement. Chapman & Hall, London.
3. Sokal, R.R. and Rohif, F.J., 1995. Biometry, 3rd Ed., W.H. Freeman, New York.
4. Wilkinson, L., 1989. SYSTAT: the system for statistics. SYSTAT Inc. Evanston, lllionois.
5. Zar, J.H., 1974. Biostatistical analysis. Prentice – Hall, Inc., Englewood Cliffs., NJ.
6. Christian, G.D., 1996. Analytical Chemistry, 4th Ed., John Wiley.
7. Day and Underwood, 1988. Quantitative analysis. Prentice Hall, India.
8. Srivasthava, A.K. and Jain, P.C., 1997. Chemical Analysis. S. Chand and Co. New Delhi.
9. Sawichi Mulik, Wittgen and Stoin, 1978. Ion Chromatographic analysis of Environmental Pollutants.
10. Williams and Wilson, 1984. A Biologist's Guide to Principles and Techniques of Practical Biochemistry.

11. Sndecor, G.W. and Cochran, W.G. Statisical Methods, Lowa state University Press.
12. Dixon, W.J. Massey Jr., F.J., McGraw Hill., Introduction to Statistical Analysis.
13. Fisher, R.A. Statistical Methods for Research Works, Oliver and Boyd, London.
14. Green, R.H., 1979. Sampling Design and Statistical Methods for Environmental Biologists, John Wiley & Sons.
15. Wardlow, A.C. 1985. Practical Statistics for Experimental Biologists. John Wiley and Sons.

ESS455 ENVIRONMENTAL HEALTH MANAGEMENT

UNIT I (13 hours)

Environmental health: Criteria, Chemical Safety; Effects of mercury, lead, chromium, cadmium, arsenic and nitrate on human health; Water borne diseases - Prevention and protection of community health from water borne diseases.

UNIT II (13 hours)

Air borne bio-allergens, seasonal changes, mode of dispersal, disease intensity and control. Effects of Physical Environment on Accidents and Crime; Diseases of Man: Effects of temperature, humidity, ionization, ultra violet radiation and acidity of air on skin, lungs, throat, nose, eye, nervous system.

UNIT III (13 hours)

Food borne diseases: Types, symptoms and prevention. Food safety. Environmental sanitation. Effects of weather and climate on human health, working efficiency, traffic and industrial accidents.

References

1. Wisner, B. and Adams, J., 2002. Environmental Health in emergencies and disasters – A Practical Guide, World Health Organization.
2. Paul R. Hunter, 1997. Waterborne disease: Epidemiology and ecology, Chichester John Wiley and Sons Ltd.
3. Eaton, A. D., Clesceri, L.S. & Greenberg, A.E. 1995. Standard Methods for the Examination of Water and Wastewater. APHA, Washington.
4. Moriarty, F., 1975. Pollutants and animals: A factual perspective. George Allan & Unwin Ltd., London.
5. Atlas, RM and Bartha R. Microbial Ecology. Benjamin-Cummings Sci. Press, USA.
6. Beven, K., 2002. Rainfall-Runoff Modeling: The Primer.
7. Beaglehole, R., Bonita, R. and Kjellstrome, T. 2006. Basic epidemiology
8. Environmental Health - Emergency Response Guide, A supplement to local emergency preparedness and response plans, Advanced Practice Centres.

PRACTICAL COURSES

ESP456 SOCIO-ECONOMIC ASPECTS OF ENVIRONMENT LAB

1. Identification of geographical and natural resources location.
2. Population resources in India based on physical features.
3. Environmental laws and its impact: Matching of Acts and utilization of resources.
4. Identification of environmental movements. Year wise & region wise.
5. Measurement of sustainable development– working out sustainable developmental index in different regions and resources. Solving some problems.
6. Working out of impact assessment of different projects.
7. Economics of pollution abatement. Work out under different pollution agencies.
8. Identification of major pollutants and their effect on human and animal health.

ESP457 ENVIRONMENTAL POLLUTION LAB

1. Estimation of residual chlorine in the water sample using Chlorotex reagent.
2. Demonstration of catalase activity in polluted waters.
3. Estimation of oil and grease in water sample.
4. Solid waste indices.
5. Physical properties of solid waste.
6. Chemical characteristics of solid waste.
   - 6.1 Biological oxygen demand of solid waste.
   - 6.2 Chloride content of solid waste.
   - 6.3 Estimation of inorganic phosphate of solid waste.
   - 6.4 Estimation of sulphates of solid waste.
7. Indicators of pollution & biomonitoring.

ESP458 ENVIRONMENTAL CHEMISTRY LAB

1. Determination of dissolved oxygen in water samples.
2. Determination of total particulates in atmospheric air/chemical analysis.
3. Determination of phosphorus by sectrophotometry.
4. Determination of half life of radionuclides.
5. Determination of BOD in water samples.
6. Determination of COD in water samples.
7. Determination of nitrites and nitrates in water samples.
8. Instruments used in Environmental Chemistry.

ESP459 ANALYTICAL AND STATISTICAL METHODS LAB

1. Determination of calcium and magnesium from different samples.
2. Analysis of hardness in water samples.
3. Analysis of alkalinity in water samples.
4. Ion exchange separation of anions and cations
5. Spectrophotometric determination of silicates
6. Statistical analysis of experimental data.

ESP460 ENVIRONMENTAL HEALTH MANAGEMENT LAB

1. Quantitative and qualitative assessment of human pathogens in soil, water and air.
2. Isolation of human pathogens using selective media.
3. Identification of environmental agents causing allergic reactions in man.
4. Assessment of drinking water quality.
5. Study of water purification.
6. Analysis of emulsion activity and emulsion stability of flour samples.
7. Analysis of foam capacity and foam stability of flour samples.
8. Study of food preservation techniques and food safety equipments.

OPEN ELECTIVE COURSES

ESE461 BASIC SCIENCE CONCEPT IN ENVIRONMENT

UNIT I (13 hours)

Definition and scope of Environmental Science; Earth and its environment: Structure and Composition. Biosphere-Atmosphere, Lithosphere, Hydrosphere and Water cycle.

UNIT II (13 hours)

Atmosphere: Structure and composition. Temperature, pressure, humidity of atmosphere. Winds and clouds – their classification, formation and circulation, artificial rain, acid rain, global warming, green house effect.

UNIT III (13 hours)

Hydrosphere: Water as a resource, sources of water, water related issues, purification of water, water management.

Biogeochemical Cycles: Sedimentary cycles, gaseous cycles, cycling of heavy metals and radioactive compounds, Effect of anthropogenic activities on biogeochemical cycles.

References

1. Agrawal, K.C., 2001. Fundamentals of Environmental Biology, Nidhi Publishers, Bikaner, India.
2. Asthana D.K. and Meera Asthana, 2006. A text Book of Environmental Studies, S. Chand & Co. Ltd., New Delhi.

3. Clarke, G.L., 1974. Elements of Ecology, John Wiley & Sons, New York.
4. Odum, E.P., 1971. Fundamentals of ecology.
5. Arya, S.P., 2002. Introduction to Micrometeorology, 2nd Ed.
6. Gilbertson, D.D., Kent, M. & Pyatt, K.B., 1985. Practical ecology for Geography and Biology: Survey, Mapping and Data Analysis. Hutchinson.
7. Haines – Young, R.H. & Petch, J.R., 1986. Physical Geography: its nature and methods. Harper.
8. John, J.W.R. and Geoffrey, F.P. 1998. People and the Earth, Cambridge University Press.
9. Tucker, M., 1988. Techniques in Sedimentology. Blackwell.

ESE462 ENVIRONMENTAL EDUCATION AND LEGISLATIONS

UNIT I (13 hours)

Introduction to environment, components of environment – biosphere, atmosphere, lithosphere, hydrosphere; biotic and abiotic components; environmental problems including acid rain, ozone hole, global warming, deforestation; significance of environmental education and legislations.

UNIT II (13 hours)

Environmental Education: Definition, goals, objectives, principles; environmental education programmes; formal (primary and secondary school level and tertiary level) and non-formal environmental education; environmental education for professional groups. Environmental education in India – Status and policy of environmental education – Action Plan. Environmental Institutions and NGOs.

UNIT III (13 hours)

Environmental Legislations: Water Act -1974, Air Act - 1981, Environment (Protection) Act – 1986, Cess Act – 1977, Role of Parliament, State legislatives, Government departments including Pollution Control Boards in environmental protection. Environmental Protection Agencies/Organisations.

Legislation for protection of forest and wildlife in India, Indian Forest Act – 1927, Forest Conservation Act – 1980, Biodiversity Acts, Wildlife Protection Acts, Coastal Regulatory Zone (CRZ), Conservation Projects.

References

1. Agrawal, K.C., 2001. Fundamentals of Environmental Biology, Nidhi Publishers, Bikaner, India.
2. Pandey, G.N., 1998. Environmental Science and Technology, Annual Publication, New Delhi.
3. Asthana, D.K. and Meera Asthana, A text book of Environmental Studies, S. Chand & Co. Ltd., New Delhi.
4. Sharma, P.D., 2012. Ecology and Environment, Rastogi Publications, Meerut.