Department of Environmental Sciences

2013-2014

Scheme
M.Sc. Environmental Sciences
(2 Year Program)
Choice Based Credit System (CBCS)

Maharshi Dayanand University
Rohtak 124001
## Choice Based Credit System

### SEMESTER-1

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course No.</th>
<th>Nomenclature of Paper</th>
<th>Type</th>
<th>L-T-P</th>
<th>Credits</th>
<th>Evaluation Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Theory</td>
</tr>
<tr>
<td>1</td>
<td>ENV-101</td>
<td>Environmental Toxicology</td>
<td>PC</td>
<td>4-0-0</td>
<td>4</td>
<td>80</td>
</tr>
<tr>
<td>2</td>
<td>ENV-102</td>
<td>Environmental Biology</td>
<td>PC</td>
<td>4-0-0</td>
<td>4</td>
<td>80</td>
</tr>
<tr>
<td>3</td>
<td>ENV-103</td>
<td>Analytical Techniques</td>
<td>PC</td>
<td>4-0-0</td>
<td>4</td>
<td>80</td>
</tr>
<tr>
<td>4</td>
<td>ENV-104</td>
<td>Environmental Pollution</td>
<td>PC</td>
<td>4-0-0</td>
<td>4</td>
<td>80</td>
</tr>
<tr>
<td>5</td>
<td>ENV-105</td>
<td>Solid waste Management</td>
<td>PE</td>
<td>4-0-0</td>
<td>4</td>
<td>80</td>
</tr>
<tr>
<td>6</td>
<td>ENB-101</td>
<td>Biochemistry</td>
<td>PE</td>
<td>4-0-0</td>
<td>4</td>
<td>80</td>
</tr>
<tr>
<td>7</td>
<td>ENB-102</td>
<td>Cell &amp; Molecular Biology</td>
<td>PE</td>
<td>4-0-0</td>
<td>4</td>
<td>80</td>
</tr>
<tr>
<td>8</td>
<td>ENV-106</td>
<td>Lab Course-I</td>
<td>PC</td>
<td>0-0-20</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>ENV-107</td>
<td>Seminar-I</td>
<td>PC</td>
<td>0-0-0</td>
<td>01</td>
<td></td>
</tr>
</tbody>
</table>

Total Credits: 31  
Total Marks: 700

### SEMESTER-2

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course No.</th>
<th>Nomenclature of Paper</th>
<th>Type</th>
<th>L-T-P</th>
<th>Credits</th>
<th>Evaluation Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Theory</td>
</tr>
<tr>
<td>1</td>
<td>ENV-201</td>
<td>Natural Resources</td>
<td>PC</td>
<td>4-0-0</td>
<td>4</td>
<td>80</td>
</tr>
<tr>
<td>2</td>
<td>ENV-202</td>
<td>Biodiversity</td>
<td>PC</td>
<td>4-0-0</td>
<td>4</td>
<td>80</td>
</tr>
<tr>
<td>3</td>
<td>ENV-203</td>
<td>Resource Management</td>
<td>PC</td>
<td>4-0-0</td>
<td>4</td>
<td>80</td>
</tr>
<tr>
<td>4</td>
<td>ENV-204</td>
<td>Biostatistics and Environmental Modeling</td>
<td>PC</td>
<td>4-0-0</td>
<td>4</td>
<td>80</td>
</tr>
<tr>
<td>5</td>
<td>ENV-205</td>
<td>Seminar-II</td>
<td>PC</td>
<td>0-0-0</td>
<td>01</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>ENV-207</td>
<td>Environmental Microbiology</td>
<td>PE</td>
<td>4-0-0</td>
<td>4</td>
<td>80</td>
</tr>
<tr>
<td>7</td>
<td>ENV-208</td>
<td>Waste water treatment Technology</td>
<td>PE</td>
<td>4-0-0</td>
<td>4</td>
<td>80</td>
</tr>
<tr>
<td>8</td>
<td>ENV-209</td>
<td>Environmental Geology</td>
<td>PE</td>
<td>4-0-0</td>
<td>4</td>
<td>80</td>
</tr>
<tr>
<td>9</td>
<td>ENV-206</td>
<td>Lab Course-II</td>
<td>PC</td>
<td>0-0-20</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

Total Credits: 31  
Total Marks: 700

2013-2014
## SEMESTER-3

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course No.</th>
<th>Nomenclature of Paper</th>
<th>Type</th>
<th>L-T-P</th>
<th>Credits</th>
<th>Evaluation Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Theory IA Total</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>marks</td>
</tr>
<tr>
<td>1</td>
<td>ENV-301</td>
<td>Environmental Chemistry</td>
<td>PC</td>
<td>4-0-0</td>
<td>4</td>
<td>80 20 100</td>
</tr>
<tr>
<td>2</td>
<td>ENV-302</td>
<td>Remote Sensing and Geographical Information</td>
<td>PC</td>
<td>4-0-0</td>
<td>4</td>
<td>80 20 100</td>
</tr>
<tr>
<td>3</td>
<td>ENV-303</td>
<td>Elementary concept of Physical Environment</td>
<td>PC</td>
<td>4-0-0</td>
<td>4</td>
<td>80 20 100</td>
</tr>
<tr>
<td>4</td>
<td>ENV-304</td>
<td>Environment Impact Assessment</td>
<td>PC</td>
<td>4-0-0</td>
<td>4</td>
<td>80 20 100</td>
</tr>
<tr>
<td>5</td>
<td>ENB-302</td>
<td>Fermentation &amp; Downstream Processing</td>
<td>PE</td>
<td>4-0-0</td>
<td>4</td>
<td>80 20 100</td>
</tr>
<tr>
<td>6</td>
<td>ENB-301</td>
<td>Tissue culture &amp; Transgenics</td>
<td>PE</td>
<td>4-0-0</td>
<td>4</td>
<td>80 20 100</td>
</tr>
<tr>
<td>7</td>
<td>ENV-306</td>
<td>Lab Course-III</td>
<td>PC</td>
<td>0-0-20</td>
<td>10</td>
<td>150</td>
</tr>
<tr>
<td>8</td>
<td>ENV-307</td>
<td>Summer Training Report</td>
<td>PC</td>
<td>0-0-0</td>
<td>01</td>
<td>50</td>
</tr>
</tbody>
</table>

Total Credits: 31
Total Marks: 700

## SEMESTER-4

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course No.</th>
<th>Nomenclature of Paper</th>
<th>Type</th>
<th>L-T-P</th>
<th>Credits</th>
<th>Evaluation Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Theory IA Total</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>marks</td>
</tr>
<tr>
<td>1</td>
<td>ENV-401</td>
<td>Environmental Laws</td>
<td>PC</td>
<td>4-0-0</td>
<td>4</td>
<td>80 20 100</td>
</tr>
<tr>
<td>2</td>
<td>ENV-402</td>
<td>IPR and Biosafety</td>
<td>PC</td>
<td>4-0-0</td>
<td>4</td>
<td>80 20 100</td>
</tr>
<tr>
<td>3</td>
<td>ENV-403</td>
<td>Environmental Management &amp; Planning</td>
<td>PC</td>
<td>4-0-0</td>
<td>4</td>
<td>80 20 100</td>
</tr>
<tr>
<td>6</td>
<td>ENV-404</td>
<td>Dissertation</td>
<td>PC</td>
<td>0-0-48</td>
<td>24</td>
<td>300</td>
</tr>
</tbody>
</table>

Total Credits: 36
Total Marks: 600
Grand Total Marks: 2700
Grand Total Credits: 129
• The candidate shall be required to undergo Summer Training (4-5 weeks) at the end of II\textsuperscript{nd} semester. She/he will be required to submit a comprehensive report before the commencement of the III\textsuperscript{rd} next semester examination. The evaluation of the training report will be based on the Seminar/Presentation on the Training Report to be presented by each candidate in the department.

• In First semester, student has the option to take one Programme elective out of ENB-101/ ENV-105/ENB-104

• In Second semester, student has the option to take one Programme elective out of ENV-207/ ENV-209/ ENV-208.

• In Third semester, student has the option to take one Programme elective out of ENB-301/ ENB-302.

• Student would deliver a seminar on topic from course work in detail during First semester as well as in second semester. Evaluation of the seminar would be done by the faculty members at the time of presentation.

**M.Sc. Dissertation Rules (From session 2013-14)**

The dissertation is to be innovative work based on small piece of research with duration allots in 3\textsuperscript{rd} semester. The allotment/distribution of students to be done at departmental level. Scheme of Chapters of dissertation is as follows-

Acknowledgement

Certificate by Supervisor

(i) Introduction with objectives.

(ii) Review of Literature (Brief)

(iii) Materials & methods

(iv) Results

(v) Discussion

(vi) Summary

(vii) Bibliography

Pattern of References/Typing/ Figures as per Ph.D. Thesis. Last date of submission will usually be 30th June. The evaluation of dissertation will be done by external examiner (Approved by the VC From panel approved by PGBOS) and internal examiner (Guide). Final marks will be mean of Internal + External.
The written part of Dissertation report shall account for 250 of marks and the viva-
voce will be conducted by a duly constituted Board of Examiners for the remaining
50 of marks. Dissertation report will be evaluated on the basis of below given criteria:

Performance Evaluation Parameter Score
Writing Quality
Novelty/Scientific Significance of Aim
Project Design
Publication Potential
Aim-RESULTS Concurrence

No. of copies of Dissertation will be- One copy for Deptt. Record, One copy for
Guide record, one copy for candidate and Soft copy to library. Any Patent/IPR based
on Dissertation will be in the name of MDU student & Guide as inventor. Publication
based on Dissertation will be under control of Guide.
Department of Environmental Sciences

2013-2014

Syllabus
M.Sc. Environmental Sciences
(2 Year Program)
Choice Based Credit System (CBCS)

Maharshi Dayanand University
Rohtak 124001

M.Sc. Environmental Science
Semester-I

ENV - 101 Environmental Toxicology

Max. Marks : 80
Time : 3 Hours.

Note
1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus and compulsory. The remaining eight questions will be set with two questions from each unit. Candidate will be required to attempt five questions in all, selecting one question from each unit. Question No. 1 is compulsory. All question carry equal marks.

Unit - I
Toxic chemicals in the environment - air, water & their effects. Pesticides in water. Biochemicals aspects of arsenic, cadmium, lead mercury, carbon monoxide, ozone and PAN pesticide.

Unit - 2
Mode of entry of toxic substance, biotransformation of xenobiotics detoxification. Carcinogens in air, chemical carcinogenicity, mechanism of carcinogenicity. Environmental carcinogenicity testing.

Unit - 3
Insecticides, MIC effects. Concept of major, trace and Rare Earth Element (REE)-possible effects of imbalance of some trace elements.

Unit - 4
Biogeochemical factors in environmental health. Epidemiological issues goiter, fluorosis, arsenic poisoning.

References :
1. Environmental chemistry - Sodhi
2. Principals of Environmental chemistry - Manhan
3. Environmental hazards & human health R.B. Philip
4. Toxicology - principles & applications - Niesink & Jon devries
5. Parasitology - Chatterjee
6. Preventive & Social medicines – Perk

M.Sc. Environmental Science

2013-2014
Semester-I

ENV - 102 Environmental Biology

Max. Marks : 80
Time : 3 Hours.

Note
1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus and compulsory. The remaining eight questions will be set with two questions from each unit. Candidate will be required to attempt five questions in all, selecting one question from each unit. Question No. 1 is compulsory. All question carry equal marks.

UNIT - I
Definition, principles and scope of ecology, human ecology and human settlements, evolution, origin of life and specification, Ecosystem stability-cybernatics and ecosystem regulation, evolution of biosphere

UNIT - II
Eco system structure and functions, abiotic and biotic component. Energy flow, food chain, food web, Ecological Pyramids-types, biogeochemical cycles, ecological succession, Ecads and ecotypes.

UNIT - III
Population ecology- density, natality, mortality, survivorship curves, age distribution, growth curves and models .r & k selection, population interactions- Mutualism, Parasitism, Predator- Prey relations, System Theory and Ecological Model.

UNIT - IV
Earths major ecosystem - terrestrial and aquatic ecosystem, soil microorganism and their functions, coastal management, criteria employed for disposal of pollutants in marine ecosystem, coastal water system and man-made reservoirs, Biology and ecology of reservoirs.

References
1. Basic ecology - E. P. Odum
2. Ecology and field biology - R.L. Smith
3. Ecology - P.D. Sharma
4. Fundamentals of ecology - E.P. Odum
5. Principles of ecology – Rickleff

M.Sc. Environmental Science

2013-2014
Semester-I

ENV - 103 Analytical Techniques

Max. Marks : 80
Time : 3 Hours.

Note
1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus and compulsory. The remaining eight questions will be set with two questions from each unit. Candidate will be required to attempt five questions in all, selecting one question from each unit. Question No. 1 is compulsory. All question carry equal marks.

Unit - I
Principles and application of Spectrophotometry (UV-Visible spectrophotometry), Titrimetry, Gravimetry, Colourimetry, NMR, ESR, Microscopy-phase, light and fluorescence microscopes, Scanning and Transmission electron microscopes.

Unit - 2
Chromatographic techniques (Paper chromatography, thin layer chromatography, Column chromatography), Atomic absorption spectrophotometry, cytophotometry and flow cytometry, Fixation and staining, Principles and techniques of nucleic acid hybridization and Cot curves, Principle of biophysical method used for analysis of biopolymer structure, Hydrodynamics methods, Plasma emission spectorocopy.

Unit - 3

Unit - 4
Methods for measuring nucleic acid and protein interactions, DNA finger printing Molecular markers RFLP, AFLP, RAPD, Sequencing of proteins and nucleic acids, southern, northern, western blotting techniques, PCR polymerase chain reaction.

References :
2. Analytical Techniques - S.K. Sahani
ENV - 104 Environmental Pollution

Note
1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus and compulsory. The remaining eight questions will be set with two questions from each unit. Candidate will be required to attempt five questions in all, selecting one question from each unit. Question No. 1 is compulsory. All question carry equal marks.

UNIT - I
Air pollution- natural and anthropogenic sources of pollution, primary and secondary pollutants, transport and diffusion of pollutants, gas laws governing the behavior of pollutants in the atmosphere. Methods of monitoring and control of air pollution, SO2, NOx, CO, SPM.

UNIT - II
Water pollution - types sources and consequences of water pollution, physico chemical and bacteriological sampling. Analysis of water quality, standards, sewage and wastewater treatment and recycling, water quality and standards.

UNIT - III
Soil pollution chemical and bacteriological sampling as analysis of soil quality, soil pollution control, industrial waste effluents and heavy metals and their interactions with soil components.

UNIT - IV

References
1. Air pollution and control - K.V.S.G. Murlikrishan
2. Industrial noise control - Bell & Bell
3. Environmental engineering -Peary
4. Introduction to environmental engineering and science
   - Gilbert Masters.
M.Sc. Environmental Science

Semester-IV

ENV -105 Solid Waste Management

Max. Marks : 80
Time : 3 Hours.

Note
1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus and compulsory. The remaining eight questions will be set with two questions from each unit. Candidate will be required to attempt five questions in all, selecting one question from each unit. Question No. 1 is compulsory. All question carry equal marks.

Unit - 1

Unit - 2

Unit - 3

Unit- 4
Disaster Management. Fly ash generation & utilization, Primary, secondary & tertiary & advance treatment of various effluents.

References :
1. Solid Waste Management CPCB. New Delhi.
2. Ecotechnology for pollution control & environmental management - By R.K. Trivedi & Arvind Kr.
3. Basic Environmental Technology - J.A. Nathanson
M.Sc. Environmental Science  
Semester-I  

ENB- 101 Biochemistry  

M.M. : 80  
Time : 3 Hrs.  

Note  
1. Nine questions will be set in all.  
2. Question No. 1 will be objective covering the entire syllabus and compulsory. The 
remaining eight questions will be set with two questions from each unit. Candidate will 
be required to attempt five questions in all, selecting one question from each unit. 
Question No. 1 is compulsory. All question carry equal marks.  

Unit - I  
Organization of Biomolecules, Concept of pH, pK, acids, bases, buffers; Principle and 
biological application of diffusion osmosis, viscosity and Donnan membrane equilibrium. 
Carbohydrates-Structure and classification of carbohydrates, Metabolism of 
carbohydrates.  

Unit – II  
Amino acids & Proteins: Structure and properties of amino acids, Types of proteins and 
their classification. Different levels of structural organization of proteins. Amino acid 
metabolism, Urea cycle. Nitrogen cycle.  

Unit - III  
Lipids- Structure and functions, Classification of lipids and their biological significance. 
Essential fatty acids. Hydrolysis of fats, Saponification value, Rancidity of fats, Iodine 
number and Acid value.  
Nucleic Acids- Structure and properties. Nucleosides and nucleotides. Biologically 
important nucleotides. Catabolism, de novo-biosynthesis of purine and pyrimidine 
nucleotides. Formation of deoxyribonucleotides.  

Unit – IV  
Photosynthesis: Light absorption and energy conversion; Calvin cycle; Hatch-Slack 
Pathway; Photorespiration. Mitochondrial oxidative phosphorylation: Mitochondrial 
electron transport chain.  

References  

2013-2014
M.Sc. Environmental Science  
Semester-I

ENB–102 Cell and Molecular Biology

M.M. : 80  
Time : 3 Hrs.

Note
1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus and compulsory. The remaining eight questions will be set with two questions from each unit. Candidate will be required to attempt five questions in all, selecting one question from each unit. Question No. 1 is compulsory. All question carry equal marks.

Unit I

Unit II
Organization of bacterial genome. Structure of eukaryotic chromosomes, DNA/RNA as the genetic material, Mitochondria and chloroplast DNA, DNA reassociation kinetics(Cot curve analysis); Repetitive and unique sequences. DNA Replication in prokaryotes and eukaryotes. DNA repair mechanisms, Recombination: Homologous and non-homologous; Site specific recombination, Transposons.

Unit III

Unit IV

References
M.Sc. Environmental Science
Semester-II

ENV – 201 Natural Resources

Max. Marks : 80
Time : 3 Hours.

Note
1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus and compulsory. The remaining eight questions will be set with two questions from each unit. Candidate will be required to attempt five questions in all, selecting one question from each unit. Question No. 1 is compulsory. All question carry equal marks.

UNIT - I
Sun as a source of energy, solar radiations and its spectral characteristics fossil fuels- classification, composition, physico- chemical characteristics and energy content of coal, petroleum and Natural gas.

UNIT - II
Principles of generation of hydroelectric power, tidal power, thermal energy conversion, wind, geo thermal energy, solar collectors, photovoltaic, solar ponds, oceans.

UNIT - III
Nuclear energy- fission and fusion, bio energy -energy from biomass and biogas, anaerobic digestion, energy use patterns in different parts of the world. Impacts of large scale exploitation of solar, wind, hydro ad ocean energy.

UNIT - IV
Mineral resources and reserves, ocean ore and recycling of resources, Environmental impact of exploitation, processing and smelting of Mineral, oceans as need areas for exploitation of Mineral resources.

References
1. Living in the environmental - T.J. Miller.
3. Encyclopedia Energy - I & II.
M.Sc. Environmental Science  
Semester-II  

ENV - 202 Biodiversity  

Max. Marks : 80  
Time : 3 Hours.  

Note  
1. Nine questions will be set in all.  
2. Question No. 1 will be objective covering the entire syllabus and compulsory. The remaining eight questions will be set with two questions from each unit. Candidate will be required to attempt five questions in all, selecting one question from each unit. Question No. 1 is compulsory. All question carry equal marks.  

Unit - I  
Biodiversity - definition, hot spots of Biodiversity, strategies for Biodiversity Conservation, National Parks, Sanctuaries and Biosphere reserves, gene pool.  

Unit - 2  
Aquatic common flora and fauna in India - phytoplankton, zooplankton and macrophytes terrestrial common flora and fauna in India - forests, endangered and threatened species.  

Unit - 3  
Strategies for Biodiversity Conservation, cryopreservation, gene banks, tissue culture and artificial seed technology new seed development policy 1988, conservation of medicinal plants.  

Unit- 4  
International conventions, treaties and protocols for Biodiversity Conservation Biodiversity in the welfare of mankind, Species concept, Biological nomenclature theories of biological classification.  

References :  
1. Global Biodiversity - W.R. L.IUCN  
2. Ecology of natural resource - Ramade  
3. Ecology - P.D. Sharma
M.Sc. Environmental Science
Semester-II

ENV - 203 Resource and Disaster Management

M.M. : 80
Time : 3 Hrs.

Note
1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus and compulsory. The remaining eight questions will be set with two questions from each unit. Candidate will be required to attempt five questions in all, selecting one question from each unit. Question No. 1 is compulsory. All question carry equal marks.

Unit - 1
Resource management meaning & concept, management of rangelands & watersheds, management of Agricultural system

Unit - 2
Management of waste resources, Management of forests, effects of deforestation. Management of fresh water ecosystem conservation strategies for non-renewable energy resources

Unit - 3
Wildlife Management & conservation efforts for threatened species, Water Management Ganga Action Plan, Yamuna Action Plan, Environmental priorities in India

Unit - 4
Natural Disaster management: Nature, cause, effects and management of cyclone, flood, earth quake, drought, disease, fire and volcanism, forecasting and warning system of disaster. Pre disaster planning-Toning of disaster - prone areas-prioritization - regulation-protection measure during disaster-Post disaster.

References:

1. Natural resources conservation - Oliver Ss. Owen.
2. Living of environment - T.J. Miller
3. Ecology of Natural resources - Ramade
4. Environmental Science- Cunningham Saigo
5. Restoration of degraded lands- J.S. Singh
Note
1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus and compulsory. The remaining eight questions will be set with two questions from each unit. Candidate will be required to attempt five questions in all, selecting one question from each unit. Question No. 1 is compulsory. All question carry equal marks.

UNIT - I
Measurement of central tendency - mean (Geometric and Harmonic), median, mode, Measurement of dispersion moments, standard deviation, skewness and kurtosis. Correlation and linear regression of one independent variable, Basic laws and concepts of probability

UNIT - II
Definition of random variable, density function, Basic concepts of binomial and normal distributions. Sampling measurement and distribution of attributes. Moments, matrices and simultaneous linear equations, tests of hypothesis and significance.

UNIT - III

UNIT - IV
Models of population growth and interactions Lotka Volterra model, Leslies matrix model, Point source stream pollution, Box model, Gaussian plume model, Linear, simple and multiple regression models, validation and forecasting.

References
1. Dynamics of Environmental Bioprocesses-Modelling and simulation-Snape and Dunn.
2. Environmental Modeling - Jorgensen
M.Sc. Environmental Science  
Semester-II

ENV - 207 Environmental microbiology

Max. Marks : 80  
Time : 3 Hours.

Note
1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus and compulsory. The remaining eight questions will be set with two questions from each unit. Candidate will be required to attempt five questions in all, selecting one question from each unit. Question No. 1 is compulsory. All question carry equal marks.

Unit - I
Microbiology- organisms in nature & their importance, sampling, culture & cultivation of microorganisms, microbes in service of nature & mankind. Batch culture & continuous culture of microbes for commercial use.

Unit - 2
Microbial Reactors, genetically modified microbes & their uses in Environmental management recycling & up gradation technologies. Production of products, energy form waste.

Unit - 3
Biogas technology, plant design, construction, operation, biogas form organic wastes, water weeds, land fills, microbiology of anaerobic fermentation

Unit- 4
Biotransformation, bioconversion, bioremediation, phytoremediation technology fermentation technology, development of stress tolerant plants, Environmental problems & Environmental monitoring through microorganism, microbiology of water, air and soil, microbes as pathological agent in plant, animal and man.

References :
Principles of microbiology - Pelzar  
Microbial bio technology - A.N. Glazer  
Microbial ecology - R.M. Atlas  
Molecular biology - H.D. Kumar  
Environmental bio Technology - Sayler & Fox
M.Sc. Environmental Sciences
Semester-II

ENV- 208 Waste Water Treatment Technology

M.M. : 80
Time : 3 Hrs.

Note
1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus and compulsory. The remaining eight questions will be set with two questions from each unit. Candidate will be required to attempt five questions in all, selecting one question from each unit. Question No. 1 is compulsory. All question carry equal marks.

UNIT - I
Overview of standards of water quality in relation to public health - Potable and nonpotable water; Methods of water sampling for pollution analysis. Principal forms of Water Pollutants and their sources; Pollution of stream, lakes and phenomenon of eutrophication; Ocean pollution –oil pollution; Ground water pollution and its control; Water pollution prevention.

Unit II
Methods of monitoring Pollution; Biological methods; Detection methods for DO, BOD, Pathogen monitoring by heterotrophic plate count; Multiple tube method; Membrane filtration methods; Other emerging techniques such as enzyme detection, hybridization, PCR, Gene probe technology etc.; Strategies for controlling pathogen transfer; Chemical methods- Detection methods for COD, pH, alkalinity, TSS, TDS, Total organic carbon, oil, grease etc.; Biosensors for pollution.

Unit III
Sewage and waste water treatments systems, Primary, secondary and tertiary treatments, Biological treatments - aerobic versus anaerobic treatments; Environmental pollution control- Bioremediation, Bioaugmentation and Biostimulation; Biofilms in treatment of waste water; Bioreactors for waste water treatments.

Unit IV
Physicochemical characteristics and treatment strategies for effluent generated by Distillery and fermentation industry; Fertilizers and pesticide manufacturing industries; Dyes and textile industries; Paper and pulp industries; Tanneries; Pharmaceuticals; Thermal power plants; Food and dairy industries; Iron and steel industries; Organic solvents; Chlorinated minerals and inorganic chemical industries and petrochemicals.

References
2. Frederick W Pontinus, Water Quality and Treatment. American water works Association, MC
M.Sc. Environmental Science  
Semester-II  
ENV – 209 Environmental Geology  

Max. Marks : 80  
Time : 3 Hours.

Note  
1. Nine questions will be set in all.  
2. Question No. 1 will be objective covering the entire syllabus and compulsory. The remaining eight questions will be set with two questions from each unit. Candidate will be required to attempt five questions in all, selecting one question from each unit. Question No. 1 is compulsory. All question carry equal marks.

UNIT - I  
Earth processes, Geological cycle, Tectonic cycle, Rock cycle, Hydrological cycle, Biogeochemical cycles, Special problems of time and scale in geology, concept of residence time and rates of natural cycles.

UNIT - II  
Catastrophic geological hazards, Prediction and perception of the hazards and adjustment to hazardous activities.

UNIT - III  

UNIT - IV  
Mineral and human use, geology of mineral resources, EIA of mineral development, recycling of mineral resources.

References  
1. Environmental geology- Edward A. Keller  
2. Physical geology - C.W. Montgomery.  
M.Sc. Environmental Science  
Semester-III  

ENV - 301 Environmental Chemistry  
Max. Marks : 80  
Time : 3 Hours.

Note  
1. Nine questions will be set in all.  
2. Question No. 1 will be objective covering the entire syllabus and compulsory. The remaining eight questions will be set with two questions from each unit. Candidate will be required to attempt five questions in all, selecting one question from each unit. Question No. 1 is compulsory. All question carry equal marks.

UNIT - I  
Stochiometry, Gibb’s energy, Chemical potential, Chemical equilibria, acid-base reactions. Solubility product, solubility of gases in water, the carbonate system, unsaturated and saturated hydrocarbons, Radio nuclides.

UNIT - II  
Classification of elements, chemical speciation, Particles, ions and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matter. Thermochemical and photochemical reactions in the atmosphere.

UNIT - III  
First law of thermodynamics, enthalphy, adiabatic transformations, second law of thermodynamics, Carnot’s cycle, entropy, Gibb’s free energy, chemical potential, phase equilibria, Gibb’s Donnan equilibrium, third law of thermodynamics, enzymes catalysis, Michaelis/ Menten equation.

UNIT - IV  

References  
1. Environmental Chemistry - G.S. Sodhi  
2. Environmental Chemistry - Mannhan  
3. Fundamentals of soil science - Henry D. Futh  
5. Environmental Chemistry - Sharma and Kaur
M.Sc Environmental Science  
Semester – III  

ENV – 302 Remote sensing and Geographical Information  

M.M. : 80  
Time : 3 Hrs.  

Note  
1. Nine questions will be set in all.  
2. Question No. 1 will be objective covering the entire syllabus and compulsory. The remaining eight questions will be set with two questions from each unit. Candidate will be required to attempt five questions in all, selecting one question from each unit. Question No. 1 is compulsory. All question carry equal marks.  

Unit - I  
Definition, Introduction and scope of remote sensing. Electromagnetic radiation, atmosphere window, Platforms, Sensors and type of scanning systems. Basic characteristics of sensors; salient features of sensors used in LANDSAT, SPOT and Indian remote sensing satellites.  

Unit - 2  

Unit - 3  

Unit- 4  
GIS technology and its uses in environmental science, Hardware and software requirement for GIS. Conceptual model of spatial information, Conceptual model of non spatial information. GPS.  

References :  
1. Introduction to Environmental remote sensing - Curtis  
3. Remote sensing of the Environment – Jenson  

2013-2014
M.Sc. Environmental Science
Semester-III

ENV - 303 Elementary Concept of Physical Environment

Max. Marks : 80
Time : 3 Hours.

Note
1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus and compulsory. The remaining eight questions will be set with two questions from each unit. Candidate will be required to attempt five questions in all, selecting one question from each unit. Question No. 1 is compulsory. All question carry equal marks.

UNIT - I

UNIT - II

UNIT - III
Primary differentiation and formation of core, mantle and crust. Igneous, sedimentary and metamorphic rocks, weathering, erosion, transportation and deposition of earth’s material by running water, wind and glaciers.

UNIT - IV
Mass and energy transfer across the various interphases, Material Balance Heat Transfer processes, scales of Meteorology, various kinds of lapse rates, vertical stability of atmosphere, cloud classification & formation.

References
1. Ecology - P.D. Sharma
2. Concepts of physical environment- Savinder Singh
3. The Atmosphere- an Introduction- F.K. Lutagens
M.Sc Environmental Science  
Semester – III

ENV – 304 Environmental Impact Assessment

M.M. : 80  
Time : 3 Hrs.

Note
1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus and compulsory. The remaining eight questions will be set with two questions from each unit. Candidate will be required to attempt five questions in all, selecting one question from each unit. Question No. 1 is compulsory. All question carry equal marks.

Unit - 1
Introduction to environment impact analysis, Environmental impact statement and Environmental management plan, ISO14000, EIA guidelines 1994, Notification of Govt. of India.

Unit - 2

Unit - 3
Guidelines for Environmental Audit, Baseline information and prediction (land, water, atmosphere, energy), Restoration and rehabilitation technologies.

Unit- 4

References:
4. Chemical principles of Environmental pollution - Lalloway and Ayers.
5. Industrial Environment - Assessment and strategy - S.K.Aggarwal
M.Sc. Environmental Science
Semester-III

ENB – 301 Tissue Culture and Transgenics

M.M. : 80
Time : 3 Hrs.

Note
1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus and compulsory. The remaining eight questions will be set with two questions from each unit. Candidate will be required to attempt five questions in all, selecting one question from each unit. Question No. 1 is compulsory. All question carry equal marks.

Unit- I

Plant Tissue Culture: Totipotency; Tissue culture media; Direct and indirect organogenesis; Direct and indirect embryogenesis; Cell suspension culture; Micropropagation – shoot tip culture, somatic embryos, artificial seeds; Applications of tissue culture; Embryo culture; Anther culture and dihaploids, Protoplast isolation and fusion, somatic hybridization, Somaclonal variations.

Unit- II

Animal Tissue Culture: Basic techniques of animal cell culture & their applications. Balanced salt solutions and simple growth media. Serum quality and cell culture. Preservation and maintenance of animal cell lines: Cryopreservation and transport of animal germplasm (i.e. semen, ovum and embryos).

Unit- III

Transgenic animals Methodology: Retroviral vector method, DNA microinjection method and engineered embryonic stem cell method. Cloning by nuclear transfer. Yeast artificial chromosome transgenesis. In Vitro fertilization and embryo transfer technology.

Unit- IV

Gene transfer in plants: Direct transformation of protoplasts; Transformation by particle bombardment; Agrobacterium mediated transformations, Ti and Ri plasmids, T-DNA genes, mechanism of T-DNA transfer; Transgene silencing.


References:
M.Sc. Environmental Science
Semester-III

ENB - 302 Fermentation and Down-stream Processing

M.M. : 80
Time : 3 Hrs.

Note
1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus and compulsory. The remaining eight questions will be set with two questions from each unit. Candidate will be required to attempt five questions in all, selecting one question from each unit. Question No. 1 is compulsory. All question carry equal marks.

Unit-I
Fermentations: Aerobic and anaerobic, Shake flask, batch and continuous operations. Solid state fermentations. Types of reactor: Batch, plug flow reactor (PFR), continuous stirred tank reactor (CSTR), Fluidized bed reactor, bubble column, air lift fermenter, Packed bed with immobilized enzymes or microbial cells, Trickling filter.

Unit-II

Unit-III
Down-stream Processing: Scope of downstream processing in biotechnology, problems, requirement of purification. Overview of a bioprocess including upstream and downstream processing. Characteristics of biotechnology products, classes of byproducts, physicochemical basis of bioseparation.

Unit-IV
Separation of particulate by filtration, centrifugation, settling, sedimentation, decanting and micro filtration. Primary isolation methods including solvent extraction, sorption, precipitation, ultra filtration, reverse osmosis, super critical fluid extraction, evaporation, super liquid extraction and foam based separation.

Purification methods: Fractional precipitation, electrophoresis, electro dialysis and various kinds of chromatography.

References:


2013-2014
M.Sc. Environmental Science  
Semester-IV  

ENV - 401 Environmental Laws  

Max. Marks : 80  
Time : 3 Hours.

Note  
1. Nine questions will be set in all.  
2. Question No. 1 will be objective covering the entire syllabus and compulsory. The remaining eight questions will be set with two questions from each unit. Candidate will be required to attempt five questions in all, selecting one question from each unit. Question No. 1 is compulsory. All question carry equal marks.

UNIT - I  

UNIT – II  

UNIT - III  

UNIT – IV  
The water (prevention & control of pollution) Act, 1974 as amended by amendment 1978 & rules 1975. Environment protection issues & problems, international & national efforts for environment protection,
M.Sc. Environmental Science
Semester-IV

ENV – 402 IPR and Biosafety

M.M. : 80
Time : 3 Hrs.

Note
1. Nine questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus and compulsory. The remaining eight questions will be set with two questions from each unit. Candidate will be required to attempt five questions in all, selecting one question from each unit. Question No. 1 is compulsory. All question carry equal marks.

Unit I
Introduction to Intellectual Property  Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of GMOs.

Unit II
Agreements and Treaties: GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments

Unit III
Patent filing procedures
National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Precautions while patenting – disclosure/non-disclosure; Financial assistance for patenting, Patent licensing and agreement, Patent infringement.

Unit IV
Biosafety
Introduction to Biological Safety Cabinets; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines - Government of India; Environmental release of GMOs; Overview of National Regulations and relevant International Agreements including Cartegana Protocol.

References
M.Sc. Environmental Science  
Semester-IV

ENV - 403 Environmental Management and Planning  
Max. Marks : 80  
Time : 3 Hours.

Note  
1. Nine questions will be set in all.  
2. Question No. 1 will be objective covering the entire syllabus and compulsory. The remaining eight questions will be set with two questions from each unit. Candidate will be required to attempt five questions in all, selecting one question from each unit. Question No. 1 is compulsory. All question carry equal marks.

UNIT - I  
Role of NGO’s public participation in environmental movements, Concepts of Environmental education and awareness Internationals environmental initiatives - the club of Rome report, Stockholm Declaration, environmental ethics.

UNIT - II  

UNIT - III  
Basic concepts of environmental planning, Environmental priorities in India, Land use planning : The land use plan (India). Soil surveys in relation to land use planning. Methods of site selection and evaluation, soil erosion, Formation and reclamation of Usar, alkaline and saline soil, waste lands and their reclamation, Desertification and its control.

UNIT - IV  

References  
1. Natural Resource Conservation Owen and Chiras.  
2. Environmental planning, policies and programs in India - K.D. Saxena.  