

**GANDHI INSTITUTE OF TECHNOLOGY AND
MANAGEMENT (GITAM)**
(Deemed to be University, Estd. u/s 3 of UGC Act 1956)
VISAKHAPATNAM *HYDERABAD *BENGALURU
Accredited by NAAC with 'A' Grade



REGULATIONS & SYLLABUS
of
Master of Science
in
(Environmental Science)
(W.e.f 2015-16 admitted batch)

Website: www.gitam.edu

M.Sc. (Environmental Science)
REGULATIONS
(W.e.f. 2015-16 admitted batch)

1. ADMISSION

1.1 Admission into M.Sc. in Environmental Science program of GITAM University is governed by GITAM University admission regulations.

2. ELIGIBILITY CRITERIA

2.1. A pass in B.E.M or any B.Sc. degree or equivalent. First preference is for B.E.M students. The remaining seats if any will be filled with B.Sc students as follows: 50% of seats are allotted for life science and remaining for Physical sciences / B.Tech/B/Pharm students.

2.2. Admission into M.Sc. (Environmental Science) will be based on an All India GITAM Science Admission Test (GSAT) conducted by GITAM University and the rule of reservation, wherever applicable.

3. CHOICE BASED CREDIT SYSTEM

Choice Based Credit System (CBCS) is introduced with effect from the admitted Batch of 2015-16 based on UGC guidelines in order to promote:

- Student Centered Learning
- Cafeteria approach
- Inter-disciplinary learning

Learning goals/ objectives and outcomes are specified leading to what a student should be able to do at the end of the program.

4. STRUCTURE OF THE PROGRAM:

4.1 The Program Consists of

- i) Foundation Courses (compulsory) which give general exposure to a Student in communication and subject related area.
- ii) Core Courses (compulsory).
- iii) Discipline centric electives which
 - a) are supportive to the discipline
 - b) give expanded scope of the subject
 - c) give inter disciplinary exposure
 - d) Nurture the student skills
- iv) Open electives are of general nature either related or unrelated to the discipline.
- v) Practical Proficiency Courses: Laboratory and Project work.

4.2 Each course is assigned a certain number of credits depending upon the number of contact hours (lectures/tutorials/practical) per week.

4.3 In general, credits are assigned to the courses based on the following contact hours per week per semester.

- One credit for each Lecture / Tutorial hour per week.
- One credit for two hours of Practicals per week.
- Two credits for three (or more) hours of Practicals per week

4.4 The curriculum of the four semesters M.Sc. program is designed to have a total of 82 credits for the award of M.Sc degree.

5. MEDIUM OF INSTRUCTION

The medium of instruction (including examinations and project reports) shall be English.

6. REGISTRATION

Every student has to register himself/herself for each semester individually at the time specified by the Institute / University.

7. ATTENDANCE REQUIREMENTS

7.1 A student whose attendance is less than 75% in all the courses put together in any semester will not be permitted to attend the end - semester examination and he/she will not be allowed to register for subsequent semester of study. He/she has to repeat the semester along with his / her juniors.

7.2 However, the Vice Chancellor on the recommendation of the Principal / Director of the Institute/School may condone the shortage of attendance to the students whose attendance is between 66% and 74% on genuine grounds and on payment of prescribed fee.

8. EVALUATION

8.1 The assessment of the student's performance in a Theory course shall be based on two components: Continuous Evaluation (40 marks) and Semester-end examination (60 marks).

8.2 A student has to secure an aggregate of 40% in the course in the two components put together to be declared to have passed the course, subject to the condition that the candidate must have secured a minimum of 24 marks (i.e. 40%) in the theory component at the semester-end examination.

8.3 Practical/ Viva voce/ Seminar etc. course are completely assessed under Continuous Evaluation for a maximum of 100 marks, and a student has to obtain a minimum of 40% to secure Pass Grade. Details of Assessment Procedure are furnished below in Table 2.

Table 2: Assessment Procedure

S. No.	Component of assessment	Marks allotted	Type of Assessment	Scheme of Examination
1	Theory	40	Continuous evaluation	(i) Two mid semester examinations shall be conducted for 15 marks each. (ii) 5 marks are allocated for quiz. (iii) 5marks are allocated for assignments.
		60	Semester-end examination	The semester-end examination Shall be for a maximum of 60 marks.
	Total	100		
2	Practicals	40	Continuous evaluation	Forty (40) marks for continuous evaluation is distributed among the components: regularity, preparation for the practical, performance, submission of records and oral presentations in the laboratory. Weightage for each component shall be announced at the beginning of the Semester.
		60	Continuous evaluation	Sixty (60) marks for two tests of 30 marks each (one at the mid-term and the other towards the end of the Semester) conducted by the concerned lab Teacher and another faculty member of the department who is not connected to the lab, as appointed by the HoD.
	Total	100		
3	Project work (IV semester)	200	Project evaluation	(i) 150 marks for evaluation of the project work dissertation submitted by the candidate. (ii) 50 marks are allocated for the project Viva-Voce. (iii) The project work evaluation and the Viva-Voce shall be conducted by one external examiner outside the University and the internal project work supervisor.

9. REAPPEARANCE

9.1 A student who has secured „F□ grade in a Theory course shall have to reappear at the subsequent semester end examinations held for that course.

9.1.1 A student who has secured „F□ grade in a Practical course shall have to attend Special Instruction Classes held during summer.

9.1.2.A student who has secured „F□ Grade in Project work / Industrial Training etc shall have to improve his/her report and reappear for Viva – voce at the time of Special Examination to be conducted in the summer vacation.

10. SPECIAL EXAMINATION

A student who has completed his/her period of study and still has “F” grade in a maximum of three Theory courses is eligible to appear for Special Examination normally held during summer vacation.

11. BETTERMENT OF GRADES

A student who has secured only a Pass or Second class and desires to improve his/her Class can appear for Betterment Examinations only in Theory courses of any Semester of his/her choice, conducted in Summer Vacation along with the Special Examinations. Betterment of Grades is permitted „only once“ immediately after completion of the program of study.

12. GRADING SYSTEM

12.1 Based on the student performance during a given semester/trimester, a final letter grade will be awarded at the end of the trimester/semester in each course. The letter grades and the corresponding grade points are as given in Table 3.

Table 3: Grades & Grade Points

Sl.No.	Grade	Grade Points	Absolute Marks
1	O (outstanding)	10	90 and above
2	A+ (Excellent)	9	80 to 89
3	A (Very Good)	8	70 to 79
4	B+ (Good)	7	60 to 69
5	B (Above Average)	6	50 to 59
6	C (Average)	5	45 to 49
7	P (Pass)	4	40 to 44
8	F (Fail)	0	Less than 40
9	Ab. (Absent)	0	-

12.2 A student who earns a minimum of 4 grade points (P grade) in a course is declared to have successfully completed the course, and is deemed to have earned the credits assigned to that course, subject to securing a GPA of 5 for a Pass in the semester/trimester.

13. GRADE POINT AVERAGE

13.1 A Grade Point Average (GPA) for the semester/trimester will be calculated according to the formula:

$$\text{GPA} = \frac{\sum [C \times G]}{\sum C}$$

Where

C = number of credits for the course,

G = grade points obtained by the student in the course.

13.2 To arrive at Cumulative Grade Point Average (CGPA), a similar formula is used considering the student's performance in all the courses taken, in all the semesters up to the particular point of time.

13.3 CGPA required for classification of class after the successful completion of the program is shown in Table 4.

Table 4: CGPA required for award of Class

Class	CGPA Required
First Class with Distinction	$\geq 8.0^*$
First Class	≥ 6.5
Second Class	≥ 5.5
Pass Class	≥ 5.0

* In addition to the required CGPA of 8.0 or more the student must have necessarily passed all the courses of every semester in first attempt.

14. ELIGIBILITY FOR AWARD OF THE M.Sc. DEGREE

14.1 Duration of the program: A student is ordinarily expected to complete M.Sc. program in four semesters of two years. However a student may complete the program in not more than four years including study period.

14.2 However the above regulation may be relaxed by the Vice Chancellor in individual cases for cogent and sufficient reasons.

14.3 A student shall be eligible for award of the M.Sc Degree if he / she fulfills all the following conditions.

- a) Registered and successfully completed all the courses and projects.
- b) Successfully acquired the minimum required credits as specified in the curriculum corresponding to the branch of his/her study within the stipulated time.
- c) Has no dues to the Institute, hostels, Libraries, NCC / NSS etc, and
- d) No disciplinary action is pending against him / her.

14.4 The degree shall be awarded after approval by the Academic Council

15. Discretionary Power:

Notwithstanding anything contained in the above sections, the Vice Chancellor may review all exceptional cases, and give his decision, which will be final and binding.

M.Sc (Environmental Science) – Scheme of Instruction

I SEMESTER

Course Code	Name of the Course	L	T	P	C	Scheme of Examination	
						Maximum Marks	
						Semester – End Examination	Continuous Evaluation
SES 701	Ecological Principles and Applications	3	1	0	3	60	40
SES 703	Environmental Microbiology	3	1	0	3	60	40
SES 705	Earth Science - System & its resources	3	1	0	3	60	40
SES 707	Environmental Chemistry and Instrumentation	3	1	0	3	60	40
SES 721	Ecological Principles and Applications Lab	0	0	3	2	60	40
SES 723	Environmental Microbiology Lab	0	0	3	2	60	40
SES 725	Earth Science - System & its resources Lab	0	0	3	2	60	40
SES 727	Environmental Chemistry Lab	0	0	3	2	60	40
Total					20	480	320
Grand Total						800	

II SEMESTER

Course Code	Name of the Course	L	T	P	C	Scheme of Examination	
						Maximum Marks	
						Semester – End Examination	Continuous Evaluation
SES 702	Air Pollution and Control	3	1	0	3	60	40
SES 704	Solid Waste Management & Soil Pollution	3	1	0	3	60	40
SES 706	Water and Wastewater Treatment	3	1	0	3	60	40
SES 708	Computer Programming	3	1	0	3	60	40
Generic Elective-I (Choose one)							
SES 742	Environmental Toxicology	3	1	0	3	60	40
SES 744	Noise and Radioactive Pollution						
SES 746	Energy and Green Technologies						
SES 748	Biodiversity & Wildlife Conservation						
SES 722	Air Pollution and Control Lab	0	0	3	2	60	40
SES 724	Solid Waste Management Lab	0	0	3	2	60	40
SES 726	Water and Wastewater Analysis Lab	0	0	3	2	60	40
SES 728	Computer Programming Lab	0	0	3	2	60	40
Total					23	540	360
Grand Total						900	

III SEMESTER

Course Code	Name of the Course	L	T	P	C	Scheme of Examination	
						Maximum Marks	
						Semester – End Examination	Continuous Evaluation
SES 801	Environmental Impact Assessment & Case studies	3	1	0	3	60	40
SES 803	Industrial Waste Management	3	1	0	3	60	40
SES 805	Industrial Safety & Disaster Management	3	1	0	3	60	40
Generic Elective-II (Choose one)							
SES 841	Remote sensing Techniques in Environmental Management	3	1	3	3	60	40
SES 843	Environmental Biotechnology & Nanotechnology						
SES 845	Environmental Planning and Sustainable Development						
SES 847	Hydrology and Watershed Management						
SES 821	Environmental Impact Assessment Lab	0	0	3	2	60	40
SES 823	Industrial Waste Management Lab	0	0	3	2	60	40
Generic Elective-II Lab (With respect to theory chosen)							
SES 881	Remote sensing Techniques in Environmental Management Lab	0	0	3	2	60	40
SES 883	Environmental Biotechnology Lab						
SES 885	Environmental Planning and Sustainable Development Lab						
SES 887	Hydrology and Watershed Management Lab						
SES 891	Seminar	4	0	0	2	100	-
Open Elective-I*		3	0	0	3	60	40
Total					23	580	320
Grand Total						900	

*Student can choose an open elective from list of open electives offered by the GITAM University

IV SEMESTER

Course Code	Name of the Course	L	T	P	C	Scheme of Examination	
						Maximum Marks	
						Semester – End Examination	Continuous Evaluation
Generic Elective-III (choose one)							
SES 842	Environmental Remediation technologies	3	1	0	3	60	40
SES 844	Public Health and Sanitation						
SES 846	Environmental Auditing						
SES 848	Environmental Modeling using MAT LAB						
Generic Elective-III Lab (With respect to theory chosen)							
SES 882	Environmental Remediation Technologies lab	0	0	3	2	60	40
SES 884	Public Health and Sanitation lab						
SES 886	Environmental Auditing lab						
SES 888	Environmental Modeling lab						
SES 892	Project & Viva-Voce	0	0	0	8	200	
Open Elective-II*		3	0	0	3	60	
Total					16	400	

*Student can choose an open elective from list of open electives offered by the GITAM University

L = Lecture hours

T= Tutorials

P= Practical

C = Credits

• Open Electives offered by Department of Environmental Studies

Paper Code	Course Title	L	C	Scheme of Examination	
				Maximum Marks	
				Semester – End Examination	Continuous Evaluation
Third Semester (Open Elective-I)					
SOE 855	Environmental Pollution, Monitoring and Control	3	3	60	40
SOE 857	Climate change and Current Issues				
SOE 859	Environmentally Sustainable Mining Methods				
Fourth Semester (Open Elective-II)					
SOE 844	Natural resources & Conservation	3	3	60	40
SOE 846	Industrial Safety				
SOE 848	Environment & Health				

Total Credits: 82

M.Sc (ES)-I SEMESTER

SES 701: ECOLOGICAL PRINCIPLES & APPLICATIONS

Hours per week: 4 (3+1)

End Examination: 60 Marks

Credits: 3

Sessionals: 40Marks

UNIT – I

Nature and scope of ecology - Concept of ecosystem: Structure -components of ecosystem, trophic levels, Ecological pyramids. Functional aspects, - Food Chain, Food Webs, Ecological energetics: energy flow and laws of thermodynamics - ecological efficiencies, productivity of ecosystem, Homeostasis.

UNIT – II

Biogeochemical cycles: carbon, nitrogen, phosphorus, sulfur and non-essential nutrients, Hydrological cycle. Effect of climatic, edaphic and biological factors on plants, animals and communities. Leibig's law of minimum, Shelford's law of tolerance.

UNIT – III

Development of communities: General process of Ecological succession, Types of succession, hydrosere, xerosere, climax concept in succession. Population and community Ecology: population characteristics, population dynamics and regulation. Nature of communities, structure and characteristics (qualitative and quantitative) of communities.

UNIT – IV

Bio diversity: Importance of biodiversity, management and conservation of biodiversity, relationship between diversity and stability and diversity and productivity. Wild life management: Wild life conservation, Wild life (protection) Act 1972, National Parks and Sanctuaries in India. Case Studies – Project Tiger and Gir lion project,

UNIT – V

Engineered Ecosystems: Man Engineered Ecosystems – Aqua Culture, Agriculture, Man and the Biosphere. Ecological Sustainability: Organic Farming, Integrated Pest management (IPM), Indicator Species.

Reference Text Books:

1. Cunningham, W. P. and Cunningham, M. A. Principles of Environment Science and Applications. 2nd ed. Tata McGraw Hill, New Delhi, India, 2004.
2. Odum, E.P. *Fundamentals of Ecology*. W.B. Saunders, USA. Indian Reprint 1996, Natraj Publishers, Dehradun, India, 1991.
3. Botkin, Daniel B. and Keller, Edward A. *Environmental Science: Earth as a Living Planet*. 6th ed. John Wiley & Sons, USA, 2007.
4. Chapman, J. L. and Reiss, M. J. *Ecology: Principles and Applications*. Cambridge University Press, UK., 1998.
5. Kemp, M. J. *Environmental Science*. The McGraw-Hill Companies. 1997.
6. Nebel, B. J. and Wright, R. T. *Environmental Science*. Prentice Hall. 1981.
7. M.S. Dash, Fundamentals of Ecology, Tata Mc Graw Hill Company

M.Sc (ES)-I SEMESTER
SES 721: ECOLOGICAL PRINCIPLES & APPLICATIONS LAB

Ecology: A) Ground Vegetation Analysis:

1. Fixation of minimum size of Quadrates
2. Fixation of minimum number of Quadrates
3. Determination of Frequency
4. Determination of Density & Abundance
5. Determination of Dominance
6. Importance Value Index (IVI)
7. Vegetation Sampling Transects
8. Diversity Measure: Shannon -Wiener, Simpson and Brillouin's Index

B) Soil Analysis:

1. Estimation of soil pH
2. Estimation of Conductivity
3. Estimation of water Holding Capacity
4. Estimation of Organic Carbon
5. Estimation of Soil Humus.

C) Field Study / Visits

1. Rocky and Sandy Coast, Hilly Terrain, Marshy Swamp, Back Waters, Forest Ecosystem
2. Lake Ecosystem, Riverine Ecosystem, Mangrove Ecosystem.

M.Sc (ES)-I SEMESTER
SES 703: ENVIRONMENTAL MICROBIOLOGY

Hours per week: 4 (3+1)
Credits: 3

End Examination: 60 Marks
Sessionals: 40Marks

UNIT – I

History and Development of Microbiology – Classification of Microorganisms (Three, four and five kingdoms), differences between Prokaryotes and Eukaryotes. Salient features of major groups of Microorganisms – Bacteria, Algae, Fungi, Protozoa, Bacteriophages and Viruses.

Microbial Nutrition and Growth – Nutritional requirements, Nutritional Forms. Microbial growth - Growth Cycle (only growth phases), Types of growth (Continuous, Synchronous and Non Synchronous), Measurement of Microbial growth, Influence of Environmental Factors on Growth.

UNIT – II

Tools and Techniques in Microbiology: Microscopy (Resolving power and Numerical Aperture). Working principles of different Microscopes: Simple Microscope, Bright field, Phase Contrast, Fluorescent Microscope and Electron Microscope (SEM & TEM).

Stains and Staining – Types of stains, Staining procedures, Staining of bacteria, Protozoa, Fungi and Algae. Isolation and Pure Culture, Types of Cultures (Pure Culture), Requirements of Cultures and Isolation & Preservation of Pure Cultures.

UNIT – III

Control of Microorganisms: Terms used in connection with Microbial Control. Physical methods- Dry and moist heat Sterilization, Filtration of Air (Laminar Air Flow Operators), Filtration of Liquids, Sterilization by Radiation. Chemical Methods - Gaseous Agents. Evaluation of Antimicrobial Chemicals.

Role of Microorganisms in Biogeochemical cycles (Carbon, Nitrogen and Sulphur) and in sewage treatment. Determination of Water Potability – MPN, IMViC and Membrane Filter Techniques.

UNIT – IV

Milk Microbiology: Sources of Microorganisms in milk, Micro flora of Milk, Microbiological examination of milk, Cattle shed sanitation, Milk House Design, **Milk Handling Techniques:** Cleaning and Sanitizing the equipment and Utensils with both Heat & Chemical Agents. Pasteurization, Types of Pasteurization. Milk Borne Diseases.

UNIT – V

Food Microbiology: Microorganisms of food spoilage and their sources, Spoilage of different food materials-fruits, vegetables, meat, fish, canned foods. Food intoxication (Botulism and Staphylococcal poisoning), food borne diseases (Salmonellosis and Shigellosis) and their detection. General account of food

preservation (Heat, Dehydration, Osmotic Pressure, Chemical and Radiation Treatments).

Reference Text Books:

1. Microbiology by M. J. Pelczar, M.A. Reid and Chan E.C.S (2007), 7th reprint edition, Tata McGraw Hill Publishing Company, New Delhi.
2. Powar and Daginawala (2005), General Microbiology Vol.I & II, 2nd Edition Himalaya Publishing House, Mumbai.
3. Microbiology by Prescott, Harley and Klein (2002) Mc. The McGraw-Hill Companies, Inc., 5th edition.
4. Microbiology by Dr. R.P.Singh(2007), Kalyani Publishers, 3rd edition.
5. Municipal & Rural Sanitation. M.Ehlers & Ernest W.Steel (2005). Tata Mc Graw Hill publishing company. 8th Edition.

**M.Sc (ES)-I SEMESTER
SES 723: ENVIRONMENTAL MICROBIOLOGY LAB**

1. Apparatus used for a Microbiological laboratory
2. Sterilization & Disinfection
3. Media Preparation : Solid Media: Nutrient Agar, EMB Agar, Sabouraud Agar
4. Liquid Media: Lactose Broth & Nutrient Broth.
5. Techniques of isolation & Inoculation and Sub culturing of Fungi & Bacteria
6. Staining & Microscopic study of Bacteria and Fungi
7. Estimation of total coli forms by MPN test
8. Bacteriological quality of Milk (MBRT)
9. Enumeration of Microorganisms from Soil by Serial Dilution method
10. Enumeration of Microorganisms from Air by Plate Method

M.Sc (ES)-I SEMESTER

SES 705: EARTH SCIENCE - SYSTEM & ITS RESOURCES

Hours per week: 4 (3+1)

End Examination: 60 Marks

Credits: 3

Sessionals: 40Marks

UNIT-I

Land Topography: Structure and composition of the Earth. Origin of the Earth.

Types of Rocks: Igneous, Sedimentary and Metamorphic Rocks, Description of Rocks. Land degradation, Land use pattern. Land conservation, Wastelands, Types of wastelands and their management.

Wetlands (Ramsar Convention) – types of wet lands, significance of wet land – Land management.

UNIT-II

Mineral Resources: Silicate minerals and Non Silicate minerals, Description of minerals like Pyroxenes, Amphiboles and Feldspars. Economic minerals like Gold, Copper, Aluminum, Iron, Manganese, Chromium, Coal, Petroleum, and Natural gases.

UNIT-III

Water Resources: Types of Water sources, Ground water, surface water etc. Water conservation – Water conservation strategies in India, watershed management, Cloud seeding for artificial rains

UNIT-IV

Energy Resources: Types of resources: Renewable and Non Renewable resources. Fossil Fuels, Nuclear Energy, Hydel Power, Geo thermal, Tidal Energy, Wind Energy and Solar Energy. Land Hazards – Like Earth Quakes and Volcanoes

UNIT-V

Structure of Atmosphere, Green House Effect, Ozone, Brief Description of Weather and climate.

Human Resource Management: Child Labor, Senior Citizens, Employment, Sex Ratio.

Reference Books:

1. Rutlys Elements of Mineralogy by HH Read. Blackie and Son Publishers Pvt. Limited.
2. A text book of Geology by PK Mukerjee. Madison Wisconsin Publishers.
3. An Introduction to the Rock forming minerals by WA Deen, RA Howie & J. Zusman Longman Group Limited, Longman House.
4. Energy Resources G.D.Rai. Khanna Publishers, New Delhi
5. Environmental Problems & Its Solutions D.K.Asthana & Meera Asthana S.Chand & Co.
6. Environmental Science S.C.Santra.

M.Sc (ES)-I SEMESTER
SES 725: EARTH SCIENCE - SYSTEM & ITS RESOURCES LAB

1. Identification of Rocks (Mega Scopic)
 - a. Igneous Rocks
 - b. Sedimentary Rocks
 - c. Metamorphic Rocks
2. Identification of Minerals (Mega Scopic)
 - a. Pyroxenes
 - b. Amphiboles
 - c. Feldspars
3. Identification of Economic Minerals (Mega Scopic)
 - a. Bauxite
 - b. Manganese
 - c. Chromium
 - d. Iron
4. Soil Particle size (sieve analysis)
5. Estimation of Heavy Metal contents in ores.

M.Sc (ES)-I SEMESTER
SES 707: ENVIRONMENTAL CHEMISTRY AND
INSTRUMENTATION

Hours per week: 4 (3+1)
Credits: 3

End Examination: 60 Marks
Sessionals: 40Marks

UNIT – I

Concept and scope of environmental chemistry – Composition of the atmosphere, structure of atmosphere. Chemical and photochemical reactions in the atmosphere, Smog formation, Acid rains, Greenhouse effect/Global warming, Ozone hole, El Nino phenomenon.

UNIT – II

Toxic chemicals in the environment, Impact of toxic chemicals on enzymes, biochemical effects of Arsenic, Cadmium, Lead, Mercury. Biochemical effects of Carbon Monoxide, Nitrogen Oxides, Sulphur Dioxide, Ozone and PAN, Cyanide. Pesticides and carcinogens. Heavy metals - Impact on the environment.

UNIT – III

Fertilizers – Introduction – Classification of fertilizers - Organic and Inorganic fertilizers – Risks of fertilizer use, Global Issues. Pesticides – Types of pesticides, Impact on the environment

UNIT – IV

Water and Waste Water Analysis – Laboratory procedures and importance of each of the following laboratory tests in the practice of sanitary engineering.

a) (i) Solids total & volatile (ii) Turbidity (iii) Color (iv) pH (v) Acidity (vi) Alkalinity (vii) Coagulation of water (viii) Hardness (ix) Water softening (x) Residual chlorine and chlorine demand (xi) Chlorides. b) (i) Biochemical Oxygen Demand (ii) Chemical Oxygen Demand (iii) Nitrogen (iv) Iron and Manganese (v) Fluoride (vi) Sulfate (vii) Phosphorous and Phosphate (viii) Grease (ix) Volatile acid (x) Gas analysis

UNIT – V

Instrumentation Principles: Basic principle, schematic diagram, components of the instruments and Environmental application of the following (detailed calculations and problems not necessary). UV – Visible spectrophotometer, Gas Liquid chromatography (GLC), Atomic absorption spectroscopy (AAS), Flame Photometry, Inductively Coupled Plasma Mass Spectrometry (ICPMS)

Reference Text Books:

1. Vogel's Textbook of Quantitative Chemical Analysis 5th Edition, ELBS.
2. Moore, W.A. and Moore E.A. Environmental Chemistry, Academic Press.
3. Johnson, D.O., Nettekville, J.T. Wood, J.c., and James, M., Chemistry and the Environment, W.B. Saunders Company, Philadelphia, 1973.
4. De, A. K. Environmental Chemistry. 4th ed. New Age International (P) Ltd., New Delhi, India.
5. Clair Sawyer, Perry McCarty, Gene Parkin, Chemistry for Environmental Engineering and Science. V ed. McGraw-Hill Education, 2003.

M.Sc (ES)-I SEMESTER
SES 727: ENVIRONMENTAL CHEMISTRY LAB

1. Volumetric analysis by EDTA titrations
2. Conductometric experiments:
 - i) Redox titrations
 - ii) Acid-base titrations
 - iii) Determination of solubility and specially soluble salts
 - iv) Precipitation titration
3. Potentiometric Experiments
 - i) Redox titrations
 - ii) Acid-base titrations
 - iii) Determination of pH
 - iv) Precipitation titration
4. Colorimetric Experiments:

Determination of cation concentrations of

 - a) Fe (II) b) Cr (VI) c) Ni (II) d) Pb (II)

M.Sc (ES)-II SEMESTER
SES 702: AIR POLLUTION AND CONTROL

Hours per week: 4 (3+1)
Credits: 3

End Examination: 60 Marks
Sessionals: 40Marks

UNIT – I

Introduction – Definition, Sources, classification of air pollutants, Natural contaminants, Gases, Primary and secondary air pollutants. Stationary and mobile sources. Meteorology: Meteorology and air pollution, primary parameters – Wind direction and speed, temperature.

Atmospheric stability and temperature inversions, Types of inversions, Adiabatic lapse rate. Secondary parameters – mixing height, precipitation, Humidity, solar radiation, visibility.

UNIT – II

Industrial plant location and city planning: Introduction, Factors to be considered for industrial plant location, Existing levels of air contaminants, Potential effects on surrounding area, meteorological factors and climate, topographical features, planning and zoning, City planning.

UNIT – III

Plume behavior: Single stack and multiple source pollution, wind rose, Stack effluent dispersion theories, effect of dilution, plume rise, stack height. Dispersion model: Wind Tunnel method, Box Model and Gaussian plume model.

Effects of air pollution on human health, plants, animals and property. Major air pollution disasters: Meuse valley (Belgium), Donora (USA), London, Bhopal gas tragedy. Indoor air pollution.

UNIT – IV

Sampling procedures: Classification of sampling methods, instruments for sampling waste gases and for atmospheric sampling, duration and sampling sites, sampling methods, high volume sampler and fine particulate (PM_{2.5} and PM₁₀) sampler. Stack monitoring.

Control of air pollution by equipment: Objectives, Settling chambers, Inertial separators, Cyclones, Filters, Electrostatic precipitators and scrubbers – description, advantages and disadvantages.

UNIT – V

Air pollution due to automobiles: Exhaust emissions; crank case emission, evaporative emissions, air-fuel ratio. Spark timing, control of exhaust emissions. Air quality and emission standards, air pollution legislations and regulations.

Reference Text Books:

1. Air pollution MN Rao & HVN Rao. Tata McGraw-Hill Publishing Company Limited, New Delhi.
2. Text book of Air Pollution and control Technologies. Y. Anjaneyulu, Allied Publishers (P) Limited, New Delhi.
3. Air Pollution Control Technology Handbook Karl B. Schnelle, Jr., Charles A. Brown, CRC Press
4. Environmental Pollution Control Engineering, CS Rao, New Age International publishers
5. Air Pollution & Control KVSG. Murali Krishna Published by Kaushal & Co.

**M.Sc (ES)-II SEMESTER
SES 722: AIR POLLUTION AND CONTROL LAB**

1. Introduction to Ambient air quality standards.
2. Demonstration of High volume sampler
3. Demonstration of Respirable dust sampler
4. Estimation of Particulate matter ($PM_{2.5}$ and PM_{10}) in ambient air by using dust sampler
5. Estimation of Sulphur dioxide in ambient air
6. Estimation of Oxides of Nitrogen in the ambient air
7. Wind rose preparation
8. Demonstration of Stack monitoring kit.

M.Sc (ES) II – SEMESTER

SES 704: SOLID WASTE MANAGEMENT & SOIL POLLUTION

Hours per week: 4 (3+1)

End Examination: 60 Marks

Credits: 3

Sessionals: 40Marks

UNIT – I

Solid Waste: Waste generation in society, types of solid wastes, Integrated Municipal Solid Waste Management– Municipal Solid Waste: Sources, types and composition of Municipal Solid Waste - Physical, chemical and biological properties of Municipal Solid Waste.

UNIT – II

Segregation and types of materials recovered from Municipal Solid Waste. Collection & transportation of Municipal Solid Waste, Disposal methods of MSW – Land filling, Composting, Incineration, Pyrolysis. Recycling and uses of Paper, Plastics, Glass, and Garbage.

UNIT – III

Hazardous waste Management: Sources and classification of hazardous wastes, Storage and collection of hazardous wastes, Treatment and disposal techniques: Physical, chemical and biological. Hazardous waste effects on health and the environment.

UNIT – IV

Hazardous waste landfills - Site characteristics. Hazardous waste reduction, recycling and reuse.

Biomedical waste: Definition, sources, classification, collection, segregation, treatment and disposal. Radioactive waste: Definition, sources, low level and high level radioactive wastes and their management, Radiation standard by ICRP and AERB.

UNIT – V

Sources and types of Soil pollution, effect of industrial effluents, fertilizers, pesticides, heavy metals and urban waste on soil characteristics. Detrimental effects of soil pollutants on flora, fauna and ground water. Soil pollution control methods.

Reference Text Books:

1. Integrated Solid Waste Management George Tchobanoglous, Hilary Theisen, Samuel A. Vigil. Tata Mc Graw Hill.
2. Manual on solid waste management, Ministry of urban affairs, GOI.
3. Design of landfill and Integrated Solid Waste Management, McGraw-Hill companies
4. Hazardous waste management by Prof. Anjaneyulu, B.S.Publications.
5. Environmental Sciences by Daniel B. Botkin and Edward A. Keller, Wiley student, 6th edition- 2009.
6. Standard handbook of Hazardous waste treatment and disposal by Harry M. Freeman, McGraw Hill 1997.
7. Management of Solid waste in developing countries by Frank Flintoff , WHO regional publications.

**M.Sc (ES) II – SEMESTER
SES 724: SOLID WASTE MANAGEMENT LAB**

1. Physical characteristics of solid waste :
 - a) Particle size; Temperature; pH; Conductivity and bulk density
2. Chemical characteristics of solid waste – Nitrogen, Phosphorus, Potassium and Heavy metals (selected).
3. Estimation of organic and Inorganic fraction of solid waste.
4. Determination of moisture in solid wastes.
5. Biological analysis of solid waste.

M.Sc (ES) II – SEMESTER

SES 706: WATER AND WASTEWATER TREATMENT

Hours per week: 4 (3+1)

End Examination: 60 Marks

Credits: 3

Sessionals: 40Marks

UNIT – I

Sources of water: Surface and ground water comparison with quality and quantity aspects, surface hydrology, runoff, ground water flow, shallow and deep wells, estimation of demand. Characteristics and quality of water - Physical, chemical and biological characteristics, standards.

UNIT – II

Water Treatment - intake unit, Sedimentation, Coagulation, Filtration and Disinfection.

Characteristics of waste water: Physical, chemical and biological characteristics, waste water sampling and analysis. Important microorganisms in waste water treatment.

UNIT – III

Waste water treatment: necessity of treatment. Preliminary treatment units: Screens - Types of screens, disposal of screening, Grit chamber, sources of grit, disposal of grit, sources of oil and grease, importance of removal, methods of oil & grease removal. Primary sedimentation: Necessity.

UNIT – IV

Activated sludge processes: biological principle, modification of ASP, Sludge volume index, sludge bulking and control. Trickling filter: biological principle, different trickling filter media & their characteristics, rotating biological contactors.

Low cost treatment methods: oxidation pond: bacteria- algae symbiosis, advantages and disadvantages of oxidation pond.

UNIT – V

Low cost treatment methods: Aerated lagoons, Oxidation ditch and septic tank. Sewage disposal.

Sludge disposal methods, advantages and disadvantages, UASBR- principle, advantages and disadvantages.

Reference Text Books:

1. Environmental Engineering by M. Ramachandraiah, Radiant Publishing House, Hyderabad.
2. Water Supply & Sanitary Engineering by G.S.Birdie & J.S.Birdie, Dhanapat Rai Publishing Company.

3. A treatise on Rural, Municipal, and industrial water management KVSG Murali Krishna.
4. Environmental Engineering by P.Venugopal Rao, Prentice Hall of India Private Limited.
5. Elements of Environmental Engineering by K.N.Duggal, S.Chand & Company Ltd.
6. Wastewater Engineering – Treatment and Reuse, Fourth Edition by Metcalf and Eddy, Tata McGraw Hill Publication.

M.Sc (ES) II – SEMESTER
SES 726: WATER AND WASTEWATER ANALYSIS LAB

1. Determination of Temperature, pH and Conductivity in water and wastewater samples.
2. Determination of turbidity of water and wastewater samples.
3. Determination of acidity / alkalinity and chloride in water and wastewater samples.
4. Determination of total solids, total dissolved solids and total suspended solids.
5. Determination of dissolved Oxygen in water and wastewater samples.
6. Determination of hardness in water and wastewater samples.
7. Determination of sulphate present in water and wastewater sample.
8. Determination of BOD of the wastewater sample.
9. Determination of COD of the wastewater sample.
10. Determination of nitrate content of the wastewater sample.
11. Determination of Coagulant dosage using Jar Test Apparatus.

M.SC (ES) II – SEMESTER
SES 708: COMPUTER PROGRAMMING

Hours per week: 4 (3+1)
Credits: 3

End Examination: 60 Marks
Sessionals: 40Marks

UNIT - I

Algorithm and Flowchart, Introduction to C language, variables, constants, data types, operators and expressions.

UNIT - II

Input – output statements, Control structures, simple if statements, If –Else, nested If-Else, Else-If ladder, Switch statement, goto statement, break statement.

UNIT - III

Decision making and looping, need for looping constructs, while loop, for loop, do-while loop.

UNIT - IV

Arrays, one dimensional arrays, two dimensional arrays, multi- dimensional arrays, character arrays(strings).

UNIT - V

Functions, functions and their advantages, parameter passing and local variables, Functions returning results.

Reference Text Books:

1. Programming in ANSI C by Balagurusamy, Tata McGraw-Hill, 5th edition, 2011
2. Computer Concepts and C Programming: A Hostistic Approach To Learning C by Basavaraj S. Anami, Shyanmukhaappa A. Angadi, Sunil Kumar S.Manvi, PHI, 2nd edition, 2010.
3. Programming in C by Ashok Kamthane Pearson publications, 2nd edition ,2011

**M.SC (ES) II – SEMESTER
SES 728: COMPUTER PROGRAMMING LAB**

1. Addition, Subtraction, Multiplication of 2 Nos.
2. Calculate area and circumference of a circle.
3. Calculate Simple interest.
4. Convert from Celsius to Fahrenheit.
5. Area of triangle given $s = \frac{a + b + c}{2}$, $area = \sqrt{s(s-a)(s-b)(s-c)}$.
6. Find the given Number is even or odd.
7. Find the biggest of three numbers.
8. Printing the reverse of an integer
9. Printing the odd and even series of N numbers.
10. Find whether a given number is Armstrong or not.
11. Find whether a given number is Prime or not.
12. Finding the first N terms of Fibonacci sequence.
13. Program to implement string handling functions.
14. Program to calculate length of a string.
15. Program to find the sum and average of an array.
16. Program to find the square root of a given number using functions.

M.Sc (ES) II – SEMESTER

(Generic Elective-I)

SES 742: ENVIRONMENTAL TOXICOLOGY

Hours per week: 4 (3+1)

End Examination: 60 Marks

Credits: 3

Sessionals: 40Marks

UNIT – I

General Account and definition of toxicology. History of Toxicology (The Early Era, The Middle Age, Recent Developments in toxicology). Disciplines of toxicology (Environmental toxicology, Food & drug toxicology, Industrial toxicology etc). Scope & importance of Environmental toxicology.

Toxicants and their classification- Definition of toxicant; Toxicants into the Ecosystems; Classification of toxicants (toxicants in air, toxicants in water).

UNIT – II

Toxicity tests. Categories of Toxic Effects. Types of toxicity test (test types based on number and condition; Test types based on exposure of toxicants. Acute toxicity test (definition, objectives of Acute toxicity test). Bioassay and types of Bioassays. Maximum acceptable toxicant concentration (MATC).

Concept of Dose-Response relationship, measurement of Dose-Response relationship, LD₅₀ and LC₅₀. Dose-Response curves, potency and toxicity. Threshold dose and no observed effect and margin of safety.

UNIT – III

Exposure of Toxicant - Routes and sites of exposure. Duration and frequency of exposure and types of human exposure

Toxicology of pesticides - classification of pesticides. Environmental impact of pesticides. Bioaccumulation and biomagnifications in food chain. Case study of - DDT in the environment.

UNIT – IV

Heavy metals in environment: Uses and pollution sources, toxicity, biochemical effects and remedial measures of Arsenic, Cadmium, Lead, Mercury and Chromium.

Environmental carcinogens-Introduction; Characteristics of Cancer and Cancer cells; Effect of Cancer; Types of Cancer (brief); Causes of Cancer. Environmental carcinogens- Types of Carcinogens (based on chemical nature, based on mode of action).

UNIT – V

Radiation and Health- Types and sources of ionizing radiation. Units of Radiation. Biological effects of ionizing radiation.

Epidemiological issues goiter, fluorosis and arsenic poisoning

Reference Text Books:

1. Concepts of Toxicology by Dr. Omkar, Vishal Publishing Company.
2. Fundamentals of Toxicology by Dr. Kamleshwar Pandey, Dr. J. P. Shukla, Dr. S. P. Trivedi, New Central Book Agency.
3. Environmental Chemistry by A. K. De, New Age International Limited, Publishers.
4. Environmental Science by S. C. Santra, New Central Book Agency.
5. Environmental biology and Toxicology by Sharma P.D., Rastogi and Lamporary., 1994

**M.Sc (ES) II – SEMESTER
(Generic Elective-I)**

SES 744: NOISE AND RADIOACTIVE POLLUTION

Hours per week: 4 (3+1)

End Examination: 60 Marks

Credits: 3

Sessionals: 40Marks

UNIT – I

Basic properties of sound waves – plane and spherical waves. Sound pressure and intensity levels, decibel, effect of meteorological parameters on sound propagation

Noise pollution definition and classification, Causes of noise pollution. Sources – machinery noise, pumps, compressors, building and construction equipment, domestic appliances, traffic – vehicular, train, aircraft.

UNIT – II

Measurement and analysis of sound, weighted sound level, Equivalent sound pressure level (Leq), Noise pollution level (NPL), Sound Exposure Level (SEL)

Traffic Noise Index (TNI), Day- Night level, noise criteria curves, sound pressure level, Noise indices.

UNIT – III

Biological and behavioral effects of noise pollution, Noise pollution control technologies: physical and biological approaches. Impact of noise on human health, Noise control and abatement measures. Noise standards and limit values; noise instrumentation and monitoring procedure.

UNIT – IV

Radioactive Pollution: Types, sources and consequences. Characteristics and hazards of radioactive materials, dispersion of radioactive materials, sampling methods. Detection of nuclear radiation G. M. Counter, Scintillation counter, semiconductor detector, Biological effects of ionizing radiations:ICRP recommendations;

UNIT – V

Radioactive pollution and its impacts - radioactive - sources - effect of pollutants on plants - animals and human beings - prevention and control measures of radioactive pollution.

Reference Text Books:

1. Environmental Noise pollution, Enda Murphy and Eoin King, Elsevier publishers.
2. Text book of Environmental Engineering, P.Venugopala Rao, Prentice hall of India, New Delhi.
3. Noise Pollution and Control, SP. Singhal, Narosa Publishers.
4. Source book on atomic energy - S. Glasstone, D. Van Nastrand & Germany.
5. Environmental radioactivity – M. Eisendbud, Academic press.
6. Essentials of nuclear chemistry – II, T. Arnika, Wiley easter.
7. Nuclear chemistry through problems – II, T. Arnika & N. S. Rajurkar, New age Int. (P) Ltd.

M.SC (ES) II – SEMESTER
(Generic Elective-I)
SES 746: ENERGY AND GREEN TECHNOLOGIES

Hours per week: 4 (3+1)

End Examination: 60 Marks

Credits: 3

Sessionals: 40Marks

UNIT – I

Energy forms, laws of conservation of energy, energy resources classification. Cultural changes and energy consumption patterns. Energy use pattern in different parts of world, India and its impacts on environment, energy and climatic change issues.

UNIT – II

Non-renewable energy- sources and categories, current status of exploitation - coal, petroleum, natural gas, nuclear fuel. Renewable energy sources and categories, current status of exploitation - solar, wind, bio fuel, tidal, geothermal, hydel energy.

UNIT – III

Green Chemistry: Introduction, Principles of Green Chemistry, green chemistry concept in resource minimization and waste minimization, Green reactions solvent free reactions, Bio catalysts.

UNIT – IV

Green technologies: Criteria for selection of appropriate green energy technologies, ecological restoration – Bioremediation – microbial and phytoremediation, renewable energy technologies and industrial ecology.

UNIT – V

Green energy and sustainable development: Biodiversity and ecosystem services for sustainable development: global warming - impacts, mitigation and adaptation, International agreements/conventions on energy and sustainability - United Nations Framework Convention on Climate Change (UNFCCC).

Green nanomaterials: biomaterials, biopolymers, bioplastics and composites. Nanomaterials for Fuel Cells and Hydrogen.

Reference Text Books:

1. Thomas G. Spiro and William M. Stigliani (2nd Edition). PHI learning Pvt. Ltd., New Delhi. 2009.
2. Energy, Ecology and the Environment, Academic Press Inc, B. R Wilson & W J Jones, 2005.
3. Fowler, J.M., Energy and the Environment, 2nd Ed., McGraw Hill, New York, 1984.
4. Encyclopedia of environmental sciences – environmental energy resources, R.P. Trivedi and Gurudeeppraju, vol 7
5. Living in the environment, G. Tyler Miller, Jr.1996. Wadsworth publishing company, California
6. Renewable Energy Sources and their environmental impact, S. A. Abbasi and N. Abbasi 2002. Prentice Hall of India, New Delhi.

**M.SC (ES) II – SEMESTER
(Generic Elective-I)**

SES 748: BIODIVERSITY AND WILDLIFE CONSERVATION

Hours per week: 4 (3+1)

End Examination: 60 Marks

Credits: 3

Sessionals: 40Marks

UNIT – I

Biodiversity: Definition; Concepts and components of biodiversity, Levels of Biodiversity, Types of Biodiversity, Biodiversity as an important resource, Value of biodiversity. Biogeographical Classification of India. Endemism

UNIT – II

Biodiversity at Global, National Levels, India as a mega diversity nation, Hot spots of biodiversity in the world. Threat to Biodiversity – Habitat loss, Wild life conservation and poaching of wild life, Man – wild life Conflicts, Threat to Indian Biodiversity– Reasons for loss of Biodiversity.

UNIT – III

Conservation of biodiversity: Biodiversity Conservation Strategies, In-situ and Ex-situ conservation. Protected Areas Network of India, Sanctuaries and National parks of India. Management of Germplasm collection, Biopiracy of Indian Phytodiversity, Ecoplanning Responsibilities. The Biological Diversity Act (2002 in force), National Biodiversity Authority, Biopiracy, Convention on Biological Diversity (CBD) and its milestones.

UNIT – IV

Wildlife: Definition, General importance, reasons for depletion of wildlife, status of Endangered and Endemic species of India, Indian perspectives, IUCN, CITES, Red data book. Wildlife conservation and management in India.

UNIT - V

Extinction of Organisms: Introduction, trends of extinction. Special conservation schemes: Project tiger, Gir lion sanctuary project, Crocodile breeding project. Values and ethics in wildlife conservation, Role of Zoos, Parks and Sanctuaries for Conservation of wildlife, Common wild animals in Indian Zoos, biosphere resources their management (outline).

Reference Text Books:

1. B.B. Hosetti (2013), Concepts in Wildlife Management 3rd revised and enlarged edition, Daya publishing House, Astral International (P) Ltd.
2. Fundamentals of Ecology – E.P. Odum and Garry W.Barrett, Thomson-Brooks - cole –distributed by East-West press private limited, New Delhi.
3. Environmental Science S.C.Santra, New Central Book Agency (P) Ltd.
4. Ecology & Environment – P.D. Sharma 10th edition – Rastogi Publications; Meerut

M.SC (ES) III – SEMESTER
SES 801: ENVIRONMENTAL IMPACT ASSESSMENT & CASE
STUDIES

Hours per week: 4 (3+1)
Credits: 3

End Examination: 60 Marks
Sessionals: 40Marks

UNIT – I

Introduction of EIA – Definition, Function and purpose of impact analysis. EIA in Indian context, EIA Notification 2006, Procedures for preparing EIA - Screening, Scoping, impact implications, Baseline studies and public hearing; Categorization of projects, list of projects and activity, Environmental Impact Statement [EIS].

UNIT – II

Impact analysis and Predictions, Impact assessment methodologies – checklist, matrices, overlays, networking and Geographical Information System(GIS). Environmental protection acts- Water Act 1972, Air Act 1981, Environmental Protection Act (EPA) 1986, Wild life Act1972, Hazardous waste rules.

UNIT – III

Environmental Management and ISO Certification: concept of Environmental Management Systems (EMS), ISO 14000. Life Cycle Analysis (LCA), Environmental audit.

Environmental Issues & case studies: Forest – Importance of forests, Forest resources of India; Deforestation – causes, consequences of Deforestation; Forest management – Dimensions of deforestation in India; Chipko Movement.

UNIT – IV

Urbanization trends in India – Impacts of urbanization on environment planning - Housing problem – slums – overcrowding – sanitation problems.

Environmental consideration in town planning. Water borne diseases.

UNIT – V

Global environmental problems- The threat to the Ozone layer – Causes for depletion of ozone. Antarctica Ozone Hole, The Montreal Protocol, Ozone depletion and related environmental problems and their mitigation. Environmental consequences of green house effect, global warming and related environmental problems and their mitigation.

Reference Text Books:

1. Y. Anjaneyulu Environmental Impact Assessment Methodologies, B.S. Publications
2. Sherman, J. Rosen, Manual for Environmental Impact Evaluation. Prentice Hall, New Jersey.
3. Canter, L.W., Environmental Impact Assessment Mc Graw Hill, New York.
4. Rosen, J.J. Manual for Environmental Impact Evaluation Prentice Hall Inc., New Jersey.
5. Environmental Science by S.C. Santra; New Central Book Agency (P) Ltd.,
6. Environment Problems & Solutions by D.K. Asthana and Meera Asthana; S.Chand & Company Ltd.,
7. Introduction to Environmental Science by Y. Anjaneyulu; BS Publications.
8. Urban Sociology by Dr. Kumar; Published by Lakshmi Narain Agarwal.

M.SC (ES) III – SEMESTER**SES 821: ENVIRONMENTAL IMPACT ASSESSMENT LAB**

1. Comparative analysis of air sampling from clean and polluted area using key Parameters.
2. Collection and Interpretation of weather data and development of wind roses.
3. Measurement of noise in silent, industrial, residential and commercial areas.
4. Effluent analysis (available effluent)
5. Case Study – At least One Situation – a) Questionnaires; b) Data Collection and Generation; c) Integration of Data and Analysis

M.SC (ES) III – SEMESTER
SES 803: INDUSTRIAL WASTE MANAGEMENT

Hours per week: 4 (3+1)
Credits: 3

End Examination: 60 Marks
Sessionals: 40Marks

UNIT – I

Principles of Industrial Waste Treatment: Introduction, Principles of industrial waste management, sources of pollution, physical, chemical, organic and biological properties, effects of waste water on streams, land environment and human health, water and waste water treatment plants.

UNIT – II

Waste reduction, alternatives for raw materials, process changes, housekeeping – pretreatment of wastes, collection of wastes, segregation – equalization – reduction in volume and strength by other methods – theories of neutralization – equalizations and proportioning.

UNIT – III

Manufacturing processes, characteristics and composition of wastes - treatment and disposal methods.

Food Industries: Sugar, Brewery and Dairy.

Miscellaneous Industries: Textile, Tanning, Fertilizers.

UNIT – IV

Manufacturing processes, characteristics and composition of wastes - treatment and disposal methods.

Material Industries: Paper, Steel – Metal- Plating and Petroleum refineries

Miscellaneous Industries: Pharmaceutical and Atomic energy plants.

UNIT –V

Common Effluent treatment plants – Advantages and suitability, limitation, effluent disposal methods.

Recirculation of Industrial wastes – Use of Municipal wastewater in Industries.

Reference Text Books:

1. Water and Wastewater technology, Mark, J Hammer and Mark, J Hammer (Jr). John wiley and Sons, New York.
2. Water and waste water analysis, B.B. Sundaresan, NEERI, Nagpur.
3. Standard methods for examination of Water and waste water, APHA, American Water work Association, Water pollution control federation, New York.
4. Industrial Waste Management, M.N. Rao and A.K. Datta.

M.SC (ES) III – SEMESTER
SPRES 823: INDUSTRIAL WASTE MANAGEMENT LAB

Estimation of physico-chemical parameters of the following Industrial Effluents

- 1) Food Processing
- 2) Dairy
- 3) Fertilizer
- 4) Steel plant
- 5) Metal Plate
- 6) Petroleum refinery
- 7) Any other available effluent

M.SC (ES) III – SEMESTER

SES 805: INDUSTRIAL SAFETY & DISASTER MANAGEMENT

Hours per week: 4 (3+1)

End Examination: 60 Marks

Credits: 3

Sessionals: 40Marks

UNIT – I

Safety: Introduction, importance of the safety, Principles of industrial safety, definitions of Accident, Incident, Hazard, explosion, Contamination, Fire, protection, housekeeping, safe measures. Safety training and education.

UNIT – II

Occupational Health: Concept of health and occupational health, Spectrum of health, Occupational and work related diseases, Levels of prevention, History of occupational health, Characteristics of occupational diseases, Essentials of occupational health service, personal protective equipments (respiratory and non-respiratory).

UNIT – III

Hazards in work places – Safety in Process plants: Nature and types of work places, type of Hazards, hazards due to improper housekeeping, workers exposure to hazardous chemicals, Physical and chemical properties of chemical leading to accidents like fire, explosion, ingestion and inhalation – atmospheric pollution, dangers of dusts, fumes, vapors in work spots, Noise and Vibration hazards.

Case studies - Hazards peculiar to the following industries: Thermal Power plants, Steel industry, Mining Industry, Fertilizers.

UNIT – IV

Environmental Concepts of Disasters: Disaster – natural and manmade, understanding the causative factors vulnerability, their analysis and evolution. Environmental implications of Earthquakes, Avalanches, Volcanic eruptions, landslides, floods and tsunamis, cyclones, hurricanes, typhoons, tornadoes, Disasters due to nuclear chemical and biological weapons, Earthquakes in the areas of larger dams, forest fires and wild life destruction.

UNIT – V

Disasters Mitigation and Management: Identification of disaster prone areas and high risk groups – Disaster warning programmes, Disaster preparedness and prevention of loss to life, livestock, property, natural resources and ecology – development of Disaster Mitigation Plans – Awareness programmes and capacity building among the Risk Groups – Post disaster environmental problems and their management.

Reference Text Books:

1. R.K.Jain and Sunil S.Rao , Industrial Safety, Health and Environment Management Systems, Khanna publishers , New Delhi (2006)
2. Slote.L.Handbook of Occupational Safety and Health, John Willey and Sons, NewYork.
3. Frank P. Lees, Loss of prevention in Process Industries , Vol. 1 and 2, Butterworth-Heinemann Ltd., London (1991).
4. Industrial Safety -National Safety Council of India.
5. The Factories Act with amendments 1987, Govt. of India Publications DGFASLI, Mumbai
6. Grimaldi and Simonds , Safety Management, AITBS Publishers , New Delhi (2001)
7. Industrial Safety and pollution control handbook: National Safety Council and Associate publishers Pvt. Ltd, Hyderabad (1993).
8. Handbook of Environmental Health and Safety: Herman Koren and Michel Bisesi, Jaico Publishing House, Delhi (1999).
9. Environmental Challenges and Ecological disasters, Gopal Bhargava, Mittal Publication, New Delhi.
10. Environmental Risks and Hazards, Susan L.C., Prentice Hall of India Pvt, Ltd. New Delhi.

**M.SC (ES) III – SEMESTER
(Generic Elective-II)**

**SES 841: REMOTE SENSING TECHNIQUES IN ENVIRONMENTAL
MANAGEMENT**

Hours per week: 4 (3+1)

End Examination: 60 Marks

Credits: 3

Sessionals: 40Marks

UNIT – I

Fundamentals of Remote Sensing:

Introduction – Energy Sources and Radiation Principles: Electromagnetic spectrum
– Energy Interactions in the Atmosphere – Energy Interactions with the Earth
Surface features – Data Acquisition & Interpretation.

Image characteristics, Scale, Brightness, Tone and other characteristics – Reference
Data - Atmosphere Windows – An Ideal Remote Sensing System – Characteristics
of Real Remote Sensing System – Platforms and Sensors.

UNIT – II

Fundamentals of Aerial photography:

Introduction – Early History of Aerial Photography – Aerial Photographs - Scale of
Photograph – Image displacements.

Techniques of photo interpretation – Advantages & Disadvantages of aerial photo –
interpretation. Applications of Remote Sensing - Land Use Land Cover analysis

UNIT – III

Applications of Remote Sensing

i) Agricultural applications

ii) Geology and Mineral Resources

iii) Forestry

iv) Water resource applications

UNIT – IV

Applications of Remote Sensing

v) Urban and Regional Planning Applications

vi) Wildlife Ecology

vii) Disaster Monitoring – Earthquakes, landslides, Drought, Desertification, Flood.

UNIT – V

Fundamentals of Geographical information system (GIS): Introduction – GIS
definition and terminology – GIS categories – Components of GIS – Fundamental
operations of GIS – A theoretical framework for GIS.

Reference Text Books:

1. Remote Sensing Principles and interpretation by Floyd F. Sabins, Jr. 3rd Edition, New York: W. H. Freeman and Company, 1987.
2. Applications of Remote Sensing by Lillie sand. Thomas M. Lillesand, Ralph W. Kiefer. John Wiley & Sons, 2000.
3. Textbook of Remote Sensing and Geographic Information System by M. Anjireddy, BSP Publications, 2011.

**M.SC (ES) III – SEMESTER
(Generic Elective-II Lab)****SES 881: REMOTE SENSING TECHNIQUES IN ENVIRONMENTAL
MANAGEMENT LAB**

1. Toposheet Analysis
2. Preparation of Thematic Maps from Toposheets

**M.SC (ES) III – SEMESTER
(Generic Elective-II)
SES 843: ENVIRONMENTAL BIOTECHNOLOGY &
NANOTECHNOLOGY**

Hours per week: 4 (3+1)
Credits: 3

End Examination: 60 Marks
Sessionals: 40Marks

UNIT – I

Environmental Biotechnology: Definition, Scope and role of Biotechnology in Environment Protection, Current Status of Biotechnology in Environment Protection, Future.

Bioreactors for Waste –Water Treatment: Aerobic biological Treatments (Activated sludge process, biological filters, Rotating Biological Contactors (RBC), Fluidized Bed reactors (FBR). Anaerobic Biological treatments: Contact Digesters, Packed column reactors, Anaerobic Baffled reactor, Upflow Anaerobic Sludge Reactor (UASB).

UNIT – II

Biomass based energy: Role of microbes in energy production, biogas production (Methanogenic bacteria), microbial hydrogen production, ethyl alcohol production from sugarcane and single cell protein (SCP).

Biofertilizers: Use of microbes as biofertilizers to improve crop productivity, Role nitrogen fixing bacteria in the enrichment of soil, Algal and fungal biofertilizers (VAM).Composting of organic wastes. Biopesticides: Bacterial (Bt pesticides), fungal (Trichoderma).

UNIT – III

Bioremediation: Definition, need and scope of bioremediation, types of bioremediation. Bioremediation of soil and water contaminated with oil spills, heavy metals and pesticides by soil microorganisms.

Phytoremediation- cleaning up the environment by plants. Phytoremediation of heavy metal contaminated soils.

UNIT – IV

Microbial Mining – Use of microbes in biomineralization. Bioleaching. Basic concepts of Genetic engineering, role of genetic engineering in pollution mitigation

Biotechnology for air pollution abatement and odor control: Deodorization process - bioscrubbers, biobeds, Biotrickling filters.

UNIT – V

Introduction to Nanomaterials – Nanocrystals, Nanorods, Nanowires and Nanowalls and fullerenes, synthesis and characterization of metal oxide nano particles.

Applications of nano particles and carbon nanotubes in Environmental Pollution control

Reference Text Books:

1. Nanochemistry: A chemical approach to Nanomaterials by G.A.Ozin & A. Arsemault, Royal society of chemistry publications
2. Synthesis of Inorganic materials By Ulrich Schubert and Nicola Housing , wiley-VCH
3. Review articles from the following journals: a) ACS Nano b) Pure Applications Chemistry.
4. Environmental Biotechnology by T.Srinivas, 1st Edition, New Age International Publications.
5. Environmental bio technology Theory and Application, Gareth M. Evans & Judith Furlong, Wiley Publications.
6. Environmental Biotechnology: A Biosystems Approach, Daniel A. Vallero, AP Publications.
7. Environmental Biotechnology: Basic Concepts and Applications, Indu Shekhar Thakur, IK International Pvt. Ltd.
8. Environmental Biotechnology.S.V.S.Rama Rastogi Publications.
9. Introduction to Environmental Biotechnology A.K.Chatterji, P.Hall of India.

M.SC (ES) III – SEMESTER (Generic Elective-II Lab)

SES 883: ENVIRONMENTAL BIOTECHNOLOGY LAB

1. General techniques of microbiology
2. Isolation and Enumeration of soil bacteria
3. Determination of microbiological quality of water H₂S Strip Test
4. Bioreactors
5. Working of bioreactor for waste water treatment
6. Demonstration of other bioreactors.
7. Estimation of pesticide residues in vegetables using Finger printing technique.

**M.SC (ES) III – SEMESTER
(Generic Elective-II)
SES 845: ENVIRONMENTAL PLANNING AND SUSTAINABLE
DEVELOPMENT**

Hours per week: 4 (3+1)
Credits: 3

End Examination: 60 Marks
Sessionals: 40Marks

UNIT - I

Introduction to environmental planning: Concept of environment Planning, Principles of ecology and definition of Environment, Importance of environmental planning, Resources and environmental degradation, Pollutants and their effects on human health, types of Environmental Planning.

UNIT – II

Analysis and prediction of Environmental issues: Environmental standards in India, Life Cycle Assessment, Material Flow Analysis, Environmental Auditing and Environmental Management Systems – ISO 140001, Eco-efficiency.

UNIT – III

Concepts of Sustainable Development, indices of sustainable development., factors affecting sustainable development, urban environmental issues – Human habitation, ecological sustainability of urban areas. Rio Earth Summit, Stockholm conference, Kyoto Protocol.

UNIT – IV

Approaches to study the sustainable development, natural resources exploitation, pattern of industrialization and harness technology.

UNIT – V

Sustainability of Water Resources, Sustainable Management of Forests, Ecosystem Management- Coastal Environments, Environmental education for sustainable development, Current environmental issues in India – Case studies: Narmada Dam, Tehri Dam, Alametti Dam.

Reference Text Books:

1. A Practical Guide to Understanding Management and Reviewing Environmental Risk Assessment Reports, Sally L. Benjamin and David, A. Bullock, (2001) Lewis Publishers, Washington D.C
2. Hand Book of Environmental Risk Assessment and Management, Peter Calow (1998), Blackwell-Synergy, London.
3. Environmental Management in Practice, Volume – I to III Instruments for Environmental Management, Nath, B., Hens,L., Compton, P and D. Devuyt (1998), Routledge, London and New York.

**M.SC (ES) III – SEMESTER
(Generic Elective-II Lab)
SES 885: ENVIRONMENTAL PLANNING AND SUSTAINABLE
DEVELOPMENT LAB**

Case studies based on the syllabus

**M.SC (ES) III – SEMESTER
(Generic Elective-II)**

SES 847: HYDROLOGY AND WATERSHED MANAGEMENT

Hours per week: 4 (3+1)

End Examination: 60 Marks

Credits: 3

Sessionals: 40Marks

UNIT - I

Atmospheric Water System

Hydrologic cycle – Climate – Weather – Layers in atmosphere – Types and forms of precipitation – Hydro meteorological measurements – Cyclones – Fronts – Winds – Monsoon – Clouds – Requirements for Precipitation.

UNIT – II Hydrologic

Processes

Rainfall – Rain gauges – Adequacy of network – Spatial and Temporal distribution – Frequency and Intensity/duration analysis – Consistency - Missing data – Abstractions – Infiltration – Evaporation – Interception – Process, Estimation and Measurement – depression and detention storages.

UNIT – III

Introduction: Concept of watershed development, objectives of watershed development, need for watershed development in India, Integrated and multidisciplinary approach for watershed management.

Characteristics of Watershed: size, shape, physiography, slope, climate, drainage, land use, vegetation, geology and soils, hydrology and hydrogeology, socio-economic characteristics, basic data on watersheds.

UNIT – IV

Principles Of Erosion: Types of erosion, factors affecting erosion, effects of erosion on land fertility and land capability, estimation of soil loss due to erosion, Universal soil loss equation.

Measures to Control Erosion: Contour techniques, ploughing, furrowing, trenching, bunding, terracing, gully control, rockfill dams, brushwood dam, Gabion.

UNIT – V

Ecosystem Management: Role of Ecosystem, crop husbandry, soil enrichment, inter, mixed and strip cropping, cropping pattern, sustainable agriculture, bio-mass management, dry land agriculture, Silvi Pasture, horticulture, social forestry and afforestation.

Planning of watershed management activities, people's participation, preparation of action plan, administrative requirements.

Reference Text Books:

1. Watershed Management by JVS Murthy, - New Age International Publishers.
2. Water Resource Engineering by R.Awurbs and WP James, - Prentice Hall Publishers.
3. Land and Water Management by VVN Murthy, - Kalyani Publications.
4. Irrigation and Water Management by D.K.Majumdar, Printice Hall of India
5. Hydrology and Soil Conservation Engineering by Ganshyam Das
6. Watershed Hydrology by R.Suresh

**M.SC (ES) III – SEMESTER
(Generic Elective-II Lab)****SES 887: HYDROLOGY AND WATERSHED MANAGEMENT LAB**

1. Build a physical model of a watershed.
2. Identify watershed features such as drainage divides, rivers, tributary.
3. Use Google Earth to view watershed features.
4. Locate watershed in and around campus.
5. Describe land cover and population changes within a watershed.

M.SC (ES) III – SEMESTER**SES 897: SEMINAR**

Students appearing for M.sc III Semester Examination should submit the record (with a soft copy in the form of a CD) of the seminars the candidate has presented during semester period. The record shall contain the text of the seminar presented with relevant data, tables, figures, references of the information sources etc., incorporating all relevant discussions held on the topic and the record shall be evaluated by the faculty in charge at the end of the semester. The candidates' performance in the seminar and the seminar record shall be evaluated.

**M.SC (ES) IV – SEMESTER
(Generic Elective-III)**

SES 842: ENVIRONMENTAL REMEDIATION TECHNOLOGIES

Hours per week: 4 (3+1)

End Examination: 60 Marks

Credits: 3

Sessionals: 40 Marks

UNIT – I

Introduction: Technologies of 20th century, Technology transfer- the North to south issue, Technology a double edge sword: A boon or a bane, Technology for sustainable development, the dawn of (Nanotechnology), Negative legacy of Science & Technology.

UNIT – II

Technology for air pollution Control, Removal of sulphur from auto fuel, Removal of SO₂ from Coal Power plants by Flue-gas desulphurization, clean coal technology, Control technologies for VOCs.

UNIT – III

Bioengineering for Waste removal – Microremediation Technology, Phytoremediation, plant species involved in Phytoremediation, Mechanism of Phytoremediation. Vetiver Grass Technology (VGT) with case studies.

UNIT – IV

Composting Technology with case studies, Composting types, Environmental factors controlling composting. Composting methods (Microbial slurry – windrows technology, Vermi technology), Composting of hazardous wastes & their Significance.

UNIT – V

Concept of Sustainable agriculture and transgenic plants. Biofertilizer technology (Rhizobium, Azospirillum, Mycorrhizal, Bluegreen algae, Azobacter, Azolla- BGA Symbiotic biofertilizer, Biomature technology, vermiculture biotechnology), Biotechnology for pest & disease control.

Reference Text Books:

1. Green Technology – P.K Sinha & Margaret Green way Pioneer Publ. Jaipur 2004.
2. Environmental Biotechnology S.K. Agarwal APH.
3. Managing Industrial Pollution S.K.Bhatia MacMillan
4. Biotechnology and Biotechnology control of insect pests, Techcigl and Recheigl Lewis.
5. Hand book of Bioremediation, Norris et al Lewis.

**M.SC (ES) IV – SEMESTER
(Generic Elective-III lab)
SES EL 882: ENVIRONMENTAL REMEDIATION TECHNOLOGIES
LAB**

1. Detection of pH, turbidity and odor in waste water
2. Measurement of BOD and COD in waste water
3. C/N ratio and N,P,K in compost and biofertilizers
4. Conduct a biodegradation study for soil organic pollutants
5. Carry out a treatability study of contaminated soil – bio absorption studies by microbes and plants.

M.SC (ES) IV – SEMESTER

(Generic Elective-III)

SES 844: PUBLIC HEALTH & SANITATION

Hours per week: 4 (3+1)

End Examination: 60 Marks

Credits: 3

Sessionals: 40Marks

UNIT – I

Water – Water requirement – Uses of Water – Sources of Water Supply. Origin and sources of water pollutants– water related disease – Purification of water on a large scale and small scale.

Water quality criteria and drinking water standards and their significance. Surveillance of drinking water quality.

UNIT – II

Swimming pools- Types of Swimming pools – Quality of swimming pool water – Cleaning of swimming pools – Treatment of swimming pool water. Sanitary and safety provisions.

Refuse sanitation: Refuse and night soil collection and disposal – Sources of refuse and night soil. Human excreta disposal – public health importance, extent of problem in India and sanitation barrier. Methods of excreta disposal.

UNIT – III

Housing – Social goals of housing, housing standards, Rural housing, Housing and health, Overcrowding and Indicators of housing.

Protection against noise and accidents – physiological factors – Prevention of vermin, insects (including lifecycles of mosquitoes and house fly) and rodents.

UNIT – IV

Indoor Sanitation-Ventilation – Standards of ventilation, types of ventilation (Natural and Mechanical Ventilation) and ventilation standards .**Lighting:** The requirement of good lighting, measurement of light, natural lighting, Measurement of daylight, Artificial lighting, lighting standards.

Air-Conditioning – Principles of air-conditioning – Insulation of buildings.

UNIT – V

Sanitation of Public places: Sanitation at Fairs, Melas and Places of Pilgrimage. Sanitation of Railway stations and bus stands.

Institutional Sanitation: Sanitation of Schools, Hospitals and Hotels.

Reference Text Books:

1. Municipal & Rural Sanitation (8th Edition) 2005, M.Ehlers & Ernest W. Steel; Tata Mc Graw – Hill Publishing Company.
2. Park's text book of Preventive and Social Medicine- K.Park.21st Edition.2011.M/S Banarsidas Bhanot Publishers.
3. Environmental Sanitation (Social & Preventive Medicine) (1st Edition), 2005. Dr. P.V. Rama Raju KVSG Murali Krishna Environmental Protection Society.
4. Environmental Sanitation-Baljeet.S. Kapoor. 2005.(5th Edition)S.Chand and Company Ltd.

**M.SC (ES) IV – SEMESTER
(Generic Elective-III Lab)
SES 844: PUBLIC HEALTH & SANITATION LAB**

1. Physical, Chemical and Biological Characteristics of Sullage.
2. Chemical and Biological properties of Swimming Pools.
3. Physical, Chemical and Biological Tests for Milk.
4. Sampling of waters in stagnant wells drains and pools for detection of larvae of Mosquitoes.
5. Sampling and analysis of wastes from Agricultural Farms.

M.SC (ES) IV – SEMESTER
(Generic Elective-III)
SES 846: ENVIRONMENTAL AUDITING

Hours per week: 4 (3+1)

End Examination: 60 Marks

Credits: 3

Sessionals: 40Marks

UNIT – I

EIA Notification: EIA in Indian context, EIA Notification 2006, Prior environmental clearance requirements, EIA authority - State and Central government, Committees for Environmental Clearance, Application for EC, Form 1- contents. Categorization of projects, list of projects, activity, financial overlays, conditions and specifications.

UNIT – II

Project categories: categorization criteria and important considerations for developmental projects - mining, thermal power, Airports and SEZ. Environmental laws: The Air (prevention and control of pollution) act 1981, The Water (prevention and control of pollution) act 1972, The Environmental protection act 1986, The Noise pollution (Regulation and Control) Rules,2000.

UNIT – III

EIA methodology- Adhoc, checklist, matrices, Overlays, networking and Geographical Information System. Description of Environment, prediction of environmental impacts, evaluation of impacts, Environmental impact statement (EIS), Impact evaluation, Environmental Management Plan (EMP), Disclosure of Consultants engaged.

UNIT – IV

Environmental audit- objectives, frequency and criteria audit team, Environmental appraisal, accounting and environmental audit. Environmental guidelines for siting of industry, Green Balance Sheet (GBS), Status of compliance of mandatory and voluntary requirements for industries -mineral, cement, pesticide and textile.

UNIT – V

Environmental Management System (EMS) - certification for EMS, Environmental Standards, ISO14000 (series) - basic principles, environmental clearance for reestablishing and operating industries in India. Material: manufacturing and environment. Green marketing, Eco-labeling, Environmental accounting, GATT/WTO.

Reference text Books

1. Bose, S. and Parekh, A. The Environment Audit:-Holy Grail or Essential Management Tool. The Management Accountant.1994.
2. Corello, V. T., Mumpower, J. L., Stallen, P. J. M., Uppuluri, V. R. R. Environmental Impact Assessment, Technology assessment and Risk Analysis. Springer-Verlag Berlin Heidelberg.1985.
3. Glasson, J. Therivel, R. and Chadwick, A.. Introduction to Environmental Impact
4. Assessment. Routledge, London. 2006
5. GOI – Ministry of MoEF Gazette Notification under sub-rule (3) of Rule 5 of Environment (Protection) Rules. 2006.
6. Morris, P. and Therivel R. (Eds) Methods of Environmental Impact Assessment. 2nd Edition, Spon Press London. 2001.
7. Petts, J. Handbook of Environmental Impact Assessment- Volume 1 and 2. Blackwell
8. Publishers, UK 2005.
9. N K Uberoi, Environmental Management, 2nd edition. Excel books, New Delhi

M.SC (ES) IV – SEMESTER (Generic Elective-III Lab) SES 886: ENVIRONMENTAL AUDITING LAB

1. Study and listing of various energy management systems prevailing in a particular industry/Organization
2. Preparation of a sample energy audit questionnaire
3. Identification and listing of various energy conservation methods useful in a particular industry
4. Identification and selection of appropriate energy conservation methods for the critical area identified
5. Draw the energy flow diagram for a industry/shop floor division
6. Comparative analysis of air sampling from clean and polluted area using key parameters.
7. Collection and Interpretation of weather data and development of wind roses.
8. Case Study – At least One Situation – a) Questionnaires; b) Data Collection and Generation; c) Integration of Data and Analysis
9. Visit to industry to study the Environmental Audit System.

**M.SC (ES) IV – SEMESTER
(Generic Elective-III)**

SES 848: ENVIRONMENTAL MODELING USING MATLAB

Hours per week: 4 (3+1)

End Examination: 60 Marks

Credits: 3

Sessionals: 40Marks

UNIT – I

Outline the nature and scope of modeling within the environmental sciences: Basic concept of environmental modeling, its scope and limitations. What is a model? Types of Models: Physical models, Mathematical models, Empirical models, Simulation models, Physical models.

UNIT – II

Environmental Modeling using MATLAB: Introduction to MATLAB, Fundamentals of Modeling, Principles and MATLAB.

UNIT – III

Transport of contaminants: Transport of solutions, Transport with Decay and Degradation, Transport and Sorption, Transport and Kinetics, Ordinary differential equations: Streeter-Phelps Model for River Purification.

UNIT – IV

Flow Modeling: The Euler Equations and the Bernoulli Theorem, Darcy's Law for Flow in Porous Media, Flow in Unsaturated Porous Media.

Groundwater Drawdown by Pumping: Confined Aquifer, Unconfined Aquifer

UNIT – V

2D and 3D Transport Solutions (Gaussian Puffs and Plumes) : 2D Instantaneous Line Source, 2D Constant Line Source, 3D Instantaneous Source, 3D Constant Source

Reference Text Books:

Environmental Modeling using MATLAB by E. Holzbecher, Springer

**M.SC (ES) IV – SEMESTER
(Generic Elective-III Lab)**

SES 888: Environmental Modeling Lab

1. Streeter –Phelps Model for River Purification
2. Darcy's Law for Flow in Porous Media
3. Confined Aquifer, Unconfined Aquifer
4. 2D Instantaneous Line Source
5. 2D Constant Line Source
6. 3D Constant Source

M.SC (ES) IV – SEMESTER

SES 892: PROJECT & VIVA-VOCE

Students appearing for M.Sc Environmental Science shall carry out a project in a relevant field, during the fourth semester, in consultation with the faculty –in-charge and submit a dissertation which will be evaluated for 200 marks.

THIRD SEMESTER, OPEN ELECTIVE-I
SOE 855: ENVIRONMENTAL POLLUTION, MONITORING AND CONTROL

Hours per week: 3
Credits: 3

End Examination: 60 Marks
Sessionals: 40Marks

UNIT – I

Pollution and pollutants. Air pollution and its effects - air pollution - sources - pollutants – organic and inorganic pollutants - gaseous pollutants– nitrogen oxides - particulate pollutants - effect of pollutants on plants – animals and human beings - photochemical oxidants - photochemical smog – Acid Rain - Green house effect - ozone depletion - global warming -Environmental pollution techniques for air pollution - monitoring and Control measures of air pollution - dust control equipments - Electrostatic precipitators and scrubbers.

UNIT – II

Water pollution and its effects - water pollution - sources -Pollutants - industrial effluents - domestic wastes - agrochemicals -Heavy metals - effect of pollutants on plants - animals and human beings. Eutrophication - waste water treatment - indicator organisms.

Water pollution analysis and monitoring – drinking Water standards.

UNIT – III

Soil pollution and its effects - soil pollution - sources - solid waste disposal and their effects - pesticides - types and effect of pollutants on Plants - animals and human beings - biomagnification - fertilizers and their effects - soil pollution Control measures - soil microbes and function - biofertilizers.

Noise pollution and its effects - noise pollution - sources – noise Exposure level and standards - impacts - noise control and abatement Measures.

UNIT IV

Marine pollution - sources and control of marine pollution – criteria Employed for disposal of pollutants in marine system – coastal Management.

Radioactive pollution and its impacts - radioactive - sources - effect of radioactivity on plants - animals and human beings - prevention and control measures of radioactive pollution.

UNIT V

Assessment and control of pollution - environmental standards - Assessment of pollution effects due to air - water - soil and radioactive Pollution - biotechnology in pollution control - microbial role in Pollution control - biomonitoring and bioremediation - pollution control Legislations for air - water - land etc. - bioleaching and biomineralization.

Reference Text Books:

1. Gilbert M. Masters, Introduction to Environmental Engineering and Science, 3rd ed. Prentice Hall of India Pvt. Ltd.(1998)
2. C.S.Rao, Environmental Pollution Control Engineering, 3rd ed., Wiley Eastern Ltd.New Age International Pvt.Ltd. (1995).
3. Metcalf & Eddy, Waste Water Engineering, Tata McGraw Hill, New Delhi (2003).
4. Nicholas P. Cherimisinoff, Biotechnology for Waste and wastewater treatment, Prentice Hall of India Pvt. Ltd. (2001).
5. Jarry A. Nathanson, Basic Environmental Technology, 4th ed., Prentice Hall of India Pvt. Ltd. (2003).
6. Environmental Pollution Analysis: Khopkar.
7. Bruce Rittman, Perry L. McCarty. Environmental Biotechnology: Principles and Applications, 2nd Edition, McGraw-Hill, 2000. 5. J.N.B. Bell (2002) Air Pollution and Plant Life, 2nd Edition, John Wiley and Sons, New Delhi.

THIRD SEMESTER, OPEN ELECTIVE-I
SOE 857: CLIMATE CHANGE AND CURRENT ISSUES

Hours per week: 3
Credits: 3

End Examination: 60 Marks
Sessionals: 40Marks

UNIT – I

Energy and carbon emissions, World energy use and current energy scenario, Trends in energy use of oil, coal and gas, Energy use and air quality, Nuclear energy and environment.

UNIT – II

Global climate change: Greenhouse effect, sources and trends of greenhouse gases, warming potential of gases. Photosynthetic mechanism and global climate change – case studies.

UNIT–III

Impacts of global warming : Polar ice caps and melting of glaciers, sea level increase, weather extreme conditions, ecosystems (terrestrial and ocean), human health, Climate change modeling studies.

UNIT – IV

CDM (Clean Development Mechanism): Definition and origin of CDM, CDM potential, CDM Market today, Carbon credits under Kyoto, Emission markets, IPCC (Intergovernmental Panel on Climate Change) UNFCCC (United Nations Framework Convention on Climate Change). National Action plan on climate change

UNIT – V

Tools to study climate change: Mitigation and adaptation strategies for global warming, biological and geological carbon sequestration, role of forests and drylands in carbon sequestration, carbon capture and storage technologies.

Reference Text books:

1. Aguado, E. and James, E.B. 2001. Understanding weather and climate, Prentice Hall, New Delhi.
2. Armstrong, F. and Blundell, B., K. 2003. Energy.....beyond oil, Oxford, New York.
3. Burroughs, W.J. 1999. The climate revealed, Cambridge University Press.
4. Cleveland, C. J. 2008. Encyclopedia of Energy, Elsevier, New Delhi.
5. Cleveland, C.J. and Morris, C. 2006. Dictionary of energy. Elsevier, Oxford.
6. Goudie, A. S. and Cuff, D. J. 2002. Encyclopedia of global change, Oxford, New York.
7. Gupta, K.R. 2005. Encyclopedia of environment Global warming: problems and policies, Atlantic Publication, New Delhi.
8. IPCC (Intergovernmental Panel on Climate Change) 1990. Climate Change: The IPCC Assessment. Cambridge University Press, Cambridge.
9. Lovejoy, T.E. and Hannah L. 2005. Climate change and biodiversity, TERI press.
10. Newton, P. C.D., Carran R.A., Edwards, G.R., Pascal A. and Niklaus. 2007. Agroecosystems in a Changing Climate. Advances in Agroecology, CRC/Taylor & Francis.

THIRD SEMESTER, OPEN ELECTIVE-I

SOE 859: ENVIRONMENTALLY SUSTAINABLE MINING METHODS

Hours per week: 3

End Examination: 60 Marks

Credits: 3

Sessionals: 40Marks

UNIT –I

Introduction to Mineral resources and mining - Overview of Mineral Resource, Mining Feasibility Studies, Mineral Processing Geology of Mineral Resources, The Business of Mining, Mining Law, Mineral Economics,

UNIT – II

Mining Practice - Surface mining methods-Surface mining methods: placer deposit and open pit mining – method of mining and mine scheduling, different types of motive power used in surface mining, productivity and maintenance of heavy earth moving machinery, hydraulic mineral transport, pneumatic mineral transport and safety aspects in surface mining.

UNIT –III

Mining Practice- Underground mining methods- Underground mining methods: Cut & Fill method, Shrinkage stopping, Board and pillar method - design and development, pillar extraction by caving and stowing using various techniques, supports, Long wall method - advance and retreat, shear and plough faces, Design of long wall workings, Thick seam mining, problems and special methods like gallery blasting, sub-level caving, horizon mining, contiguous, hydraulic mining, underground coal gasification.

UNIT –IV

Mining Environment and safety- Off-shore mining methods: dredging, transportation and safety aspects of surface, underground and offshore mining. Environmental & Water Issues, Remediation & Reclamation

UNIT – V

Sustainable practices in mining -Sustainability Practices in Mining, Mine ventilation-Underground atmosphere; Heat load sources and thermal environment, air cooling; Mechanics of air flow, distribution, natural and mechanical ventilation; Mine fans and their usage; Auxiliary Social License / Native (Local) Peoples, Ethics etc. Case histories of negative impacts caused by some past mining practices, Air, water, soil and noise pollution due to mining

Reference Text Books:

1. Sustainable Mining Practices: A Global Perspective Edited by Vasudevan Rajaram, Subijoy Dutta, Krishna Parameswaran, Taylor & Francis 2005, Internet Resources

FOURTH SEMESTER, OPEN ELECTIVE-II
SOE 844: NATURAL RESOURCES AND CONSERVATION

Hours per week: 3
Credits: 3

End Examination: 60 Marks
Sessionals: 40Marks

UNIT – I

An introduction to Natural resources: Natural resource, type of Natural resources – renewable and non renewable resources, Basic human requirement, Finite nature of natural resources, limitations of non renewable resources.

UNIT – II

An introduction to Forest resources, Water resources, Mineral resources, Food resources, Energy resources, Land as a resource their use and over-exploitation, case studies

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 – III

Principles of generation of hydroelectric power, tidal power, thermal energy conversion, wind, geo thermal energy, solar collectors.

Nuclear energy- fission and fusion, bio energy - energy from biomass and biogas, anaerobic digestion, energy use patterns in different parts of the world.

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.

Impacts of large scale exploitation of Natural Resources on environment.

UNIT – V

Man and the global resources, Lack of sustainability of modern society

Natural resources and associated problems: Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles, towards sustainable development

Reference Text Books:

1. Non – Conventional Energy sources, G. D. Ari, Khanna Publications
2. Environmental studies, D. K. Asthana Meera Asthana, S. Chand & Company Ltd.
3. Environmental Science S.C.Santra, New Central Book Agency (P) Ltd.,
4. Ecology & Environment – P.D. Sharma 10th edition – Rastogi Publications; Meerut

FOURTH SEMESTER, OPEN ELECTIVE-II

SOE 846: INDUSTRIAL SAFETY

Hours per week: 3
Credits: 3

End Examination: 60 Marks
Sessionals: 40Marks

UNIT – I

Safety: Introduction, importance of the safety, Principles of industrial safety, definition – Accident, Incident, Hazard, explosion, Contamination, Fire, protection, housekeeping, safe measures. Safety training and education.

UNIT – II

Occupational Health: Concept of health and occupational health, Spectrum of health, Occupational and work related diseases, Levels of prevention, History of occupational health, Characteristics of occupational diseases, Essentials of occupational health service, personal protective equipments (respiratory and non-respiratory).

UNIT – III

Hazards in work places – Safety in Process plants: Nature and types of work places, type of Hazards, hazards due to improper housekeeping, workers exposure to hazardous chemicals, Physical and chemical properties of chemical leading to accidents like fire, explosion, ingestion and inhalation – atmospheric pollution, dangers of dusts, fumes, vapors in work spots., Noise and Vibration hazards.

Case studies - Hazards peculiar to the following industries: Thermal Power plants, Steel industry, Mining Industry, Fertilizers.

UNIT – IV

Control of Fire Hazards: Statutory provisions regarding fire safety. Factors contributing towards fire. Chemistry of fire. Classification of fires. Common causes of industrial fires. Determination of fire load. Fire resistance of building materials. Design of building plant, exits, etc. for fire safety. Prevention of fire. Portable extinguishers. Water systems, carbon-di-oxide systems. Foam extinguisher system. Dry chemical extinguishing system. Industrial fire detection and alarms. Sprinkle systems. Special precautionary measures in handling/processing flammable liquids, gases, vapours, mists and dusts

UNIT – V

Safety Management: Management: Concept, definition, nature and importance, Role and functions of a manager, Elements and functions of Management. Management Principles: Authority, responsibility & power of Management, Span of Control. Delegation and decentralization of authority. General principles of Management.

Reference Text Books:

1. R.K.Jain and Sunil S.Rao , Industrial Safety, Health and Environment Management Systems, Khanna publishers , New Delhi (2006)
2. Slote.L.Handbook of Occupational Safety and Health, John Willey and Sons, NewYork.
3. Frank P. Lees, Loss of prevention in Process Industries , Vol. 1 and 2, Butterworth-Heinemann Ltd., London (1991).
4. Industrial Safety -National Safety Council of India.
5. The Factories Act with amendments 1987, Govt. of India Publications DGFASLI, Mumbai
6. Grimaldi and Simonds , Safety Management, AITBS Publishers , New Delhi (2001)
7. Industrial Safety and pollution control handbook: National Safety Council and Associate publishers Pvt. Ltd, Hyderabad(1993).
8. Handbook of Environmental Health and Safety: Herman Koren and Michel Bisesi, Jaico Publishing House, Delhi (1999).

FOURTH SEMESTER, OPEN ELECTIVE-II
SOE 848: ENVIRONMENT & HEALTH

Hours per week: 3
Credits: 3

End Examination: 60 Marks
Sessionals: 40Marks

UNIT – I

Epidemiology and Community Health: Introduction: Epidemiology, Types of Diseases, Natural History of Disease, Definitions of Health, components of Health, Ecology of Health, Spectrum of health, Determinants of health, Primary health Services, Concepts of Disease, Phases of Disease, The Disease Causative Agents, Host Factors of Disease, Modes of Transmission of Disease, Disease Prevention and Control, Glossary of Terms Related.

UNIT – II

Water Borne (Intestinal) Diseases: Introduction: Cholera, Typhoid, Dysentery, Hepatitis (Jaundice) Poliomyelitis, Dracunculosis, Amoebiasis, Food Poisoning, Hookworm Disease, Diarrhea.

UNIT – III

Personal Hygiene: Personal Habits, Home Sanitation, cigarette Smoking, Alcoholism, Mental Health, Smoke Tips on Keeping healthy, Disease and Symptoms, Daily Allowance of Nutrients.

UNIT – IV

Food and Health: Fats and Health, Carbohydrates and Health, Balanced Diet, Food Adulteration

Milk Sanitation: the Dairy, Milk as Vehicle of Infection, Essentials of Milk Sanitation, Milk and Bacteria, Legal Responsibility for Quality control of Milk, Sanitary Measures, Cleaning Process, Milk Handling, Pasteurization.

UNIT – V

Solid Waste Management: Introduction, Characteristics of Refuse, Disposal of Refuse by Dumping, Hog Feeding, Incineration, Sanitary Land Filling, Composting, Discharge to Sewers and Salvaging

Reference Text Books:

1. K.V.S.G.Murali Krishna, P.V.Rama Raju, Reem Publications, Pvt.Ltd, New Delhi-110002