ACHARYA NAGARJUNA UNIVERSITY

A State Government University, Accredited with "A" Grade by NAAC

Nagarjuna Nagar - 522 510, Guntur, Andhra Pradesh, India.

M.Sc. ENVIRONMENTAL SCIENCES

SYLLABUS

2022 - 2023 onwards

UNIVERSITY COLLEGE OF SCIENCES

PROGRAM CODE:

ANUCS09


ACHARYA NAGARJUNA UNIVERSITY
సత్యం సర్వం ప్రతిష్ఠితమ్

ABOUT UNIVERSITY

ACHARYA NAGARJUNA UNIVERSITY (ANU)

- A Brief Profile

Acharya Nagarjuna University, a State University established in 1976, has been constantly striving towards achieving progress and expansion during its existence for over four decades, in terms of introducing new courses in the University Colleges, affiliated colleges and professional colleges. Spread over 300 acres of land on the National High Way (NH-16) between Vijayawada and Guntur of Andhra Pradesh, the University is one of the front ranking and fastest expanding Universities in the state of Andhra Pradesh. The University was inaugurated on 11th September, 1976 by the then President of India, Sri Fakruddin Ali Ahmed and celebrated its Silver Jubilee in 2001. The National Assessment and Accreditation Council (NAAC) awarded "A" grade to Acharya Nagarjuna University and also has achieved 108 International ranks, 39 National ranks UI Green Metrics rankings and many more It is named after Acharya Nagarjuna – one of the most brilliant preceptors and philosophers, whose depth of thought, clarity of perception and spiritual insight were such that even after centuries, he is a source of inspiration to a vast number of people in many countries. The University is fortunate to be situated on the very soil where he was born and lived, a soil made more sacred by the aspiration for light and a state of whole someness by generations of students. With campus student strength of over 5000, the University offers instruction for higher learning in 68 UG & PG programs and guidance for the award of M.Phil. and Ph.D. in 48 disciplines spread over six campus colleges and one PG campus at Ongole. It also offers 160 UG programs in 440 affiliated colleges in the regions of Guntur and Prakasam Districts. It has a Centre for Distance Education offering 87 UG & PG programs. Characterized by its heterogeneous students and faculty hailing from different parts of the state and the country, the University provides most hospitable environment for pursuing Higher Learning and Research. Its aim is to remain connected academically at the forefront of all higher educational institutions. The University provides an excellent infrastructure and on- Campus facilities such as University Library with over one lakh books & 350 journals; Computer Centre; University Scientific Instrumentation Centre; Central Research Laboratory with Ultra-modern Equipment; Well-equipped Departmental Laboratories; Career Guidance and Placement Cell; Health Centre; Sports Facilities with Indoor & Outdoor Stadiums and Multipurpose Gym; Sports Hostel; Separate hostels for Boys, Girls, Research Scholars and International Students; Pariksha Bhavan (Examinations Building); Computers to all faculty members; Wi-Fi connectivity to all Departments and Hostels; Canteen, Student Centre & Fast-food Centre; Faculty Club; Dr. H.H. Deichmann & Dr. S.John David Auditorium cum Seminar Hall; Post office; Telecom Centre; State Bank of India; Andhra Bank; Energy Park; Silver Jubilee Park; Fish ponds; internet center; xerox center; cooperative stores; Water harvesting structures.

VISION, MISSION & OBJECTIVES OF THE UNIVERSITY

ACHARYA NAGARJUNA UNIVERSITY

VISION

To generate sources of knowledge that dispels ignorance and establish truth through teaching, learning and research.

MISSION

To promote a bank of human talent in diversified faculties – Commerce & Management Studies, Education, Engineering & Technology, Humanities, Law, Natural Sciences, Pharmacy, Physical Education & Sports Sciences, Physical Sciences and Social Sciences that would become an investment for a prosperous society.

OBJECTIVES

- To inspire and encourage all who would seek knowledge through higher education and research.
- To provide quality instruction and research for the advancement of science and technology.
- To promote teaching and research studies in disciplines of societal relevance.
- To bridge the gap between theory and practice of the principles of higher education.
- To develop human talent necessary for the industry.
- To open up avenues of higher education and research through non-formal means.
- To invite and implement collaborations with other institutes of higher learning on a continuous basis for mutual academic progress.
- To motivate and orient each academic department/centre to strive for and to sustain advanced levels of teaching and research so that the university emerges as an ideal institute of higher learning.
- To focus specially on the studies involving rural economy, justifying its existence in the rural setting.

VISION

&

MISSION OF THE COLLEGE

ACHARYA NAGARJUNA UNIVERSITY

UNIVERSITY COLLEGE OF SCIENCES

VISION OF THE COLLEGE:

University College of Sciences envisages to be a good team of people with scientific temperament, research bent and a flair for Teaching & Learning for the betterment of the Community, Society, State and the Country at large.

MISSION OF THE COLLEGE:

The College intends to incubate and nurture the Leaders, Mentors, Educators and researchers who can transform the country and contribute to advances in science while addressing the challenges faced by the society for the betterment of human life.

VISION & MISSION OF THE DEPARTMENT

ACHARYA NAGARJUNA UNIVERSITY

UNIVERSITY COLLEGE OF SCIENCES

DEPARTMENT OF ENVIRONMENTAL SCIENCES

VISION OF THE DEPARTMENT:

To achieve excellence in academic, Research and Environmental Awareness & Social Relevance so as to reach the sustainable Development Goals.

MISSION OF THE DEPARTMENT:

To promote the Human Resource adequacy to handle Environmental Problems through Resources Management, Quality Management, increase Economic affluence, Contribute to Scientific temperament among Public leading to innovation, Incubation of Sustainable Development Goals

ACHARYA NAGARJUNA UNIVERSITY

UNIVERSITY COLLEGE OF SCIENCES

DEPARTMENT OF ENVIRONMENTAL SCIENCES

PROGRAMME SPECIFIC OUTCOMES (PSO's):

PSO1	To educate students with a strong foundation in fundamental in Environmental Sciences, Ecology, Biostatistics, Natural Resources, Environmental Chemistry, etc
PSO2	To impact knowledge and skills in advanced laboratory technical in analytical chemistry, Microbiology, Biotech, Air Pollution anable students to technically analyse the pollution components.
PSO3	To train students with skills in the application of Environmental Statistics computational tools for the analysis and interpretation.
PSO4	To prepare students for careers in academia, industry and government, and to develop the skills necessary to succeed in Environmental issues.
PSO5	To develop professional development, including the ability to critically evaluate scientific literature and stay current with developments in Environment as multidisplinary approach.

PROGRAMME OUTCOMES (PO's):

After the successful completion of the M.Sc. Botany (2 year) Degree Programme, the graduates will be able to:

PO1	To impart high quality life science and environment in a highly competent academic environment
PO2	Develop and establish advanced knowledge and apply concepts of Environmental Sciences in the domain of nature and industrial research.
PO3	Acquire critical thinking supported by advanced analytical skills to address Environment and Nature related problems
PO4	Learn advanced computing methods required for environmental sciences as well as industrial requirements
PO5	Enhanced skills for employability through activities such as on hand training through industry and nature, internship, project work, seminars.

STRUCTURE

ACHARYA NAGARJUNA UNIVERSITY
UNIVERSITY COLLEGE OF SCIENCES
DEPARTMENT OF ENVIRONMENTAL SCIENCES
M.Sc. ENVIRONMENTAL SCIENCES

COURSE STRUCUTRE

S. No.	Course Code	Title of the Paper	Number of Credits	Instruction of Theory hours	Instruction of Practical's (h)	Theory marks 70+30*	Practical marks 70+30*	Total marks
SEMESTER-I								
1	**ES 1.1 (22)**	Ecological Principles and Biodiversity Conservation	4	5	3	100		100
2	**ES 1.2 (22)**	Paper II: Biostatistics and Computer Applications	4	5	3	100		100
3	**ES 1.3 (22)**	Paper III: Natural Resources Conservation and Management	4	5	3	100		100
4	**ES 1.4 (22)**	Paper IV: Environmental Chemistry and Instrumentation	4	5	3	100		100
5	**ES 1.P1 (22)**	Practical I	1				50	50
6	**ES 1.P2 (22)**	Practical II	1				50	50
		CREDITS	**18**					**500**
SEMESTER-II								
7	**ES 2.1 (22)**	Paper I: Water Pollution, Monitoring and Management	4	5	3	100		100
8	**ES 2.2 (22)**	Paper II: Atmospheric Pollution, Monitoring and Control	4	5	3	100		100
9	**ES 2.3 (22)**	Paper III: Environmental Microbiology	4	5	3	100		100
10	**ES 2.4 (22)**	Paper IV: Applications of Remote Sensing and GIS	4	5	3	100		100
11	**ES 2.P1 (22)**	Practical I	1				50	50
12	**ES 2.P2 (22)**	Practical II	1				50	50
13		Non-Core Paper						
14		Project	14			200		300
		CREDITS	**32**					**800**

* 30% of theory and practical marks through internal assessment.

	SEMESTER-III							
15	**ES 3.1 (22)**	Paper I: Environmental Biotechnology	4	5	3	100		100
16	**ES 3.2 (22)**	Paper II: EIA & EMS	4	5	3	100		100
17	**ES 3.3 (22)**	Paper III: Environmental Protection, Acts, Legislations and Policies	4	5	3	100		100
18	**ES 3.4 (22)**	Paper IV: Environmental Toxicology	4	5	3	100		100
19	**ES 3.P1 (22)**	Practical I	1				50	50
20	**ES 3.P2 (22)**	Practical II	1				50	50
21		Non-core Paper						
		CREDITS	**18**					**500**
	SEMESTER IV							
22	**ES 4.1 (22)**	Paper I: Industrial Pollution: Monitoring and Management	4	5	3	100		100
23	**ES 4.2 (22)**	Paper II: Waste Management	4	5	3	100		100
24	**ES 4.3 (22)**	Paper III: Environment and Industrial Safety	4	5	3	100		100
25	**ES 4.4 (22)**	Paper IV: Ecofriendly Technologies	4			100		100
26	**ES 4.P1 (22)**	Practical I	1				50	50
27	**ES 4.P2 (22)**	Practical II	1				50	50
28		Project Work & Viva Voce	14					300
		CREDITS	**32**					**800**
		TOTAL	**100**					**2600**

FIRST SEMESTER

ACHARYA NAGARJUNA UNIVERSITY
UNIVERSITY COLLEGE OF SCIENCES
DEPARTMENT OF ENVIRONMENTAL SCIENCES
M.Sc. ENVIRONMENTAL SCIENCES
SEMESTER-I

ES 1.1 (22): ECOLOGICAL PRINCIPLES AND BIODIVERSITY CONSERVATION

COURSE OBJECTIVES:

- The main objective of the paper is to educate the students about environment and it's role in human development.
- This paper also gives a scope to understand the internal relationships and inter dependence between and among the different biotic and their interaction with abiotic components along with the structural adoptions and functional adjustments of organisms of their environment.

COURSE OUTCOMES: To prepare the students to gain knowledge about relations and interrelations between organisms and their physical environment.

UNIT-I

Nature, Scope and principles of Ecology

Concept of Ecosystem: Structure and Functions

Ecological energetic: Transformation and transfer of energy.

Learning Outcomes: This unit was useful to understand the internal relationships between organisms and their environment and also gain knowledge about transformation of energy in different levels in ecosystem

UNIT-II

Biogeochemical cycles: Maintenance of air; cycling of nitrogen, phosphorus, Sulfur and Hydrological cycle.

Leibig's law of minimum and Shelford's law of tolerance. Concept of Ecological niche; Microclimate; Ecological indicators.

Learning Outcomes: To understand the role of satellites and sensors with their imaginary techniques to interpreted data for different research areas.

UNIT-III

Population Ecology: Group attributes of populations; population interactions and natural regulation of populations.

Community Ecology: Nature of communities; concept of a biotic community; classification of communities; characteristics of communities.

Learning Outcomes: To evaluate the environment through aireal photographs and digital digital software to identify the resources.

UNIT-IV

Concept of productivity and measurement of primary productivity.

Development of communities: Ecological succession, general trends in ecological succession concept of climax.

Learning Outcomes: This unit provides a basic knowledge about how to prepare a management plans by using remote sensing and GIS data.

UNIT-V

Biogeography: Biogeographic regions of India and the world. Endemic species; Endangered species; Major biomes of India and the World.

Biodiversity: Conservation and Management.

Learning Outcomes: To gain knowledge about applications of remote sensing and GIS data in risk assessment and pollution monitoring

PRACTICALS:

i) Area-species curves
ii) Area-quadrat curves
iii) Use of quadrats, transects and plotless techniques
iv) Frequency, density, dominance and importance value index
v) Estimation of plant cover
vi) Biomass structure and biomass allocation patterns
vii) Adaptations of hydrophytes, xerophytes, halophytes and mangroves.

LIST OF BOOKS SUGGESTED:

1) Basic Ecology, E.P. Odum, 1983, Holt-Saunders International Edition.
2) Systems Ecology. H.T. Odum 1983. John Wiley and Sons, New York.
3) Concepts of Ecology. E.J. Kormondy, 1996. Fourth Edition, Pretice-Hall of India, Pvt. Ltd.
4) Introduction to Ecology, Paul Colinvaux, 1971. Wiley International Edition.
5) Fundamentals of Ecology, E.P. Odum, 1971, W.B. Saunders & Co.
6) Plant Ecology, Michael J. Crawley, 1986, Blackwell Scientific Publications.
7) Ecology: Individuals, populations and Communities; Begon, Harper and Townsend, 1986, Blackwell Scientific Publication.
8) Methods in plant Ecoloy, P.D.Moore & S.B. Chapman, 1986,
9) Blackwell Scientific Publications.
10) Environmental and plant Response. Michael Treshow, 1970, McGraw Hill Publications.
11) Population Biology of Plants. J.L. Harper, 1977, Academic Press.

Note: Question papers contain 5 questions with internal choice have to be set covering each unit. Each question carries 14 marks

COURSE OUTCOMES:

CO1: Learning Principles of Ecosystems and Biodiversity alignment in nature.

CO2: Attain advanced knowledge in working models of ecosystems and its their dynamics.

CO3: Enrich the skills to critically analyses ecosystem productivity and biodiversity.

CO4: Understand the various Conservation processes in situ and ex situ.

CO5: Enhance practical approaches for application of Ecosystem in Environmental Sustainability.

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	2	2
CO2	2	3	3	3	3
CO3	3	2	3	2	1
CO4	3	3	2	3	3
CO5	3	3	3	3	3

(if the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

ES 1.2. (22): BIOSTATISTICS AND COMPUTER APPLICATIONS

COURSE OBJECTIVES:

1) The Paper deals with fundamentals of statistics to be used in Biology in general and Environmental studies in particular.
2) The Paper deals with collection of data, analysis and interpretation of numerical data after conducting a survey or an experiment.
3) To enumerate the data according to a reasonable standard of accuracy.
4) To draw effective conclusion and make recommendation for specific purpose.

UNIT-I

Introduction and importance of Biostatistics.

Data collection and categorisation; primary and secondary data. Development of Questionnaire.

Sampling and sample designs : Introduction; census and sampling methods.

Random sampling and Non-random sampling methods. Size of samples; Merits and limitations of sampling. Application of samplings in ecological and environmental monitoring studies.

Learning Outcome: The Students learn different data types and prepare questionnaires. Further students get an understanding of selection of sampling techniques for different studies.

UNIT-II

Data Presentation - Classification and tabulation of data: Frequency distributions. Types of Tables. Diagrammatic and Graphic presentation. General rules for constructing diagrams. Types of diagrams; Graphs; Logarithmic graphs.

Measures of Central tendency and dispersion : Characteristics of average - Geometric, Arithmetic and Harmonic mean; Median and Mode.

Learning Outcome: The Students learn data presentation and organization and estimation of dispersion and central tendancy, such as means median and mode.

UNIT-III

Tests of significance: Testing of hypotheses; level of significance. Standard deviation, Standard error, Coefficient of variation.

Students. t-Test; `F' test; Chi-square Test;

Learning Outcome: The students learn to frame a hypothesis, estimate standard depiction and also subject the data to t-test, F test, chinsware test. For testing hypothesis.

UNIT-IV

Correlation and regression : Types of correlation; scattered diagram.

Applications of linear regression correlations; Non-destructive methods of measurement of biomass and productivity.

Learning Outcome: The students learn to find relationship that exists between and among the variables and will be able to judge the relationship is positive or negative.

UNIT-V

Computer Applications: Components of computers; use of computers in Environmental Studies;

Hardware, Software, Accessories of Computers.

Fundamentals of Data Operating Systems; Languages; Packages, Data Base Management System, M.S. Office, Internet.

Learning Outcome: the Students learn the fundaments of the computer hardware and soft ware; Fortune Students will be able to learn to utilize the Environmental packages in various fields or environmental studies.

COURSE OUTCOMES: After completion of this course the students would be able to plan or design an experiment, organize data, analyse the facts and interpret the data to draw effective conclusions.

PRACTICALS:

Exercises, examples and illustrations based on the theory.

REFERENCES BOOKS:

1) Gupta, S.C. and V.K. Kapoor, 2000. Fundamentals of mathematical statistics. Sultan Chand & Sons, New Delhi.
2) Gupta, S.C. and V.K. Kapoor, Fundamentals of Applied Statistics.
3) Bailey, N.J. Statistical Methods in Biology.
4) Palani Samy S. and M. Manoharam. Statistical methods for Biologists.
5) Lud Wig, J.A., and J.F. Reynolds, 1988. Statistical Ecology, John Wiley & Sons, NewYork.

Note: Question papers contain 5 questions with internal choice have to be set covering each unit. Each question carries 14 marks

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	3
CO2	2	3	3	2	3
CO3	2	2	3	3	3
CO4	3	2	3	3	3
CO5	3	2	3	3	1

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

COMPULSORY FOUNDATION:

ES 1.3 (22): NATURAL RESOURCES : CONSERVATION AND MANAGEMENT

COURSE OBJECTIVES:

- The Paper explain about Natural Resources, Conservation and Management.
- How natural resources were useful to society.
- How it was useful to human welfare and development.
- It was useful to the students in their jobs in Environment field.

UNIT-I

Introduction and classification of Natural Resources.

Mineral resources Metallurgical resources of India and their distribution.

Learning Outcomes: it creates knowledge among the students about the distribution of Natural Resources and it will also help in their jobs in Environmental field.

UNIT-II

Conservation and management of Non-renewable fossil fuel (coal and Petroleum Products).

Nature of water resources, water bodies and dynamic models of ground water movement.

Learning Outcomes: It creates knowledge among students about water resources distribution in India, it gives how much water content used for irrigation, Industries, domestic purpose etc among student community. It uses in their jobs.

UNIT-III

Solar energy: Collection, concentration and storage, uses of solar energy. Photovoltaic cells, Flat plate collectors,

Water stills and solar dryers.

Wind energy: Wind mills, Wind farms and aerogenerators.

Geothermal energy; Ocean thermal energy conversion (OTEC)., Hydel energy.

Learning Outcomes: It gives knowledge among students about Renewable resources – Ecofriendly resources and their applications without effect to the Environment.

UNIT-IV

Hydrogen as energy source.

Bioenergy: Conversion of biomass -Pyrolysis, methanization, Alcoholic fermentation, Briquetting.

Learning Outcomes: It gives an idea among the students about different types of ecofriendly fuels. Generally fuels like petrol, diesel, produce Air pollution but ecofriendly fuels like hydrogen, etc is not created any pollution.

UNIT-V

Land and soil erosion.

Desertification: Desert development programmes. Prevention of expansion of deserts.

Forests: Classification, characteristics, distribution importance and conservation.

Benefits & Problems of Major Dams Dead sea.

Learning Outcomes: This unit gives knowledge among students about land resources and forests in India. It gives an idea about the distribution and importance of forests. How to conserve them and forests role in the ecological balance.

PRACTICALS:

1) Measurement of solar insolation.
2) Measurement of wind direction and velocity.
3) Efficiency of solar collectors.
4) Production of biogas from organic wastes.
5) Assessment of species diversity of the University Campus.
6) Survey of the genetic diversity of the major crops and weeds.
7) Study of the impact of grazing on fodder resources.

LIST OF BOOKS SUGGESTED:

1) Our Common Future. WCED Report by Brundtland, G.H. 1987, Oxford University Press.
2) Wealth of India, C.S.I.R.
3) Bioenergy Society of India. Vols. 1 to 4.
4) Survey of Environment Published by the Hindu News paper from 1992 onwards.
5) Environment and Natural Resource Conservation by Trivedi 1994.
6) Environment and Natural Resources by R.K. Sinha 1995.
7) Environmental Resource Management by L.K. Jha 1997.
8) Global biodiversity by R.K. Sinha.
9) Environmental Management in India by M. Hussian.
10) Mineral Resources of India by R.K. Mukherjee.
11) Ecological Integrity and Management of Ecosystems by Woodley S. G. Francis and K. James.
12) Principles of Sustainable Development by Dougles M. Muschett.
13) Watershed Management in India by J.V.S. Murthy 1994.

COURSE OUTCOMES:

CO1. The students learn conventional and nonconventional energy and conservation
CO2. Application of hybrid technologies for reducing conventional energy use
CO3. Conservation of energies household and industrial energy

Note: Question papers contain 5 questions with internal choice have to be set covering each unit. Each question carries 14 marks

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	2
CO2	3	2	3	3	2
CO3	2	3	3	3	2
CO4	3	3	3	2	3
CO5	3	2	3	3	2

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned).

ELECTIVE FOUNDATION:

ES 1.4 (22): ENVIRONMENTAL CHEMISTRY AND INSTRUMENTATION

COURSE OBJECTIVES:

- The paper explains environmental Chemistry.
- How the Environment and changes.

UNIT-I

Fundamentals of Environmental Chemistry: Stochiometry, Acid-base reactions: Solubility product, solubility of gases in water, the carbonate system; unsaturated and saturated hydrocarbons.

Brief account of the chemical environment, and properties of lithosphere, atmosphere, hydrosphere and biosphere.

Learning Outcome: This unit gives the knowledge to the students about Environmental Chemistry what kind of actions and reaction occurred in the atmosphere and also know the chemical Environment and properties of lithosphere, atmosphere, hydrosphere and biosphere.

UNIT-II

Composition of Lithosphere. Chemistry of - igneous, sedimentary, and metamorphic rocks.

Soil formation and development - Morphology, texture, Structure, physico-chemical properties.

Learning Outcome: very useful and interesting knowledge about rocks and formations of soils and their structure and texture morphology etc.

UNIT-III

Atmospheric chemistry: Atmospheric composition : Origin and occurrence of smog; Acid rain - sources and effects of smog and acid rain.

Green house gases - Green house effect - Global warming and climate change.

Learning Outcome: The students get knowledge about on the acid rains smog, green house effects global warming how above matters happened in the atmosphere they may get the knowledge.

UNIT-IV

Stratospheric chemistry: Chemistry of ozone layer; Light absorption and principles of photochemistry; Montreal Protocal Catalytic and non-catalytic destruction of ozone, Ozone depleting substances, Biological consequences of ozone depletion.

Learning Outcome: This unit deals the Toxic Chemicals present in the atmosphere how they enter into the life of living organisms how they effect the enzymatic systems. Students get the knowledge ozone depletion, how to effect the Environment.

UNIT-V

Principles of Analytical methods: Titrimetry, gravimetry, colorimetric, Spectrophotometry.

Instrumental methods of Analysis: Principles and practices of spectroscopy - Analysis of environmental samples by spectroscopy, GC, GLC and HPLC.

Principles of AAS.

Learning Outcome: This units will help the students to gain the knowledge about on the instruments like GC, GLC, HPLC, AAS etc.

PRACTICALS:

1. Volumetric analysis by EDTA titrations.
2. Gravimetric estimation - sulphate ion.
3. Conduct metric experiments
   (a) Redox titrations
   (b) Acid-base titrations
   (c) Determination of solubility of sparingly soluble salts
   (d) Precipitation titrations.
4. Potentiometric experiments:
5. Colorimetric experiments Determination of cation concentrations of

(a) Fe (b) Cr (c) Ni (d) Pb

LIST OF BOOKS SUGGESTED:

1) Colin Baird, 1999. Environmental Chemistry, W.H. Freeman & Company, New York.
2) R.A. Bailey, H.M. Clerke, J.P. Ferris, S. Krause and R.L. Strong, 1978. Chemistry of the Environment, Academic Press, New York.
3) APHA, 1998. Standard Methods for the Examination of Water and Waste Water, 20th Edn. Washington.
4) De A.K. 1995. Environmental Chemistry. New Age International Ltd., New Delhi.
5) Ramteke D.S. and C.A. Moghe. 1988. Manual on Water and Waste Water analysis, NEERI, Nagpur.
6) Samuel, J., Williamson, 1971, Fundamentals of Air Pollution, Addison-Wesley Publishing Company.
7) Richard P. Werne, 1985, Chemistry of Atmosphere - Clarendon Press, Oxford.
8) Fuller, E.C. 1974, Chemistry of Atmosphere - Clarendon Press, Oxford.
9) Johnson, D.O., Netterville, J.T. Wood, J.C. and James, M., 1973, Chemistry and the Environment, W.B. Saunders Company, Philadelphia.
10) Truk, et al.. Environmental Sciences, Saunders Collen Series.
11) Auria, D., J.M. Gilchrist, and Johnson, J.J. 1972. Chemistry and the Environment - A Laboratory Experience.
12) Bender, G.T. 1972, Chemical Instrumentation, A Laboratory Manual Based on clinical chemistry, W.B. Saunders Company, Philadelphia.

Note: Question papers contain 5 questions with internal choice have to be set covering each unit. Each question carries 14 marks

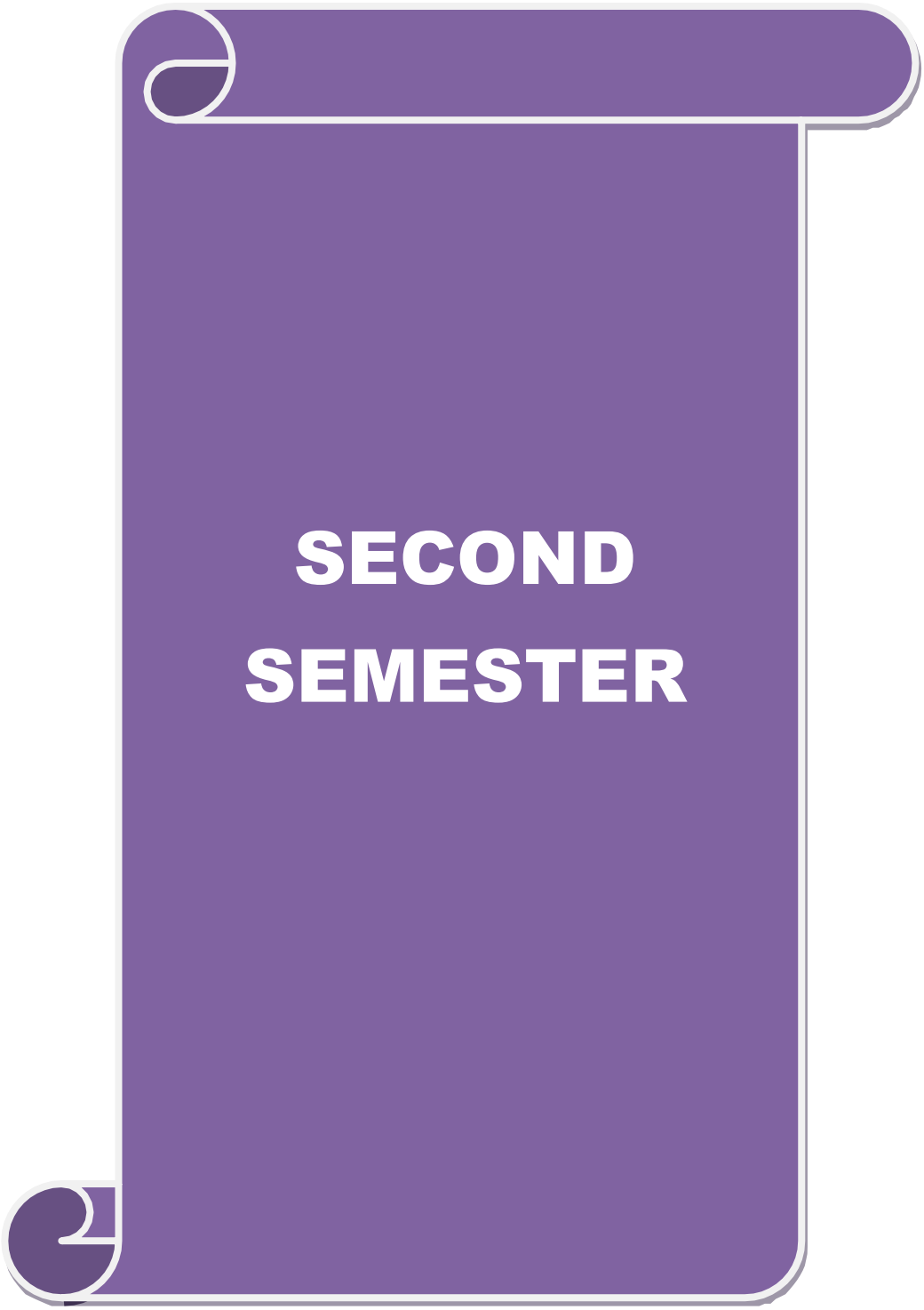
COURSE OUTCOMES:

1) Students acquaint the different sources of energy and their specific utilization
2) Conservation of energy processes
3) Use of hybrid technologies such as wind as well as solar
4) The research attitude will be developed by the students on acquaintance with the local uses

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	3
CO2	3	3	2	3	3
CO3	3	3	3	3	2
CO4	3	2	3	3	2
CO5	2	3	3	2	3

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)


SECOND
SEMESTER

M.Sc. ENVIRONMENTAL SCIENCES

SEMESTER-II

ES 2.1 (22): WATER POLLUTION: MONITORING AND MANAGEMENT

COURSE OBJECTIVE: Knowledge in water Pollution Monitoring and Management.

UNIT-I

Introduction: Classification of water, Sources and importance: Water Quality Parameters and Standards.

Drinking Water standards of WHO and APHA (American Public Health Association)

COURSE OUTCOMES: This unit deals the water quality and parameter and standards. This is very useful after completion of their studies for job, how to analyze the water quality, whether. They are upto the standers or not they can analyze. Such type of knowledge is very useful to the students and also they may know the water harvesting methods, to how to conserve the rain water.

UNIT-II

Sources of water pollutants and their effects. Oxygen demanding wastes; Synthetic organic compounds; Inorganic and mineral substances; Eutrophication, sediments; Radioactive substances; Thermal discharges; oils; Industrial wastes.

Waste Water sampling; Sampling methods; Grab sample, Composite sample; Quality of sample; Sample container, Sampling equipment, Preservation of sample.

COURSE OUTCOMES: This unit deals what kind of water pollutants are there in industries how they destroy the natural water bodies how it affects the humans. They may get practical knowledge to bring the samples. What kind samples are there how to bring the samples in containers.

UNIT-III

Methods of Analysis of physical, Chemical and microbiological parameters of water, waste water and Industrial effluents.

Methods and equipment used in waste water treatment; Preliminary treatment; Screens, Grit chambers, Skimming tanks, Oil and Grease traps.

COURSE OUTCOMES: This unit fully gain knowledge in practical manner it is very useful in laboratories and how to analysis the physical, Chemical, Microbiological Parameters.

UNIT-IV

Primary treatment: Sedimentation, Plain sedimentation sedimentation with coagulation; Filteration, stabilization and disinfection methods.

Secondary treatment: Design principles in Biological treatment, Activated sludge process, Sludge treatment and disposal.

COURSE OUTCOMES: This unit tells how to control pollutants present in effluent in industrial and domestic purpose. The students definitely get the knowledge effluent treatment plant.

UNIT-V

Advanced waste water treatment: Adsorption; Ion exchange; Electrodialysis; Reverse osmosis; Treatment with activated carbon.

ETP design criteria. Common effluent treatment plants; Combined effluent treatment plants; Sewage treatment plants.

COURSE OUTCOMES: Finally Pollutants and polluted water treated by the advanced methods like ion exchange, reverse osmosis etc were useful to the students.

PRACTICALS:

1) Determination of Total Dissolved Solids (TDS)
2) Determination of Total Solids.
3) Measurement of Dissolved oxygen (DO)
4) Determination of Chlorides.
5) Determination of Hardness.
6) Determination of Calcium.
7) Determination of Magnesium.
8) Determination of Nitrates.
9) Determination of Sulphate.
10) Determination of Phosphate.
11) Determination of Fluorides.
12) Determination of Na (sodium).
13) Determination of K (potassium).
14) Determination of residual chlorine.
15) Determination of Biological Oxygen Demand (BOD)
16) Determination of Chemical Oxygen Demand (COD)

BOOKS SUGGESTED:

1) Water Pollution. Kudesia V.P. Pragati Prakasham, Meerut.
2) Standard methods for the examination of water and wastewater APHA, American Water Works Association, Water Pollution Control Federation, New York.
3) Ecological aspects of used water treatment. Curds, C.R. and Howkes H.A. Academic Press, London 1983.
4) Water and waste water Technology, Mark, J.H. 1986, John Wiley and Sons, New York.
5) Environmental Chemistry Moore, W.A. and Moore E.A. Academic Press London
6) Environmental Chemistry De. A.K. 1993, Wiley Eastern Limited, New Delhi
7) Quality criteria for water. Russel, E. Train, Castle House publication 1979, London
8) Waste water treatment. Mogens Henze, Pul Marremoes, Jansen, Arvin, Springer - Verlag publication.

9) Water and Waste Water Analysis: Birdi & Birdi 1996.
10) Water pollution - Causes, Effects and Control. P.K. Goel 1997. New Age International Publisher.

Note: Question papers contain 5 questions with internal choice have to be set covering each unit. Each question carries 14 marks

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	2	3
CO2	3	3	2	3	3
CO3	2	3	3	3	3
CO4	2	3	3	3	2
CO5	3	3	3	2	3

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

ES 2.2 (22): ATMOSPHERIC POLLUTION: MONITORING AND CONTROL

COURSE OUTCOMES:

1) Knowledge on the stratification of atmosphere, composition and toxicity of the air and automobile pollutants and how the pollutants diffuse in to the atmosphere.
2) The students also learn sampling of ambient air pollutants and stock pollution.
3) The Students also imparted knowledge on working mechanism of the pollution control equipment and selection of air pollution control equipment for industry to be established based with production capacity and on the location of industry.

UNIT-I

Vertical structure of atmosphere; thermal profile; air circulation; weather and climate.

Sources of Air Pollution: Natural and combustion; stationary and mobile sources.

Learning outcome: The students learn about the atmosphere stratification. The different between weather and climate, wind vatterns and sources of pollution.

UNIT-II

Effects of the primary and secondary pollutants on vegetation and animals, materials and structures and human health. Effects of smoking on health and environment.

Automobile pollution - Impact of technology and fuels, National and Eurostandards.

Learning outcome: The students learn about the individual pollutants and their affects on vegetation, material and human health.

UNIT-III

Noise pollution: Sources, properties and measurement of noise. Impact of noise and noise control.

Meteorological aspects of air pollution: Temperature lapse wind Roses and Pollution Roses; Global Warming and climatic change.

Learning Outcome: The students learn impacts of noise on human health. Further the meteorological aspects such as stability and in version in atmosphere. Gross impacts of Global warming and climate change.

UNIT-IV

Air pollution modelling and prediction: Plume rise, Gaussian Plume Model modeling Pollutant transformation; model performance, accuracy and utilization.

Measurement and monitoring of air pollution:

Elements of sampling system; sampling systems for gaseous, and particulate system; static and stack sampling systems.

Learning Outcome: The students learn about the diffusion of air pollutants in the atmosphere. Also they learn sampling of gaseous pollutants in the atmosphere and stacks of industry.

UNIT-V

Air Pollution Control Concepts

Air Pollution Control devices : Introduction; Removal of dry particulate matter, liquid droplets and mists; gaseous pollutants; odours.

Bag house fitters, scrubbers, venture scrubbers etc.

Learning Outcome: The air pollution equipment range available for canrol of air pollutants such as dry particulate, liquid droplats and gaseorm pollutants and Q dours.

PRACTICALS:

1) Principles and functioning of Air pollution equipment (demonstration)
2) Sampling and analysis of particulate matter.
3) Construction of Windrose
4) Estimation of NOx.
5) Estimation of SOx.
6) Estimation of CO2.
7) Estimation of CO.
8) Identification of Episode days.
9) Effective Stack Height
10) Determination of Flow Rate for stack monitoring
11) Box model

BOOKS SUGGESTED:

1) Stern, 1987. Fundamentals of Air Pollution. Academic Press, New York.
2) Rao, HCV, Air Pollution 1990.
3) Kudesia, V.P., 1994. Air Pollution, International Student Edition, NcGraw-Hill - Kosakusha Ltd., Tokyo.
4) Perkins, H.C., Air Pollution, McGraw-Hill - Kosakusha Ltd., Tokyo
5) De, A.K., 1993. Environmental Chemistry, Second Edition, Wiley Eastern Ltd, New Delhi.
6) Sewall, G.H., Environmental Chemistry, Second Edition.
7) Warne, R.P., 1985. Chemistry of Atmosphere, Claredon Press, Oxford.
8) Mackenthum, K.M. 1998. Basic concepts in Environment Management, Lewis Publ. London.
9) Fuller, E.C., 1974. Chemistry and Man's Environment, Houghton-Muflin company, Boston
10) Lee, S.D., 1977, Biochemical Effects of Environmental Pollutants. Anna Arbor Science Publishers Inc., Ann.

Note: Question papers contain 5 questions with internal choice have to be set covering each unit. Each question carries 14 marks

COURSE OBJECTIVES:

1) To impart knowledge on structure of the atmosphere.
2) To impart knowledge on wind patterns.
3) To impart knowledge on atmosphere pollution.
4) To train the students in analysis and estimation of air pollutions and continuous monitoring.
5) To equip the students about the latest developments in the air pollution control equipment and its purpose.

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	2	2
CO2	2	3	2	3	2
CO3	2	3	3	2	1
CO4	2	2	2	3	3
CO5	2	3	2	2	3

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

ES 2.3 (22): ENVIRONMENTAL MICROBIOLOGY

COURSE OBJECTIVES:

This paper gives knowledge among students about the distribution and uses of microorganisms in the Environment. It gives an idea about harmful disease causing microbes and how to control these diseases students know about microbial role in the Environment.

UNIT-I

Diversity of microorganisms: Classification, occurrence, distribution and ecological importance of microorganisms.

Characteristics of Protists, Prokaryotes and Viruses.

Learning Outcomes: This unit gives knowledge among the students about occurrence and classification of microbes and their ecological importance it was very useful to students working in microbiological labs in their future.

UNIT-II

Nutrition and metabolism of microbes: Photoautotrophs, chemolithotrophs, organotrophs, parasites and symbionts and their environmental importance.

Microbial decomposition of organic matter: organic sources; carbon cycle; aerobic and anaerobic decomposition. Factors affecting organic matter decomposition.

Soil microorganisms and their interactios. Biofertilizers, single cell protein.

Learning Outcomes: This unit gives knowledge about Nutrition Metabolism of Microbes. It was very useful to students working in labs and pharmacy Industries.

UNIT-III

Role of microorganisms in cycling of Carbon, Nitrogen, Phosphorus and sulphur.

Water - borne pathogens and water - borne diseases: Hepatitis, Polio, Cholera, Bacterial dysentery, Typhoid, Giardiasis, Amoebiasis, and Schistosomiasis. Detection of fecal contamination of water; Detection of viruses; Microbial standards of water quality. Air-borne diseases.

Learning Outcomes: It gives an idea about cycling of Nutrients in the Environment and Microbial role in the Biodegradation of organic matter, i.e. Aerobic biodegradation & anaerobic degradation.

UNIT-IV

Biogenic Pollution; microbial toxins.

Microbial damage of crops. Brief account of fungal, bacterial and viral diseases of crop plants.

Learning Outcomes: It gives knowledge about microbial damage of crops. What type of precautions we will take in the agriculture field to reduce the microbial diseases and improve the agricultural products.

UNIT-V

Biodegradation of xenobiotic, recalcitrant compounds. Biological detoxification of toxic substances.

COVID-19 its impact on different organs of human body and control measures Environmental management for control of spreading of COVID – 19.

Learning Outcomes: It gives knowledge among the students about solid waste and biodegradation of xenobiotics and recalcitrant compounds. How we will remove these pollutants from the Environment and biodegradation of toxic substances. Ecofriendly fuels production from solid organic waste. Different types of food supplements i.e. single cell protein was also studied in this unit. It is very useful in their jobs.

PRACTICALS:

1) Preparation of slants and plates.
2) Staining and microscopic study of fungi and bacteria.
3) Estimation of bacterial populations by plate count method.
4) Estimation of microbial population by MPN methods.
5) Measurement of size of microbes by micrometry.
6) Detection of fecal contamination of water.

LIST OF BOOKS SUGGESTED:

1) Microbiology: Fundamentals and applications Atlas, R.M., 1984, Macmillan Publishing Co., New York.
2) Microbiology-An Environmental Perspective Paul Edmonds, 1978, Macmillan Publishing Co., New York.
3) Microbiology. Mitchell, R., 1974, Prentice-Hall, London.
4) Microbial Ecology. Alexander, M., 1971, John Wiley & Sons, Inc., New York.
5) Introduction to Soil Microbiology, Alexander, M., 1977, John Wiley & Sons, Inc., New York.
6) Pinciples of Microbial Ecology. Brock, T., 1966, Prentice- Hall - Englewood Cliffs, New Jersey.
7) 7. General Microbiology. Schlegal, N.G., 1986, Cambridge University Press, UK.
8) Industrial Microbiology. Ross, F.C., 1986, Second Ed., Charless E. Merrill Publishing Co., Columbo.
9) Biological field and laboratory methods for measuring the quality of surface water and effluents, Weber, C.I., 1973, EPA-670/4-73, Ohio.

Note: Question papers contain 5 questions with internal choice have to be set covering each unit. Each question carries 14 marks

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	2
CO2	3	3	2	3	1
CO3	3	2	3	2	3
CO4	2	3	3	2	3
CO5	2	3	3	3	2

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

ES 2.4 (22): APPLICATIONS OF REMOTE SENSING & GIS

COURSE OUTCOMES: To prepare the students to gain knowledge about different concepts of remote sensing and GIS processes for resource management and environmental monitoring.

UNIT-I

Fundamentals of remote sensing. Electromagnetic radiation and its interactionwith atmosphere.

Spectral reflectance of Earth's surface features in different wave regions of Electromagnetic spectrum. Spectral signatures.

Learning Outcomes: This unit gives a basic knowledge regarding the remote sensing with specific principles and their applications to be understand.

UNIT-II

Characteristics of space Plat forms and sensors; Satellite types and their sensors.

Fundamentals of satellite image interpretation, techniques of digital data acquisition and interpretation. Multispectral data analysis.

Learning Outcomes: To understand the role of satellites and sensors with their imaninary techniques to interpreted data for different research areas.

UNIT-III

Image processing methods for future extraction: Aerial Photographs; Visible, infrared and microwave data; Digital data storage and retrieval.

Applications of remote sensing in environment monitoring; resource assessment and management; and disaster management.

Learning Outcomes: To evaluate the environment through aireal photographs and digital digital software to identify the resources.

UNIT-IV

Introduction, definition and Terminology of GIS. GIS categories, components, and fundamentals. Theoretical framework of GIS; Data collection, data inputs and output;

GIS types: Raster GIS; Vector GIS; feature based GIS mapping. GIS spatial analysis; Computational Analysis Methods (CAM); Visual Analysis Methods (VAM).

Learning Outcomes: This unit provides a basic knowledge about how to prepare a management plans by using remote sensing and GIS data.

UNIT-V

GIS data storage, manipulation and analysis. Integrated analysis of spectral and attribute data. GIS analysis functions.

Applications of GIS in Risk assessment, Pollution monitoring; Resource management; Urban development, Aquatic resource evaluation and Forest fire control.

Learning Outcomes: To gain knowledge about applications of remote sensing and GIS data in risk assessment and pollution monitoring.

COURSE OBJECTIVES: The main objective of this paper is to provide exposure to the students to gain knowledge about the concepts and applications of remote sensing and GIS leading to modeling and mapping of natural resources management and also useful to acquire skills in storing, managing digital data for environmental monitoring and management.

REFERENCE BOOKS:

1) Remote Sensing and its Applications by LRA Narayan Universities Press (India) Ltd., (1999).
2) Remote Sensing and Geographical Information Systems by M.Anji Reddy (2001), B.S. Publications, Hyderabad.
3) Elements of Photo-grammetry by Paul, Wolf.
4) Elements of Photogrammetry by K.K.Rampal.
5) Principles and Applications of Photogeology by Shiv Pandey.
6) Remote Sensing and Image Interpretation by T.M.Lillesand and R.W.Kiefer.
7) Remote Sessing in Hydrology by E.T.Engman and R.J. Curney.
8) Geographic information systems - A Management Perspective by Stan Aronoff.
9) Geographic Information Systems - David Martin.

Note: Question papers contain 5 questions with internal choice have to be set covering each unit. Each question carries 14 marks

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	2
CO2	3	2	3	2	3
CO3	3	2	3	3	3
CO4	3	2	3	2	3
CO5	3	3	2	3	3

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THIRD SEMESTER

M.Sc. ENVIRONMENTAL SCIENCES

SEMESTER-III

ES 3.1 (22): ENVIRONMENTAL BIOTECHNOLOGY

COURSE OUTCOMES: To prepare the students how to prevent arrest and reverse environmental degradation through the appropriate use of biotechnology in combination with other technologies, while supporting safety procedures.

UNIT-I

Introduction: Scope, importance and applications.

Basic concepts of Biotechnology - Recombinant DNA technology, Gene cloning, gene transfer and production of transgenic plants, animals and microbes.

Environmental safety evaluation of GEMs and GMOs.

Learning Outcomes: To understand the basic biotechnological methods involved in environmental protection.

UNIT-II

Production of renewable fuels like methane (biogas), hydrogen and alcohol.

Removal and recovery of metals - biosorption, metal leaching and microbial mining.

Learning Outcomes: To gain knowledge about alternative fulels through environmental applications to evolve bioabsorption and relevant processes.

UNIT-III

Microbial production of SCP; food and feed supplements. Mushroom cultivation.

Biological control of pests, pathogens and insects.

Bifertilizers; Biological nitrogen fixation, VAM fungi and mycorrhiza.

Learning Outcomes: To understand the how to control biological polluting through biological active process and how to improve environmental resources through bio-fertilizers etc.

UNIT-IV

Use of microbes in bioreactors; Augmentation and stimulation; production of vaccines, hormones, enzymes, antibiotics.

Immobilization of microbes and enzymes. Biofilms and Biocatalysts.

Production of biodegradable plastics.

Learning Outcomes: To inculculate the knowledge in related to biofilms, biocatalysts and also the production of biodegradable plastics.

UNIT-V

Vermicomposting and composting.

Bioremediation and ecorestoration.

Biotechnology and IPR; TRIPS, Patents.

Learning Outcomes: To understand the traditional and technological methods to prevent pollution through bioremediation and ecorestoration.

COURSE OBJECTIVES: The main objective of the Environmental Biotechnology is the conservation of resources via the recycling of waste material and give knowledge how to use micro organisms in recovery of pollutents at larger scale.this paper also gives a scope to understand how to reclaiming organic and inorganic pollted resources, applications of microbes to degrade recalcitrant compounds and also removal of heavy metals found in environment.

PRACTICALS:

1) Production of biogas from different organic waste materials.
2) Application of Biofertilizers.
3) Mushroom Cultivation.
4) Production of extra cellular enzymes (amylase).
5) Vermicomposting.
6) Biosorption
7) Immobilisation of microbes.

LIST OF BOOKS SUGGESTED:

1) Gupta, P.K. 1995. Elements of Biotechnology, Rastosi Co.
2) Casida, 1994. Industrial Microbiology, Wiley Eastern Publishers.
3) Bilgrami, K.S. and A.K. Pandey, 1992. Introduction to Biotechnology. CBS Publishers & Distributors, Delhi.
4) Jogdand, S.N. 1995. Environmental Biotechnology, Himalaya Publishing House, Bombay.

Note: Question papers contain 5 questions with internal choice have to be set covering each unit. Each question carries 14 marks.

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	2
CO2	3	2	3	3	2
CO3	3	2	3	3	2
CO4	3	2	3	2	3
CO5	2	3	3	2	3

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

ES 3.2 (22): ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AND MANAGEMENT SYSTEMS (EMS)

COURSE OUTCOMES:

- On studying this paper, the students will be able to prepare Environmental impact Assessment reports ricle is a prerequisites for Environmental Chance from the M/o Environment, forests and chemical change
- The students will be able identify negative, positive long term, shaste term impacts of the project actions and will be trained to suggest various Environmental Management members.
- The students will be able to take up tasks related to ISO Certification procedures for the industry.
- The Students can individually take up Environmental audit report preparation as employment through consultancy works.

UNIT-I

Introduction: Aims and objectives, of EIA; Scope of EIA. Basic Contents of Environmental Impact Statement (EIS); Frame Work of EIA. Description of Environmental Setting.

Methods of EIA: Qualities of a good method. Types of Methods: Adhoc procedures, Checklists, Matrices, Networks, Overlay maps and Quantitative methods.

Learning Outcomes: The students learn the basic contents and methodologies for preparation of EIA reports.

UNIT-II

Prediction and Assessment of Impact on air, water and noise Environments.

Environmental impacts on biological, Socio-economic and cultural environments.

Learning Outcomes: The students will be able to predict and assess the magnitude of pacts on various Environmental components.

UNIT-III

Public participation in Environmental decision making.

Preparation of Environmental Management Plan: selection of Environmental Factors; importance of alternatives in Environmental Planning.

Learning Outcome: The students will be able to record the proceedings of the public hartly on the industry and prepare assessors for the queries and them finalise Environmental Management Plan.

UNIT-IV

EMS: ISO 9000 and 14000 guidelines, standards and certification procedures.

Risk assessment and emergency preparedness.

Learning Outcomes: The Students will be able to prepare documents related to various ISO certifications for any industry and also can prepare risk assessment reports.

UNIT-V

Environmental Audit: Introduction and scope; Types of Audits-Compliance Audit, Surveillance and EMS audit.

General approach Guidelines for preparation of audit report; preaudit activities; activities at the site; post audit activities

Learning Outcome: The students will be able to prepare Environmental Audit reports for the industries and also prepare compliance reports.

COURSE OBJECTIVES:

1) The paper aims at impart training to the students on preparation of Environmental Impact assessment reports for various project actions.
2) To train the students for selection of EIA methodologies for proposed project action and
3) To train the students to evaluate the impacts on air, water, socio-economic and cultural and biological Environments.
4) To import knowledge on international certification procedures for industries and Environmental audit procedure.
5) This paper helps the students to take up consultancy work for preparation of EIA

PRACTICALS:

1) Site mapping.
2) Location of different units of an industry within the site.
3) Guidelines and preparation of questionnaire.
4) Preparation of questionnaire for Environment Health Survey.
5) Developing environmental considerations for Thermal,
6) Hydroelectic, Fertilizers, Cement Industry.
7) Preparation of Model EIA Report.
8) Preparation of Environmental Audit Reports.

BOOKS SUGGESTED:

1) Erickson, P.A. 1979. Environmental Impact Assessment Principles and Applications.
2) Canter, L.W., 1977. Environmental Impact Assessment McGrawhill, New York.
3) Rosen, J.J., 1976. Manual for Environmental Impact Evaluation. Prentice Hall Inc., New Jersey.

4) Rao and Wooten (Eds.) 1980. Environmental Impact Analysis Handbook. McGraw Hill Book Copany.
5) Bindu N. Lohani, 1984. Environmental Quality Management. EmSeries, South Asian Publishers, New Delhi.
6) Alan Gilpin, 1995. Environmental Impact Assessment. Cambridge University Press.
7) Weinstein, 1996. The Basic Total Quality Management, CRC Press, Florida.
8) Sherman, J. Rosen, 1976. Manual for Environmental Impact Evaluation. Prentice-Hall, New Jersey.

Note: Question papers contain 5 questions with internal choice have to be set covering each unit. Each question carries 14 marks

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	1
CO2	3	3	3	3	2
CO3	3	3	2	3	3
CO4	3	3	3	2	2
CO5	3	3	2	2	3

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

ES 3.3 (22): ENVIRONMENTAL PROTECTION: ACTS, LEGISLATION AND POLICIES

COURSE OBJECTIVES: This paper gives knowledge on Environmental problems and Environmental Protection methods, procedures for the main objective of Environmental Protection.

UNIT-I

Water Pollution (Prevention and Control) Act, 1974. (as amended upto 1988).

Air Pollution (Prevention and Control) Act, 2020.

Learning Outcomes: It gives knowledge about sources of Air and Water Pollution. And Air Pollution control Rules and Water Pollution Control rules released by the Central Pollution control Board and State Pollution Control Board.

UNIT-II

Hazardous Chemicals (Handling and Disposal) Act, 1997.

Forest Conservation Act, 1980.

Indian Wildlife Protection Act, 1972 (amended 1991).

Biomedical Waste (Management and Handling) rules - 1998.

Learning Outcomes: This Unit gives knowledge about Forests conservation wild life and biodiversity conservation acts. It gives knowledge about Hazardous waste and biomedical waste management rules released by the central government. It is very useful to students in their jobs in Environmental field.

UNIT-III

Environmental Protection Act 1986 and Rules.

CRZ notification; WTO; IPR and Patenting Acts.

Municipal Solid Waste (Management and Handling) rules – 2000-2020.

Learning Outcomes: This paper deals about Environment protection. It gives knowledge about coastal Regulation Zone for industries, domestic and other construction activities, and also gives knowledge about municipal solid waste management rules released by the central government. It is very useful to students in Environmental field.

UNIT-IV

International Conventions: Stockholm Conference 1972; Earth Summit, 1992.

Montreal Protocol; Kyoto Protocol.

Prominent litigations on Environmental issues in India.

(a) Mathura Refinery (b) Silent Valley Project

(c) Sardar Sarovar Project (d) Tehri Dam

Learning Outcomes: It gives knowledge about international conversions for the protection of Environment. It gives knowledge about major Environmental issues in India; It is very useful to students in their jobs.

UNIT-V

Enforcement of laws, rules and regulations. Powers and respensibilities of CPCB and SPCB'S.

Creation of environmental awareness through environmental education; role of media, Government and non-governmental organisations.

Learning Outcomes: It gives knowledge about Central Pollution Control Board and State Pollution control Board responsibilities and their powers and role of media in the Environmental protection for creation of awareness among people about the importance of Environment.

PRACTICALS:

Adoption of some villages to create awareness & to amelrate facility on Protection acts and policies on environmental issues.

Case studies: Ganga pollution case, Tehri dam case, Mathura refinery case, Bhopal gas leak case.

SUGGESTED BOOKS:

1) The Environment Protection Act, 1986. Commercial Law Publishers (India) Pvt. Ltd.
2) National Environmental Policy Act, 1969. L.W. Canter, E.P.A. Publications.
3) Hazardous Chemicals (Handling and Disposal) Act, 1997, APPCB, Hyderabad.
4) Air Pollution, V.P. Kudesia, 1994. International Student Edition.

Note: Question papers contain 5 questions with internal choice have to be set covering each unit. Each question carries 14 marks.

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	2
CO2	3	2	3	3	3
CO3	2	3	3	3	2
CO4	3	3	2	2	3
CO5	3	2	3	2	3

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

ES 3.4 (22): ENVIRONMENTAL TOXICOLOGY

COURSE OBJECTIVE: Environmental toxicology Provides Knowledge on toxicants present in Environment.

UNIT-I

Introduction: Environmental toxicants; Cycling of toxic chemicals in Environment. Types of Hazardous substances:

(a) Toxic substances (b) Explosive substances (c) Radioactive substances.

Toxicants present in atmosphere; sources, status and affects of dioxin, PAH, PCB and PBB.

Learning Outcome: This unit deals to student about cycling of toxic Chemical in Environment, very harmful chemicals like PAH, PCB, PBB and etc., they may get the knowledge on that.

UNIT-II

Toxicants present in hydrosphere. Atmosphere, Lithosphere, Industrial solvents and vapours,

Heavy metals and their adverse effects Toxicity of

(a) Mercury, (b) Lead, (c) Cadmium, (d) Arsenic, (e) Chromium,

(f) Copper, (g) Zinc.

Learning Outcome: This is deals the Toxicant present in hydrosphere and about heavy metals like mercury, lead, cadmium, arsenic; chromium, copper, zinc etc are present in the hydrosphere.

UNIT-III

Uptake and entry of toxic chemicals. Routes of exposure and sites of exposure, duration and frequency of exposure. Dose-Response relationship.

Bio-transformation of toxicants: Biotransformation mechanism of xenobiotics and their effects.

Learning Outcome: Students get the knowledge on uptake and entry of toxic chemicals bio-transformation of toxicants, factors effecting biotransformation of xenobiotics.

UNIT-IV

Methods for testing chemical toxicity: ASTM standard methods; single species toxicity,

Algal growth toxicity, acute toxicity tests; sub acute dietary toxicity tests.

Measurement and interpretation of ecological effects of Chemicals: Toxicity at population and Community levels;

Learning Outcome: This unit help the students gain the knowledge testing Chemical toxicity and ASTM standard methods etc.,

UNIT-V

Biological Monitoring of Toxic chemicals; Methods and objectives of Exposure Monitoring, Food - Chain as a source of toxic chemical exposure Bio-Chemical markers.

Biomedical aspects of Environmental Toxicology: Physico - Chemical and physiological

Variables influencing the toxicity of chemicals, public health. Side effects of medicines on human beings; the skin, blood, respiratory system and liver; long term and short-term effects.

Learning Outcome: This unit give the knowledge on toxic chemicals biological monitoring and Toxic chemicals exposure etc.,

PRACTICALS:

1) Effect of pesticides on fish, insects and earth worms.
2) Effects of noise on persons working in noise-polluted units – A survey.
3) Health problems of smokers Vs non-smokers - Survey.
4) Pesticide effects on professional sprayers - Survey.
5) Prevention of spoilage of food and vegetables.
6) Purification of water for drinking purposes.
7) Prevention and spread of communicable diseases: Preparation of dos and don'ts for public use.

BOOKS SUGGESTED:

1) Ram Kumar, 2000. Environmental Chemical Hazards, Sarup & sons, New Delhi.
2) Beyer, W.N., Heing, H.G. and Norwood, AWR 1996, Environmental Contaminants in Wildlife, CRC Lewis Publishers, New York.
3) Dikshithl, T.S.S., 1996, Safety evaluation of Environmental Chemicals New age international (P) Ltd., New Delhi.
4) Lave, L.B. and Upton, A.C., 1987. Toxic chemicals, health and the environment. John Hopkins University Press, Baltimore and London
5) Treshow, M. Environment and Plant Response, 1970, McGraw-Hill Pub
6) National Book Trust. You and Your Health 1995, NBT, New Delhi.
7) American Public Health Association (APHA) Manuals.
8) WHO - Our planet, Our Health 1993, Oxford University Press, Delhi.
9) Survey of Environment - Published by the Hindu News Paper.
10) Dikshith, T.S.S. 1991, Toxicology of pesticides in Animals, CRC Press Inc. Boca Raton, Florida.
11) Kiernan, J.A. 1990. Histological and Histochemical Methods: Theory and Practice 2nd ed. Pergamon Press, New York.
12) Bartosek, I. Animals in Toxicological Research 1982, Ravan Press, New York
13) Dinham, B., 1993. The Pesticide Hazard: A Global health and Environmental Audit.

Note: Question papers contain 5 questions with internal choice have to be set covering each unit. Each question carries 14 marks

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	2
CO2	3	3	2	3	2
CO3	2	3	3	2	2
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FOURTH SEMESTER

M.Sc. ENVIRONMENTAL SCIENCES

SEMESTER-IV

ES 4.1 (22): INDUSTRIAL POLLUTION: MONITORING AND MANAGEMENT

COURSE OBJECTIVE: All Industrial Pollution and Monitoring and Management.

UNIT-I

Classification and criteria for selection of site for establishment of industry.

Social, economic environmental impacts of industries statutory requirements for monitoring and management of emissions and effluents.

Learning Outcome: This units deals classification of Industries based on the Environmental effects its provides knowledge on the EIA before and after establishing the Industries. How the licenses and permits etc provides.

UNIT-II

Environmental Monitoring and Management of -

a) Agribased industries - Sugar and distilleries; vegetable oils; Ginning and dairy.
b) Cement industries and stone crushers.

Learning Outcome: This unit provides the knowledge to students how to Monitoring manage the all pollutants in agribased, sugar, cements textiles etc., Industries.

UNIT-III

Environment monitoring and management of -

a) Bulk drug and Pharmaceutical industries
b) Fertilizer plants

Learning Outcome: This unit gives the knowledge to the students how to monitoring mange the all pollutions in bulk drug pharmaceutical, fertilizers industries etc.,

UNIT-IV

Environment monitoring and management of -

(a) Power Plants - Thermal, gas based, and Hydroelectric power plants

(b) Solar, wind, nuclear power plants

Learning Outcome: This units provides the knowledge to the students about all pollutions like thermal, gas based and hydroelectric, solar wind, nuclear mini power plants etc., create all pollutions, those pollutions how to Monitoring and Manage.

UNIT-V

Environment monitoring and management of -

(a) Petro-chemical industries

(b) Steel plants

(c) Paper and Pulp industry

Learning Outcome: This unit provide the knowledge on the petrochemical steel paper and pulp Industries student will get the knowledge to Monitoring and Management.

PRACTICALS:

1) Every student is required to do a project of four to six weeks duration in industry of his/her choice at the end of third semester or during the fourth semester.
2) Ambient Air quality monitoring - Equipment and methodology.
3) Stack monitoring - Equipment and Methodology.
4) Effluent treatment plants - Design criteria.
5) Effluent treatment monitoring - Equipment and methodologies.
6) Industrial EMS.
7) Environmental Auditing.

BOOKS SUGGESTED:

1) Beta G.liptak. Environmental Engineers, Vol.I to III. Chilton Book co., Radnor Pennsylvania
2) Lead better. Air Pollution Vol.I & III.
3) Stern, A.C. Air Pollution Vol.I to V.
4) Metcalf & Eddy. Waste Water Engineering. Treatment and Disposal.
5) Edmond Besselievre & Max Schwart. The treatment of Industrial Wastes. McGraw Hill.
6) Gotax - Solid Waste Management.
7) Booklets on different industries.

Note: Question papers contain 5 questions with internal choice have to be set covering each unit. Each question carries 14 marks

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	2
CO2	3	3	2	3	2
CO3	3	2	3	2	3
CO4	3	2	3	3	2
CO5	3	3	3	2	3

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

ES 4.2 (22): WASTE MANAGEMENT

COURSE OBJECTIVES: It gives knowledge about different types of wastes and the proper disposal methods. It is very useful to students in their jobs.

UNIT-I

Characteristics, criteria and classification of wastes.

Waste management and handling rules.

Scope and objectives of waste management.

Waste reduction, recycling, and reuse strategies.

Learning outcomes: its gives an idea to the students about classification of wastes, recycling reduction and reuse strategies. Its is useful in their jobs.

UNIT-II

Sources of wastes, collection, segregation, transportation,storage, treatment and disposal of wastes.

Design criteria for a secure landfill and incineration.

Learning Outcomes: It gives knowledge about how hazardous waste handling & conservation, secure landfills construction and waste disposal methods.

UNIT-III

Handling and Management of biomedical waste.

Handling and Management of Hazardous Waste.

Disposal of nuclear waste.

Learning Outcomes: It deals with the municipal solid waste and different disposal techniques for biodegradable waste and ecofriendly waste management practices.

UNIT-IV

Handling and Management of Municipal Solid Waste (MSW).

Disposal and Treatment of biogradable waste - composting, vermicomposting and biomethanization.

Learning Outcomes: It gives knowledge about disposal of biomedical, Hazardous and nuclear waste disposal method it is very useful to students in their jobs.

UNIT-V

Problems of disposal of sludge from effluent treatment plants (ETP's), combined effluent treatment plants (CETP's) and sewage treatment plants (STP's).

Disposal of fly-ash from thermal power plants.

Management of plastic waste and synthetic polymers.

Learning Outcomes: It gives knowledge about disposal of sludge from common effluent treatment plants. Students acquire knowledge about disposal of fly ash and the ecofriendly disposal methods. It also gives knowledge about plastic waste management and disposal methods for the protection of the Environment.+

PRACTICALS:

1) Testing for degradability, persistence and toxicity of different types of wastes.
2) Study of the impact of the chosen waste materials on seed germination and radicle elongation.
3) Active participation in waste minimization programmes.
4) Landfill designs & design criteria.

LIST OF BOOKS SUGGESTED:

1) The Municipal Solid Waste Handbook, U.S. Environmental Protection Agency.
2) Waste incineration and Public Health. National Research Council, National Academy Press, Washington DC. 1999.
3) Richard T.Wright and Bernard J.Nebel. 2002. Environmental Science. Towards a sustainable Future. Prentice Hall of India Pvt. Ltd. New Delhi - 110 002.

Note: Question papers contain 5 questions with internal choice have to be set covering each unit. Each question carries 14 marks

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	2
CO2	3	3	2	3	2
CO3	3	3	3	2	2
CO4	3	2	3	2	3
CO5	3	3	2	2	3

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

ES 4.3 (22): ENVIRONMENT AND INDUSTRIAL SAFETY

COURSE OUTCOMES:

- The students after studying this paper will be able to identify changes in ambient environment quality and on site impacts.
- The students will be able to identify hazards in work place and potential accident reports in various Industries.
- The students will be able to prepare accident investigation reports and develop strategies to mitigate the impacts of disasters.

Unit I: Workplace Hazards:

Nature and types of hazards. Hazards in mining activities. Hazards in the fertilizer industry, petroleum refinery and organic chemical factories; Metallurgical, pulp and paper industry, industries; glass, ceramics and cement industries; alcohol and sugar industries.

Learning outcomes: The Students broadly understand work place hazard in various Industries such as petrochemical, dyeing and fabring, coke oven plat, pesticide plant, Chemical factories etc.,

Unit II

Control of Hazards and Accidents due to fire explosion. Thermal power plants, steel and metallurgical industries, atomic power and mechanical workshops.

Learning Outcomes: The Students will be acquainted with control of hazards and accidents.

Unit III: Safety in Process Plants:

Disaster mitigation and control: Personal Protective Equipments. Industrial Hygiene: Principles, health and safety ergonomics. Safety monitoring and Safety Information Systems.

Learning Outcomes: The Students will be able to prepare safety mannls, safety monitoring and SIS systems.

Unit IV:

Plant and Personnel Safety: illumination, ventilation checklists for plant maintenance – guarding of moving machinery. Safety committee; safety councils. Mock Drills and Man Power training.

Learning Outcomes: The students will be able to prepare checklist for plant maintenance, monitoring of first aid principles and training of safety devastation teams

Unit V:

Accident Investigation: Classification of accidents – accident reports – analysis of accidents – causes, remedies – rehabilitation of workers.

Legal Aspects of Industrial Safety - safety measures in factories act, mines act, pollution control acts for water, air, and land, child labour and women employee acts. On site, offsite emergency plans.

Learning Outcomes: The students will be able to write accident investigation report and prepare on site, off site emergency plans.

PRACTICALS:

1) Industrial visits
2) Preparation of site maps and industrial layouts with regard to approach to accident sites
3) Checklists of personal protective equipments
4) Preparation of on-site emergency plans
5) Preparation of accident reports
6) Preparation of rehabilitation plans
7) Assessment of safety adequacy in the industry
8) Assessment of women employees safety in the industry
9) First Aid Methods.
10) Preparation of Safety Information Manual.

REFERENCE BOOKS:

1) Industrial Safety. Rolland P. Blake II Ed., Prentice Hall Inc. New York 1953.
2) Chemical Hazards of the work place, Procter Hughes and Fischman. JB Lippincoff Co., Philadelphia (1978).
3) Industrial Safety Handbook W. Handley Mc-Graw Hill, London.
4) Protecting personnel at hazardous waste sites. SP Levine. Martin Butterworth Publishers, London. 1985.
5) Controlling in-plant air borne contaminants. John D. Constance, Marcel Dekker Inc. New York.
6) Techniques of safety management, Dan Paterson II Ed., McGraw Hill – Kogakusha. New Delhi. 1978.

COURSE OBJECTIVES:

1) To impart knowledge to the students on importance of ambient Environment safety and Industrial safety.
2) To Train the students on identification of potential work place hazards and accidents in industries.
3) To train the students on disaster mitigation and control industrial hygiene, personal safety accident etc.
4) To train the students to prepare accident reports.

Note: Question papers contain 5 questions with internal choice have to be set covering each unit. Each question carries 14 marks

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	3
CO2	2	3	3	2	3
CO3	3	2	3	2	3
CO4	3	2	3	2	3
CO5	3	2	3	2	3

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

ES 4.4 (22): ECO FRIENDLY TECHNOLOGIES

COURSE OUTCOMES: To prepare the students and gaining knowledge about different ecofriendly technologies, which is useful to the environmental Protection and resource management.

UNIT-I:

Nature, scope and application aspects of eco friendly technologies: Renewable Energy sources as eco friendly technologies.

Power generation - Wind Energy, Geothermal Energy, Ocean (Tidal) Energy, Hydropower, Biomass, Solar Power.

Learning outcomes: To prepare students how to prevent pollution by the use of ecofriendly technologies and gain knowledge about important natural resources.

UNIT-II:

Energy Efficiency of the technologies or practices within the establishment.

Technology transformation methods in domestic and Industrial application

Learning outcomes: To prepare the students prepare energy efficiency products and procedures for future generations to meet their needs.

UNIT –III:

Environmental Ethics, Use of technologies or practices for energy conservation, waste reduction, reuse and recycling.

Waste handling: waste disposal. Recycling of used plastic (Recycled Plastic Technologies).

Learning outcomes: The present unit is useful to provide knowledge regarding energy conservation reuse, recycle and environment ethics towards the environmental education.

UNIT-IV:

Organic farming and managing land resources.

Rain water harvesting and improvement of soil moisture and development of green cover.

Learning outcomes: To gain knowledge about natural resources to develop ecofriendly methods for agricultural practices, mining and wild life protection.

UNIT-V:

Biotechnological concepts of eco-friendly technology: Biosensors, Bio-films, Biofertilizers, Biopesticides, Bioplastics production, Biodiesel Production.

Nano technology and nono-particals role of in the pollution control equipment.

Learning outcomes: To understand the biotechnological applications in related to environmental management.

PRACTICALS:

1) Extraction of Biodiesel & Solvent Extraction method
2) Solar and Wind energy system mechanism.

3) Phytoremediation experiments for recovery of heavy metals
4) Electrophoresis process for estimation of proteins.
5) Preparation of Biofertilizers by Algae, fungi and Bacteria
6) Biopolymers production using Cellulose
7) Production house hold gas by using food waste and animal waste.

Note: Question papers contain 5 questions with internal choice have to be set covering each unit. Each question carries 14 marks

COURSE OBJECTIVES: This paper provides basic knowledge about ecofriendly technologies and recents advancements in sustainable models of energy by mainly focusing on renewable and energy efficient technologies. It also provides a comprehensive outlook about the recent concepts of ecofriendly technologies like Bio films, Bio sensors, Bio fuels, Bio plastics etc.

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	2
CO2	3	2	3	3	2
CO3	3	2	3	3	2
CO4	3	2	3	3	2
CO5	3	2	3	3	3

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

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