

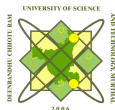
CENTER OF EXCELLENCE FOR ENERGY AND ENVIRONMENTAL STUDIES
DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE AND TECHNOLOGY

MURTHAL: 131 039(SONEPAT)

SCHEME OF STUDIES & EXAMINATIONS

Master of Science in Environmental Science (ES) (SEMESTER - I)

S. No.	Course No.	Course Title	Teaching Schedule			Marks				Credits	Duration of Exam.
			L	P/D	Total	Class Work	Theory	Practical	Total		
1	ES 101	Ecology And Biodiversity	4	0	4	50	100	--	150	4	3
2	ES 103	Environmental Chemistry	4	0	4	50	100	--	150	4	3
3	ES 105	Fundamental of Environmental Sciences	4	0	4	50	100	--	150	4	3
4	ES 107	Environmental Education	4	0	4	50	100	--	150	4	3
5	ES 109	Energy Resources	4	0	4	50	100	--	150	4	3
6	ES 111	Remedial Biology (for Mathematics students)	2	0	2	00	100	--	100	0	3
7	ES 113	Remedial mathematics (for Biology students)	2	0	2	--	100	--	100	0	3
8	ES 115	Environmental and Energy Lab I	0	8	8	50	00	50	100	3	3
Grand Total			22	8	30	300	600	50	950	23	--



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SCHEME OF STUDIES & EXAMINATIONS

Master of Science in Environmental Science (ES) (SEMESTER - II)

S. No.	Course No.	Course Title	Teaching Schedule			Marks				Credits	Duration of Exam.
			L	P/D	Total	Class Work	Theory	Practical	Total		
1	ES 102	Environmental Impact Assessment	4	0	4	50	100	--	150	4	3
2	ES 104	Solar Energy and Basics of Photovoltaics	4	0	4	50	100	--	150	4	3
3	ES 106	Environmental Laws	4	0	4	50	100	--	150	4	3
4	ES 108	Environmental Pollution	4	0	4	50	100	--	150	4	3
5	ES 110	Analytical Techniques	4	0	4	50	100	--	150	4	3
6	ES 112	Environmental and Energy Lab II	0	8	8	50	--	50	100	3	3
7	ES 114	Field Visit*	0	00	00	50	--	--	50	2	--
		Summer Training**	--	--	--	--	--	--	--	--	--
Grand Total			20	8	28	350	500	50	900	25	--

* Report based on field visit.

** Four week training in summer vacations



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MURTHAL: 131 039(SONEPAT)

SCHEME OF STUDIES & EXAMINATIONS

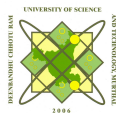
Master of Science in Environmental Science (ES) (SEMESTER - III)

S. No	Course No.	Course Title	Teaching Schedule			Marks				Credits	Duration of Exam.
			L	P/D	Total	Class Work	Theory	Practical	Total		
1	ES 201	Solid and Hazardous Waste Management	4	0	4	50	100	--	150	4	3
2	ES 203	Environmental Pollution and Control	4	0	4	50	100	--	150	4	3
3	ES	Elective- I	4	0	4	50	100	--	150	4	3
4	ES 205	Summer Training Evaluation	0	1	1	100	--	--	100	2	--
5	ES 207	Seminar	0	2	2	50	--	--	50	2	3
6	ES 213	Dissertation-I	0	8	8	50	--	100	150	4	--
Grand Total			12	11	23	250	300	200	750	20	--

List of Electives (III) Semester

ES 209 Natural hazards and disaster management

ES 211 Energy Policy and Planning



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SCHEME OF STUDIES & EXAMINATIONS

Master of Science in Environmental Science (ES) (SEMESTER - IV)

S. No.	Course No.	Course Title	Teaching Schedule			Marks				Credits	Duration of Exam.
			L	P/D	Total	Class Work	Theory	Practical	Total		
1	ES	Elective ó II	4	--	4	50	100	--	150	4	3
2	ES	Elective ó III	4	--	4	50	100	--	150	4	3
3	ES	Elective ó IV	4	--	4	50	100	--	150	4	3
3	ES 214	Dissertation-II	--	10	10	50	--	100	150	10	--
Grand Total			12	10	22	200	400		600	22	--

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

List of Electives: (IV) Semester

ES 202 Environmental Geosciences

ES 204 Environmental Microbiology and Biotechnology

ES 206 Water Resources

ES 208 Emerging Technologies for Energy and Environmental applications

ES 210 Nuclear Energy

ES 212 Solar Energy Utilisation

ES -101 ECOLOGY AND BIODIVERSITY

M. Sc. - ES (ENVIRONMENTAL SCIENCE) 1st Year (I - Semester)

L	T	P/D	Credits	Class Work	: 50 Marks
4	--	--	4	Examination (Theory/Practical)	: 100 Marks
				Total	: 150 Marks
				Duration of Examination	: 3 Hours

UNIT – I

History and scope of ecology, Levels of Organization Hierachy, trophic levels, productivity and energy flow, food chain, food webs, cycling of elements, Concept of carrying capacity, Sustainable development.

UNIT – II

Population Characteristics, Population Dynamics, Community Characteristics, community interactions , Autecology of Species, Biogeochemical Cycles- Nitrogen, Phosphorus, Sulfur, Carbon and Hydrological Cycle.

UNIT – III

Ecological succession, primary and secondary processes in successions, models of successions, Ecosystem- its kind, structure and function, Major ecosystem- Pond, Marine, Grassland, Forest and Desert.

UNIT – IV

Biodiversity - definition, hot spots of Biodiversity, strategies for Biodiversity Conservation, National Parks, Sanctuaries and Biosphere reserves, gene pool. IUCN red data book, International conventions, treaties and protocols for Biodiversity Conservation, Biodiversity in the welfare of mankind, Species concept.

Reference Books:

1. Global Biodiversity - W.R. L.IUCN
2. Ecology of natural resource - Ramade
3. Ecology and Environment - P.D. Sharma
4. Fundamentals of Ecology ó E. P. Odum
5. Concept of Ecology : Dash

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

ES -103 ENVIRONMENTAL CHEMISTRY

M. Sc. - ES (ENVIRONMENTAL SCIENCE) 1st Year (I - Semester)

L	T	P/D	Credits	Class Work	: 50 Marks
4	--	--	4	Examination (Theory/Practical)	: 100 Marks
				Total	: 150 Marks
				Duration of Examination	: 3 Hours

UNIT I

Fundamental of Environmental chemistry: Stoichiometry, Gibbsø energy, chemical Potential, chemical equilibrium acid base reactions, Solubility product, solubility of gases in water, Unsaturated and saturated hydrocarbons, radio nuclides

UNIT II

Chemical compositions of Air: Classification of elements, chemical speciation, Particles, Ions and radicals in atmosphere, chemical processes for formation of inorganic and organic particulate matter, thermo chemical and photochemical reaction in atmosphere Oxygen and Ozone chemistry, chemistry of air pollutants, photochemical smog

UNIT III

Water Chemistry: Chemistry of water, Concept of DO, BOD, COD, Sedimentation coagulation, filtration, redox potential

UNIT IV

Soil Chemistry: Inorganic and organic components of soil, Nitrogen pathways and NPK in soils

References

1. Environmental Chemistry - G.S. Sodhi
2. Environmental Chemistry - Mannhan
3. Fundamentalsø of soil science - Henry D. Futh.
4. Textbook of limnology - G.A. Cole
5. Environmental Chemistry - Sharma and Kaur.
6. Environmental Chemistry - A K De.
7. Environmental Chemistry ó B K Sharma.

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

ES -105 FUNDAMENTAL OF ENVIRONMENTAL SCIENCES
M. Sc. - ES (ENVIRONMENTAL SCIENCE) 1st Year (I - Semester)

L	T	P/D	Credits	Class Work	: 50 Marks
4	--	--	4	Examination (Theory/Practical)	: 100 Marks
				Total	: 150 Marks
				Duration of Examination	: 3 Hours

UNIT – I

Definition, principles and scope of Environmental Science. Physico-chemical and Biological factors in the Environment. Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere.

UNIT II

Mass and Energy transfer across the various interfaces, material balance. First and Second law of thermodynamics, heat transfer processes.

UNIT III

Earth, Man and Environment. Ecosystems, Pathways in Ecosystems. Geographical classification and zones. Environmental implication of energy uses, CO₂ emissions, global warming, air and thermal pollution.

UNIT IV

Natural resources, conservation and sustainable development.

Recommended Books

1. P.K.Nag, Engineering Thermodynamics, Tata Mc-Graw Hill, New Delhi, 1991.
2. J.B.Jones and R.E.Dugan, Engineering Thermodynamics, PHI, New Delhi, 1996
3. Y.A.Cengel and M.A.Boles, Thermodynamics: An Engineering Approach, Tata Mc-Graw Hill, New Delhi, 1998.
4. Bejan, Advanced Engineering thermodynamics, John Wiley, Toronto, 1988
5. M. W. Zemansky, Heat and Thermodynamics 4th Edn. McGraw Hill, 1968.
6. Ecology of natural resource ó Ramade
7. Ecology and Environment - P.D. Sharma

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

ES 107 ENVIRONMENTAL EDUCATION

M. Sc. - ES (ENVIRONMENTAL SCIENCE) 1st Year (II - Semester)

L	T	P/D	Credits	Class Work	: 50 Marks
4	--	--	4	Examination (Theory/Practical)	: 100 Marks
				Total	: 150 Marks
				Duration of Examination	: 3 Hours

UNIT I

Environmental ethics- Global imperatives, Global environmental problems-Ozone depletion, global warming and climatic change.

Current environmental issues in India: Context: Narmada Dam, Tehri Dam, Almethi Dam, Soil erosion, Formation and reclamation of Usra, Alkaline and Saline Soil

UNIT II

Waste lands and their reclamation, Desertification and its control, Vehicular pollution and urban air quality, Depletion of Natural Resources,

UNIT III

Waste disposal, recycling and power generation, Fly ash utilization, Water Crises-conservation of water

UNIT IV

Environmental Hazards, Eutrophication and restoration of Indian lakes, Rain water harvesting, Wetlands conservation, Epidemiological issues (i.e Goitre, Fluorosis, Arsenic)

Reference:

1. Environmental Management of Mining operations, ENVIS. N L Ramanathan and R Mehta.
2. Environment and management: An Indian Scenerio ó A B Chaudhary.
3. Assessment of water Pollution, S R Mishra.
4. Air Pollution A K Srivastava.

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks

ES 109 ENERGY RESOURCES
M. Sc. - ES (ENVIRONMENTAL SCIENCE) 1st Year (I - Semester)

L	T	P/D	Credits	Class Work	: 50 Marks
4	--	--	4	Examination	: 100 Marks
				(Theory/Practical)	
				Total	: 150 Marks
				Duration of Examination	: 3 Hours

UNIT I

Sun as source of energy, solar radiation and its spectral characteristics.

UNIT II

Fossils fuels-classification, compositions, Physico-chemical characteristics and energy content of coal, Petroleum and natural gas, Principles of generation of hydroelectric power, tidal, Ocean thermal energy conversion,

UNIT III

Wind Energy, Geothermal energy, Solar collector, Photovoltaic, solar pond, nuclear energy-Fission and fusion, magneto hydrodynamic power, Bio energy-energy from biomass and biogas, Anaerobic digestion, energy use pattern in different parts of the World.

UNIT IV

Environmental implication of energy uses, CO₂ emissions, global warming, air and thermal palliation, radioactive waste and radioactivity from nuclear reactors, Impacts of large scale exploitation of Solar, Wind, Hydro and Ocean energy.

Reference Books::

1. Twidell & AW. Wier, Renewable energy resources, English Language book, Society I E & FN Spon (1986).
2. Grey & O.K. Ganhus, Tidal power, Plenum Press, New York (1972).
3. Goswami. Alternative energy in agriculture, Vol. II CRC Press Inc. Florida, 1986.
4. E.R. Berman, Geothermal Energy; Noyes DATA Corporation, New Jersey, 1975.
5. D.A Stafford. & D.L. Hawke & R Horton, CRC Press Inc., Florida.
6. N.K. Bansal., M. Kleeman & M. Mielee, Renewable conversion technology, Tata McGraw Hill, New Delhi.

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

ES 111 Remedial Biology

M. Sc. - ES (ENVIRONMENTAL SCIENCE) 1st Year (I - Semester)

L	T	P/D	Credits	Class Work	: 00 Marks
2	--	--	0	Examination (Theory/Practical)	: 100 Marks
				Total	: 100 Marks
				Duration of Examination	: 3 Hours

Unit-I

Evolution of biosphere, Diversity of life forms. Biological communities, species interaction, Communities properties, Plant diversity and nomenclature with major classes of plants; Phytogeographical regions; Rare and threatened plants and exploration of plant wealth.

Unit-II

Animal diversity and categories of animals; Rare and threatened species of mammals, aves, reptiles, pisces etc.; Exploration and conservation of faunal wealth. Microbial diversity, bacteria, fungi, actinomycetes; Microbial diversity in man-made ecosystems and natural ecosystems. Importance of flora and fauna in nutrient cycling, its effect, degradation and metabolism.

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks

ES 113 Remedial mathematics

M. Sc. - ES (ENVIRONMENTAL SCIENCE) 1st Year (I - Semester)

L	T	P/D	Credits	Class Work	: 00 Marks
2	--	--	0	Examination (Theory/Practical)	: 100 Marks
				Total	: 100 Marks
				Duration of Examination	: 3 Hours

Elementary numerical analysis: roots of equations, systems of linear algebraic equations, solution of ordinary differential equations. Differentiation of simple mathematical functions- product rule, quotient rule and chain rule. Integration- by parts, substitution and by partial fractions. Linear differential equations and their solution. Introduction to Matrices and Determinants. Introduction to Vectors- addition, subtraction, multiplication of vectors. Equation of Straight Line and Solving Linear System of Equations.

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks

ES 115 ENVIRONMENT AND ENERGY LAB- I

M. Sc. - ES (ENVIRONMENTAL SCIENCE) 1st Year (I - Semester)

L	T	P/D	Credits	Class Work	: 50 Marks
--	--	3	3	Examination (Theory/Practical)	: 50 Marks
				Total	: 100 Marks
				Duration of Examination	: 3 Hours

1. To determine the pH value of soil, water and waste water sample.
2. To determine the turbidity of water and waste water sample.
3. To determine the conductivity of soil, water and waste water sample.
4. To determine the total alkalinity of the water sample.
5. To determine the total hardness of the water sample.
6. To determine the normality and morality of a given solution.
7. Determination of Thermal Efficiency of Flat Plate Collector.
8. Study of Thermal Performance of a Built In Storage Solar Water Collector.
9. Performance evaluation of wind generators.
10. Measurement of Intensity of solar radiation
11. Study of solar collector.
12. Characteristics of SPV system.

NOTE: Any five experiments from environment and five from energy will be conducted.

ES 102 ENVIRONMENTAL IMPACT ASSESSMENT

M. Sc. - ES (ENVIRONMENTAL SCIENCE) 1st Year (II - Semester)

L	T	P/D	Credits	Class Work	: 50 Marks
4	--	--	4	Examination (Theory/Practical)	: 100 Marks
				Total	: 150 Marks
				Duration of Examination	: 3 Hours

UNIT I

Introduction to environmental impact analysis, environmental impact assessment and environmental Management Plan.

UNIT II

EIA guidelines 1994. Notification of Government of India, Impact Assessment Methodologies, generalized approach to impact analysis Procedure for reviewing environmental impact analysis and statement. Guidelines for Environmental Audit

UNIT III

Introduction to environmental Planning, Base line information and prediction (land, water, atmosphere, energy etc), restoration and rehabilitation technologies, Land use policy for India

UNIT IV

Urban planning for India. Rural planning and Land use pattern, Concept and strategies of sustainable development, Cost-Benefit analysis, Environmental priorities in India and Sustainable development

ReferenceBooks :

1. Environmental Impact Assessment- John Glasson.
2. Methods of Environmental Impact Assessment - Morris and the rivell.
3. Environmental Impact Assessment - L. W. Canter.
4. Chemical principles of Environmental pollution - Lalloway and Ayers.
5. Industrial Environment - Assessment and strategy - S.K. Aggarwal

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

ES 104 SOLAR ENERGY AND BASICS OF PHOTOVOLTAICS

M. Sc. - ES (ENVIRONMENTAL SCIENCE) 1st Year (II - Semester)

L	T	P/D	Credits	Class Work	: 50 Marks
4	--	--	4	Examination (Theory/Practical)	: 100 Marks
				Total	: 150 Marks
				Duration of Examination	: 3 Hours

UNIT I

P-N junction Solar Cells: P-N diode structure, band diagram, the contact potential, junction analysis at equilibrium, p-n junction under reverse & forward bias, linear graded junction asymmetrical doped junction. Computation of parameters of depletion region, signal, breakdown voltage, dynamic resistance, diffusion capacitance & recombination current, Quantitative analysis of heterojunctions.

UNIT II

Photo voltaic effect, current generation in illuminated p-n junction, solar cell, characteristics & parameters, back surface field solar cells, photovoltaic module & arrays, energy storage.

UNIT III

Solar energy collectors: Flat plate solar energy collectors, selective absorber surface, Transparent plates, Collector energy losses, Thermal analysis of collectors, Air heating collectors. Collector performance testing, concentrating collectors. Thermal analysis of concentrating collectors. Tracking requirements.

UNIT IV

Thermal energy storage & solar Thermal Devices: Storage of solar energy water storage, stratification of water storage .Packed-bed storage. Solar pond chemical storage.

Reference Books:

1. Essentials of Solar Cells by R.K. Kotnala & N.P. Singh, Allied published Pvt. Ltds, New Delhi, 1986.
2. Semiconductor Devices by Nauro Zamluto . Mc Graw Hill 1989 (Int. Ed.)
3. Solid State Electronic Devices. III ed. By B.G. Streetman, Prentice Hall India Pvt. Ltd., N.D, 1991.
4. Solar cells by Martin Green. Pergamn Press.
5. Solar energy Thermal processes: Duffie & Buckman, Wiley & Sons, New York.
6. Solar energy by S.P. Sukhatma, Tata Mc Graw Hill, New Delhi.

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

ES 106 ENVIRONMENTAL LAWS

M. Sc. - ES (ENVIRONMENTAL SCIENCE) 1st Year (II - Semester)

L	T	P/D	Credits	Class Work	: 50 Marks
4	--	--	4	Examination (Theory/Practical)	: 100 Marks
				Total	: 150 Marks
				Duration of Examination	: 3 Hours

UNIT –I

Environment protection-issues and problems, International and National efforts for Environment Protection, Provision of Constitution of India regarding Environment (Article 48A and 58A).

UNIT –II

Environmental Policy Resolution, Legislation, Public Policy Strategies in Pollution Control, Wildlife Protection Act, 1972 amended 1991, Forest Conservation Act, 1980, Indian Forests Act (Revised) 1982, Air (Prevention and Control of Pollution) Act, 1981 as amended by Amendment Act, 1987 and Rule 1982, Motor Vehicle Act, 1988,

UNIT –III

The Water (Prevention and Control of Pollution) Act, 1974 as amended up to 1988 and Rules 1975, The Environment (Protection) Act, 1986 and Rules 1986.

UNIT –IV

Scheme of labelling of environmentally friendly products (Ecomark), Public Liability Insurance Act, 1991 and Rules 1991. Vienna Convention and Montreal protocol, Quoto Protocol, Earth Summit, Biodiversity conservation and Agenda 6 21.

ReferenceBooks :

1. Economics and Enviornment: Good Steie
2. Environmental Planning, Policies and Programmes in India: K D Saxena
3. Land Use and Enviornmnet: S M Mujtava
4. Environmental administration and Law: Paras Diwan.
5. Enviornmental Laws: V K Garg

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

ES 108 ENVIRONMENTAL POLLUTION

M. Sc. - ES (ENVIRONMENTAL SCIENCE) 1st Year (II - Semester)

L	T	P/D	Credits	Class Work	: 50 Marks
4	--	--	4	Examination (Theory/Practical)	: 100 Marks
				Total	: 150 Marks
				Duration of Examination	: 3 Hours

UNIT I

Air: Natural and anthropogenic source of pollution, Primary and Secondary pollutants, Transport and diffusion of pollutants, gas laws governing the behaviour of pollutants in the atmosphere, Acid rain, Air Quality standards

UNIT II

Water: types, Sources and consequences of water pollution, Water Crises-Conservation of water.

UNIT III

Soil: Physio-chemical and soil quality, heavy metals their interaction with soil components,

UNIT IV

Noise: Sources of noise pollution Measurements of noise and indices, effect of metrological parameters on noise propagation, Noise exposure levels and Standards.

Marine: Sources of Marine pollution

References:

1. Environmental Pollution ó Peavy and Rowe.
2. Environmental Pollution and Solution ó Asthana and Asthana.
3. Environmental radioactivity M Eisendbud.
4. Environmental Science ó A study of Inter relationships ó E D Enger and B E Smith.

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

ES 110 ANALYTICAL TECHNIQUES

M. Sc. - ES (ENVIRONMENTAL SCIENCE) 1st Year (II - Semester)

L	T	P/D	Credits	Class Work	: 50 Marks
4	--	--	4	Examination (Theory/Practical)	: 100 Marks
				Total	: 150 Marks
				Duration of Examination	: 3 Hours

UNIT I

Titrimetry, Gravimetry, Colourimetry, Chromatography, Gas Chromatography.

UNIT II

Spectrophotometry, Atomic Absorption Spectrophotometry, GLC, HPLC.

UNIT III

Electrophoresis. X ó ray fluorescence, X ó ray diffraction, Flame photometry.

UNIT IV

Scanning electron microscopy (SEM), Transmission electro microscopy (TEM), Raman spectroscopy, Atomic force microscopy (AFM).

Reference books:

1. B.E. Warren (1969). X-ray Diffraction. New York. ISBN 0-486-66317-5.
2. Blow D (2002). Outline of Crystallography for Biologists. Oxford: Oxford University Press. ISBN 0-19-851051-9.
3. Burns G.; Glazer A M (1990). Space Groups for Scientists and Engineers (2nd ed.). Boston: Academic Press, Inc. ISBN 0-12-145761-3.
4. Clegg W (1998). Crystal Structure Determination (Oxford Chemistry Primer). Oxford: Oxford University Press. ISBN 0-19-855901-1.
5. Scanning Electron Microscopy and X-ray Microanalysis: Third Edition- by [Joseph Goldstein](#).

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

ES 112 ENVIRONMENT AND LAB - II

M. Sc. - ES (ENVIRONMENTAL SCIENCE) 1st Year (II - Semester)

L	T	P/D	Credits	Class Work	: 50 Marks
--	--	3	3	Examination (Theory/Practical)	: 50 Marks
				Total	: 100 Marks
				Duration of Examination	: 3 Hours

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1. To determine residuals chlorine of given sample.
 2. To determine the hydroxyl carbonate and bicarbonate ions in a given sample.
 3. To remove both types of hardness from the given water sample.
 4. To determine the Calcium and Magnesium ions from the given water sample.
 5. To determine the organic carbon in given sample.
 6. To determine the total nitrogen in soil sample.
 7. Determine the I-V and P-V characteristics of PV module with varying radiation and temperature level.
 8. Determine the I-V and P-V characteristics of series and parallel combination of PV modules.
 9. Study of Performance of Solar Lamp.
 10. Study of solar hot air collector/ solar dryer.
 11. Performance evaluation of box type and concentrating type solar cooker.
 12. Charging and discharging characteristics of battery.

NOTE: Any five experiments from environment and five from energy will be conducted.