

UNIVERSITY OF RAJASTHAN,
JAIPUR

~~M.A./M.SC./M.COM~~

(~~ENVIRONMENT SCIENCE~~)

2013-2014 (PREVIOUS)-I/II SEMESTER

2014-2015 (FINAL)- III/IV SEMESTER

Prepared by

M
16/9

checked by


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5.3	73	3.3	53	1.3	31.4
5.2	72	3.2	52	1.2	30.6
5.1	71	3.1	51	1.1	29.8
5	70	3	50	1	29
4.9	69	2.9	49	0.9	28.2
4.8	68	2.8	48	0.8	27.4
4.7	67	2.7	47	0.7	26.6
4.6	66	2.6	46	0.6	25.8
4.5	65	2.5	45	0.5	25
4.4	64	2.4	43.8	0.4	20
4.3	63	2.3	42.6	0.3	15
4.2	62	2.2	41.4	0.2	10
4.1	61	2.1	40.2	0.1	5

The enhancement of CGPA by 0.01 will enhance percentage as given below:

Grade	SGPA or CGPA	Percentage enhancement on 0.01 CGPA enhancement
O	5.50 to 6.00	0.5
A	4.50 to 5.49	0.1
B	3.50 to 4.49	0.1
C	2.50 to 3.49	0.1
D	1.50 to 2.49	0.12
E	0.50 to 1.49	0.08
F	0.00 to 0.49	0.5

For example (i) CGPA of 5.73 is equivalent to 86.5%, (ii) CGPA of 5.12 is equivalent to 71.2%, (iii) CGPA of 4.34 is equivalent to 63.4%, (iv) CGPA of 3.26 is equivalent to 52.6%, (v) CGPA of 2.17 is equivalent to 41.04%, and (vi) CGPA of 1.11 is equivalent to 29.88%.

2. Eligibility:

A candidate who has secured more than 50% or CGPA of 3.0 in the UGC Seven Point scale [45% or CGPA 2.5 in the UGC Seven Point Scale for SC/ST/Non-creamy layer OBC] or equivalent in the Bachelor degree in Science or Engineering or Technology

as notified on
University website

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or Medicine or Pharmaceutical Science shall be eligible for admission to First Semester of a Master of Science course.

3. Scheme of Examination:

(A) Each theory paper EoSE shall carry 100 marks The EoSE will be of 3 hours duration. Part 'A' of theory paper shall contain 10 Short Answer Questions of 20 marks, based on knowledge, understanding and applications of the topics/texts covered in the syllabus. Each question will carry two marks for correct answer.

(B) Part "B" of paper will consist of Four questions with internal choice (except in cases where a different scheme is specifically specified in the syllabus_ of 20 mark each. The limit of answer will be five pages.

(C) Each Laboratory EoSE will be of four/six hour durations and involve laboratory experiments/exercises, and viva-voce examination with weightage in ratio of 75:25.

4. Semester Structure:

The details of the courses with code, title and the credits assign are as given below.

Abbreviations Used

Course Category

CCC: Compulsory Core Course

ECC: Elective Core Course

OEC: Open Elective Course

SC: Supportive Course

SSC: Self Study Core Course

SEM: Seminar

PRJ: Project Work

RP: Research Publication

Contact Hours

L: Lecture

T: Tutorial

P: Practical or Other

S: Self Study

Relative Weights

IA: Internal Assessment (Attendance/Classroom Participation/Quiz/Home Assignment etc.)

ST: Sessional Test

EoSE: End of Semester Examination

The medium of instruction and examination shall be English only.

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First Semester:

S. No.	Subject Code	Course Title	Course Category	Credit	Contact Hours Per week			EoSE Duration (Hrs.)	
					L	T	P*	Thy	P
1.	ENV 101	Fundamentals of Ecology and Environmental Science	CCC	6	4	2	0	3	0
2.	ENV 102	Ecosystems, Biodiversity and Remote sensing	CCC	6	4	2	0	3	0
3.	ENV 103	Environmental Pollution and Human Health	CCC	6	4	2	0	3	0
4.	ENV 104	Energy and Environment	CCC	6	4	2	0	3	0
5	ENV 111	Practical	CCC	12	0	0	18	0	4

Second Semester

S. No.	Subject Code	Course Title	Course Category	Credit	Contact Hours Per week			EoSE Duration (Hrs.)	
					L	T	P*	Thy	P
1.	ENV 201	Biotechnology and Environment	CCC	6	4	2	0	3	0
2.	ENV 202	Municipal Toxic and Hazardous Waste Management	CCC	6	4	2	0	3	0
3.	ENV 203	Environmental Laws and Policies	CCC	6	4	2	0	3	0
4.	ENV 204	Environmental Impact Assessment(EIA)	CCC	6	4	2	0	3	0
5.	ENV 211	Practical	CCC	12	0	0	18	0	4

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Third Semester

S. No.	Subject Code	Course Title	Course Category	Credit	Contact Hours Per week			EoSE Duration (Hrs.)	
					L	T	P*	Thy	P
1.	ENV 301	Microbiology and Environment	CCC	6	4	2	0	3	0
2.	ENV 302	Biostatistics and Environmental Systems Analysis	CCC	6	4	2	0	3	0
3.	ENV 303	Air Pollution Monitoring, Control Technology and Management	CCC	6	4	2	0	3	0
4.	ENV 304	Water Pollution Monitoring, Control Technology and Management	CCC	6	4	2	0	3	0
5.	ENV 311	Practical	CCC	12	0	0	18	0	4

Fourth Semester

S. No.	Subject Code	Course Title	Course Category	Credit	Contact Hours Per week			EoSE Duration (Hrs.)	
					L	T	P*	Thy	P
1.	ENV 401	Climate Change and Atmospheric Issues	CCC	6	4	2	0	3	0
2.	ENV 402	Disaster Management	CCC	6	4	2	0	3	0
3.	ENV 403	Environmental Physics	CCC	6	4	2	0	3	0
4.	ENV 404	Nuclear Waste Management	CCC	6	4	2	0	3	0
5.	ENV 411	Practicals	CCC	12	0	0	18		4

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ENV 101: Fundamentals of Ecology and Environmental Science

History and scope of Ecology and Environmental Science, structure and Functional aspects of Ecosystem (Food Chain, Food Web, Energy flows, Pyramids of Energy number and biomass, productivity and Biogeochemical cycling.

Structure and Composition of atmosphere, hydrosphere, Lithosphere and Biosphere, Mass and energy transfer across the various interfaces, materials balance. First law and second law of thermodynamics heat transfer process, scale of meteorology Pressure, temperature, Precipitation, humidity radiation and wind.

Environmental Chemistry; Stoichiometry, Bigg's energy, Chemical potential, Chemical Equilibrium, acid base reaction, Solubility product, Solubility of gases in water, the carbonate system, saturated and unsaturated hydrocarbons and radio nuclides. Principle and the environmental application of the analytical methods viz; Trimetri, Gravimetry, colourimetri, Spectrophotometry, Flame photometry, Chromatography, GLC, HPLC, Electrophoresis, X-ray fluorescence, X-ray diffraction.

ENV 102: Ecosystem, Biodiversity and Remote Sensing

Global distribution, types, structures, characteristic fauna and flora and economic importance of terrestrial ecosystems (Forests, Grasslands Deserts, Wastelands, Wetlands) Aquatic ecosystems (Lentic and Lotic types) and marine ecosystem.

Wildlife; Distribution of Wildlife at National and Global level, Wildlife trade, Wildlife sanctuaries, National Parks, Biosphere Reserves, Tiger Projects, Elephant Projects, Crocodile Project, Protected Area Networks. Traditional and modern tools of Identification of plant animals and microbes.

Concepts of Biodiversity, Economics of Biodiversity, causes of losses of Biodiversity, Hot spots of Biodiversity, modern techniques of Measurements and monitoring and biodiversity, L , B and r Alpha, Beta, and Gama diversity, shanon Index, *Ex-situ* and *In-situ* conservation of Biodiversity.

Remote sensing; Tools, Techniques and applications of remote sensing in monitoring of terrestrial and aquatic ecosystems, mining, deforestation, desertification and deterioration of marine ecosystem.

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ENV 103: Environmental Pollution and Human Health

Air Pollution and Human Health, Atmospheric composition and stratification, types of air pollutants, sources of emissions of air pollutants, air pollution and impacts on plants, air pollution and impacts on animals, air pollution and impacts on buildings and monuments.

Types of water Resources, Types of water Pollutants, sources of water pollutants, adverse impacts of water pollution on plants and animals, water standards for different kinds of uses. Economics of water, management of water Resources.

Water Borne, Water washed, water based and water related diseases. Diseases caused due to fluoride, nitrate and different metals. Control of water (borne, based, washed and related) diseases.

Noise Pollution, Source, causes and biochemical aspects of noise pollution, Sources and impacts of radiations on Environment and human beings. Causes of land and thermal pollution and related adverse impacts.

ENV 104: Energy and Environment

Various methods of energy (power) production, coal based and gas based thermal power generation and related impacts on environment.

Hydropower potential in our country, methods of hydropower generation, Geothermal power potential in country.

Nuclear power generation and related impacts on environment and plants, animals and human beings.

Energy demand and supply issues. Non-conventional methods of power generation, solar power, wind power, Nuclear fusion.

ENV111: Practicals

Based on exercises related with theory papers.

ENV201: Biotechnology and Environment

Genetic engineering for Environmental Conservation, Plasmids, isolation of plasmids, cloning of DNA.

Recombinant DNA technology and development of Genetically engineered microorganisms (GEMS), Polymerase Chain Reaction (PCR) and development of Gene probes for environmental remediation, use of GEM in bioremediation.

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Emerging technology for environmental bioremediation, Microelectromechanical systems (MEMs), Genosensor technology.

Integrated Treatment System, PCB treatment process, Enzymes contributing to sustainable industrial development.

ENV 202: Municipal, Toxic and Hazardous Waste Management.

Systematic generation of Municipal Solid Waste, methods of collection, treatment and disposal. Sanitary land filling techniques.

Classification and treatment of chemical, Industrial and Toxic waste, safe disposal techniques.

Reprocessing of Nuclear Waste, recovery of nuclear filling material for reuse, treatment and safe disposal of Nuclear Waste.

Classification, nature and characteristics of hazardous waste, techniques of hazardous waste treatment and safe disposal

ENV 203: Environmental Laws and Policies

Provisions of Environmental laws in Indian Constitution. Environmental Policies of India and Rajasthan. International Conventions, Protocols and Treaties.

International Organizations for Conservations of Environment; UNEP, WWF, UNESCO, IGBP, IUCN, GEF.

Indian Forest Act, 1927, Forest (Conservation) Act, 1980, Wildlife (Protection) Act, 1972 and Biological Diversity Act, 2002.

Water (Prevention and Control of Pollution) Act, 1974, cess Act, 1977.

Air (Prevention and Control of Pollution) Act 1981, Environmental (Protection) Act, 1986, National Environment Tribunal Act, 1995. National Environment Appellate Authority Act, 1997.

ENV 204: Environmental Impact Assessment (EIA)

Procedure and methodologies of EIA, Cost-benefit analysis, Environmental clearance procedure with particular reference to India. ISO, sustainable Development.

Environmental Impact Assessment, Environmental Auditing and Monitoring of Thermal Power projects.

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Environmental Impact Assessment, Environmental Auditing and Monitoring of Nuclear Power Projects, siting and Mitigation of adverse impacts of Nuclear Power Projects.

Environmental Impact Assessment, Environmental Auditing and Monitoring of mining projects, River Valley Projects, Tourism, Irrigation and Dams.

ENV 211: Practicals

Based on exercises related with theory papers.

ENV 301: Microbiology and Environment.

Basic Concept of bacteria, fungi, algae, Protozoa and viruses. Use of microorganisms in bioremediation of soil and oil spills.

Bio - fertilizers, Rhizobium, Azotobacter, Nitrogen fixation, vermitechnology and vermicomposting.

Xenobiotics, biodegradation of harmful (toxic) organic pollutants-pesticides, herbicides, chloroaromatic and benzene.

Applications of microbes in removal of heavy metals and other contaminants from water and soil.

ENV 302: Biostatistics and Environmental Systems Analysis

Basic elements and tools of statistical analysis; Probability, Sampling, Measurement and Distribution of attributes.

Arithmetic Geometric and Harmonic means, matrices.

Test of hypothesis and significance, analysis of variance.

Introduction to environmental system analysis; approach to development of model, Linear simple and multiple regression model, validation and forecasting. Models of population growth and interaction- Lotka volterra model, Leslie's matrix model, Point source stream Pollution model, box model, Gaussian Plane model.

ENV 303: Air Pollution monitoring, Control Technology and Management

Meteorological aspects of Air Pollutants dispersion, Temperature lapse rate and stability, wind roses, plume behaviour, Dispersion of air pollutants, solution to the atmospheric dispersion equation; Air Pollution management.

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Air sampling and monitoring (Ambient) collection of gaseous pollutants, collection of particulate pollutants, stack sampling monitoring and analysis of air pollutants.

Air pollution control techniques and equipments, particulate emission control by gravitational settling chambers, cyclone separators, fabric filters, electrostatic precipitator, wet scrubbers.

Control of specific gaseous pollutants; control of SO_x, control of NO_x, control of hydrocarbons, and controls of carbon mono-oxide.

ENV 304: Water Pollution Monitoring, Control

Technology and Management.

Categories of waste water, generation of waste water, water resource management.

Waste water sampling and monitoring; methods of analysis, determination of organic matter, inorganic substances, physical characteristics of bacterial measurements.

Waste water treatment, Basic processes of primary treatments; Pre treatment. sedimentation and floatation.

Secondary treatments; Activated sludge process, Trickling filter, sludge treatment and disposal. Advanced waste water treatment, N-removal, P-removal, Advanced Biological Systems, Chemical oxidation, Removal of suspended solids, Dissolved solids.

ENV 311:Practicals

Based on exercises related with theory papers.

ENV401: Climate Change and Atmospheric Issues

Greenhouse gases, Chemistry and Physics of Global warming, Climatic Models.

Climatic Change, Climate Change factors, carbon foot prints, carbon credits, carbon sequestration process.

Chemistry of upper ,lower and middle stratosphere, Chemicals responsible for ozone depletion, process of ozone depletion at different latitudes, impacts of ozone depletion, Alternative chemicals.

Chemistry of Acid rain, global quantum of acid rain, adverse impacts of acid rain, mitigation methods against acid rain.

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ENV 402: Disaster Management

Earth's process and disasters; Concepts of residence time and rates of natural cycles.

Catastrophic geological hazards; Floods, Landslides, Earth quakes, tsunami, Volcanic and avalanche.

Prediction and perception of the hazards and adjustments to hazardous activities.

Resources; minerals resources, Petroleum, oil and gas environmental impacts of exploitation and processing. Water resources, Global water Balance, Ice sheets and fluctuation of sea levels, Hydrological cycles. Environmental geochemistry.

ENV 403: Environmental Physics.

Characteristics of ultrasonic fields and their production and management. Piezoelectric induction and Ultrasonic fields configuration. Nonlinear Ultrasonic fields composition, dependence of ultrasound absorption in critical binary liquid system, particle coagulation by means of ultrasound. Acoustic Radar measurement of Acoustic Non-linearity parameters of sea water, Ultrasonic temperature measurement.

Laser applications, Laser light transmission through the atmosphere, molecular absorption and particle scattering techniques for detection of molecules of pollutants by absorption of laser, radiation, Remote monitoring capabilities of laser systems, single and double ended systems, LIDARM Raman LIDAR, Resonance LIDAR.

Microwaves; Environmental aspects of microwave radiations, Microwave decomposition of toxic vapour stimulants, effects of Radio frequency electrical seed treatment, radio frequency electrical fields for stored grain insect control, electromagnetic energy for insect control.

Electrical detection of airborne particulate using surface ionization techniques, submicron and centimicron particulate detection. Characteristics of electromagnetic precipitation of fuel oil ash.

ENV 404: NUCLEAR WASTE MANAGEMENT

Nuclear Fuel Cycle and Radioactive Waste Generation

Radioactive wastes from fuel cycle activities-mining and milling. uranium enrichment, fuel fabrication, reactor operation, and reprocessing. Classification and amount of radioactive

wastes-low-level wastes, high-level wastes: radioactivities, toxicity.

Radioactive Waste Treatment Technologies

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Volume reduction and solidification of LLW. Spent fuel storage. Vitrification of reprocessing HLW. Solidification of TRU wastes. Effect of nuclear material recycling on waste generation.

Radioactive Waste Disposal Technologies

Disposal technologies for LLW. Disposal technologies for HLW. Multi-barrier concept. Heat analysis for buried HLW.

Safety Assessment of Geological Disposal

Waste management policy and regularity issues: ethical aspects and stakeholder engagement in radioactive waste management different disposal approaches and disposal site characterization; the concept of surface and geological disposal.

ENV 411: Practicals

Based on exercises related with theory papers.

Suggested Readings : List of Books

1. Ecology and our Endangered Life Support System. Odum, E.P. 1989. Sunderland, Mass, ISE.
2. Living in the Environment, Principles, connections and solutions. Miller, G.T.(Jr). 2004. Books/Cole-Thomson Learning, USA.
3. Principles of Environmental Science; Inquiry and Applications, Cunningham, W.P. and Cunningham, A. 2003. Tata McGraw-Hill publishing Company Ltd. New York, USA.
4. Climatology; An atmospheric Science. Oliver, J.E. and Hidore, J.J. 2003. Pearson Education, Singapore.
5. Understanding weather and climate. Aguado, E and Burt, J.E. 2001. Prentice Hall, N.J. USA.
6. Atmospheric Chemistry and Global change, Brasseur, G.P., Orlando, J.J. and Tyndall, G.S. 1999. Oxford University Press, New York, USA.
7. Geosystems, Christopherson, R.W. 2000. Prentice Hall, N.J. USA.
8. World Regional Geography: A Development Approach. Clawson, D.L. 2001. Prentice Hall, N.J. USA.
9. Introduction to Meteorology, Cole, F.W. 1980. John Wiley and Sons, New York, USA.
10. Principles of Atmospheric Physics and Chemistry. Richard, G. 1995. Oxford University Press, New York, USA.
11. Global environmental change. Hidore, J.J. 1996. Prentice Hall, N.J. USA.
12. Our changing Planet. Mackenzie, F.T. 1998. Prentice Hall, N.J. USA.
13. Chemistry of Atmosphere. Wayne, R.P. 1999. Oxford University Press.
14. World Geography. Hussain, 2004. Rawat Publication, New Delhi.

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15. Ecology; Theories and applications. Stiling,P.2002. Prentice Hall of India Pvt. Ltd. New Delhi.
 16. Atmosphere and Air Pollution Control Techniques. Khan,T.I. 2004.Avishkar Publishers, Jaipur.
 17. Air Pollution Control Theory Crawford, . 2002 Tata Mc Graw Hill,New Delhi.
 18. Ecology in practice,Castric and Barker,1984.UNESIO Paris.
 19. Environmental Impact of Production and use of Enewrgy, Prakash,I 1988.Scientific publishers, Jodhpur.
 20. Desert Ecology. Prakash 1988.Scientific Publishers Jodhpur.
 21. Disease Ecology, Learonth, A. 1988.Slackwell,Oxford.
 22. Environmental and Natural Resources Economics Titenberg, T. 1986. Foreseman and Co. London.
 23. State of the world. World watch Institute Annual Reports.
 24. Our Common Fitire.1998 Oxford Universities Press.
 25. Global Biodiversity Conservation Measures. Khan, T.I. and Al-Ajmi, D.N. 1999 Pointer Publishers,Jaipur.
 26. Hydrogen Energy; Economics and Social Challenges. Ekins, P 2010.RFF Press London.
 27. The Economics of Waste. Porter,R.C. 2002.RFF Press, London.
 - 28 Climate Change Economics and Policy. Ioman,M.A.2001.RFF Pres, London.
 29. The Economics of Ecosystems and Biodivrsity. Ecological and Economic foundation. Earth scan 2010.RFF Press. London.
 30. Conserving and valuing ecosystem services and Biodiversity. Ninan, K.N. 2008 RFF Press, London.
 31. The Trade in wildlife. Oldfield, S 2002. RFF Press London.
- .22.
32. Small is profitable. Lovins, A.B. 2003. RFF Press, London.
 33. The Solar economy. Scheer, H.2004 RFF Press London.
 34. Environmental Principles and Policies, Beder, S. 2006, RFF Publishers, London.
 35. Managing Solid Wastes in Developing Countries, Holmes, J.R.1984 John Wiley and Sons, New York,USA.
 36. Solid Waste management in developing Countries. Wilson, D.C. and Nair, C 1991 Singapore.
 37. Introduction to Energy. Cassedy E.S. and Grossman,p.z.1998 Cambridge University press. N.Y.
 38. Prospects for Sustainable energy cassedy, E.S. jr.2000 Cambridge University Press U.K.
 39. Ecology Facts. Allaby . 1986.Bridge House, London.
 40. Ecology colin van X,P 1986.John Wiley and sons NY
 41. Environmental Ipaact Assessment. Wathen,P. 1988.unwin Hyman, Boston.
 42. Industry Environment and the law. Shastri,S Bakre,P.P. andKhan,T.I.1996.RBSA Publishers, Jaipur.
 43. Water and sanitation.Bourne,P.G.1984.Academic press. New York.
 44. Biotechnology and Waste Water treatment Cambridge University press, London.

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45. Principles of Water quantity Control. Tebbut, T.H.Y. 1983.WHO.
46. Waste Water Engineering Metcalf and Eddy. 1972. McGraw Hill, N.Y.
47. Air pollution Control equipments, Brauer, H and varma, Y.B.G. 1981. Springer, Berlin.
48. Nuclear Development: Advanced Nuclear Fuel Cycles and Radioactive Waste Management. OECD,Nuclear Energy Agency Published by: OECD Publishing.
49. Radioactive Waste: The problem and its management, K.R. Rao.CURRENT SCIENCE, 1534 VOL.81,No.12, 25 DECEMBER 2001.

K.R. Rao
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