

SHIVAJI UNIVERSITY, KOLHAPUR.



Accredited By NAAC with 'A' Grade
CHOICE BASED CREDIT SYSTEM

Syllabus For

B.Sc. Part - II

Environment Science (Entire)

SEMESTER III AND IV

(Syllabus to be implemented from June, 2020 onwards)

B.Sc. Part - II
Environment Science (Entire)

SEMESTER III AND IV

(Syllabus to be implemented from June, 2020 onwards.)

- ❖ Guidelines shall be as per B. Sc. Regular Programme
- ❖ Rules and Regulations shall be as per B.Sc. Regular Programme except CBCS R.B.Sc.3 Structure of Programme and List of Courses.
- ❖ Preamble :

This syllabus is framed to give sound knowledge with understanding of Environment science to undergraduate students of

B.Sc. Environment Science (Entire) Programme. Students will learn Environment Science as a separate course (subject) from B. Sc. I.

The goal of the syllabus is to make the study of Environment Science popular, interesting and encouraging students for higher studies including research.

Structure of B. Sc. Environment Science (Entire) Programme Sem III & IV
Structure – II

S E M E S T E R – III (Duration – 6 Months)																			
Sr. No.	Course (Subject) Title	TEACHING SCHEME						EXAMINATION SCHEME											
		THEORY				PRACTICAL			THEORY				PRACTICAL						
		Credits	No. of lectures	Hours		Credits	No. of lectures	Hours	Hours	Max	Total Marks	Min	Hours	Max	Min				
1	DSC-C1	2	3	2.4		4	8	6.4		2	50	100	35	PRACTICAL EXAMINATION IS ANNUAL					
2	DSC-C2	2	3	2.4						2	50								
3	DSC-C3	2	3	2.4						4	8	6.4	2		50	100	35		
4	DSC-C4	2	3	2.4									2		50				
5	DSC-C5	2	3	2.4						4	8	6.4	2		50	100	35		
6	DSC-C6	2	3	2.4									2		50				
7	AECC-C	4	4	3.2						---	---	---			---	---			
	TOTAL	16	22	17.6						12	24	19.2			300	---			
S E M E S T E R – IV (Duration – 6 Months)																			
1	DSC-D1	2	3	2.4		4	8	6.4		2	50	100	35		As per BOS Guide-lines	100	35		
2	DSC-D2	2	3	2.4						2	50								
3	DSC-D3	2	3	2.4						4	8	6.4	2					50	100
4	DSC-D4	2	3	2.4									2	50					
5	DSC-D5	2	3	2.4						4	8	6.4	2	50				100	35
6	DSC-D6	2	3	2.4									2	50					
7	AECC- C AECC- D	---	---	---						---	---	---	3	70	100	25	---	---	---
	TOTAL	12 28	18 40	14.4 32						12 24	24 48	19.2 38.4		400 700		---			
• Student contact hours per week : 32 Hours (Min.) • Total Marks for B.Sc.-II (Including EVS): 1000																			
• Theory and Practical Lectures : 48 Minutes Each • Total Credits for B.Sc.-II (Semester III & IV) : 52																			
• DSC : - Discipline Specific Core Course : All papers are compulsory.																			
• AECC- Ability Enhancement Compulsory Course (C) : Environmental Studies: EVS (Theory – 70 & Project – 30 Marks)																			
• Practical Examination will be conducted annually for100 Marks per course (subject).																			
• There shall be separate passing for theory and practical courses also for Environmental Studies.																			

CBCS B.Sc. Environment Science: Part 2 (Sem III & IV)

Course code	Name of Course	Course code	Name of Course
Sem III		Sem IV	
DSC-C1	Disaster Management-1 (Natural)	DSC-D1	Environmental Microbiology
DSC-C2	Biostatistics	DSC-D2	Environmental Management System & Audit
DSC-C3	Environmental Ethics and Environmental Issues	DSC-D3	Environmental Engineering - 2[waste water]
DSC-C4	Environmental Engineering - 1[water]	DSC-D4	Environmental Education & Policy
DSC-C5	Environmental Impact Assessment	DSC-D5	Environmental Economics
DSC-C6	Environmental Biotechnology	DSC-D6	Disaster Management-II (Man made)
AECC – C	Environmental Studies (Theory)	AECC – D	Environmental Studies (Project)

AECC-C: - Ability Enhancement Compulsory Course: Environmental Studies**Practical**

DSC-P5	Lab Course V (Based on DSC-C1, DSC-C2, DSC-C3, DSC-C4)	DSC-P7	Lab Course VII (Based on DSC-D3, DSC-D4, DSC-D5, DSC-D6)
DSC -P6	Lab Course VI (Based on DSC-C5, DSC-C6, DSC-D1, DSC-D2)		

Semester III
Disaster Management I (Natural) – Paper I
(DSC-C1 – Disaster Management-1 (Natural))
Credits 2 (Marks 50) Hours 30, 37.5 Lectures of 48 minutes

Course Outcome:

1. Understand the concepts, effects and mitigation measures of natural disasters.
2. Get acquainted with assessment of hazards and legal aspects.

Unit	Lecture Hours
Unit I	15
A: Introduction to natural disasters: Definition and types of natural disasters, concept and conditions of hazards, vulnerability, risk Guidelines for hazard assessment and vulnerability analysis, Assessment in sudden onset emergencies, assessment in slow onset emergencies Disaster vulnerability in India and future trends	8
B: Flood, Drought, Tsunami, Earthquakes Flood: Flood risk mapping, flood plain management, watershed management, climate variability and change, flood forecasting, flood mitigation Droughts: Definition, causes and types of drought, effects and mitigation of droughts, case studies Tsunami: History and causes of Tsunami, effects of Tsunami, warning and monitoring of Tsunami, mitigation of Tsunami	7
Unit II	15
A: Tornadoes, Hurricanes, Earthquakes Types of hurricanes, Katrina and Rita hurricanes, Effects of winds on buildings, Debris management planning Introduction to tornado, formation of tornado, monitoring and predicting tornadoes, types of tornadoes and mitigation measures Earthquakes: warning and effects of earthquakes, preventive measures of earthquakes	8
B: Natural disaster mitigation and legal aspects Community health and awareness, safety and preparedness for emergencies, Practical and sustainable approaches to disaster recovery National Calamity Management Act, State Disaster Management Act Natural disaster management in national development Disaster management in India Disaster Management ethics	7

SUGGESTED BOOKS:

1. Talwar A. K. and Juneja Satish (2009). Natural Disaster Management, Commonwealth Publication, New Delhi
2. Kapur Anu, Neeti, Meeta, Deeptima, Roshani, Debanjali., Disasters in India, Rawat Publications, New Delhi
3. Brenda D. Philips (2016). Disaster recovery. CRC press, London.
4. Arvind Kumar (2006). Disaster Management, Amol publications, New Delhi.
5. Prabhas C. Sinha (2006) Disaster Relief, SBS Publishers & Distributors PVT. Ltd., New Delhi.

6. Gupta Manisha (2018), Disaster Management, DND Publications, Jaipur
7. Gaur R.C. (2018), Environmental Engineering and Disaster Management, New Age International Publishers, Delhi

Semester III
Biostatistics – Paper II
(DSC-C2 – Biostatistics)
Credits 2 (Marks 50) Hours 30, 37.5 Lectures of 48 minutes

Course Outcome:

1. Understanding use of statistical methods for environmental studies.
2. Understanding methods of collection and analysis of data.

Unit	Lecture Hours
Unit I	15
A: Introduction to statistics: Definition and functions of statistics, origin of statistics, statistical methods, characteristics of statistical data, importance of statistics in biological and physical sciences, limitations of statistics, Types of data, methods of collecting data: primary and secondary data, classification and organization of data Vital statistics: Introduction, measures of mortality, standard death rate, measures of fertility, life tables	7
B: Diagrammatic representation and measures of central tendency Bar graph, histogram, frequency polygon, pie chart, Ogive curve Introduction to measures of central tendency, Arithmetic mean, weighted arithmetic mean, geometric mean, harmonic mean, mode, median: introduction, merits and demerits, relation between mean, mode and median	8
Unit II	15
A: Measures of dispersion: Introduction and characteristics of good measure of dispersion, absolute and relative measures, Mean deviation and coefficient of mean deviation, mean deviation in continuous and discrete series, merits and demerits Range and co-efficient of range Quartile deviation and co-efficient of quartile deviation Standard deviation: standard deviation for discrete and continuous series, merits and demerits Variance, coefficient of variation	7
B: Sampling, Coerrelation and regression Introduction to sampling, steps involved in sampling, types and methods of sampling Correlation and regression: relation between variables, linear regression analysis, regression analysis of grouped data, correlation analysis, Karl Pearson's coefficient of correlation	8

SUGGESTED BOOKS:

1. Gupta C. B., Gupta Vijay (2010) An Introduction to Statistical Methods, Asian Books Pvt. Ltd., New Delhi
2. Bhowal M. K., Barua Pronob (2006) Statistics. Daya Publishing House, New Delhi.
3. Gupta S. P. (2005), Statistical Methods, Sultan Chand and Sons Publishers, New Delhi

4. Gaur A.S., Gaur S.S. (2006), Statistical Methods for Practice and Research, Sage Publication, New Delhi
5. Medhi J. (2006), Statistical Methods, New Age International Publishers, New Delhi
6. Rastogi V. B., (2009) Fundamental of Biostatistics, Ane Books Pvt. Ltd., New Delhi

Semester III
Environmental Ethics and Environmental Issues – Paper III
(DSC-C3 – Environmental Ethics and Environmental Issues)
Credits 2 (Marks 50) Hours 30, 37.5 Lectures of 48 minutes

Course Outcome:

1. Understand the causes and effects of various environmental issues.
2. Get acquainted with environmental ethics from Indian perspective.

Unit	Lecture Hours
Unit I	15
A: Introduction to environmental issues: Environmental problems i.e. indoor and workplace: water and sanitation, overcrowding, accident, garbage, disease vectors, hazardous waste Global environmental issues with case studies Development and environmental issues in India	8
B: Urbanization and environmental issues Demographic profile, Population density, Impact of urbanization on environment Denundation of rural population and urbanisation and environmental protection Role of NGOs in tackling environmental issues, cities and ecological sustainability, city problems within global perspective	7
Unit II	15
A: Environmental ethics Introduction to environmental ethics, concept and history of environmental ethics, relation between environment and people, spirituality and environmental ethics, population and environmental ethics Challenges to the world environmental ethics Human nature interaction in third world country	8
B: Environmental ethics from Indian perspectives: Significance of Indian traditions for environmental ethics, Women in forest, Indian heritage of conservation ethics, environment protection in Indian culture: cultural evolution, nature worship, tribal tradition, reservation of forest, movements for environmental protection Population control in the light of environmental protection	7

SUGGESTED BOOKS:

1. Sayeed Unisa (2016), Population, health and environment, Rawat publications, Jaipur.
2. S.C.Naik (2005), Society and Environment, Oxford & IBH Publishing Co.Pvt.Ltd., New Delhi.
3. Prakash Chand Kandpal (2018), Environmental Governance in India, Sage Publications, London.
4. Dr. M.N.Madhyastha (2003), Prospects and problems of Environment, Daya Publishing house, Delhi.

5. G. Tyler Miller,Jr. (2007), People and Environment, Cengage learning India Ptd. Ltd., New Delhi.
6. George A. James(1999), Ethical Perspectives on Environmental issues in India,A.P.H. Publishing corporation, New Delhi.
7. Diana Mitlin David Satterthwaite Environmental problems in third world cities, Earthscan publications Ltd., London.

Semester III
Environmental Engineering-1 (Water) – Paper IV
(DSC-C4 – Environmental Engineering-I (Water))
Credits 2 (Marks 50) Hours 30, 37.5 Lectures of 48 minutes

Course Outcome:

1. Understand the demand of water for various purposes.
2. Understand various steps involved in water treatment.

Unit	Lecture Hours
Unit I	15
A: Introduction to Environmental Engineering Introduction to environmental engineering, rate of demand, factors affecting rate of demand: domestic, civic, industrial, business, loss etc, Population forecasting and methods of population forecasting Surface runoff, precipitation, measurement of rainfall, points to be considered for selecting rain gauge	8
B: Sedimentation and Coagulation Theory of sedimentation, types of sedimentation tanks, design aspects of continuous sedimentation tanks Coagulation of water, principles of coagulation, usual coagulants, feeding of coagulants: dry feeding and wet feeding,	7
Unit II	15
A: Filtration and Disinfection Introduction to filtration, theory of filtration, classification of filters i.e. slow sand filters and rapid sand filters, essential parts of filter, pressure filters, advantages and disadvantages of pressure filters Disinfection: introduction to disinfection, methods of disinfection, Chlorination, properties of chlorine, applications of chlorine	7
B: Other Methods of Water Treatment: Flow diagram of general water treatment plant Colour, odour and taste removal: aeration, treatment by activated carbon, use of copper sulphate Iron and manganese removal, fluoridation	8

SUGGESTED BOOKS:

1. Mathur Shruti, Kumar Rajendra (2017), Water on earth, Rawat Publication, New Delhi
2. Rangwala S.C., Rangwala K.S. (2004), Water supply and sanitary engineering, Charotar Publishing House, Anand
3. Basak N.N. (2012), Environmental Engineering, Tata McGraw Hill Education Private Limited, New Delhi
4. Rao M.N., Datta A.K. (2018), Waste water treatment, CBS Publishers and Distributors Pvt Ltd, New Delhi
5. Mark J. Hammer (2015), Water and wastewater, Pearson Publication, Noida

6. Mackenzie L. Davis, David A. Cornwell (2014), Introduction to environmental engineering, New York
7. R. Parker, N. Morris, F.N. Fair, S.C.Bhatia (2008), Waste water engineering, CBS Publishers and Distributors, New Delhi
8. Patra K. C. (2002), Hydrology and water resources engineering , Narosa publishing house, New Delhi
9. Metcalf and Eddy (2003), Waste water engineering treatment and reuse, Tata McGraw Hill, New Delhi

Semester III
Environmental Impact Assessment– Paper V
(DSC-C5 – Environmental Impact Assessment)
Credits 2 (Marks 50) Hours 30, 37.5 Lectures of 48 minutes

Course Outcome:

1. Understand the need and objectives of EIA.
2. Understand the impacts of various developmental activities on environment.

Unit	Lecture Hours
Unit I	15
A: Introduction to EIA Definition, concept, objectives and scope of EIA, Elements and components of EIA, Baseline studies in EIA: pre and post monitoring EIA in developed and developing countries, Public participation in EIA Uncertainties in EIA, EIA protocol and Term of Reference, EIA and legal aspects	7
B: Methodologies and impacts of EIA Impacts of EIA: negative and positive, tangible and intangible, reversible and irreversible, primary and secondary Methodologies of impact prediction: matrix methodology, network methodologies, checklist methodologies Public participation in EIA, identification of publics, selection of public participation techniques, Public hearing	8
Unit II	15
C: Prediction of impact on air and water: Identification of types and quantities of air pollutants and their impacts, impact predictions: mass-balance approaches, box model approach, air quality dispersion model, Identification and incorporation of mitigation measures Identification of surface water quality, impact predictions: mass balance approach, aquatic ecosystem modelling approach, mitigation measures	7
D: Prediction of impacts on soil, groundwater and socioeconomic environment; Identification of impacts on soil and groundwater, qualitative and quantitative approaches, assessment of impact significance, mitigation of impacts Prediction and identification of socio-economic impacts, education service impacts, traffic and transportation system impacts, Human health impacts EIA report writing	8

SUGGESTED BOOKS:

1. Canter L.W. (1996) Environmental Impact Assessment, McGraw-Hill, Inc., New Delhi.

2. A.K. Shrivastava (2017) Environmental Impact Assessment, A P H Publishing Corporation, New Delhi.
3. R.R. Barthwal (2012) Environmental Impact Assessment, New age international Publishers, New Delhi.
4. G. Madan Mohan (2008) Environmental and Sustainable Development, omega Publication, New Delhi.
5. M. Anji Reddy (2019) Environmental Impact Assessment theory and Practice, BS Publication, Hyderabad.
6. R.R. Barthwal (2002) Environmental Impact Assessment, New age International publishers, New Delhi.

Semester III
Environmental Biotechnology– Paper VI
(DSC-C6– Environmental Biotechnology)
Credits 2 (Marks 50) Hours 30, 37.5 Lectures of 48 minutes

Course Outcome:

1. Understand the need and importance of biofuels, biopesticides and vermicomposting.
2. Inculcation of biotechnology approaches to solve environmental problems.

Unit	Lecture Hours
Unit I	15
A: Introduction to environmental biotechnology: Introduction to environmental biotechnology, scope and objectives of environmental biotechnology, Vermicomposting: introduction, composting process, factors affecting composting, characteristics of vermicompost and benefits Biofuels: Hazards due to fossil fuels, biofuels as alternative to fossil fuels, ethanol, biodiesel, biogas	7
B: Biopesticides and biotechnology in forestry Biopesticides: introduction and approaches of biological control of pest, various bacterial insecticides, advantages and disadvantages of microbial insecticides, Use of pheromones for pest management, Biological control of weeds Biotechnology in forestry and wasteland development: tree improvement through biotechnology, tissue culture techniques	8
Unit II	15
A: Biotechnology in combating environmental pollution Air pollution and its control through biotechnology, methods of biofiltration Xenobiotics in environment, oxic and anoxic degradation of xenobiotics, Biotechnological approach to address environmental problems	7
B: Genetically Modified Organisms and IPR: Genetically Modified Organisms in environment, effects of GMO's on environment, effects on human health, biosafety management Environmental biotechnology and Intellectual Property Rights Genetic engineering, concept of bio-safety, role of biotechnology in conservation of species	8

SUGGESTED BOOKS:

1. Sohal H.S (1994), Environment and biotechnology, Ashish Publishing house, New Delhi.
2. T. Srinivas (2008), Environmental Biotechnology, New age International Publishers, New Delhi.
3. H.K. Das (2017), Textbook of Biotechnology, Wiley Publications, New Delhi.
4. Scragg Alan (2011), Environmental Biotechnology, Oxford University Press, New York

5. Buddola Viswanath, Environmental Biotechnology, Narosa publication house, New Delhi.
6. Colin R., Kristiansen B.(2001),Basic Biotechnology,Cambridge University press, UK.
7. Bhattacharyya B. C., (2010), Environmental biotechnology, Oxford university press, New Delhi.
8. Jha Ashwini (2017), Environmental Biotechnology Principles and applications, Anmol Publication Pvt. Ltd., New Delhi.
9. A.K. Chatterji, (2011), Introduction to Environmental Biotechnology, PHI Private Ltd. , New Delhi.

Semester IV
Environmental Microbiology– Paper I
(DSC-D1 – Environmental Microbiology)
Credits 2 (Marks 50) Hours 30, 37.5 Lectures of 48 minutes

Course Outcome:

1. Understand the basic concepts and scope of environmental microbiology.
2. Study the mechanism of various waterborne and airborne diseases.

Unit	Lecture Hours
Unit I	15
A: Introduction to Microbiology Definition, Scope and history of Microbiology Types of Microbiology: Medical, Agricultural, Industrial, Food Microbiology Preservation and Maintenance of Microbial culture, Terms used in Microbiology: Uni cellular and Multi cellular organisms, Algae, Fungi, Protozoa, Viruses, Bacteria Environmental microbiology, interrelations with other fields of microbiology and applications	7
B: Water Microbiology Introduction, Human diseases associated with water and their classification, Microbial agents associated with water borne diseases, Prevention and control of water borne diseases Role of micro- organisms for the treatment of waste water Most probable number	8
Unit II	15
A: Air Microbiology Introduction to aerial microbiology, Transport and deposition of micro-organisms in air, Types of air borne microbial diseases and their causal agents, Mode of transmission, Allergic disorders by air micro-flora, Indoor and out door air microbiology, Air sanitation: Ventilation, safety cabinets, disinfectants, sprays, Electro static precipitation, Bio-aerosol control in laboratory	8
B: Soil Microbiology Introduction to soil microbiology: Micro flora of soil, their functions and factors affecting their population: Bacteria, actinomycetes, Fungi, Algae, Protozoa, Viruses. Methods of studying Ecology of Soil microflora: Sample collection, Sample processing, Isolation of culture	7

SUGGESTED BOOKS:

1. Mark Coyne (1999), Soil Microbiology, Delmar Thomson learning, New York.
2. K. Vijaya Ramesh (2004), Environmental microbiology, MJP Publishers, Chennai.

3. I Edward Alcamo (1998), Microbiology, Schaum's outline series, McGRAW- Hill, New Delhi.
4. G. Rangaswami (1993), Agricultural Microbiology, Prentice- Hall of India Ptv. Ltd., New Delhi.
5. P.D. Sharma (2005), Environmental Microbiology, Narosa Publishing House, New Delhi.
6. RG Buckley 2016), Environmental Microbiology, CBS Publishers & Distributors, New Delhi.

Semester IV
Environmental Management System and Audit– Paper II
(DSC-D2 – Environmental Management System and Audit)
Credits 2 (Marks 50) Hours 30, 37.5 Lectures of 48 minutes

Course Outcome:

1. Understand the scope, objectives and need of environmental auditing.
2. Understand the importance of Environment Management System.

Unit	Lecture Hours
Unit I	15
Introduction to Environmental Auditing: Preamble, scope and objectives of environmental auditing, Applicability of statutory environmental statement audit, Qualities of an environment auditor, Contents of EA reports. Preparation of documents for consent to establish/ consent to operate / Renewal	8
Frame and Tools of Environmental Auditing: Principle elements of an environmental audit: External audit and Internal audit, Need of Environmental Audit, Aims of Environmental Auditing. Framework for a comprehensive audit: Identifying the auditors, Consultants, In-house auditing, Combining the external auditor and in-house staff, Community involvements. Tools for Auditing.	7
	15
Types and Procedure of Environmental Auditing: Background of auditing strategy, type of audit: Approach A & B, Environmental audit in India: Background of environmental audit, onjectives and advantages of environmental audit, Environmental audit procedure: Pre audit activities, activities at site, Post audit activities.	8
Environment Management System: Introduction, definition and need of Environment Management System, Scope, application and benefits of ISO certification, principles of ISO series Requirement of Environment Management System, Deming cycle of continuous improvement	7

SUGGESTED BOOKS:

1. Environmental audit by Mhaskar AK
2. Environmental audit by Mhaskar AK
3. Environmental Assessment and Statements by Harr and Hagerty (1977)
4. Environmental Assessment and Statements by Harr and Hagerty (1977)

5. Environmental Auditing by Central Pollution Control Board.
6. Stoner, Freeman, Gilbert – Management – Prentice Hall of India Ltd., New Delhi – VIth Edition
7. Environmental Auditing by Central Pollution Control Board

Semester IV
Environmental Engineering (Waste water) – Paper II
(DSC-D3 – Environmental Engineering (Waste water))
Credits 2 (Marks 50) Hours 30, 37.5 Lectures of 48 minutes

Course Outcome:

1. Study the characteristics and constituents in waste water.
2. Understanding primary, secondary and tertiary treatments to be provided to waste water.

Unit	Lecture Hours
Unit I	15
A: Introduction to waste water engineering: Characteristics of waste water, Constituents in waste water: metallic constituents and their sources, effluent discharge limits for metals and other characteristics Domestic and industrial waste water sources, Flow diagram of waste water treatment plant: ETP and STP	8
B: Physical treatments to waste water: Screening: types of screens, gravity separation, particle settling theory, grit removal: grit characteristics and types of grit chambers, Aeration, types of aeration systems Removal of VOC by aeration, oil and grease removal Low cost treatments: stabilization ponds, septic tanks, lagoons	7
Unit II	15
A: Biological treatments to waste water: Objectives of biological treatment, Aerobic biological oxidation, biological nitrification and denitrification, Activated sludge process and recent developments, Trickling filters and types of trickling filters, Bio-digesters, rotating biological contractors	8
B: Chemical treatments to waste water: Role of chemical processes in wastewater treatment, Chemical precipitation for phosphorus removal Removal of heavy metals and dissolved inorganic substances Chemical oxidation and its applications Chemical neutralization and stabilization Tertiary treatments: reverse osmosis	7

SUGGESTED BOOKS:

1. Mathur Shruti, Kumar Rajendra (2017), Water on earth, Rawat Publication, New Delhi

2. Rangwala S.C., Rangwala K.S. (2004, Water supply and sanitary engineering, Charotar Publishing House, Anand
3. Basak N.N. (2012), Environmental Engineering, Tata McGraw Hill Education Private Limited, New Delhi
4. Rao M.N., Datta A.K. (2018), Waste water treatment, CBS Publishers and Distributors Pvt Ltd, New Delhi
5. Mark J. Hammer (2015), Water and wastewater, Pearson Publication, Noida
6. Mackenzie L. Davis, David A. Cornwell (2014), Introduction to environmental engineering, New York
7. R. Parker, N. Morris, F.N. Fair, S.C.Bhatia (2008), Waste water engineering, CBS Publishers and Distributors, New Delhi
8. Patra K. C. (2002), Hydrology and water resources engineering, Narosa publishing house, New Delhi
9. Metcalf and Eddy (2003), Waste water engineering treatment and reuse, Tata McGraw Hill, New Delhi

Semester IV
Environmental Education and Policy – Paper IV
(DSC-D4 – Environmental Education and Policy)
Credits 2 (Marks 50) Hours 30, 37.5 Lectures of 48 minutes

Course Outcome:

1. Study the background, need, objectives and status of environmental education.
2. Get acquainted with various environmental laws in India.

Unit	Lecture Hours
Unit I	15
A: Introduction to Environmental Education Definition and background of environmental education, need and objectives of environmental education. Status of environmental education in new education policy – Role of various institutions in protection of environment (Govt. and Non Govt.)	8
B: Introduction to Environmental law: Introduction to environmental law, need for environmental law in India, magna carta on human environment, our common future Indian constitution and 42 nd amendment of 1976, right to constitutional remedies and environment, fundamental duties of citizens for environment, Polluter pays principle, corporate social responsibility	7
Unit II	15
A: Environmental laws The environment (Protection) Act, 1986. The water (prevention and control of pollution) act, 1974 The air (prevention and control of pollution) act, 1981 Public Liability Insurance Act, 1991. Noise Pollution and Law, Sec. 119 and 120 of the Motor Vehicles Act, 1989 and rules framed there under.	8
B: Environmental Pollution and Control under other laws: Provisions of Indian Penal Code, 1860 Provisions under Criminal Procedure Code, 1973 National Environment Tribunal Act, 1995 Coastal Regulation Zone, 2011: objectives and physical limits of zone National Environmental Policy, 2006: objectives, principles and strategies	7

SUGGESTED BOOKS:

1. Bell stuart, MCGillivray, Environmental law, Oxford University Press, New Delhi
2. Singh Gurdeep (2005) Environmental law in India, Macmillan India Ltd, Delhi
3. Shastri S.C. (2015), Environmental Law, Eastern Book Company, Lucknow
4. Divan Shyam, Rosencranz (2013), Environmental Law and policy in India, Oxford University Press, New Delhi
5. Venkat Aruna 2011), Environmental Law and Policy, PHI Learning Pvt. Ltd., New Delhi
6. Chatterjee Benimadhab (2003), Environmental Laws, Deep and Deep Publications Pvt. Ltd., New Delhi
7. Dr. S. R. Mynemi (2016), Environmental Law, Asia Law House, Hyderabad
8. Shastri S. C. (2005), Environmental Law, Eastern Book Company, Lucknow

Semester IV
Environmental Economics – Paper V
(DSC-D5– Environmental Economics)
Credits 2 (Marks 50) Hours 30, 37.5 Lectures of 48 minutes

Course Outcome:

1. Study the need of economics for environment management.
2. Study the environmental valuation and techniques of biodiversity valuation.

Unit	Lecture Hours
Unit I	15
A: Introduction to environmental economics Role of economics in environment, Need of eco-principles, Environmental economics Vs traditional economics, evolution and growth of environmental economics, Training environmental inputs into the economy, environment and economic growth, environment and development.	8
B: Environmental valuation and theories Introduction to environmental valuation: meaning and types of environmental values, valuation of intangible benefits of the environment Hardin's thesis of tragedy of the commons, social cost benefit analysis, cost effectiveness analysis	7
Unit II	15
A: Sustainability of economic development: Concept of sustainable development, Policy approach of sustainable development, role of technology and human values, Management of sustainable development and institutions Techniques of biodiversity valuation: Market based techniques revealed preferences techniques, stated preference techniques.	8
B: Economics of environmental policies: Introduction to environmental management policy, need for environmental policy, Instruments for environmental policy, Instruments for environmental policy Principles of commercial forestry economics, Economic incentives for environment regulations.	7

SUGGESTED BOOKS:

1. Ashwani Mahajan (2010), Environmental Economics, Centrum Press, New Delhi.
2. Ranbindra N. Bhattacharya (2004), Environmental Economics, Oxford university Press, New Delhi.

3. Janet M. Thomas (2007), Environmental Economics, South- Western Cengage learning, New Delhi.
4. G.S. Nayudu(2008), Environmental Economics, Adhyayan Publishers & Distributers, New Delhi.
5. K. Singh (2007), Environmental Economics, SAGE Publications, New Delhi.
6. Ramprasad Sengupta (2001), Ecology and Economics, Oxford University Press, New Delhi.
7. N. Hanley (1997), Environmental Economics in Theory and Practice, Macmillan Press Ltd., London.
8. S.L. Lodha (1991), Economics Of Environment, RBSA Publishers, Jaipur.
9. Rabindra N. bhattacharya (2001), Environmental Economics, Oxford University Press, New Delhi.

Semester IV
Disaster Management-II (Man made) – Paper VI
(DSC-D6 – Disaster Management (man made))
Credits 2 (Marks 50) Hours 30, 37.5 Lectures of 48 minutes

Course Outcome:

1. Understand causes and mitigation measures of man-made disasters.
2. Understand various measures of disaster preparedness and disaster management in India.

Unit	Lecture Hours
Unit I	15
A: Introduction to man made disasters: Concept and types of man-made disasters, Causes effects and management of man-made disasters: fire accident, road, rail and air traffic accident, industrial accidents Case studies: Bhopal gas leakage, Exxon valdez oil spill, Chernobyl nuclear explosion Biological disasters: Epidemics: causes, effects and management, Dengue, HIV & AIDS, Covid 19, Mad cow disease	7
B: Understanding the risk of man-made disasters: Introduction to disaster risk, Key considerations for understanding disaster risk for industrial, chemical, nuclear, transport and marine pollution hazards Role of stakeholders in man made disasters Case studies: Protecting denube delta from industrial accidents, nuclear waste mapping in central Asia, Pipeline transport accidents, Baltic marine environment protection commission	8
Unit II	15
A: Enhancing disaster preparedness: Key considerations for enhancing disaster preparedness for effective response of industrial, nuclear and transport hazards, Mock drill Case studies: Chernobyl recovery and development programme, UNECE convention on transboundary effects of industrial accidents, Regional, transboundary early warning system Role of community in disaster management	7
B: Introduction to multihazard approach and Disaster Management in India: Reducing the risk of Natech hazards, Collaboration, engagement and partnership, Transboundary cooperation, Multiple dimensions of disaster risk, GIS and remote sensing, Scientific methodologies for monitoring, Innovation and technology, Communication and training Role of UNDP and NCDM in disaster management National Disaster Policy, 2009	8

SUGGESTED BOOKS:

1. Kapur Anu, Neeti, Meeta, Deeptima, Roshani, Debanjali., Disasters in India, Rawat Publications, New Delhi
2. Brenda D. Philips (2016). Disaster recovery. CRC press, London.
3. Arvind Kumar (2006). Disaster Management, Amol publications, New Delhi.
4. Prabhas C. Sinha (2006) Disaster Relief, SBS Publishers & Distributers PVT. Ltd., New Delhi.
5. Gupta Manisha (2018), Disaster Management, DND Publications, Jaipur

DSC-P5 LAB COURSE

Sr. No.	Name of Experiment
1	Study of movement of tectonic plates
2	Study of formation of tornadoes
3	Determine various measures of watershed management to avoid flood
4	Study of epicentre for earthquakes and tsunami
5	Study of natural disaster management with local context
6	Study of plotting of graphs and diagrams
7	Determination of measures of central tendency
8	Determination of measures of dispersion
9	Determination of correlation coefficient and regression
10	Preparation of life table
11	Determine fertility, natality and mortality rate of given population
12	Study indoor environmental problems and mitigation measures with local context
13	Determine importance of various plant species in indian traditions
14	Determine importance of various animals in Indian culture
15	Study the cultural evolution in India with respect to environmental ethics
16	Determine optimum dose of Alum required for given water sample
17	Determine residual chlorine from given water sample
18	Determine phosphate from given water sample
19	Determination of turbidity of given water sample
20	Determination of MPN from given water sample
21	Determination of Sulphate from water sample
22	Determination of permanganate value of water
23	Population forecasting for water supply scheme
24	Estimation of water quality index
25	Measurement of rainfall with the help of rainguage

DSC- P6 LAB COURSE

Sr. No.	Name of Experiment
1	Measurement of rainfall with the help of rain gauge
2	Prediction of impacts on air quality
3	Prediction of impacts on water quality
4	Study of vermicomposting techniques through field visit
5	Study of biofertilizers through field visit
6	Study of Genetically Modified Organisms used in local area
7	Study of anaerobic digestion of cattle waste
8	Preparation of media for microbial culture
9	Isolation of culture of microbes from water
10	Use of microorganisms as bio-indicators for water/soil pollution monitoring
11	Study of microorganisms by Standard Plate Count method
12	Isolation of bacteria from soil and decaying matter
13	Study of Membrane Filter Technique
14	Study of cultural characteristics of microorganisms
15	Study of Phosphorus solubilizing bacteria
16	Study of motility of microorganisms
17	Gram staining
18	Preparation of green audit report
19	Preparation of audit check list
20	Study of raising of non-confirmative report through case study

DSC- P7 LAB COURSE

Sr. No.	Name of Experiment
1	To prepare report on various types of local industrial effluents
2	Analysis of pH and electrical conductivity from different types of effluents
3	Visit to Common Effluent Treatment Plant
4	Determination of MLSS and MLVSS
5	Determination of Hexavalent Chromium
6	To study designing of Sewage Treatment Plant
7	Determination of oil and grease from given waste water sample
8	Determination of Sludge Volume Index
9	Study of toposheets for disaster management
10	Study of hazardous chemicals from textile and foundry industry
11	Study of emergency preparedness system at industry
12	Study of material safety data sheet
13	Study of characteristics of hazards
14	Study of elasticity of demand and factors affecting demand through market survey
15	Study of diminishing marginal utility
16	Study of economics of pollution control
17	Cost benefit analysis of environmental regulations
18	Relative importance of farm production economics through field visit
19	Study of evaluation of economic environmental benefits
20	Study of techniques of valuation of biodiversity
21	Determination of carbonates and bicarbonates from water sample
22	Determination of ammonia from water sample
23	Langelier calcium carbonate saturation index
24	Determination of nitrite from water sample
25	Determination of nitrate from water sample