



# **Centurion University of Technology & Management**

**M.Sc. (Environmental Science) syllabus**

**School of Applied Sciences**

**(Two years programme)**

**2018**

**Basket-1**

**Core Courses (CC)**

Sl. No.	Code	Subject Name	Type of course	T-P-Pr (Credit)	Credits
1.	MSES1101	Foundation course of Environmental Science and Fundamentals of Environmental Chemistry	Theory	4-0-0	4
2.	MSES1102	Environmental Toxicology, Analytical Methods	Theory	4-0-0	4
3.	MSES1103	Environmental Pollution Control and Monitoring	Theory	4-0-0	4
4.	MSES 1104	Statistical methods, Remote Sensing and Computer Application	Theory	4-0-0	4
5.	MSES 1105	EVS Laboratory-I	Practice	0-0-6	4
6.	MSES1206	Fundamentals of Ecology, Ecosystems, Community & Population	Theory	4-0-0	4
7.	MSES1202	Natural Resources and Management	Theory	4-0-0	4
8.	MSES1203	Environmental Hazards, Risks and Disaster Management	Theory	4-0-0	4
9.	MSES 1204	Bio Resources and Biodiversity Conservation	Theory	4-0-0	4
10.	MSES 1205	EVS Laboratory-II	Practice	0-0-6	4
11.	MSES2301	Environmental Microbiology and Biotechnology	Theory	4-0-0	4
12.	MSES2302	Environmental Management System	Theory	4-0-0	4
13.	MSES2303	Environmental Laws and Awareness	Theory	4-0-0	4
14.	MSES 2304	Environmental Geology	Theory	4-0-0	4
15.	MSES 2305	EVS Laboratory-III	Practice	0-0-6	4
16.	MSES2401	Environmental Pollution Control and Management	Theory	4-0-0	4
17.	MSES2402	Forest Ecology and Modeling	Theory	4-0-0	4
18.	MSES2403	Stress Biology and Toxicology	Theory	4-0-0	4
19.	MSRM5101	Introduction to Research	Theory	2-0-0	2
20.	MS0301	Project/Dissertation	Project	0-0-6	8
21.	MS1401	Seminar	Practice	0-0-6	4
22.	MS0801	Internship	Project	0-0-2	2
<b>Total</b>					<b>88</b>

**Basket-2**  
**Skill Elective Courses**

<b>Sl. No.</b>	<b>Code</b>	<b>Subject Name</b>	<b>Type of course</b>	<b>T-P-Pr (Credit)</b>	<b>Credits</b>
<b>1</b>	MSSE0201	Waste management	Practice	0-6-0	4
<b>2</b>	MSSE0202	Public Health and Sanitation	Practice	0-6-0	4
<b>3</b>	MSSE0203	Disaster Management	Practice	0-6-0	4
<b>Total</b>					<b>12</b>

**Basket-3**  
**Domain courses**  
(Student can opt any domain offered by the University)

**Basket-1**  
**Core Courses (CC)**

## MSES1101 Foundation course of Environmental Science and Fundamentals of Environmental Chemistry

Subject Name	Code	Type of course	Credit
Foundation course of Environmental Science and Fundamentals of Environmental Chemistry	MSES1101	Theory	4

### Objective

- The student will be able to know basic knowledge about the environment and its allied problems.

### Learning outcome

- Knowledge to deal with the study of nature and its function.
- They will also acquire the knowledge of hydrological cycles and ecological balance.

### Evaluation Systems

Internal Examination	Component	% of Marks	Method of Assessment
	Internal Test	30	Written examination
	Assignment & attendance	10	Report Presentation
External Examination		60	Written examination
<b>Total</b>		100	

### Course Outline

#### Module-I: (10 Hrs)

Definition, Concept and Scope of ecology and environmental science. Earth, man and environment. Ecosystem. Pathways in ecosystems, geographical classification and zones.

#### Module-II: (07 Hrs)

Physicochemical and biological factors in the environment, effect of anthropogenic activities, ecosystem degradation, Concept and Strategies of sustainable development. Laws & regulation for protection of environment in India and sustainable development.

#### Module-III (07 Hrs)

Structure and composition of the Atmosphere, Hydrosphere, Lithosphere and Biosphere. Mass and energy transfer across the various interfaces, Material Balance, First and Second laws of thermodynamics, Heat transfer process. Meteorological characteristics of the atmosphere, Scale of Meteorology.

#### **Module-IV: (07 Hrs)**

**Atmospheric chemistry:** chemical speciation, particles, ions and radicals in the atmosphere, chemical process for formation of inorganic and organic particulate matter, Oxygen and ozone chemistry. Chemistry of air pollutants, Photochemical smog- formation, fate and effects.

#### **Module-V: (07 Hrs)**

**Fundamentals of Environmental Chemistry:** Stoichiometry, Gibb's energy, Chemical potential, Chemical equilibrium, Acid base reaction, Solubility product, Solubility of gases in water.

#### **Module-VI:(07 Hrs)**

**Water chemistry:** Chemistry of water. Concept of DO, BOD, COD in water, Particulate and Dissolved Organic Carbon (POC & DOC), Characteristics of natural, marine, and fresh water system. Hydrological cycle.

#### **Module-VII:(06 Hrs)**

**Soil chemistry:** Inorganic and organic components of soil, Mineral cycles, Nitrogen pathway and NPK in soil.

#### **Reference**

Text Books:

1. Panigrahi, A. K. and AlakaSahu (2012): Text book on Environmental Studies. Giribala Publishing House, Berhampur.
2. Das, R. C., Baral. J. K., Sahu, N. C. and Misra, M. K. (1998). The Environmental Divide: The Dilemma of Developing Countries. A. P. H. Publication, New Delhi.
3. Kumar, H. D. and S.P. Adhikary (2006).A Text Book on Environmental Engineering. India Tech Publishing, New Delhi.

ReferenceBooks:

1. Baird, C. and Cann, M. (2008). Environmental Chemistry, 2008, W.H. Freeman, USA.
2. Manahan, S. E. (2008). Fundamentals of Environmental Chemistry, 3rd Edition, CRC Press, USA.
3. Connell D. W. (2005).Basic concepts of Environmental Chemistry 2nd Edition, CRC Press, USA.
4. Girard J. (2010). Principles of Environmental Chemistry 2nd Edition, James &Barlett Publishers, USA.
5. Harrison R M (2007). Principles of Environmental Chemistry, RSC Publishing, UK.
6. Hillel, D. (2007). Soil in the Environment: Crucible of Terrestrial Life, 1st edition, Academic Press, USA.
7. Lancaster M.(2002). Green Chemistry: An Introductory Text, RSC Publishing, UK.
8. Manahan, S. E. (2006). Green chemistry and the ten commandments of sustainability, 2 nd Edition, Chem Char Inc. Publishers, USA.
9. Manahan, S. E. (2010). Water chemistry: green science and technology of nature's most renewable resource, CRC Press, USA.
10. Clark J. H. and Macquarrie, D. J. (2002). Handbook of Green Chemistry and Technology, Wiley- Blackwell, UK.

## MSES1102 Environmental Toxicology and Analytical Methods

Subject Name	Code	Type of course	Credit
Environmental Toxicology and Analytical Methods	MSES1102	Theory	4

### Objective

- The student will be able to know about different toxic chemicals in environment.

### Learning outcome

- They will gain knowledge to deal in different instrumentation techniques for environmental pollution monitoring.

### Evaluation Systems

Internal Examination	Component	% of Marks	Method of Assessment
	Internal Test	30	Written examination
	Assignment & attendance	10	Report Presentation
External Examination		60	Written examination
<b>Total</b>		100	

### Course Outline

#### Module-I (10Hrs)

**Toxicology-definition, Toxic chemicals in environment:** Air, Water and Soil: Pesticides in Water and Soil, movement of toxicants in bio-systems, factors affecting Toxicity. Dose effect and response,

#### Module-II (08Hrs)

Response curves, Dose effect relationship (Statistical concept of toxicity). Radioactive isotopes. Pathogens and mutagens. Toxic chemicals and hazard, concept of toxicity, LC<sub>50</sub> & LD<sub>50</sub> concepts; toxicity test, mechanism of toxicant action.

#### Module-III (07 Hrs)

Biochemical aspects and toxicity of Arsenic, Cadmium, Chromium, Lead and Mercury,

#### Module-IV: (07 Hrs)

Pesticides, mechanism of action of pesticides and herbicides. Non-target pesticide toxicity, toxic effect and environmental fate of DDT, Malathion, Carbaryl, Atrazine, Methyl isocyanate toxicity,

**Module-V: (06 Hrs)**

Carcinogens in the air. Antidotes and neutralization of toxicity.

**Module-VI: (08 Hrs)**

UV visible spectrophotometry, Atomic Absorption Spectrophotometry (AAS), Chromatography, GLC, HPLC, Electrophoresis, X-ray Fluorescence, X-ray Diffraction, Flame photometry,.

**Module-VII:(06 Hrs)**

Centrifugation techniques, Bomb-calorimetry, Radioisotopes: detection and measurement

**Reference**

Text Books:

1. Patnaik, P. (2010); Handbook of environmental analysis, CRC Press, USA.
2. Shukla, S. K. and Srivastava, P. R. (1992); Methodology for environmental monitoring and assessment, Commonwealth Publishers, New Delhi.

Reference Books:

1. Skoog D. A., Holler F.L. and Crouch, S. R.(2007); Principles of instrumental analysis, Thomson Brooks/Cole Publishers, USA
2. Svehla G. (1996); Vogel's qualitative inorganic analysis, 7th Edition, Prentice Hall, USA
3. Wiersma G.(2004); Environmental monitoring, CRC Press, UK.
4. Eaton, A. D., Clesceri, L.S., Rice, E.W. and Greenberg, A.E. (2005); Standard methods for examination of water and wastewater 21st Edition. American Public Health Association, American Water Worker Association, Water Environment Federation, USA.
5. Ewing, G. W. (1985); Instrumental methods of chemical analysis, 5th edition, McGraw Hill Publications, USA

## MSES1103 Environmental Pollution, Control and Monitoring

Subject Name	Code	Type of course	Credit
Environmental Pollution, Control and Monitoring	MSES1103	Theory	4

### Objective

- The student will be able to know about different sources of pollution.

### Learning outcome

- They will gain Knowledge on the role of microbes on soil quality.
- Aware of the basic phenomenon's of earth sciences.
- Able to apply the effects of meteorological parameters in the dispersion of air pollutants.

### Evaluation Systems

Internal Examination	Component	% of Marks	Method of Assessment
	Internal Test	30	Written examination
	Assignment& attendance	10	Report Presentation
External Examination		60	Written examination
<b>Total</b>		100	

### Course Outline

#### Module-I (08Hrs)

Concept of Environmental Pollution and Monitoring, Meteorology: Meteorological parameters. Monitoring of parameters viz. Wind rose. Inversion zone. Precipitation. Evaporation. Maximum and minimum temperature. Humidity, Solar intensity, Cloud cover, Atmospheric stability.

#### Module-II (08Hrs)

**Air pollution monitoring:** Natural and anthropogenic sources of air pollutants. Primary and secondary pollutants. Methods of monitoring and control of air pollution, control of particulate and gaseous air pollutants. Air sampling and analysis of air quality, effect of air pollutants on humans, plants, animals and climate. Acid rain and Greenhouse effect.



### **Module-III (07Hrs)**

**Water pollution monitoring:** Types, sources and effect of water pollution. Prevention and control of water pollution. Bacteriological sampling and analysis of water quality. Water quality standards, sewage and waste water treatment and recycling.

### **Module-IV: (06 Hrs)**

**Marine pollution:** Sources of marine pollution and its control, Radioactive and thermal pollution.

### **Module-V: (08 Hrs)**

**Soil pollution monitoring:** Sources and control of soil pollution. Soil sampling. Sediment sampling, Soil analysis (physical, chemical and biological). Role of soil microbes on maintenance of soil quality.

### **Module-VI:(06 Hrs)**

**Noise pollution monitoring:** Sources, measurement and indices. Noise control and abatement measures. Noise exposure levels and standards, Impact of noise pollution on human health.

### **Module-VII:(07 Hrs)**

**Bio-monitoring:** Concept of Bio-monitoring, Bio-monitoring of water bodies and air pollutants, Bio-mapping of water bodies. Biological diversity indices.Toxicity testing by aquatic and terrestrial bio-assay. Biomass of water bodies, Bio-magnification and Accumulation of pollutants.

### **Reference**

#### Text Books:

1. Wastewater Engineering: Treatment, disposal, Reuse – Metcalf & Eddy Inc.4th ed. TMGHI, New Delhi, 2003.
2. Environmental Engineering- Peavy, HS, Donald RR & G. Tchobanoglous, MGH Int. Ed. New York, 1985.
3. Edzwald, James K. (ed.) Water quality & treatment: A handbook on drinking water

#### Reference Books:

1. Ujang, Zaini (Ed.) Municipal wastewater management in developing countries: Principles and Engineering.
2. Natural Resources conservation-Oliver S Owen &Chiras 6. Natural Resource Conservation-Owen &Chiras 7. Living in the Environment –T.J.Miller

## MSES 1104 Statistical methods, Remote Sensing and Computer Application

Subject Name	Code	Type of course	Credit
Statistical methods, Remote Sensing and Computer Application	MSES 1104	Theory	4

### Objective

- The student will learn about different statistical methods and developmental models

### Learning outcome

- They will acquire the knowledge of remote sensing and scope of computer in environmental science.
- Acquire the basic knowledge of computer and its applications.
- Compute the data in a more meaningful manner.

### Evaluation Systems

Internal Examination	Component	% of Marks	Method of Assessment
	Internal Test	30	Written examination
	Assignment& attendance	10	Report Presentation
External Examination		60	Written examination
<b>Total</b>		100	

### Course Outline

#### Module-I (08Hrs)

**Statistical methods and developmental models:** Probability, Sampling, Measurement and distribution of attributes.

#### Module-II (07Hrs)

Distribution- normal, poisson and binomial. Arithmetic, Geometric and Harmonic means. T- and  $\chi^2$ -test, matrices, simultaneous linear equations, tests of hypothesis and significance.

#### Module-III (07Hrs)

**Approaches to developmental models:** linear, simple and multiple regression models, Validation and forecasting

#### **Module-IV (07Hrs)**

Models of population growth and interactions- Lotka- Volterra model, Leslie's matrix model, Point source stream population model, Box model, Gaussian plume model.

#### **Module-V (07Hrs)**

**Remote sensing:** Principles of remote sensing and its application. Application of GIS in environmental management.

#### **Module-VI (07Hrs)**

**Computer Applications:** What are Computers? Scope of computer in Environmental Sciences. Data processing, Binary systems of numbers and their application in computer, input and output devices,

#### **Module-VII (07Hrs)**

Central Processing Unit, Software and hardware. Programming languages and basic programming, MS office.

#### **Reference**

Text Books: Sinha, P.K., Computer Fundamentals, BPB Publications.

Reference Books:

1. Gookin, D. (2007). MS Word for Dummies.Wiley.
2. Harvey, G. (2007). MS Excel for Dummies.Wiley.

## MSES1206 Fundamentals of Ecology, Ecosystems, Community & Population

Subject Name	Code	Type of course	Credit
Fundamentals of Ecology, Ecosystems, Community & Population	MSES 1206	Theory	4

### Objective

- The student will learn about interactions of abiotic and biotic components of ecosystem.

### Learning outcome

- They will acquire the knowledge of remote sensing and scope of computer in environmental science.

### Evaluation Systems

Internal Examination	Component	% of Marks	Method of Assessment
	Internal Test	30	Written examination
	Assignment & attendance	10	Report Presentation
External Examination		60	Written examination
<b>Total</b>		100	

### Course Outline

#### Module-I (07Hrs)

**Fundamentals of ecology:** Definition, principles and scopes of ecology, Human ecology and human settlement, origin of life and speciation,

#### Module-II (09Hrs)

**System Ecology:** organism and environmental complex, interactions, biological stress and strain, tolerance hypothesis, concept of limiting factors, law of minimum and organismal response to environmental changes; System concept in ecology and ecosystem and system attributes, survey of natural and man-made ecosystem.

#### Module-III (07Hrs)

**Ecosystem:** Structure and functions of ecosystems, abiotic and biotic components, concept of ecosystem energetics: energy flow and ecological efficiencies and energy flow models. Food chains, food web, ecological pyramids types and diversity

#### **Module-IV (07Hrs)**

**Ecosystem productivity:** concept of primary and secondary productivity, methods of measurement of productivity and relationships between GPP, NPP. Autotrophic respiration in efficient ecosystem.

#### **Module-V (07Hrs)**

**Ecological succession:** Concept, type, and mechanism of ecological succession, changes during succession.

#### **Module-VI (07Hrs)**

**Community ecology:** concepts of community, parasitism. Prey-predator relationship. Community structure and attributes; Analysis of plant communities (analytical and synthetic characters), ecotones.

#### **Module-VII (07Hrs)**

**Population Ecology:** Characteristics of a population, population growth curve, life history strategies, Human population and regulation. Carrying capacity, niche concept and its significance.

#### **Reference**

Text Books:

1. Joshi, B.D., Tripathi, C.P.M and Joshi, P.C. Biodiversity and Environmental Management. APH, New Delhi, 2009.
2. Joshi, P.C. and Joshi, N. Biodiversity and conservation. APH Publishing Co-operation, New Delhi, 2009. 7. Kohli, R. K., Jose, S., Singh, H. P. and Batish, D. R. Invasive Plants and Forest Ecosystems. CRC Press / Taylor and Francis, 2009.
3. Lomolino, M.V., Riddle, B.R., Whittaker, R.J. and Brown, J.H. Biogeography (4th Ed). Sinauer Associates, 2010.
4. Odum, E.P., Barrick, M. and Barret, G.W. Fundamentals of Ecology (5th Ed). Thomson Brooks/Cole Publisher, California, 2005.
5. Pandey, B.N. and Jyoti, M.K. Ecology and Environment. APH Publishing Co-operation, New Delhi, 2012.
6. Rana, S.V.S. Essentials of Ecology and Environmental science (5th Ed), PHI Learning Pvt. Ltd, 2013.
7. Sharma, P.D. Ecology and Environment. Rastogi Publications. New Delhi, 2009.

Reference Books:

1. Agren, Goran I. Terrestrial Ecosystem Ecology: Principles and Applications, Swedish University of Agricultural Sciences, 2012.
2. Day, John W., Kemp W. M., Alejandro Yáñez-Arancibia and Byron C. Crump. Estuarine Ecology (2nd Ed), Wiley-Blackwell Publishers, 2012.

3. Fatik B. Mandal. and Nepal C. Nandi. Biodiversity: Concepts, Conservation and Biofuture, Asian Books, 2013.
4. Jorgensen, Sven Erik. Encyclopedia of Ecology. Vol 1-5. Elsevier Publishers. Netherlands, 2008.
5. Smith, T.M and Smith, R.L. Elements of Ecology (8th Ed), Benjamin Cummings, 2012.
6. Vandermeer, John H., Riddle, B.R. and Brown, J.H. Population Ecology : First principle (2nd Ed). Princeton University Press, 2013.
7. William J. Mitsch, James G. Gosselink, Li Zhang, Christopher J. Anderson Wetland ecosystems, Wiley-Interscience, 1989.

## MSES1202 Natural Resources and Management

Code	Course Title	Course Type	Credits
MSES1202	Natural Resources and Management	Theory	4

### Objective

- The student will learn to apply various steps for conservation of natural resource.

### Learning outcome

- They will acquire the knowledge of energy, minerals and land resources.

### Evaluation Systems

Internal Examination	Component	% of Marks	Method of Assessment
	Internal Test	30	Written examination
	Assignment& attendance	10	Report Presentation
External Examination		60	Written examination
<b>Total</b>		100	

### Course Outline

#### Module-I (10Hrs)

The Earth system and the biosphere-conservation of matters in various geospheres-lithosphere, hydrosphere, atmosphere and biosphere, energy budget of the earth, relation between soils, biomes and climates. Concept of natural resources, Resources and reserves, renewable and non-renewable resources. Exhaustible and non-exhaustible resources in general.

#### Module-II (10Hrs)

**Energy resources:** Sun as a sources of energy: solar radiation and its spectral characteristics and biological advantages; Solar energy: solar collector, photovoltaic, solar ponds.

Fossil fuels (coal, petroleum, and natural gas) as energy sources for automobiles, industry, agriculture and household. Hydroelectricity, tidal, wind, geothermal and ocean thermal energy.

**Nuclear energy:** sources, fission and fusion reactions, nuclear reactors and electric power generation.

### **Module-III (08Hrs)**

**Mineral Resources:** Non-renewable mineral resources in general in India. Coal, bauxite, chromite, Iron ore, Manganese resources of Odisha in particular.

### **Module-IV (07Hrs)**

Ocean as mineral resources, ocean ore and recycling of resources. Environmental impacts of mineral exploitation (processing and smelting) and environmental management plans.

### **Module-V (07Hrs)**

**Water Resources:** Global water balance and hydrological cycle. Origin and composition of sea water. Ocean resources. Surface and ground water. Rain water harvesting.

### **Module-VI (07Hrs)**

**Land Resources:** India's land area and its classification, survey of forest, grasslands, agriculture lands, waste lands, urban areas, aquatic areas with regards to rivers, lakes,

### **Module-VII (07Hrs)**

Coastal areas and maritime economic zones with regards to ecological features and productivity and impacts of human activities, land use planning, land use policy in India.

### **Reference**

Text Boooks:

1. Anderson, David A. (2013) Environmental economics and natural resource management, Taylor and Francis 4th Edition.
2. Gurdev Singh (2007) Land resource management, Oxford publishers.
3. Kathy Wilson Peacock. (2010) Natural resources and sustainable developments. Viva Books.
4. Lynch, Daniel R. (2009) Sustainable natural resource management for scientists and engineers. Cambridge University Press.
5. Jaidev, Somesh (2010) Natural resources in 21st century. Oxford Publishers.
6. Mishra, S.P (2010) Essential Environmental Studies, Ane Books.
7. Kumar, H.D. (2001) Forest resources: Conservation and management. Affiliated East-West Press.

Reference Books:

1. Kudrow, Nikolas J (Ed) (2009) Conservation of natural resources, Nora Science, New



2. York.
3. Grigg, Neil S. (2009) Water resources management : Principles, regulations, and cases,
4. McGraw Hill Professional.
5. Beckman, Daniel W. (2013) Marine environmental biology and conservation. Jones and
6. Barlett learning.
7. Primak R.B (2014) Essentials of Conservation biology, Sinauer Publishers, 6th edition

## MSES1203 Environmental Hazards, Risks and Disaster Management

Code	Course Title	Course Type	Credits
MSES1203	Environmental Hazards, Risks and Disaster Management	Theory	4

### Objective

- The student will learn to identify and describe the types of natural and non-natural disasters and the implications of disasters on environment.
- They will acquire the knowledge and describe the main hazards to which our region is, or may be, vulnerable.

### Learning outcome

- They will know the legal framework for disaster management and how the effects of disasters can be reduced on vulnerable groups.

### Evaluation Systems

Internal Examination	Component	% of Marks	Method of Assessment
	Internal Test	30	Written examination
	Assignment & attendance	10	Report Presentation
External Examination		60	Written examination
<b>Total</b>		100	

## Course Outline

### Module-I (10Hrs)

Definition of Hazard and Disaster, Environmental hazards: Natural and technological hazards, Hazardous installations, Hazardous materials, survey of flammable substances, Hazardous waste management and Handling rule.

### Module-II (07Hrs)

Definition of hazardous waste, sources and generation of solid wastes, their characterization, chemical composition and classification.

### Module-III (08Hrs)

Different methods of disposal and waste management of solid wastes, onsite handling and processing, disposal techniques - open dumping, land filling, incineration, composting, potential method of disposal- utilization, recovery, and recycling.

#### **Module-IV (06Hrs)**

Hospital waste management, waste minimization techniques.

#### **Module-V (07Hrs)**

Concept of risk analysis, methodologies for risk analysis: advantages and limitations, Identification and selection of risk analysis methodology, guidelines for conducting risk analysis.

#### **Module-VI (07Hrs)**

Identification of hazardous material, evaluation, vulnerable analysis; methodologies of safe distance and safe handling, case studies.

#### **Module-VII (07Hrs)**

Different types of models for risk analysis. Characteristics and salient features of different models, hazardous operation HAZOP. Case studies on risk analysis for major projects.

#### **Reference**

Text Books:

1. Parasuraman S., India Disasters Report: Towards a Policy Initiatives, Oxford University Press, 2004.
2. Goel S.L. and Kumar Ram, Disaster Management, Deep and Deep Publications, 2001

ReferenceBooks:

1. William H. Dennen and Bruce R. Moore, WCB Publishers, Iowa, 1986.
2. John M. Wallace and Peter V. Hobbs, Atmospheric Science: An Introductory Survey, Academic Press, New York, 1977.
3. EgbortBocker and Rienk Van Grondille, Environmental Physics, John Wiley & Sons Ltd., 1999.
4. Barbar W. Murk et. al., Environmental Geology, John Wiley & Sons, New York, 1996.
5. Bohle, H. G., Downing, T. E. and Watts, M. J. Climate change and social vulnerability: the sociology and geography of food insecurity, Global Environmental Change. No.4, pp. 37-48.
6. Collins Larry R. and Schneid Thomas D., Disaster Management and Preparedness, Taylor and Francis 2000
7. Living With Risk: A global Review Of Disaster Reduction Initiatives 2004 Vision, United Nations, 2004.

## MSES1204 Bio resources and Biodiversity Conservation

Code	Course Title	Course Type	Credits
MSES1204	Bioresources and Biodiversity Conservation	Theory	4

### Objective

- The course is designed to provide information to the students about the natural resources of the planet Earth and causes of their depletion.

### Learning outcome

- They will know the fundamental environmental issues with a focus on resource conservation and management for future use.

### Evaluation Systems

Internal Examination	Component	% of Marks	Method of Assessment
	Internal Test	30	Written examination
	Assignment & attendance	10	Report Presentation
External Examination		60	Written examination
<b>Total</b>		100	

### Course Outline

#### Module-I (10Hrs)

**Bio-resources:** Survey and regeneration of bio-resources, Biodiversity of India in general and Odisha in particular (marine, forest, and wild life resources). Non-timber forest resources, harvest, trade and management of non-timber forest products

#### Module-II (07Hrs)

Bio-energy resources: energy from biomass and biogas, energy plantation, petro-plants, hydrocarbon from higher plants, methane, bio-ethanol and bio-hydrogen generation.

#### Module-III (07Hrs)

**Common flora and fauna of India:** phytoplankton. Zooplankton and macrophytes. Endangered and threatened species, Red data book.

#### **Module-IV (07Hrs)**

Forest ecology: Major terrestrial biomes of the world, biogeographically zones and forest types in India, Structure and functions of forest ecosystem, Forest depletion and its impacts, Forest management.

#### **Module-V (07Hrs)**

**Biodiversity conservation:** Definition and concepts of biodiversity, strategies for conservation: in-situ and ex-situ conservation, Biosphere reserve, National parks and Sanctuaries,

#### **Module-VI (07Hrs)**

Conservation of mangroves and wet land vegetation, concept of gene pool and germplasm conservation, gene banks and seed banks.

#### **Module-VII (07Hrs)**

Hot spots of biodiversity, biodiversity indices. Biotechnology for biodiversity conservation, conservation of biological diversity. Biodiversity bill and legislation in India.

#### **Reference**

Text Books:

1. Kothari, A. (1997). Understanding Biodiversity: Life sustainability and Equity. Orient Longman, New York.
2. Negi, S. S. (1993). Biodiversity and its Conservation in India. Indus Publishing Company, New Delhi.
3. Nagar Santosh and Adhav Madhavi (2010), Practical Book of Biotechnology and Plant Tissue Culture, S Chand & Company
4. Purohit S.D (2012), Introduction to Plant Cell, Tissue and Organ Culture, Prentice Hall India Learning Private Limited
5. M. C. Gayatri (2015), Plant Tissue Culture: Protocols in Plant Biotechnology (Pb), Narosa Publishing House Pvt. Ltd. - New Delhi
6. Kalyan Kumar De (2008), Plant Tissue Culture, New Central Book Agency
7. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad — 380 013, India, Email: mapin@icenet.net (R) 3. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
8. Heywood, V.I. & Watson, R.I. 1995. Global Biodiversity Assessment. Cambridge Univ. Press 1140p.

Reference Books:

1. Saxena and Brahmam (1961-64) Flora of Odisha,
2. R.N.Chopra, S.L.Nayar and I.C.Chopra, 1956.Glossary of Indian medicinal plants, C.S.I.R.,New Delhi.
3. TimirBaranJhaandBiswajitGhosh(2016),Plant Tissue Culture: Basic and Applied,Platinum Publishers; 2nd Edition
4. Clark R.S., Marine Pollution, Clarendon Press Oxford (TB)
- 5.Cunningham, W.P.Cooper, T.H.Gorhani, E & Hepworth, M.T.2001. Environmental Encyclopedia, Jaico Publ. House. Mumbai, 1196

## MSES2301 Environmental Microbiology and Biotechnology

Code	Course Title	Course Type	Credits
MSES2301	Environmental Microbiology and Biotechnology	Theory	4

### Objective

- This course covers the importance of all different aspects and effects of environmental Biotechnology and microbiology.

### Learning outcome

- They will know the fundamental knowledge about microorganisms and Basic concepts and issues related to Environmental biotechnology which can be useful in environmental applications.

### Evaluation Systems

Internal Examination	Component	% of Marks	Method of Assessment
	Internal Test	30	Written examination
	Assignment & attendance	10	Report Presentation
External Examination		60	Written examination
<b>Total</b>		100	

## Course Outline

### Module-I (10Hrs)

Microbes in ecosystem-diversity, Distribution, Classification and ecological importance, factors affecting growth of microorganisms in the ecosystem. Characteristics of protists, prokaryotes and viruses.

### Module-II (07Hrs)

Micro-flora of the atmosphere; Identification of aeroallergens; Airborne disease and allergies.

### Module-III (07Hrs)

**Microbial nutrition:** Photoautotrophs, Chemolithotrophs, Organotrophs, Parasites, Symbionts and their environmental importance. Organic matter decomposition by soil microorganisms, organic composting, waste management, application of microbes in Agriculture.

#### **Module-IV (07Hrs)**

**Survey of microbial toxins, brief account of diseases:** Hepatitis, polio, Bacterial dysentery. Amoebiasis, Typhoid, detection of faecal contamination of water, microbial standards of drinking water quality, air borne microbes, fungal disease; prevention and control of disease.

#### **Module-V (07Hrs)**

**Environmental biotechnology:** Basic concepts and issues. Bioremediation of contaminated soils and waste lands. Bio-mining and bioleaching, biosorption, phytochelation.

#### **Module-VI (08Hrs)**

**Phytoremediation of metals:** phytoextraction, rhizofiltration, phytoremediation of organics, roles of siderophores and phytosiderophores, Aerobic and anaerobic treatment of waste water and role of microbes. Methanogens, fermenting bacteria and technological process.

#### **Module-VII (06Hrs)**

Biotransformation of toxic metal pollution. Air pollution and its biotechnological monitoring;

#### **Reference**

Text Books:

1. Balaji S., (2010). Nanobiotechnology, MJP Publishers, Chennai.
2. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
3. Hawkins R.E, Encyclopedia of Indian Natural History, Bombay Natural History Society , Bombay (R)
4. Jadhav & Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284 p.

Reference Books:

1. McKinney, M.L. & Schoch, R.M. 1996. Environmental Science systems & Solutions. Web enhanced edition. 639p.
2. Mhaskar A.K. Matter Hazardous, Techno-Science Publications (TB)
3. Miller T.O. Jr., Environmental Science, Wadsworth Publishing Co. (TB)



## MSES2302 Environmental Management System

Code	Course Title	Course Type	Credits
MSES2302	Environmental Management System	Theory	4

### Objective

- This course covers the importance of concept of Environmental Management System (EMS) and Environmental Impact Assessment.

### Learning outcome

- They will know the fundamental knowledge about Environmental Management Plan and implementation of environmental management systems.

### Evaluation Systems

Internal Examination	Component	% of Marks	Method of Assessment
	Internal Test	30	Written examination
	Assignment & attendance	10	Report Presentation
External Examination		60	Written examination
<b>Total</b>		100	

### Module-I (10 Hrs)

Concept of Environmental Management System (EMS) and Environmental Impact Assessment (EIA). Dimensions of environmental degradation and concern of UNO on this Matter. World Conference on Human Environment of Stockholm 1972, UNEP, Rio Conference 1992. International Chamber of Commerce, Business Charter for Sustainable Development. World Organizations: Green Peace International, IUCN, WWF (World Wide Fund for Nature)

### Module-II (10Hrs)

**Environmental Management:** Principles and elements, Resource allocation, Responsibility and Accountability, Continuous performance elevation. Top management Commitment and leadership. Environmental Impact Analysis (EIA) concept, Environmental impact statements and Environmental Management Plan, EIA guidelines of Govt. of India, Impact assessment methodologies. Generalized approaches to impact analysis. Procedure for reviewing EIA and statement. Guidelines for environmental audit, Social Impact Assessment (SIA).

### Module-III (08Hrs)

**Environmental planning:** Concept and principles. General aspects, identification of Environmental aspects and evaluation of associated environmental impacts. Environmental labelling and life cycle assessment standards. Environmental Legislation & legal requirements. Environmental objectives and targets. Environmental management plans and programmes. Urban and Rural Planning in India.

#### **Module-IV (06Hrs)**

Implementation of environmental management systems, resource-human, physical and Financial, environmental values and modification, knowledge, skills and training

#### **Module-V (06Hrs)**

EMS Report writing and documentation, EMS records, information management records and Operational control, emergency preparation and regulations.

#### **Module-VI (06Hrs)**

**Measurement and evaluation:** Benefit-cost analysis, measurement and monitoring of ongoing performance, ISO and Indian standards, Development of ISO 14000 series.

#### **Module-VII (06Hrs)**

Audit of EMS, Principles, British Audit practices for ISO 14011 and 14012, EARA code of practice, EMS Audit preparation and execution, Corrective and preventive action.

#### **Reference**

Text Books:

1. Kulkarni, V. and Ramachandra, T.V. Environmental Management. Capital Pub. Co., New Delhi. 2006.
2. Fischer, T. B. (2007). Theory and Practice of Strategic Environmental Assessment, Earthscan, London.

Reference Books:

1. Petts, J. Handbook of Environmental Impact Assessment- Volume 1 and 2. Blackwell Publishers, UK 2005.
2. Glasson, J. Therivel, R. and Chadwick, A. Introduction to Environmental Impact Assessment. Routledge, London. 2006.
3. Canter, W. L. (1995) Environmental Impact Assessment, McGraw-Hill Science/ Engineering/ Math, New York.
4. Lawrence, D. P. (2003) Environmental Impact Assessment: practical solutions to recurrent problems, John Wiley & Sons, Hoboken NJ.
5. Morris, P. and Therivel, R. (1995) Methods of Environmental Impact Assessment, UCL Press, London.
6. Petts, J. (1999) (ed) Handbook of Environmental Impact Assessment, volume 1 and 2, Blackwell Science, Oxford.
7. Therivel, R. and Partidario, M. R. (1996) (eds) The Practice of Strategic Environmental Assessment, Earthscan, London.
8. Vanclay, F. and Bronstein, D. A. (1995) (eds) Environmental and Social Impact Assessment, Wiley & Sons, Chichester
9. Wood, C. (2003) Environmental Impact Assessment – A Comparative Review, Prentice Hall, London.

## MSES2303 Environmental Laws and Awareness

Code	Course Title	Course Type	Credits
MSES2303	Environmental Laws and Awareness	Theory	4

### Objective

- This course covers the importance of concept of Environmental Management System (EMS) and Environmental Impact Assessment.

### Learning outcome

- They will know the Forest laws and wildlife protection acts.
- Wasteland reclamation and Desertification and its control.

### Evaluation Systems

Internal Examination	Component	% of Marks	Method of Assessment
	Internal Test	30	Written examination
	Assignment & attendance	10	Report Presentation
External Examination		60	Written examination
<b>Total</b>		100	

### Course Outline

#### Module-I (16Hrs)

**International Laws on Environment:** UN Framework convention on climate change-1992, objectives and scope, affiliated instruments and organization. Rules and review procedure. Vienna convention for the protection of Ozone layer 1985. Montreal Protocol 1987: Objectives and scope, affiliated instruments and organization review procedures.

#### Module-II (07Hrs)

Environmental education and Awareness- Environmental ethics and global Imperatives. Current environmental issues in India: Narmada Dam, Tehri Dam, Almetti Dam, controversy with Chattisgarh for water resources.

#### Module-III (07Hrs)

Land acquisition policies & acts. Forest laws and wildlife protection acts, Rehabilitation and resettlement (R & R) policy with respect to land acquisition.

#### **Module-IV (07Hrs)**

Environmental policy 1986&2004: Soil erosion, formation and reclamation of USAR, alkaline and saline soil. Wasteland reclamation, Desertification and its control.

#### **Module-V (07Hrs)**

**Water Act 1974:** Preliminaries and definitions. Constitution of Pollution Control Boards. Powers and functions of the boards, Prevention and control of water Pollution.

#### **Module-VI (08Hrs)**

Power of State Govt. (Act-19).Power to obtain information and to take samples of effluents etc. Refusal or withdrawal of consent by state board. Power of state boards to make application to the Courts for restraining pollution in water bodies etc. and power to give directions, penalties and procedures.

#### **Module-VII (06Hrs)**

Urbanization, industrialization and consumerism: Manufacture, storage and import of Hazardous chemical Rule 1989- Salient features of Insurance Liability Act1991,

#### **Reference**

Text Books:

1. Odum, E.P., Barrick, M. and Barret, G.W. Fundamentals of Ecology (5th Ed). Thomson Brooks/Cole Publisher, California, 2005.
2. Environmental Planning, Policies & Programmes in India – K.D. Saxena.
3. Environmental Administration and Law- ParasDiwan

Reference Books:

1. Don Sayre, Inside ISO 14000, Deep & Deep Publications (1997)
2. Land – Use and Environment – S.M. Mujtava
3. S.DalelaSaurath, ISO 9000; A Manual for Total Quality Management, 1st ed. (1992).
4. Suresh Jain and Vimla Jain, Environmental Laws in India, The Lawyers home, Indore.

## MSES2304 Environmental Geology

Code	Course Title	Course Type	Credits
MSES2304	Environmental Geology	Theory	4

### Objective

- The student will learn about different resources such as land, water and energy.

### Learning outcome

- They will learn water pollution & its impact on ground water quality & soil control & measurement of water pollution.

### Evaluation Systems

Internal Examination	Component	% of Marks	Method of Assessment
	Internal Test	30	Written examination
	Assignment & attendance	10	Report Presentation
External Examination		60	Written examination
<b>Total</b>		100	

### Course Outline

#### Module-I (09Hrs)

Land resources: Land as resource, Land utilization and over-utilization, Land capability studies, Land use patterns, Impact assessment of land use.

#### Module-II (08Hrs)

Desertification & its impact on Environment & Society, Droughts, measure to combat Desertification.

#### Module-III (09Hrs)

Soil formation and development, classification of soil, soil erosion, soil conservation practices, soil pollution and its impact on man, animals & vegetation with reference to agro-chemicals and solid waste, prevention & control of soil pollution.

#### Module-IV (07Hrs)

**Water resources:** Surface & subsurface water resources, favourable Geological condition for underground water, water holding capacity of soil & rocks, (porosity, permeability & water flow characteristics) types of aquifers, yield of water, effect of withdrawal of ground water, recharge of ground water,

### **Module-V (06Hrs)**

Management of water resource, classification of source and types of water pollution, water pollution & its impact on ground water quality & soil; control & measurement of water pollution

### **Module-VI (06Hrs)**

**Energy Resources:** Heat budget of the earth, Thermonuclear Process in the sun, conventional & alternative sources of energy (fossil fuel, hydropower, geothermal, wind, solar, biomass etc.)

### **Module-VII (07Hrs)**

**Environmental Meteorology:** forces responsible for the dynamics in the atmosphere and ocean, geostrophic balance, Thermal wind circulation and vortexes; General circulation in the atmosphere, tropical monsoons, Introduction to modelling the climate.

### **Reference**

Text Books:

1. Edzwald, James K. (ed.) Water quality & treatment: A handbook on drinking water
2. Wastewater Engineering: Treatment, disposal, Reuse – Metcalf & Eddy Inc. 4th ed. TMGHI, New Delhi, 2003.

Reference Books:

1. Environmental Engineering- Peavy, HS, Donald RR & G. Tchobanoglous, MGH Int. Ed. New York, 1985.
2. Ujang, Zaini (Ed.) Municipal wastewater management in developing countries: Principles and Engineering.

## MSES2401 Environmental Pollution Control and Management

Code	Course Title	Course Type	Credits
MSES2401	Environmental Pollution Control and Management	Theory	4

### Objective

- The student will learn about different environmental pollution and its control.
- They will acquire the knowledge of Acquire the knowledge of basic rationale of water quality management.

### Learning outcome

- Suggest the suitable technologies for the treatment of drinking water and wastewater.
- They will be able to operate and manage troubleshoot problems of municipal and industrial water and wastewater treatment plants.
- Design the water and wastewater treatment plant with various capacities.
- Know the various methods for water resource management.

### Evaluation Systems

Internal Examination	Component	% of Marks	Method of Assessment
	Internal Test	30	Written examination
	Assignment & attendance	10	Report Presentation
External Examination		60	Written examination
<b>Total</b>		100	

### Course Outline

#### Module-I (10Hrs)

Water Quality standard (drinking water tolerance limit for disposal of waste water). Conventional treatment methods of waste water: preliminary. Primary (Sedimentation, Neutralisation, Coagulation etc.) **Module-II (07Hrs)**

Secondary treatment (Aerated lagoons, Trickling filtration, Activated sludge process, oxidation ditch, oxidation pond, anaerobic digestion etc),.

#### Module-III (07Hrs)

Tertiary treatment (evaporation reverse osmosis, dialysis, ion exchange, chemical precipitation activated carbon treatment etc), Low cost methods of waste water treatment: use of aquatic macrophytes and algae

**Module-IV (07Hrs)**

Origin characteristics effects and treatment of the liquid effluents generated from the following industries; Sugar, Paper, Textile, Iron and Steel, Tannery, Ambient air quality and permissible limit.

**Module-V (07Hrs)**

Methods for control of air pollution-particulate. Sealing chamber. Inertial separators cyclones filters and electrostatic precipitators and (Scrubbers, Absorbers, Combustion and Thermal decomposition.), Origin, characteristics, effects and control of gaseous effluents generated from the following industries: coal based thermal power plant, iron and steel, aluminium and paper.

**Module-VI (07Hrs)**

Water, Air and Soil pollution due to mining activities. Reclamation of distributed land due to mining pollution control methods in mining areas.

**Module-VII (07Hrs)**

Management of over burdens. Characterisation of solid waste generated from industries with reference to fly-ash. Food processing wastage, sugar industry waste and their method of disposal and management.

## Text Books:

1. Edzwald, James K. (ed.) Water quality & treatment: A handbook on drinking water
2. Wastewater Engineering: Treatment, disposal, Reuse – Metcalf & Eddy Inc. 4th ed. TMGHI, New Delhi, 2003.

## Reference Books:

3. Environmental Engineering- Peavy, HS, Donald RR & G. Tchobanoglous, MGH Int. Ed. New York, 1985.
4. Ujang, Zaini (Ed.) Municipal wastewater management in developing countries: Principles and Engineering.
5. Natural Resources conservation-Oliver S Owen & Chiras
6. Natural Resource Conservation-Owen & Chiras
7. Living in the Environment –T.J. Miller



## MSES2402 Forest Ecology and Modelling

Code	Course Title	Course Type	Credits
MSES2402	Forest Ecology and Modelling	Theory	4

### Objective

- The student will learn about forest ecosystem, Afforestation programs, Principles, and forest management.

### Learning outcome

- They will know about Forest policy in India, different approaches for ecological model building and modelling of nutrient flow in forest ecosystem.

### Evaluation Systems

Internal Examination	Component	% of Marks	Method of Assessment
	Internal Test	30	Written examination
	Assignment & attendance	10	Report Presentation
External Examination		60	Written examination
<b>Total</b>		100	

### Course Outline

#### Module-I (10Hrs)

Forest types and composition, primary production of forest ecosystem, composition and structure of forest and their ecosystem.

#### Module-II (07Hrs)

Major forest types in India: studies of forest diversity - methods of measurement of forest diversity, Forest depletion and its impact, Forest floor management, weed control.

#### Module-III (07Hrs)

Afforestation programs, Social forestry, Agroforestry, Plantation programs, Silviculture. Principles, forest management, concept of Endangered species, conservation of forest biodiversity, forest regeneration, concept of overgrazing, forest litter degradation.

#### Module-IV (07Hrs)

Forest policy in India, Forest policy on 1994 and 1952, National commission and agriculture, report in forestry, Indian Forest act 1927, Wildlife Protection Act 1972, Wasteland Development Award.

#### Module-V (07Hrs)

System concept in ecology, state variables and forcing functions. Modelling components, Mathematical tools for model building. Modelling of energy flow processes and matter transfer, modelling of nutrient flow in forest ecosystem (N and P model compartmental model for ecosystem analysis).

**Module-VI (07Hrs)**

Approaches for ecological model building. Modelling procedure, data collection, conceptual models, model formulation, and analysis of model sensitivity, simulation and calibration.

**Module-VII (07Hrs)**

Model testing and validation, Model stability test, Determination of model complexity, Modelling constraints. Application of models as experimental tools.

## Text Books:

1. Joshi, B.D., Tripathi, C.P.M and Joshi, P.C. Biodiversity and Environmental Management. APH, New Delhi, 2009.
2. Kohli, R. K., Jose, S., Singh, H. P. and Batish, D. R. Invasive Plants and Forest Ecosystems. CRC Press / Taylor and Francis, 2009.

## Reference Books:

1. Agren, Goran I. Terrestrial Ecosystem Ecology: Principles and Applications, Swedish University of Agricultural Sciences, 2012.
2. Day, John W., Kemp W. M., Alejandro Yáñez-Arancibia and Byron C. Crump. Estuarine Ecology (2nd Ed), Wiley-Blackwell Publishers, 2012.
3. Fatik B. Mandal. and Nepal C. Nandi. Biodiversity: Concepts, Conservation and Biofuture, Asian Books, 2013.
4. Jorgensen, Sven Erik. Encyclopedia of Ecology. Vol 1-5. Elsevier Publishers. Netherlands, 2008.
5. Joshi, P.C. and Joshi, N. Biodiversity and conservation. APH Publishing Co-operation, New Delhi, 2009.

## MSES2403 Stress Biology and Toxicology

Code	Course Title	Course Type	Credits
MSES2403	Stress Biology and Toxicology	Theory	4

### Objective

- The student will learn about different stresses of Environment and Toxic action of metals and Pesticides in ecosystem.
- The student will know about the environmental toxicants and their effects.

### Learning outcome

- They will Low and high temperature stresses. Organismal response to chilling, freezing and high temperature stresses and molecular mechanisms of resistance.
- They will learn about Phytoremediation of metal and pesticide pollution.

### Evaluation Systems

Internal Examination	Component	% of Marks	Method of Assessment
	Internal Test	30	Written examination
	Assignment& attendance	10	Report Presentation
External Examination		60	Written examination
<b>Total</b>		100	

### Course Outline

#### Module-I (10Hrs)

Environmental stress and organismal responses to stress, Biological stress and strain. Concepts of Homeostasis. Stress injury and resistance. Classifications of injuries and resistance in general.

#### Module-II (06Hrs)

General aspects of Toxicology. Properties of toxicants and fate of toxicants in the environment.

#### Module-III (08Hrs)

Temperature and Oxidative stress - Low and high temperature stress. Organismal response to chilling, freezing and high temperature stresses and molecular mechanisms of resistance. Heat shock proteins and their expressions. Oxidative stress.

**Module-IV (07Hrs)**

Water, Salinity and Heavy metal stress: Drought and flooding stresses - nature of stress injuries and resistance, osmotic stress, osmoregulation. Salt stress - injury and resistance. Ion and heavy metal stress.

**Module-V (07Hrs)**

Uptake and accumulation of toxic substances, patterns of uptake toxicities, analysis of dose effect relationship, acute, sub-acute and chronic toxicity tests.

**Module-VI (07Hrs)**

Toxic action of metals and Pesticides; Ecosystem response to toxicants, OSAR, chemical and biological degradation of pesticides.

**Module-VII (07Hrs)**

Sources of metal pollution, metal uptake, biological transformation of toxic metals, metal and pesticide tolerance. Phytoremediation of metal and pesticide pollution. Genetic aspects of toxic resistance.

## Text Books:

1. Tatiya, Ratan raj (2013) Elements of industrial hazards: Health, safety, environment and loss prevention Taylor and Francis.
2. Theodore, Louis (2012) Environmental health and hazard risk assessment: Principles and calculations, CRC Press

## Reference Books:

1. Wong, Ming H. (Ed.) (2013) Environmental contamination: Health risks and ecological restoration, CRC press
2. Ware, George M.(Ed) (2007) Reviews of environmental contamination and toxicology. Vol. 190: Continuation of residue reviews, Springer Publishers
3. Manahan, Stanley E. (2013) Fundamentals of environmental and toxicological chemistry: Sustainable sciences, CRC press

## MSRM5101 Introduction to Research

Code	Course Title	Course Type	Credits
MSRM5101	Introduction to research	Theory	2

### Module-I: (13Hrs)

**Research: Introductory Concepts:** Curiosity and Research, Common sense vs. Sciences, Role of Observation and Scientific Methods, Experiments as the basis of Sciences, Various types of Research Methods in Sciences, Discussion of various research methods.

**Overview of Research Process:** Problem Definition, Proposition of Hypotheses, Hypothesis Testing, Types of Possible Errors in Hypothesis Testing, Proposition of Models and Theories, Literature Review, Experimental Design, Sampling and Survey, Measurement of Values and Dealing with Errors, Validation of Results, Improving Theories, Models and Experiments, Safety and Ethics.

### Module-II: (12Hrs)

**Data Analysis-I:** Use of Statistics in Data Analysis, Probability Distributions, Central Limit Theorem and its applications in Data Analysis, Comparing many experimental measurements, Data with many values of independent variables.

**Data Analysis-II:** Building Mathematical Models, Ingredients of Mathematical Models, Estimation, Regression methods, Fourier Transforms, Iterative Maps, Differential Equations.

**Other Methods of Data Analysis:** Tables, Graphs and Charts.

### Module: III (5hrs)

**Documentation and Presentation:** Scientific Proposal Writing, Scientific Report Writing, Parts of a Scientific Report, Presentations, Ethical Issues in Report Writing.

### Text Books:

1. Michael P Marder, 2011, Research Methods for Science, Cambridge University Press.

### Reference Books:

1. Eugene Bright Wilson, 1991, An Introduction to Scientific Research, Dover Publications Inc.
2. Ranjit Kumar, 2011, Research Methodology: A Step by Step Guide, Sage South Asia Publication.

### Industrial Visit

Code	Course Title	Course Type	Credits
MS0801	<b>Internship</b>	Practice	2

#### 1. Scientific visit to any Industry for Pollution Management and Monitoring

### Basket-3

### Skill Electives

#### MSSE0201 Waste Management

Code	Course Title	Type of Course	Credit
MSSE0201	Waste Management	Practice	4

### Objective

- The course aims at the training of the students in the laboratory for identification and
- Characterization of different types of solid waste.
- The students will also learn various methods to analyze waste physical and chemical characteristics.
- A field exposure for solid waste management will also be imparted.
- The student will know about the environmental toxicants and their effects.

### Learning outcome

- The students will be able to design various experiments for management of solid waste.

### Evaluation Systems

Internal Examination	Component	% of Marks	Method of Assessment
	Lab. /Project work	60	Practice
	Report	40	Report Presentation
<b>Total</b>		100	

### Experiments

1. To determine physical composition of solid wastes.
2. To determine moisture content, pH and conductivity of solid waste sample.

3. To determine NPK in solid waste material.
4. To determine C/N ratio.
5. Composting/Vermicomposting Experiments for the management of Solid Organic Waste.
6. A visit to normal and secured landfill site, biological composting/vermicomposting units in the city.

### **MSSE0202 Public Health and Sanitation**

Code	Course Title	Course Type	Credit
MSSE0202	Public Health and Sanitation	Practice	4

#### **Objective**

- The course aims at the training of the students in the laboratory to analyze waste water and soil samples.

#### **Learning outcome**

- The students will be able to know different industrial wastes water and can analyse different parameters of waste water and its impact on public health .

#### **Evaluation Systems**

<b>Internal Examination</b>	<b>Component</b>	<b>% of Marks</b>	<b>Method of Assessment</b>
	Lab. /Project work	60	Practice
	Report	40	Report Presentation
<b>Total</b>		100	

#### **Experiments**

1. Study of Physical characteristics of water: Colour, Odour, Turbidity, Temperature.
2. Estimation of pH of water/soil sample.
3. Determination of conductivity/TDS of the water sample.
4. Determination of salinity of the water/soil sample.
5. Determination of dissolved oxygen in water sample.
6. Determination of COD and Total Organic Content.
7. Determination of BOD.
8. Determination of Total Kjeldahl Nitrogen (TKN), ammonical nitrogen etc. in water and soil samples.
9. Determination of fluoride content in soil/ water and its impact on human being.
10. Determination of sulphate reducing bacteria in a given sample of water.
11. Vehicular emission testing and its impact on human health.

## MSSE0203 Disaster Management

Code	Course Title	Course Type	Credit
MSSE0203	Disaster Management	Practice	4

### Objective

- The course will upgrade the information, knowledge and skill of the students about natural hazards which in turn will enable them to act with confidence in pre and post disaster situations.
- Define and describe disaster management, hazard, emergency, disaster, vulnerability, and risk.

### Learning outcome

The students will be able to define and describe disaster management, hazard, emergency, disaster, vulnerability, and risk.

Identify and describe the types of natural and non-natural disasters and the implications of disasters on environment.

- List and describe the main hazards to which our region is, or may be, vulnerable.
- Describe briefly how the effects of disasters can be reduced on vulnerable groups.
- Know the legal framework for disaster management.

### Evaluation Systems

Internal Examination	Component	% of Marks	Method of Assessment
	Lab. /Project work	60	Practice
	Report	40	Report Presentation
<b>Total</b>		100	

### Experiments

1. Role of GPS, GIS and Remote Sensing in disaster management
2. Decision-making models and processes.
3. Pre-Disaster Management activities and model making.
4. Hazard monitoring, tracking and modeling
5. Principles and Practice of Disaster Relief and Recovery of a given model.