Institute of Environmental Studies
Kurukshetra University, Kurukshetra

Syllabus of

M. Tech.

(Energy & Environmental Management)

(I – IV Semester)

KURUKSHETRA UNIVERSITY KURUKSHETRA
Scheme of Examination and Courses of Reading for M.Tech. (Energy and Environmental Management) (w.e.f. 2013-14 IN PHASED MANNER)

FIRST SEMESTER
M.TECH. (ENERGY AND ENVIRONMENTAL MANAGEMENT)

Sr. No.	Course No.	Course	Sessionals	Exam. Marks	Total Marks
1	MEMT-101	Ecology and Systems Analysis	40	60	100
2	MEMT-102	Energy Resources and Management	40	60	100
3	MEMT-103	Energy and Climate Change	40	60	100
4	MEMT-104	Research Techniques and Quantitative Methods	40	60	100
5	MEMT-105	Practical (Based on papers MEMT-101 and 102)	Examination to be held annually alongwith paper MEMT-205		
6	MEMT-106	Practical (Based on papers MEMT-103 and 104)	Examination to be held annually alongwith paper MEMT-206		
		Semester Total			400

Note: Each Theory Exam paper will be of 3 hours and practical examination will be of 6 hours duration.

KURUKSHETRA UNIVERSITY KURUKSHETRA
Scheme of Examination and Courses of Reading for M.Tech. (Energy and Environmental Management) (w.e.f. 2013-14)

SECOND SEMESTER
M.TECH. (ENERGY AND ENVIRONMENTAL MANAGEMENT)

Sr. No	Course No.	Course	Sessionals	Exam. Marks	Total Marks
1	MEMT-201	Environmental Assessment and Management	40	60	100
2	MEMT-202	Renewable Energy and Technology	40	60	100
3	MEMT-203	Environmental Remote Sensing & GIS	40	60	100
4	MEMT-204	Environmental Biotechnology and Biofuels	40	60	100
5	MEMT-205	Practical-I Ecology, Environmental Assessment and Environmental Biotechnology	40	100	140
6	MEMT-206	Practical-II Renewable Energy, Statistics and Remote Sensing	40	100	140
		Semester Total			680

Note: Each Theory Exam paper will be of 3 hours and practical examination will be of 6 hours duration.

KURUKSHETRA UNIVERSITY KURUKSHETRA
Scheme of Examination and Courses of Reading for M.Tech. (Energy and Environmental Management) (w.e.f. 2014-15)

THIRD SEMESTER
M.TECH. (ENERGY AND ENVIRONMENTAL MANAGEMENT)

Sr. No.	Course No.	Course	Sessionals	Exam. Marks	Total Marks
1	MEMT-301	*Elective-I	40	60	100
2	MEMT-302	*Elective-II	40	60	100
3	MEMT-303	Industrial Training/Minor Project	-	100	100
4	MEMT-304	Seminar and Viva Voce on Industrial Training/Minor Project	-	60	60
		Semester Total			360

Elective- I	Elective- II
Energy Conservation and Efficient Systems	Industrial Energy
Ecological Economics and Energy Systems	Energy from Waste
Environmental Bioremediation Technology	Natural Resource Management
Environmental Policies, Laws and Impact Assessment	Environmental Modeling

Note*1: For each Elective I and II, students can opt for any one out of four courses.

Note 2 : The minor project in the form of industrial training (4-5 weeks) with some Industry/NGO/Research Institute will be submitted by the student in the 3rd Semester and the student will give a presentation on the industrial training/ minor project.

KURUKSHETRA UNIVERSITY KURUKSHETRA
Scheme of Examination and Courses of Reading for M.Tech. (Energy and Environmental Management) (w.e.f. 2014-15)

FOURTH SEMESTER
M.TECH. (ENERGY AND ENVIRONMENTAL MANAGEMENT)

Sr. No.	Course No.	Course	Sessionals	Exam. Marks	Total Marks
1	MEMT-401	Dissertation	50	200	250
2	MEMT-402	Seminar on Dissertation	-	50	50
3	MEMT-403	Viva-voce on Dissertation	-	30	30
4	MEMT-404	Progressive Seminar/ Laboratory Development Work	30	-	30
		Semester Total			360

Note : The M.Tech. Dissertation will be evaluated by the Internal Supervisor and one External Examiner.

The Dissertation will be based on scientific data collection, fieldwork as well as community participation.

ECOLOGY AND SYSTEMS ANALYSIS

MEMT-101

Max.Marks : 60
Time : 3 hours

Note:-
Nine questions will be set in all.
Question No.1, which will be objective/short answer type covering the entire syllabus, will be compulsory.
The remaining eight questions will be set unit-wise with two questions from each Unit I, II, III&IV.

The candidates will be required to attempt Q.No.1 and four, selecting one question from each unit. All the questions carry equal marks.

Unit-I

Introduction : Aims and scope of ecology, biological levels of organization-genes to biosphere, Sustainable development, Ecological sustainability, Ecological footprint, Living planet Index, Human dimensions in ecology
Population ecology: Population and metapopulation, Population growth and regulation, Biotic interactions: Competition, mutualism, parasitism, predator-prey relations.

Unit-II

Community structure and organization: Nature of community and continuum, Ecological niche, Keystone species, Biological diversity, Ecosystem disturbance and succession.
Biome and aquatic systems: Distribution, characteristics, climate and biota.
Natural and anthropogenic disturbances, Invasive species: Ecology, impacts and control.

Unit-III

Ecosystem components, Ecosystem processes-photosynthesis and decomposition,
Global C and N cycle, Man's impact on nutrient cycles.
Energy in biological systems: Biological energy transformations, global distribution of primary productivity, human appropriation of productivity, energy flow models of terrestrial and aquatic systems.

Unit-IV

Concept of ecosystem modeling, Ecosystem stability, Cybernetics and ecosystem regulation.
Systems theory, Ecological models: Compartment model, matrix model, statistical model, mathematical model, energy-circuit analog model.
Analytical models in Ecology: logistic model of population growth, Lotka-Volterra model Models of succession.

Suggested Reading

1. Begon, M., Harper, J.L. and Townsend, C.R. 1986. *Ecology: Individuals, Populations and Communities*. Blackwell, Oxford.
2. Botkin, D.B. and Keller E.A. 2004. *Environment Science: Earth as a Living Planet*. John Wiley & Sons Inc., New York.
3. Chapin, F.S., Matson, P.A. and Mooney, H.A. 2002. *Principles of Terrestrial Ecosystem Ecology*. Springer-Verlag, New York.
4. Krebs, Charles (2008). The ecological world view, CABI, United Kingdom.
5. MEA 2005. *Ecosystems and Human Well-being: health synthesis, a report of the World Resources Institute*, Washington, D.C. www.wri.org.
6. Muller-Dombols, D. and Ellenberg, H. 1974. *Aims and Methods of Vegetation Ecology*, Wiley, New York
7. Nair, P.K.R., Rao M.R. and Buck L.E. (eds.). 2004. New *Vistas in Agroforestry: A Compendium for 1st World Congress of Agroforestry*, Kluwer Academic Publishers, Dordrecht, the Netherlands.
8. Odum, E.P. 1971. *Fundamentals of Ecology*, Saunders, Philadelphia.
9. Odum, E.P. 1983. *Basic Ecology*, Sanders, Philadelphia
10. Robert E. R. 2001. *The Ecology of Nature*, W.H. Freeman and Company.
11. Singh K.P. and. Singh J.S. 1992. Tropical Ecosystems: Ecology and Management. Wiley Eastern Limited, Lucknow, India.
12. Singh, J.S., Singh S.P. and Gupta S.R. 2006. *Ecology, Environment and Resource Conservation*, Anamaya Publishers, New Delhi.
13. Smith, R.L. 1996. *Ecology and Field Biology*, Harper Collins, New York.
14. Townsend, C.R., Begon, M. and Harper, J.L. 2003. *Essentials of Ecology*, Blackwell Publishing, Oxford
15. Young, A. 1997. *Agroforestry for Soil Management*, CAB International, UK.

ENERGY RESOURCES AND MANAGEMENT

MEMT- 102

Max.Marks : 60
Time : 3 hours

Note:-
Nine questions will be set in all.
Question No.1, which will be objective/short answer type covering the entire syllabus, will be compulsory.
The remaining eight questions will be set unit-wise with two questions from each Unit I, II, III&IV.

The candidates will be required to attempt Q.No.1 and four, selecting one question from each unit. All the questions carry equal marks.

Unit-I

Basic concepts of energy: Theoretical treatment of energy, Laws of thermodynamics, Carnot Efficiency, Energy quality and Energy budget.

Energy balance of earth: Sunlight electromagnetic spectrum, Major flows in global hydrological cycle, Ocean, Currents and heat flux, Atmospheric circulation, Earth's energy budget

Unit-II

Energy resources: Non-renewable energy resources, Fossil fuels - origin and development of coal - fired power plants - cleaner coal combusion - origin and reserves of petroleum and natural gas - composition and classification of petroleum - petroleum refining .

Environmental problems associated with petroleum.

Unit-III

Renewable energy resources: New developing renewable energy sources - nuclear fission reactors - fission power and the environment, Solar energy - collection and storage - present scenario in India, Wind energy and management, Tidal energy and management, Geothermal energy, Bio-gas plants and energy management.

Unit-IV

Importance of management of energy sources, management of fossil fuel sources, oil crisis and economic development, OPEC Market behavior, management of oil and natural gas- extraction and processing, management strategies of renewable energy sources.

Suggested Reading

1. Barrow, C. J. 2005. *Environmental Management and Development*. Taylor and Francis Group, London, New York.
2. Chaudhuri, S.P. G. 2007. *Renewable Energy in the Sundarbans, TERI.*
3. Chremisinoff, N.P. 2006. *Environmental management systems handbook for refineries* , Gulf Publishing Company, Houston, Texas
4. Christopher S. and Mark Y.2002. *Installing Environmental Management Systems*. EarthScan London.
5. Cleveland, C. J. 2008. *Encyclopedia of Energy*, Elsevier, New Delhi.
6. Cleveland, C.J. and Morris, C. 2006. *Dictionary of energy*. Elsevier, Oxford.
7. DeBarry, P.A. 2004. *Watersheds: Processes, Assessment and Management*, John Wiley and Sons, Inc, Hoboken, New Jersey.
8. Holechek, J.L.., Cole, R. A., ans Fisher, V. 2000. *Natural resources*, Prentice Hall, New Jersey, USA.
9. Kothari, D.P., Singal, K.C. and Ranjan, R. 2008. *Renewable energy sources and emerging technologies*, Prentice hall, New Delhi.
10. Miller, G.T. 1997. *Environmental Science: Working With the Earth*, Wadsworth Publishing Company, Belmont, California.
11. Owen, O. S. and Chiras, D.D. 1990. *Natural resource conservation-An ecological approach*, Macmillon, New York.
12. Owen, O.S., Chiras, D.D.and Reganold, J.P. 1998. *Natural Resource Conservation: Management for Sustainable Future*, Prentice Hall.
13. Podobnik, b.Global energy shifts. 2006. TERI press.
14. Singh, J.S., Singh S.P. and Gupta S.R. 2006. *Ecology, Environment and Resource Conservation*, Anamaya Publishers, New Delhi.
15. Sorensen, B. 2006. *Renewable energy*, Elsevier Publication, New Delhi.

ENERGY AND CLIMATE CHANGE
MEMT-103

Max.Marks : 60
Time : 3 hours

Note:-
Nine questions will be set in all.
Question No.1, which will be objective/short answer type covering the entire syllabus, will be compulsory.
The remaining eight questions will be set unit-wise with two questions from each Unit I, II, III&IV.

The candidates will be required to attempt Q.No.1 and four, selecting one question from each unit. All the questions carry equal marks.

Unit-I

Energy and carbon emissions, World energy use and current energy scenario, Trends in energy use of oil, coal and gas, Energy use and air quality, Nuclear energy and environment, Energy production, Fission and fusion, Geoengineering

Unit-II

CO_2 challenge, Energy efficiency, Fossil fuels and CO_2 emission reduction,

Global warming as an energy problem

Impact of climate change on energy demand.

Sensitivity of energy demand to temperature changes.

Climate protection and energy changes.

Unit–III

Global climate change**:** Greenhouse effect, greenhouse gases: sources, trends, radiative forcing, warming potential of gases.

Phosynthetic mechanism and global climate change, Impacts of global warming : Polar ice caps and melting of glaciers, sea level increase, weather extreme, ecosystems, human health, coral leaf bleaching, surface ocean chemistry, biogenic calcification in oceans, Climate change modeling and general circulation models.

UNIT IV

Tools to study climate change: Mitigation strategies for global warming; biological carbon sequestration, carbon sequestration in geological formations, role of forests and drylands in carbon sequestration, carbon capture and storage technologies.

Kyoto protocol, CDM and carbon trading.

Suggested Reading

1. Aguado, E. and James, E.B. 2001. *Understanding weather and climate*, Prentice Hall, New Delhi.
2. Armstrong, F. and Blundell, B., K. 2003. *Energy……beyond oil*, Oxford, New York.
3. Burroughs, W.J. 1999. *The climate revealed,* Cambridge University Press.
4. Cleveland, C. J. 2008. *Encyclopedia of Energy,* Elsevier, New Delhi.
5. Cleveland, C.J. and Morris, C. 2006. *Dictionary of energy*. Elsevier, Oxford.
6. Goudie, A. S. and Cuff, D. J. 2002. *Encyclopedia of global change,* Oxford, New York.
7. Gupta, K.R. 2005. *Encyclopedia of environment Global warming: problems and policies*, Atlantic Publication, New Delhi.
8. IPCC (Intergovernmental Panel on Climate Change) 1990. *Climate Change: The IPCC Assessment*. Cambridge University Press, Cambridge.
9. James C., Werksman H. and Roderick P. 2006. *Improving compliance with International Environmental Law,* Earthscan, London.
10. Lovejoy, T.E. and Hannah L. 2005. *Climate change and biodiversity*, TERI press.
11. Newton, P. C.D., Carran R.A., Edwards, G.R., Pascal A. and Niklaus. 2007. *Agroecosystems in a Changing Climate.* Advances in Agroecology, CRC/Taylor & Francis.
12. Sorokhtin, O.G.,Chilingar, G.V. and Khilyuk, L.F. 2007. *Global warming and global cooling: Evolution of climate and earth*, Elsevier, Netherland.
13. Steffen, W., Sanderson A., Tyson P. D., Jager J., Matson P. M., Moore B., Oldfield F., Richardson K. , Schnellnhuber H. J., Turner B. L. and Wasson R. J. 2004. *Global change and the Earth system: a Planet under Pressure*, Springer-Verlag, New York, USA.
14. Vig, N.J.and Axelrod, R.S. 1999. *The Global environment*, Earth Scan London.
15. Wallace, J. M. and Hobbs, P. V. 1940. *Atmospheric science*, Elsevier, Tokyo

RESEARCH TECHNIQUES AND QUANTITATIVE METHODS

MEMT-104

Max.Marks : 60
Time : 3 hours

Note:-
Nine questions will be set in all.
Question No.1, which will be objective/short answer type covering the entire syllabus, will be compulsory.
The remaining eight questions will be set unit-wise with two questions from each Unit I, II, III&IV.

The candidates will be required to attempt Q.No.1 and four, selecting one question from each unit. All the questions carry equal marks.

Unit - I

Principles and applications of spectroscopy: UV-Vis, Spectrophotometry, Flame Photometry, Atomic Absorption Spectrophotometry (AAS), Colorimetry, Fluorometry, Inductively Coupled Plasama – Atomic Emission Spectroscopy (ICP – AES), Inductively Coupled Plasama – Mass Spectroscopy (ICP – MS).

Unit - II

Chromatography: Principles and applications of chromatographic techniques: (a) Paper (b) Thin Layer Chromatograpy (TLC)(c) Column (d) Gel (e) Gas Chromatography (GC) and (f) High Performance/Pressure Liquid Chromatography (HPLC)

Microscopy: Optical, Phase Contrast, Automation method of analysis.

Unit - III

Types of data and measurement level; Statistical applications in environmental data analysis, Sampling methods for water, air and soil analysis, Measures of Central Location and Dispersion, Probability, Correlation and Regression, Standard error of estimate, Test of significance-t test for mean, difference between two means, variance and correlation coefficients, Chi-square test.

Unit - IV

Analysis of variance (ANOVA); Principles of experimental design randomization, replication and local control, Types of experimental design- CRD, RBD, LSD, Simple factorial design; Analysis of experimental designs.

Methods of vegetation analysis, Methods of estimating plant biomass and productivity

Isolation and enumeration of soil microorganisms, Methods of analysis of soil microbial diversity, Soil enzymes, Soil carbon, Methods of water quality assessment

Suggested Reading:

1. Alexander, S. K., Strete, D. and Jane, N. 2004. *Laboratory exercises in organism and molecular microbiology*. McGraw Hill.
2. Clark, R.N. 1999. *Spectroscopy of Rocks and Minerals, and Principles of Spectroscopy*, U.S. Geological Survey, Denver.
3. Gomez, K.A. and Gomes, A.A. 1984. *Statistical Procedures for Agricultural Research*, John Wiley and Sons, New York.
4. Hoshmand, A.R. 1998. *Statistical Methods for Environmental and Agricultural Sciences*, CRP Press, New York.
5. John, W. and Mark, M. (eds). 2004. *Environmental Modeling: Finding Simplicity in Complexity*, John Wiley and Sons Inc., New York.
6. Kolay, A.K. 2007. *Solid genesis, Classification Survey and Evaluation*, Atlantic Publication, New Delhi.
7. Lo, C.P. and Yeung A. K.W. 2006. *Concepts and Techniques of Geographic Information Systems*, Prentice Hall, New Delhi.
8. Luo, Y and Zhou, X. 2006. *Soil Respiration and the Environment*, Elsevier, New York.
9. Muller-Dombols, D. and Ellenberg, H. 1974. *Aims and Methods of Vegetation Ecology*, Wiley, New York.
10. Sivasankar, B. 2007. *Bioseparations, Principles and Techniques*, Prentice Hall of India, New Delhi.
11. Snedecor, G.W. and Cochran, W.G. 1975. *Statistical Methods*, Oxford and IBH, New Delhi.
12. Vogal, A.I., *Instrumentation Methods*
13. Skoog and West. *Instrumentation Methods*
14. Villard. *Instrumentation and Method of Analysis*
15. Sokal, R.R. and Rohlf, F.J. 1969. *Biometry*, W.H. Freeman, San Francisco.
16. Zhang, C. 2007. *Fundamentals of Environmental Sampling and Analysis*, John Wiley and Sons, New Jersey.

ENVIRONMENTAL ASSESSMENT AND MANAGEMENT
MEMT-201

Max.Marks : 60
Time : 3 hours

Note:-
Nine questions will be set in all.
Question No.1, which will be objective/short answer type covering the entire syllabus, will be compulsory.
The remaining eight questions will be set unit-wise with two questions from each Unit I, II, III&IV.

The candidates will be required to attempt Q.No.1 and four, selecting one question from each unit. All the questions carry equal marks.

Unit-I

National environmental polices-2006, Approaches, objectives, principles and frameworks.
Purposes and aims of environmental impact assessment, EIA methodology, EIA processes: Project screening, scoping, base-line data, impact identification: prediction, evaluation, valuation of environmental impacts, mitigation, public participation, presentation, review and decision making, monitoring and auditing.

UNIT -II

Environmental Management Plan, Environmental components of EIA.
Environmental procedures in India; Impact, identification and methods, Case studies of EIA of hydroelectric dam and river valley project, Thermal power plants and petroleum exploration,; Types of environmental audits ; Environmental audit and EIA

UNIT-III

Energy audits-energy conservations ;Provision of energy conservation Act, 2001, List of energy Intensive industries and other establishments, Physical and operational data for the facility, Energy audit procedure, safety considerations, safety checklist, conducting the audit visit in industries .
Primary identification of energy conservation opportunities: Post-audit analysis, energy audit report, energy audit report format, energy action plan.
Institutional designs for renewable energy resources.

Unit-IV

Environmental management systems in India, ISO_14001.
Environmental sustainability – dimension and sustainability models.
Environmental sustainability indicators, sustainability index, strategies for sustainable development, Traditional knowledge systems for sustainable development
Introduction to environmental law and environmental protection act in India.
Role of Judiciary in environmental conservation in India.

Suggested Readings:

1. MEA 2005. *Ecosystems and Human Well-being: health synthesis, a report of the World Resources Institute,* Washington, D.C. www.wri.org.
2. Singh, J.S., Singh S.P. and Gupta S.R. 2006. *Ecology, Environment and Resource Conservation,* Anamaya Publishers, New Delhi.
3. Barrow, C. J. 2005. *Environmental Management and Development*. Taylor and Francis Group, London, New York.
4. Christopher S. and Mark Y.2002. *Installing Environmental Management Systems*. EarthScan London.
5. Miller, G.T. 1997. *Environmental Science: Working With the Earth*, Wadsworth Publishing Company, Belmont, California.
6. Owen, O. S. and Chiras, D.D. 1990. *Natural resource conservation-An ecological approach*, Macmillon, New York.
7. Owen, O.S., Chiras, D.D.and Reganold, J.P. 1998. *Natural Resource Conservation: Management for Sustainable Future,* Prentice Hall.
8. Singh, J.S., Singh S.P. and Gupta S.R. 2006. *Ecology, Environment and Resource Conservation,* Anamaya Publishers, New Delhi.
9. Nair, M.N.B. (eds.) 1998. *Sustainable Management of Non-wood Forest Products*, Faculty of Forestry, University Putra, Malaysia.
10. Barrow, C. J. 2005. *Environmental Management and Development*, Taylor and Francis Group, London and New York.

RENEWABLE ENERGY AND TECHNOLOGY
MEMT-202

Max.Marks : 60
Time : 3 hours

Note:-
Nine questions will be set in all.
Question No.1, which will be objective/short answer type covering the entire syllabus, will be compulsory.
The remaining eight questions will be set unit-wise with two questions from each Unit I, II, III&IV.

The candidates will be required to attempt Q.No.1 and four, selecting one question from each unit. All the questions carry equal marks.

Unit-I

Energy alternatives, the solar option, the nuclear option, tar sands and oil shale, tidal energy, geo-thermal energy.
Solar energy : Solar radiations, solar thermal conversion devices and storage, applications
Solar photovoltaic conversion, Wave energy and Ocean thermal energy conversion,
Hydroelectric energy

Unit-II

Indirect and direct solar energy conversion
Photovoltaic conversion : Optical effect of pn-junction, design and analysis of PV cell, PV cell fabrication, system design, Solar power heaters
Wind energy: Conversation to wind flow, wind energy converters, commercial wind power development, wind energy storage and transfer.

Unit-III

Solar energy for industrial process heat.
Industrial process heat- temperature requirement, consumption pattern.
Designing thermal storage, transport of energy, concentrating solar collector system, industrial applications of concentrating collector.
Designs of energy collecters, tracking systems, absorbers and energy concentrators.

Unit-IV

Biomass energy: Sources of biomass energy, Petroleum plants, Energy plantations, Production of biogas from organic wastes.
Recent trends in biodiesel production
Bio- ethanol production: Lessons from national and international experience.
Energy from organic wastes

Suggested Reading:

1. Chaudhuri, S.P. G. 2007. *Renewable Energy in the Sundarbans, TERI.*
2. Holechek, J.L., Cole, R. A., ans Fisher, V. 2000. *Natural resources,* Prentice Hall, New Jersey, USA.
3. Kothari, D.P., Singal, K.C. and Ranjan, R. 2008. *Renewable energy sources and emerging technologies,* Prentice hall, New Delhi.
4. Metcalf and Eddy (eds). 2003. *Wastewater Engineering: Treatment and Reuse*. Tata McGraw-Hill, New Delhi.
5. Podobnik, B. 2006. *Global energy shifts*. TERI press.
6. Sorensen, B. 2006. *Renewable energy*, Elsevier Publication, New Delhi.
7. Vesilind, P. A. and Morgan, S. M. 2004. *Introduction to Environmental Engineering* Thomson, Brooks/Cole.
8. Wang , L.K., Hung, Y.T. and Shammas, N.K.(eds). 2006. *Advanced Physicochemical Treatment Processes*, Springer-Verlag, New York.

ENVIRONMENTAL REMOTE SENSING AND GIS
MEMT-203

Max.Marks : 60
Time : 3 hours

Note:-
Nine questions will be set in all.
Question No.1, which will be objective/short answer type covering the entire syllabus, will be compulsory.
The remaining eight questions will be set unit-wise with two questions from each Unit I, II, III&IV.

The candidates will be required to attempt Q.No.1 and four, selecting one question from each unit. All the questions carry equal marks.

Unit-I

Physical basis of Remote Sensing, Electromagnetic spectrum, Atmospheric windows, Rayleigh scattering, Spectral reflectance, Energy-matter interaction.

Basic principles of global positioning system, GIS- basic concept

Unit – II

Remote Sensing process, Platforms and sensors used in Remote Sensing; Systems for data collection-Passive Remote Sensing and Active Remote Sensing; Microwave Remote Sensing, Multispectral Remote Sensing.

Unit-III

Visual image processing, Classifications, Procedures and Map accuracy, Elements of visual image interpretation, Ground truthing, Digital image processing.

Photogrammetry: Basic concepts, Types of aerial photographs, Application of Remote Sensing in Energy resource management.

Unit-IV

Data structure: Raster and Grid data, Analytical modeling in GIS- A general account.
GIS project design and management, problem identification, implementation evaluation

GIS application in natural resource management, biodiversity and gap analysis, Environmental impact assessment, solid waste management and disaster management.

Suggested Readings

1. Bettinger, P. and Wing, M.G.2004. *Geographic Information Systems: Applications in Forestry and Natural Resources Management,* McGraw Hill, London.
2. Burrough, P. A. and McDonnell, R. A. 2007. *Principles of Geographical Information Systems*, Oxford University Press, New York.
3. Campbell, J. B. 2003. *Introduction to Remote Sensing*, Taylor & Francis, London and New York.
4. Gupta, R. P. 2005. *Remote Sensing Geology*, Springer, New Delhi.
5. Jensen, J. R. 2006. *Remote Sensing of the Environment: An Earth Resource Perspective,* Dorling Kindesle (Pearson Education) South Asia.
6. Lo, C.P. and Yeung, A. K.W. 2006. *Concepts and Techniques of Geographic Information Systems,* Prentice Hall, New Delhi.
7. Longley, P. A., Goodchild, M.F., Maguine, D. J. and Rhind, D. W. 2003. *Geographic Information Systems and Science,* John Wiley and Sons Ltd., New York.
8. Quattrachi, D.A. and Goodchild M.F. 1977. *Scale in remote sensing and GIS,* Lewis Publishers, New York.
9. Sahu, K. C. 2008. *Textbook of Remote Sensing and Geographical Information Systems,* Atlantic Publication, New Delhi.
10. Schowengerdt, R.A. 2007. *Remote Sensing: Models and Methods for Image Processing,* Academic Press, Elsevier, New York.
11. Wilson, J. P. and Fotheringham, A. S. 2008. *The Handbook of Geographic Information and Science CABI,* UK Blackwell, USA.
12. Lillesand, T.M. and Kiefer, R.W. *Principles of Image Interpretation*.
13. McCoy, R.M.2006. *Field Methods in Remote Sensing,* Ranwat Publication.
14. Star, J.L., Estes, J.E. and McGwire, K.C. 1997. *Integration of Geographic Information Systems and Remote Sensing,* Cambridge Uni. Press.
15. Chang K.T.2006. *Introduction to Geographic Information Systems,* McGraw-Hall.
16. Drury, S.A. 1998. *Images of the Earth: A Guide to Remote Sensing*, Oxford Science Publications.

ENVIRONMENTAL BIOTECHNOLOGY AND BIOFUELS
MEMT-204

Max.Marks : 60
Time : 3 hours

Note:-
Nine questions will be set in all.
Question No.1, which will be objective/short answer type covering the entire syllabus, will be compulsory.
The remaining eight questions will be set unit-wise with two questions from each Unit I, II, III&IV.

The candidates will be required to attempt Q.No.1 and four, selecting one question from each unit. All the questions carry equal marks.

Unit-I

Microbes and environmental management
Biodegradation of macromolecules and xenobiotics, Recalcitrance of Xenobiotics, Co-metabolism, Biodegradation of toxic organic pollutants by Aerobic, Anaerobic and Anoxic biological processes.
Biosensors in detection of Environmental Pollution – BOD sensor, Methane biosensor, Ammonia and nitrate biosensor.
Environmental applications and Bioreactors.

Unit-II

Phytotechnology, Bioremediation techniques: aerobic and anaerobic, Bioremediation of metal contaminated sites and spilled oil, Biosorption, Bioaccumulation, Bioleaching and Biomining for recovery of resources.
Micropropagation and cloning of plants – application in forestry, Somaclonal variations; Conservation of endangered species; Biotechnology in preservation of bio-diversity; *In situ* and *ex situ* conservation, Gene banks.

Unit-III

Biological Processing of waste water, Biotechnology for solid, hazardous and radioactive waste management, Biodegradable plastics
Biotechnology for wasteland management; Biofertilizers and Biopesticides and IPM.
GMO's and Biosafety guidelines. IPR and environment

Unit-IV

Biofuels: Biodiesel fuels, their origin, chemical and physical properties; Biodiesel production; Advantages and disadvantages of biodiesel; Storage and use of biodiesel.
Biorefinery concept – biomass derived chemical products.
Biomass gasification and types of gasifiers; Policy issues in biofuels, Indian Biofuel Programme, Bioethanol production.

Suggested Readings

1. Armstrong, F. and Blundell, B. K. 2007. *Energy……beyond oil*, Oxford, New York.
2. Bhojvaid, P.P. 2007. *Biofuels Towards a Greener and Secure Energy Future* Teri Press, New Delhi.
3. Buchanan, G. and Jones 2004. *Biochemistry and Molecular Biology of Plants,* IK International Pvt. Ltd., New Delhi.
4. Cleveland, C.J. and Morris, C. 2006. *Dictionary of Energy*. Elsevier, Oxford.
5. Evans, J. (ed). 2001. *Forest Handbook Volume 1*, Blackwell Science, Oxford.
6. Glick, B.R. and Pasternak, J.J. 2007. *Molecular Biotechnology: Principles and Applications of Recombinant DNA*. Washington, D.C. ASN Press.
7. Kothari, D.P., Singal, K.C. and Ranjan, R. 2008. *Renewable Energy Sources and Emerging Technologies,* Prentice hall, New Delhi.
8. Kushik, N. 2004. *Biopesticides for Sustainable Agriculture, Prospects and Constraints* Teri Press, New Delhi.
9. Lovejoy, T. E. and Harnah L. 2006. *Climate Change and Biodiversity*, Teri Press, New Delhi.
10. Moran, H. and Rawn, S. P. 2006. *Principles of Biochemistry,* Pearson Education.
11. Nelson, G.C. 2001. *Genetically Modified Organisms in Agriculture: Economics and Politics*. Academic Press.
12. Rosillo-Calle, F., Groot, P., Hemstock, S. L. and Woods 2007. *The Biomass Assessment Handbook,* Earth Scan, London.
13. Spiros, N.A. and Reineke, W. 2002. *Biotechnology for the Environment: Soil Remediation*, Kluwer Academic Publishers, Springer-Verlag , New York.
14. Thomas, J.A. and Fuchs, R. 2002. *Biotechnology and Safety Assessment*, Academic Press.
15. Turk. J. 1989. *Introduction to Environmental Studies*, Saunders College Publishing.

ENERGY FROM WASTE
MEMT-302 (E-II)

Max.Marks : 60
Time : 3 hours

Note:-
Nine questions will be set in all.
Question No.1, which will be objective/short answer type covering the entire syllabus, will be compulsory.
The remaining eight questions will be set unit-wise with two questions from each Unit I, II, III&IV.

The candidates will be required to attempt Q.No.1 and four, selecting one question from each unit. All the questions carry equal marks.

Unit-I

Definition, classification & sources of waste; physical, chemical and biological properties of waste as a fuel; Waste handling before thermal conversion, Preparation of recycled fuel, Mass combustion of waste, Combustion of recycled fuel. Emission reduction during combustion

Unit-II

Technologies for solid waste disposal and recovery of energy from municipal solid waste and industrial waste, Organic waste blending systems, Utilization and treatment of fly ash, land-fill gas utilization in energy production.
Energy generation from waste: Refuse Derived Fuel RDF - waste to energy- design and fuel analysis.

Unit-III

Biochemical conversions: sources of energy generation: industrial waste, agro residues; anaerobic digestion biogas production; types of biogas plant
Thermochemical conversions: sources of energy generation, Industrial applications of gasifiers, Briquetting; utilization and advantages of briquetting; Environmental impacts of biochemical and thermochemical conversion.

Unit-IV

Biomass: procedures of characterization, Integrated biomass gasification for electricity generation. Bio-energy as byproduct of waste processing, bioenergy assessment; bio-methanation from sludge digestion, types of reactors, UASBR (Upper Anaerobic Sludge Blanket Reactor), Biorefinery concept.
Alcohol fuels: vegetable oil as fuels, bioethanol production and technology; biodiesel biohydrogen technology: potential of organic waste for hydrogen production; biofuel refining and technology; commercial biomass energy markets and economics.

Suggested Reading

1. Parker, Colin, & Roberts, 1985. *Energy from Waste - An Evaluation of Conversion Technologies*, Elsevier Applied Science, London.
2. Shah, Kanti, 2000. *Basics of Solid & Hazardous Waste Management Technology*, Prentice Hall.
3. Datta Manoj, 1997. *Waste Disposal in Engineered Landfills*, Narosa Publishing House.
4. Bhide A.D., Sundaresan BB, *Solid Waste Management in Developing Countries*,INSDOC, New Delhi
5. Khandelwal K.C., Mahdi S S, 1986. *Biogas Technology - A Practical Handbook*, Tata McGraw Hill.
6. Maheswari R.C., 1997. *Bio Energy for Rural Energisation* , Concepts Publication.
7. Parker, Colin, & Roberts, 1985. *Energy from Waste - An Evaluation of Conversion Technologies*, Elsevier Applied Science, London.
8. Bent Sorensen (2nd Ed), 2000. *Renewable Energy*, Academic press, New York.
9. Lal B., Reddy MRVP, 2005. *Wealth from Waste*, Rajkamal Electric Press, Delhi.
10. Cleveland C.J., 2008. *Encyclopedia of Energy*, Elsevier, New Delhi
11. Bhatia S.C., 2007. *Solid and Hazardous Waste Management*, Nice Printing Press, Delhi.
12. Mande S., Kishore V.V. N., 2007. *Towards Cleaner Technologies-A Process Story on Thermal Gasifiers for Heat Applications in Small and Micro Enterprises*, IG Printers Pvt. Ltd., New Delhi.
13. Wall J.D., Harwood C.S., Demain A., 2008. *Bioenergy*, Printed in USA.

ENERGY CONSERVATION AND EFFICIENT SYSTEMS
MEMT-301 (E-Ia)

Max.Marks : 60
Time : 3 hours

Note:-
Nine questions will be set in all.
Question No.1, which will be objective/short answer type covering the entire syllabus, will be compulsory.
The remaining eight questions will be set unit-wise with two questions from each Unit I, II, III&IV.

The candidates will be required to attempt Q.No.1 and four, selecting one question from each unit. All the questions carry equal marks.

Unit –I

Conservation of energy: overview, concept and principle of energy conservation, Laws of thermodynamics, Energy conservation as preservation of resources, Conservation measures for energy, Energy scenario: energy pricing in India, energy sector reforms, Managing an effective energy conservation programme, Material and energy balance.

Unit-II

Energy efficiency: introduction, definition and importance, benefits of energy efficiency, potential for energy efficiency, industrial energy efficiency, The effect of efficiency improvement on primary energy demand, Energy distribution, generation and Demand Side Management (DSM). Energy analysis.

Unit-III

Sustainable energy technologies and energy efficiency, Energy intensity, Pathways to improve energy intensity. Cogeneration, concept, options (steam/gas, turbine, diesel engine based), Reduction of energy loss, energy recovery, urban ecosystems and quality of environment. Energy efficiency in buildings (green building and built up area), Passive solar heating, low and high temperature solar water heating, Photovoltaics

Unit-IV

Wind power, Wave tidal power and technologies for use. Biomass and technologies, geothermal, nuclear, alternative transport, hydrogen economy, energy efficient motors, windows, lighting. Energy consumption in pumps, fans, compressed air systems, refrigeneration and air conditioning system and energy saving opportunities with energy efficiency, waste heat recovery. Bureau of energy efficiency and star rating.

Suggested Reading

1. Barrow, C. J. 2005. *Environmental Management and Development*, Taylor and Francis Group, London and New York.
2. Bhattacharya, R.N. 2001. *Environmental Economics: An Indian Perspective*, Oxford University Press.
3. Cleveland, Cutler J. 2008. *Encyclopedia of Energy*, Elsevier, New Delhi.
4. Coley, David 2008. *Energy and climate change*, John Wiley and Sons Ltd., England.
5. Hunter, M.L. 1996. *Fundamentals of Conservation Biology*, Blackwell Science.
6. Meffe G.K. and Corroll C. R. 1994. *Principles of Conservation Biology,* Sinaur Associates Inc., Sunderland, Massachusetts
7. Owen, Oliver S. and Chiras, Daniel D. (1990). *Natural Resource Conservation-An Ecological Approach* Macmillon, New York
8. Kothari. D.P., Singal, K.C. and Ranjan, R. 2008. *Renewable Energy Sources and Emerging Technologies*, Prentice hall, New delhi
9. Cleveland, C.J. and Morris, C. 2006. *Dictionary of Energy*, Elsevier, Oxford.
10. Kreith. F., Goswami. D.Y.2007. *Handbook of Energy Efficiency and Renewable Energy*, Taylor & Francis Group, LLC
11. Wiley J.S., Turner W.C., *Energy Management Handbook*.
12. Kreithand F., Goswami D.Y., *Handbook of Energy Efficiency and Renewable Energy*, C.R.C. Press.
13. Polimeros G., 1981. *Energy Conservation Handbook*, Industrial Press, New York.
14. Reay D.A., Span E. and F.N., 1979. *Heat Recovery Systems*, London.
15. *Bureau of Energy Efficiency- Guidebooks* Vol. 1,2,3 for National Certification for EM/EA

ENVIRONMENTAL BIOREMEDIATION TECHNOLOGY
MEMT-301 (E-Ib)

Max.Marks : 60
Time : 3 hours

Note:-
Nine questions will be set in all.
Question No.1, which will be objective/short answer type covering the entire syllabus, will be compulsory.
The remaining eight questions will be set unit-wise with two questions from each Unit I, II, III&IV.

The candidates will be required to attempt Q.No.1 and four, selecting one question from each unit. All the questions carry equal marks.

Unit-I

Introduction to bioremediation, Historical development of environmental bioremediation, Requirements for bioremediation, Constraints and priorities of bioremediation, Applications of bioremediation technologies.
Xenobiotic compounds, their structure and persistance in environment, Oil spills, Oil products in environment. Biodegradation- principles and mircobiology; Microconversions of xenobiotics

Unit-II

Biotransformation of pesticides and hydrocarbons, Biodegradation kinetics, Bioavailability, Biomineralization, Testing for biodegradability, Numerical modelling of biodegradation. Biological processing of waste water, Bioreactors – designs used for treatement of sludge and removal of metals from waste water. Biodegradable plastic, Biodegradation of PAH in environment.

Unit-III

Bioremediation strategies – biostimulation and bioaugmentation, Bioremediation techniques *in-situ* and *ex-situ*. Bioremediation of organic and metal contaminated environments. Metal toxicity and bioavailability. Biosorption and precipitation. Bioremediation technologies for heavy metal and radionuclides removal. Phytoremediation and its processes, role of phytochelatins. Applications of genetic engineering in phytoremediation. Algal and fungal based bioremediation.

Unit-IV

Gaseous bioremediation, biofilms, bioscrubbers, bioventing, Soil Vapour Extraction (SVE), Water recirculation systems, Air sparging, Biobarriers, Composting, Phytoremediation for air

pollutants. Political and scientific challenges for broader implementation of bioremediation technologies. Role of biosensors in bioremediation technologies, Biofilms and their applications.

Suggested Reading:

1. Scragg A., 2008. *Environmental Biotechnology*, Oxford Univesity Press. New York
2. Singh S.N., Tripathi R.D., 2007. *Environmental Bioremediation Technologies*, Springer, New York.
3. Das H.K. 2007. *Textbook of Biotechnology*, Kanak Enterprises Ltd. Gaziabad.
4. Mohapatra P.K. 2007. *Textbook of Environmental Biotechnology*, I.K. Publishing House, New Delhi.
5. Olguin E.J., Sanchez G., Hernandez E. 2005. Environmental Biotechnology and Cleaner Processes, Replika Press, Kundli.
6. Trivedi P.C. 2008. Pollution and Bioremediation, Sheetal Printer, Jaipur, India.