M. Tech. in Renewable Energy Technology
(II yr. Scheme & Syllabus)

Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

Syllabus

Name of the Programme: M.Tech. in Renewable Energy Technology	**Year**: II	**Semester**: III
Course Name: Advanced Heat Transfer	**Course Code**: MEPL311	**Credit**: 3
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hours	**Teaching Scheme:** 3L+0T+0P	

Module No.	Contents	Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	**Conduction:** Derivation of heat conduction equation, analysis of basic 1D and 2D conduction. Lumped system analysis, Heisler charts, semi-infinite solid, use of shape factors in conduction, 2d transient heat conduction. product solutions Multi-dimensional steady and unsteady problems in Cartesian and Cylindrical coordinates	8
3	**Convection:** Forced convection: Conservation equations, Integral and analytical solutions, Boundary layer analogies, Internal and external flows, Laminar and turbulent flows, Flow across cylinders and tube banks, and Empirical solutions. Free and forced convection: Governing equations, Laminar and turbulent flows, Analytical and empirical solutions. Combined free and forced convection	9
4	**Heat Transfer with Phase Change:** Dimensionless parameters in boiling and condensation, boiling modes, pool boiling, correlations, forced convection boiling, the physical mechanism of condensation, laminar and turbulent film condensation, film condensation in tubes, and dropwise condensation, predict heat transfer coefficients in HVAC systems, cryogenics.	8
5	**Heat Exchangers and Heat Pipes:** Basic design methodologies – LMTD and effectiveness NTU methods, overall heat transfer coefficient, causes and remedies fouling of heat exchangers, classification of heat exchangers. Classification, construction and applications of heat pipe, NDT, fouling level monitoring, micro bore cleaning technology	9
6	**Radiation:** Laws of thermal radiation. Radiation properties of surfaces. View factors for diffuse radiation. Radiation exchange in ideal black surfaces and diffuse gray enclosures. Radiation effects in temperature measurement. Enclosure theory for surfaces with wall temperatures with continuous functions of space. Spectrally diffuse enclosure surfaces. Approximate solution methods for one-dimensional media, The optically thin and optically thick approximations. Radiation in participating media, Gas radiation. Combined Conduction and Radiation	10
	Total	**45**

Text Books:

1. Fundamentals of Heat and Mass Transfer by Frank P. Incropera, David P. DeWitt, Theodore L. Bergman, Adrienne S. Lavine (John Wiley and Sons)
2. Heat and Mass Transfer by Yunus Cengel, Afshin Ghajar (TMH)
3. Principles of Heat Transfer by Kreith, F. and Bohn, M.S, (Thomson Learning Publication).

Reference Books:

1. Heat and Mass Transfer Data Book by C.P. Kothandaraman and S. Subramanyam (New Age)
2. Fundamentals of Engineering Heat and Mass Transfer by R.C. Sachdeva (New Age)
3. Process Heat Transfer by D.Q. Kern (TMH)

Prerequisite:

1. Fundamentals of Mathematics, Thermodynamics and Fluid mechanics

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Name of the Programme: M.Tech. in Renewable Energy Technology	**Year**: II	**Semester**: III
Course Name: Solid Waste Management	**Course Code**: MEPL312	**Credit**: 03
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hours	**Teaching Scheme:** 3L+0T+0P	

Module No.	Contents	Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	**Generation of Solid Waste:** Goals and Objectives of Solid Waste Management. Classification of Solid Waste, Industrial, commercial, domestic, municipal solid waste etc., Factors Influencing Generation of Solid Waste, Characteristics of Solid Waste and quantification.	10
3	**Onsite Handling, Storage and Processing:** Onsite handling, Onsite Storage, Dust bins, Community Containers, Container Locations, Onsite Processing methods and techniques for different kinds of waste, Effect of handling and storage of solid waste on public health and aesthetics.	9
4	**Solid Waste Collection, Transfer and Transport:** Collection Systems, Equipment and Labour Requirement, Collection Routes, various Transfer and Transport Systems.	8
5	**Processing and Disposal Methods:** Processing Techniques - Mechanical Volume Reduction, Biological treatment, Drying and dewatering. Methods of Disposal- Sanitary Land filling, Composting, Incineration, Bioremediation.	8
6	**Recovery of Resources, Conversion Products and Energy:** Material Recovery, Energy Generation and Energy Recovery Operation, Reuse in other applications. Case Study	9
	Total	**45**

Text Books:

1. K. Sasikumar, Snoop Gopi Krishna, Solid Waste Management, Prentice Hall India Learning Private Limited, 2009
2. Solid Waste Engineering Principles and Management Issues by G. Technobanogious, H. Theisen & R. Blssen, Mc Graw Hill Book Co.

Reference Books:

1. N. N. Bandela, D. G. Tare, Municipal Solid Waste Management, BR Publishing Corporation, 2009
2. George Tchobanoglous, Frank Krieth, Handbook of Solid Waste Management, 2nd edition, McGraw Hill Publication, 2002
3. T. V. Ramachandran, Management of Municipal Solid Waste, Centre for Ecological Sciences, IISc Karnataka Research Foundation, 2009
4. George Techobanoglous et al, “Integrated Solid Waste Management”, McGraw-Hill Publication, 1993.

Prerequisite:

1. Basics of Engineering Chemistry

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Name of the Programme: M.Tech. in Renewable Energy Technology	**Year**: II	**Semester**: III
Course Name: Environmental Impact Analysis	**Course Code**: MEPL313	**Credit**: 03
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hours	**Teaching Scheme:** 3L+0T+0P	

Module No.	Contents	Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	Sustainable Development, Environmental Impact Assessment, Environmental Impact Statement, EIA - As an Integral Part of the Planning Process, Public participation in environmental decision-making process	8
3	Project and Environment description, Anticipated Environmental Impacts and Mitigation Measures, Environmental Monitoring Programme	9
4	Environmental attributes: Air, Water, Noise, Socioeconomic, Cultural and biological, Purposes of defining the Environmental Setting, Inclusion or Exclusion of Environmental Items	9
5	Prediction and methods of assessment of impacts on various attributes of the environment, carbon credits, case study	9
6	Decision Making & Project Management and Implementation; EIA notifications and Amendments, Case study	9
	Total	**45**

Text Books:

1. Environmental Impact Assessment, Canter, Larry, McGraw Hill publications
2. Environmental Impact Assessment, Shrivastava A.K., Baxter Nicola, Grimm Jacob. APH Publishers

Reference Books:

1. Environmental Impact Analysis Handbook by Whooten, Rau. McGraw Hill publications
2. Life Cycle Assessment Handbook: A Guide for Environmentally Sustainable Products, Mary Ann Curran, Wiley, 2012
3. Environmental Impact Analysis– A Decision-Making Tool, Jain, R K. Van Nostrand Reinhold Company

Prerequisite:

1. Basic environmental knowledge

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Name of the Programme: M.Tech. in Renewable Energy Technology	**Year**: I	**Semester**: III
Course Name: Research Methodology & IPR	**Course Code**: NP40.02	**Credit**: : 03
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 03 hours	**Teaching Scheme:** 3L+0T+0P	

Module No.	Contents	Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	**Research Methodology**: Basic Statistics, Inferential statistics, Central tendency of data, Standard deviation, frequency distribution, level of measurement, Probability distribution, Normal distribution, Correlation, Numerical problems, Introduction to research, Need of research, Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem	9
3	**Research Approaches:** Approaches of investigation of solutions for research problems, Sample design, data collection, Regression and Z-test, t-test, ANOVA, analysis, interpretation, Necessary instrumentations, Effective literature studies approaches, analysis. Plagiarism, Research ethics, examples	9
4	**Effective Technical Writing**: Development of Research Proposal, citation of references, Report writing, Precautions for writing research reports	8
5	**Nature of Intellectual Property**: Patents, Designs, Trademarks, and Copyright, Geographical Indications. Process of Patenting and Development, International Scenario, International Cooperation on Intellectual Property	9
6	**Patent Rights:** Scope of Patent Rights, Procedure of patenting, Licensing and transfer of technology, patent Infringement and Enforcement. New developments in IPR: IPR of Biological Systems, Computer Software, etc. Case Studies on Intellectual Properties	9
	Total	**45**

Text Books:

1. Research Methodology by C. R. Kothari, New Age Publication, 2nd Revised Edition
2. Research Methodology - Concept and Cases 2020 - Deepak Chawla, 2nd Edition, Vikas Publications
3. Intellectual Property- A Primer for Academia by Dr. Rupinder Tewari and Ms. Mamta Bhardwaj, Honorary Director Publication Bureau, Panjab University Chandigarh

Reference Books:

1. Research Methodology and Quantitative Methods - Rao G. Nageswara, B S Publications
2. Intellectual Property rights - 2020 by Ganguli Prabuddha, McGraw Hill Education

Prerequisite:

1. Knowledge of Basic Statistics

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Name of the Programme: M.Tech. in Renewable Energy Technology	**Year**: II	**Semester**: III
Course Name: Energy Management	**Course Code**: MEPL340.01	**Credit**: 03
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hours	**Teaching Scheme:** 3L+0T+0P	

Module No.	Contents	Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	Energy Basics, Energy Scenario, sector-wise energy consumption - Global and Indian, history of rate of consumption of various conventional fuel, their availability in future, Energy generation and Distribution, Uneven distribution of energy resources, Load curves, types of power plants, Base load, Intermediate load, Peak load plant, Energy displacement – Energy storage plants. Impact of energy on economy, development and environment, Energy policies, Energy strategy for future	12
3	Energy Management: supply side and demand side, Energy Auditing, Conservation & Resource Development, utilization of energy for Sustainable Development	10
4	Sector-wise Energy Management - Industry, commercial and domestic Buildings, Transport, Agriculture	8
5	Energy forecasting techniques; future rate of consumption of fossil fuels, need for renewable energy resources, Energy Integration, Energy Matrix	8
6	Energy management for cleaner production, application of renewable energy, Case study	6
	Total	**45**

Text Books:

1. Amlan Chakrabarti, Energy Engineering and Management, Prentice Hall India, 2011.
2. Eastop T. D. and D. R. Croft, Energy Efficiency for Engineers & Technologists, Longman, 1990.
3. Rao S. and B. B. Parulekar, Energy Technology, Khanna Publishers, 2005

Reference Books:

1. General Aspects of Energy Management and Audit, Bureau of Energy Efficiency
2. Energy Management, P. Venkataseshaiah and K.V. Sharma, Wiley Publication
3. Energy Management, WR Murphy and C McKay, Elsevier Publication

Prerequisite:

1 Basic Knowledge of energy technology.

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Name of the Programme: M.Tech. in Renewable Energy Technology	**Year**: II	**Semester**: III
Course Name: Waste to Energy Conversion	**Course Code**: MEPL340.02	**Credit**: 03
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hours	**Teaching Scheme:** 3L+0T+0P	

Module No.	Contents	Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	**Introduction:** The Principles of Waste Management and Waste Utilization. Waste Management Hierarchy and 6R Principle of Sustainability. Waste as a Resource and Alternate Energy sources, Functions of Waste Management – Collection, Segregation, Transportation and Storage Requirements. Location of Waste to Energy Plants	9
3	**Waste Resources:** Sector-wise Waste production: Domestic, Industrial, Agriculture, Postconsumer, Classification of waste – agro-based, forest residues, domestic waste, medical waste, industrial waste (hazardous and non-hazardous) and their quantification. Characterization of waste for energy utilization	9
4	**Technologies for Waste to Energy:** Biochemical Conversion: Energy production from organic waste through anaerobic digestion and fermentation. Thermo-chemical Conversion: Combustion, Incineration and heat recovery, Pyrolysis, Gasification: Plasma Arc Technology and other newer technologies	9
5	**Waste to Energy Methods:** Landfill gas, collection and recovery. Refuse Derived Fuel (RDF) – fluff, briquettes, pellets. Alternate Fuel Resource (AFR) – production and use in Cement plants, Thermal power plants and Industrial boilers. Energy from Plastic Wastes – Non-recyclable plastic wastes for energy recovery. Energy Recovery from other wastes, case studies of techniques for energy generation through waste	9
6	**E-waste:** Definition, Classification**,** E-waste in the global context, Rise of e-waste in India, Impact of hazardous e-waste in India, Global trade in hazardous waste, Management of e-waste, e-waste legislation, Recycling of e-waste and energy conversion, International Standards	8
	Total	**45**

Text Books:

1. Nicholas P. Cheremisinoff. Handbook of Solid Waste Management and Waste Minimization Technologies. An Imprint of Elsevier, New Delhi (2003).
2. M. Dutta, B. P. Parida, B. K. Guha and T. R. Surkrishnan. Industrial Solid Waste Management and Landfilling practice. Narosa Publishing House, New Delhi (1999).

Reference Books:

1. 1.Waste-to-Energy in Austria – White Book – Figures, Data Facts, 2nd Edition, May 2010
2. Hagerty, D. Joseph; Pavoni, Joseph L; Heer, John E., "Solid Waste Management", New York, Van Nostrand

Prerequisite:

1. Environmental Engineering

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Name of the Programme: M.Tech. in Renewable Energy Technology	**Year**: II	**Semester**: III
Course Name: Water Pollution Control Engineering	**Course Code**: MEPL340.03	**Credit**: 03
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hours	**Teaching Scheme:** 3L+0T+0P	

Module No.	Contents	Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	**Environmental pollution** - Definition, Types of water pollution: Causes, Industrial and Domestic effluents, Pesticides, Health Hazards, Control measures, Abatement Techniques	8
3	**Municipal sewage and Waste Industrial effluent** - Primary treatment, Screening, equalization, coagulation, etc. Secondary treatment - Trickling Filter, Activated sludge process - Aerobic and Anaerobic treatment, Sludge treatment and Disposal-Tertiary Treatment - Evaporation, Reverse Osmosis, Dialysis, Ion Exchange, Biofilter, Adsorption and Absorption	9
4	**Treatment Method -** Waste water composition, Characteristics: COD, BOD, Turbidity, Microbial contamination. Physical Unit Operation, Chemical Precipitation and Biological Treatment - Physical unit operation: Screening , Grit and Detritus removal, Solid Removal through sedimentation, aerobic and anaerobic ponds, low cost treatment ponds, Live examples of water treatment plants located nearby	9
5	**Bioremediation technique** - Soil and ground water remediation, Site characterization, containment, removal and treatment, Factors influencing bioremediation and optimization of remediation, Biomethanation: Feedstocks, composition, factors influencing gas production, biogas application design consideration	9
6	**Agencies of water quality testing** - Pollution Control Boards (State and Central), Duties and Responsibilities, Introduction to environmental Laws	9
	Total	45

Text Books:

1. R.K Trivedy and Siddharth Kaul, “Low cost waste water treatment technologies”, ABD Publishers, Jaipur
2. P.C Trivedi, “Pollution and Bioremediation”, Aavishkar Publishers, Jaipur
3. S. K. Agarwal, “Water Pollution” Ashish Publishing House

Reference Books:

1 Goel, P.K. and Sharma, K.P. “Environmental Guidelines and Standards in India”, Technoscience Publications, Jaipur
2. P.K. Goel “Water Pollution: Causes, Effects and Control”, New Age International, Publishers, New Delhi
3. S.J. Arceivala “Wastewater Treatment and Disposal”, Marcel Dekker Inc, New York

Prerequisite:

1. Environmental Pollution
2. Renewable Energy

Name of the Programme: M.Tech. in Renewable Energy Technology	**Year**: II	**Semester**: III
Course Name: Pre Dissertation	**Course Code**: MEPD360	**Credit**: 12
Max Marks: 400	**CIE:** 240	**SEE:** 160

Module No.	Contents
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite *Dissertation Contents: As per topic approved by supervisor* 1. Decide the area of research and tentative topic for research. 2. Collect experiment based research papers on selected area of research. (atleast 5 papers) 3. Prepare a summary of the collected research paper and discuss it with supervisor. 4. Add other relevant research papers and continue the literature view. 5. Write down the tentative research objectives. 6. Present the findings and work done.

Teaching and Examination Scheme

II Year IV Semester: M.Tech. (RET)

S. No.	Course Code	Course Name	Category	Teaching Scheme				Marks			Credit
				L	T	P	Exam Hrs	CIE	SEE	Total	20
1	MEPD470	Dissertation	REW	-	-	-	-	360	240	**600**	**20**

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Name of the Programme: M.Tech. in Renewable Energy Technology	**Year**: II	**Semester**: IV
Course Name: Dissertation	**Course Code**: MEPD470	**Credit**: 20
Max Marks: 600	**CIE:** 360	**SEE:** 240

Module No.	Contents
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite *Dissertation Contents: As per topic approved by supervisor* 1. Plan and develop an experimental set-up or CFD model for the research work. 2. Prepare a detailed literature review. 3. Discussion with Supervisor and review the objectives. 4. Presentation. 5. Review and finalize the topic, objectives and methodology. 6. Write the outcomes of research and explore the patent and business opportunities. 7. Prepare a research paper. 8. Prepare a thesis. 9. Final presentation.

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