MASTER OF TECHNOLOGY

Mechanical Engineering Department

Semester - II

Teaching Scheme

Course Code	Course Name	Lecture hours	Tutorial hours	Practical hours	Credit
HS 5001	Research Methodology	2	0	0	2
ME 5005	Advanced Refrigeration & Air-Conditioning	3	1	2	5
ME 5006	Advanced Manufacturing Techniques II	2	1	3	4
ME 5007	Power Generation II: Energy Conversion	3	0	0	3
ME 5501	Mini-Project#	0	0	6	4
	Total	**10**	**2**	**11**	**18**
#Converted from Elective II, in Academic Year 2016−17.					

MASTER OF TECHNOLOGY

Mechanical Engineering Department

Semester - II

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">HS 5001</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Research Methodology</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>IV</td><td>Prerequisites,if any</td><td colspan="4">None</td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">Introduction to engineering research: Definition, characteristics and types, basic research terminology, qualities of a researcher, research methods vs methodology, overview of engineering research methods, role of Information and Communication Technology (ICT) in research, research ethics, intellectual property rights and scholarly publishing.
Research formulation: Defining and formulating the research problem, selecting the problem, necessity of defining the problem, literature survey — significance in defining a problem, various sources, critical review, identifying gap areas from literature review and research databases, development of working hypothesis.
Research design and data analysis: Research design − basic principles, need of research design, features of good design, important concepts relating to research design, observation and facts, laws and theories, method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis, hypothesis testing, generalization and interpretation.
Technical writing: Types (thesis, report, journal papers etc.), qualities, structure and components of good technical document, use of software tools (Word processing, LATEX, etc.), illustrations and tables, bibliography, referencing and footnotes. Oral presentation − planning, software tools, creating and making effective presentation, use of visual aids, importance of effective communication.</td></tr>
</table>

VI	Textbooks/References	1. Blessing, L.T.M., Chakrabarti, A., DRM: A Design Research Methodology, Springer, 2009, ISBN: 978-1-84882-586-4. 2. Chandra, S., Sharma, M.K., Research Methodology, Narosa Publishing House, 2013, ISBN: 978-81-8487-246-0. 3. Cohen, L., Manion, L., Morrison, K., Research Methods in Education, Routledge (Taylor and Francis Group), 2011, ISBN:978-0-415-58336-7. 4. Goddard, W., Melville, S., Research Methodology — An Introduction, Juta and Company Ltd., 2004, ISBN: 978-0-702- 15660-1. 5. Kothari, C.R., Garg, G., Research Methodology — Methods and Techniques, New Age International, 2014, ISBN: 978-81- 224-3623-5. 6. Kumar, R., Research Methodology — A Step-by-Step Guide for Beginners, SAGE, 2011, ISBN: 978-1-84920-300-5. 7. Pandey, P., Pandey, M.M., Research Methodology — Tools and Techniques, Bridge Centre, 2015, ISBN: 978-606-93502- 7-0. 8. Panneerselvam, R., Research Methodology, PHI Learning Pvt. Ltd., 2014, ISBN: 978-81-203-4946-9. 9. Rugg, G., Petre, M., A Gentle Guide to Research Methods, Open University Press, 2007, ISBN: 978-0-335-21927-8. 10. Singh, Y.K., Fundamentals of Research Methodology and Statistics, New Age International, 2006, ISBN: 978-81-224- 2418-8. 11. Walliman, N., Research Methods — The Basics, Routledge (Taylor and Francis Group), 2011, ISBN:978-0-415-48994-2.

MASTER OF TECHNOLOGY

Mechanical Engineering Department

Semester - II

I	Course Code	**ME 5005**			
II	Course Title	**Advanced Refrigeration & Air-Conditioning**			
III	Credit Structure	L	T	P	C
		3	1	2	5
IV	Prerequisites,if any	Knowledge of basic thermodynamics and applied thermodynamics including basic refrigeration and air conditioning.			
V	Course Objective	The course is designed to give an in-depth study of theory of advanced refrigeration and air-conditioning and their applications. The techniques of analysis and design of refrigeration and airconditioning systems including domestic and industrial applications, focusing on energy and environmental aspects. System optimization will also be discussed. This course will help the students to understand the underlying principles of operations in different Refrigeration & Air conditioning systems and components. It will also provide knowledge on design aspects of Refrigeration & Air conditioning systems and present cold chain infrastructure in India			
VI	Course Content	Review of Basic Refrigeration systems, Actual Vapour compression system, Multi stage compression, Multi evaporative systems, Vapor absorption system. Complete Vapour compression systems, Graphical method, analytical method, Newton-Raphson Method, optimal design of Evaporators, installation, Service and maintenance of VCRS. Alternative refrigerants, pros and cons of existing refrigerants, study of Montreal and Kyoto Protocols, Worldwide present scenario on alternative refrigerants, comparative study, and selection of refrigerant focusing on ODP & GWP. Trans-critical Vapour compression remigration, CO2 refrigeration system in trans-critical cycle. Challenges and opportunities in warm climatic conditions. Component design issues. Analysis, modifications and optimization of the system of the system. Cryogenics, Introduction to Cryogenics and its applications. Properties of cryogenic uids. Properties of materials at cryogenic temperature. Gas-Liquefaction and Refrigeration Systems. Gas Separation. Cry coolers. Cryogenic Insulations. Vacuum Technology. Refrigeration components, design and selection criteria of Compressors, Condensers, Expansion Valves, Types of expansion devices, sizing of capillary tube design. Review of Air Conditioning systems, Psychometric processes, Psychometric processes, design of summer, winter and year round air conditioning. Design of cooling tower, Load Calculations, Cooling & Heating, Selection of air-conditioning apparatus cooling and dehumidification. Design of Air conditioning apparatus, coil equipment, optimal design of cooling and dehumidifying coils, spray equipment, air washer and cooling tower design. Transmission and distribution of air, duct design Transmission and distribution of air in rooms, centrifugal and axial ow fans and fan arrangements. Refrigeration and air conditioning controls. Introduction to Cold Chain, Application of Refrigeration & Air Conditioning Systems, Food processing by refrigeration and storage, transportation refrigeration, Cooling and heating of foods, freeze drying and heat drying of foods. Current development, strategy and plan for cold chain in India and worldwide scenario.			

VII	Course Outcome	Upon completion of this course, the students can understand the various design and applied conditions of different Refrigeration & Air conditioning systems and also able to design complete Refrigeration & Air conditioning systems for domestic and industrial scales.
VIII	Textbooks/References	1. Arora, C.P., Refrigeration and Air Conditioning, 3rd edition, McGraw Hill, New Delhi, 2012. 2. Roy J. Dossat, Principles of Refrigeration, 4th edition, Pearson Education Asia, 2009. 3. Gupta D K and Dasgupta M S, Book Chapter "Transcritical CO2 Refrigeration System in Tropical Region: Challenges and Opportunities" Handbook of Research on Advances and Applications in Refrigeration Systems and Technologies, IJI Global Publication USA 2016. 4. Stoecker, W.F. and Jones J. W., Refrigeration and Air Conditioning, McGraw Hill, New Delhi, 1986. 5. ASHRAE Hand book, Fundamentals, 2012. 6. Jones W.P., Air conditioning engineering, 5th Edition, Elsevier Butterworth-Heinemann, 2001. 7. Manohar Prasad, Refrigeration and air-conditioning, Wiley Eastern Ltd, 1983. 8. Edward G. Pita, Air Conditioning Principles and Systems, 4th Ed., Pearson Education Asia, 2003.

MASTER OF TECHNOLOGY

Mechanical Engineering Department

Semester - II

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">ME 5006</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Advanced Manufacturing Techniques II</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>1</td><td>3</td><td>4</td></tr>
<tr><td>IV</td><td>Prerequisite(s), if any</td><td colspan="4">Manufacturing Processes, Basics of Automation, FEM and Statistics</td></tr>
<tr><td>V</td><td>Pedagogy</td><td colspan="4">Lectures, Seminars, Demonstrations, Hands On, Team Activities, Projects</td></tr>
<tr><td>VI</td><td>Course Content</td><td colspan="4">Joining Technology: This provides an advanced knowledge of the joining technology and the corresponding joining techniques and processes. Their industry specific application fields, with particular emphasis on the infrastructure sectors related to railways, aerospace, marine and automobile, would be explained. In addition, practical fundamentals with special emphasis on the finite element method correlating mechanical properties to HAZ will be discussed.
Automation: This is intended to impart knowledge in the field of automation and robotics which is of interest to various manufacturing industries. Special focus would be on the robot as it is one of the key element of exible automation and production engineering. Fundamental non-robot components and machines that are important for the implementation of automated production systems shall also be discussed.
Machining Technology: This is proposed to provide detailed insight into machining processes as it is the most important precondition to understand their principle working mechanisms and hence to use this knowledge for their planning and optimization. Automation of the cutting force measurement, surface roughness measurement and tool wear measurement, are in the focus of this module. Emphasis would be on the problems related to companies in the HVM sector (e.g. automotive, aerospace, defence, medical engineering) where at least 25% of the process time for components arises from machining.
Laboratory Work: The laboratory work strictly incorporates experimental research. The laboratory work is performed in groups. Before the laboratory, the experiments need to be prepared. This means that each student has to possess an adequate knowledge of the theoretical foundations and practical implementation of the experiment.
Scientific ProjectWork: The Scientific Project includes a studyrelated homework in a team work format. Thereby, each student has to show his/her own preparation to evaluate their own performance. After the submission of the work, the results should be presented in the form of a presentation by each student.</td></tr>
</table>

VII	Textbooks/References	1. Material and Processes in Manufacturing, Paul De Garmo, J.T. Black, and Ronald A. Kohser, Prentice Hall of India Private Limited, 2001. 2. Nontraditional Manufacturing Processes, Benedict. G.F., Marcel Dekker Inc., 1987. 3. Modern Machining Processes, Pandey P. C. and Shan H. S., McGraw Hill Education, 1980. 4. Mechanical Metallurgy, George E Dieter, McGraw Hill Education. 5. Elsevier,Springer,and Wiley ebooks from http://iitram.ac.in/library/index.php/ecollection/ebooks

MASTER OF TECHNOLOGY

Mechanical Engineering Department

Semester - II

I	Course Code	**ME 5007**			
II	Course Title	**Power Generation II: Energy Conversion**			
III	Credit Structure	L	T	P	C
		3	0	0	3
IV	Prerequisite(s), if any	None			
V	Course Objective	This fast-paced course exposes students to both traditional and non-conventional methods of electricity generation. While focussing on energy conversion processes, emphasis is also given to environmental and economic aspects. A wide range of topics are touched upon, with students expected to do an in-depth study of their areas of interest.			
VI	Course Content	**Context & Perspectives:** World and India Energy Outlook; The Energy Conversion Chain Electricity from Finite and Renewable Sources; Energy and the Environment **Fuels & Combustion:** Classification of Fuels; Properties, Stoichiometry, Chemical Kinetics; Basics of Combustion and Pollutant Formation **Combustion Systems & Devices:** Solid Fuels Pulverised, Fluidized Bed, and Stoker/Grate Firing Systems; Liquid & Gaseous Fuels Injection and Atomization Devices, Gas Turbines, Compression Ignition (CI) Engines **Emissions & (After-)Treatment:** Legislation and Limits; NOx and SOx Reduction Methods, Particulate Control; Gasification, Carbon Capture and Storage (CCS) **Non-Conventional Sources of Energy:** Solar, Wind, Nuclear, and Hydro-Methods and Technologies for Harnessing Energy; Overview of Biomass, Tidal, Geothermal, Waves, and Ocean Thermal Energy Conversion (OTEC); Waste to Energy; Future Prospects **Energy Storage:** The Intermittency Challenge; Types of Energy Storage Thermal, Electrical, Chemical, and Mechanical; Storage Efficiency; Existing Technologies and Directions for Further Research and Development **Economics of Electricity Generation:** Variable Load Problem; Fixed and Variable Costs, Interest, Depreciation; Levellized Cost of Electricity (LCOE), Feed-In Tariffs			
VII	Course Outcome	Upon successful completion of this course, students will become acquainted with state-of-the-art in energy conversion methods, their environmental impact, and economics. They will be able to make informed decisions about the best-suited technology for any given situation.			

VIII	Textbooks/References	1.Latest reports from International Energy Agency (IEA), Government of India (GoI) and other independent agencies on World and India Energy Outlook. 2. Power Plant Engineering by R. K. Hegde, Pearson Education, 2015. 3. Renewable Energy and Climate Change by Volker Quaschning, Wiley India, 2012. 4. Power Generation from Solid Fuels by Hartmut Spliethoff, Springer-Verlag, 2010. 5. Gas Turbine Combustion: Alternative Fuels and Emissions, by Arthur H. Lefebvre and Dilip R. Ballal, Third Edition, CRC Press, 2010. 6. Non-Conventional Energy Resources by B. H. Khan, McGraw Hill Education, 2009. 7. Sustainable Energy: without the hot air, by David JC MacKay, UIT Cambridge, 2008. Available Online at http://withouthotair.com 8. Power Plant Engineering: The Theory and Practice of Stationary Electric Generating Plants by Frederick T. Morse, East West Press, 1953.

MASTER OF TECHNOLOGY

Mechanical Engineering Department

Semester - II

I	Course Code	**ME 5501**			
II	Course Title	**Mini-Project**			
III	Credit Structure	L	T	P	C
		0	0	6	4
IV	Prerequisite(s), if any	None			
V	Project Objectives & Outcome	1. Identify and compare technical and practical issues related to the area of student interest and specialization. 2. Infer principles of working of machines and processes. 3. Outline annotated bibliography of research demonstrating scholarly skills. 4. Comprehend the knowledge gained in the course work. 5. Demonstrate the ability in problem solving and to communicate effectively. 6. Prepare a well-organized report employing elements of technical writing and critical thinking. 7. Demonstrate the ability to describe, interpret and analyze technical issues and develop competence in presenting.			
VI	Project Content	Specific work to be decided in consultation and by mutual agreement with a faculty advisor.			
VII	Textbooks/References	Latest research, patent, and product literature, from all possible sources, relevant to the chosen area of work.			