
GENERAL AND ACADEMIC BRANCH – IV “E” SECTION

Read :- 1. U.O.of even.No. dtd 22.06.2012.
2. Minutes of the meeting of the Board of Studies in Engineering (PG) held on 12.10.2012 (Item.No.1.a)

ORDER

As per paper read as (1) above, an expert committee consisting of the following members were constituted for framing the syllabus for the M.Tech course in Energy Systems.

(b) Dr.K.R.Jayadevan Associate Professor, Dept.of.Mechanical Engineering Govt.Engineering College, Thrissur – 680 009.


Vide paper read as 2nd above, the meeting of Board of Studies in Engineering (P.G) held on 30.03.2012, vide item No. 1 (a) unanimously decided to approve the scheme & syllabi of the M.Tech course in Energy Systems w.e.f. 2012 admission.

Considering the urgency of the matter, the Vice-Chancellor has accorded sanction to implement the Scheme & Syllabus of the M.Tech Course in Energy Systems, subject to ratification by the Academic Council, vide paper read as 3rd above.

Sanction has therefore been accorded for implementing the Scheme & Syllabus of the M.Tech Course in Energy System w.e.f. 2012 admissions. Contd…2.
Orders are issued accordingly. The syllabus is available in University website.

Sd/-
DEPUTY REGISTRAR (GA.IV)
For Registrar.

To
The Principals of all affiliated Engineering Colleges offering M.Tech Course.

Copy to :- PS to VC/PA to PVC/PA to Registrar/PA to CE/Enquiry/EX.Section/
EG.I.Section/DR.M.Tech/M.Tech Tabulation Section/ Chairman, BOS in
Engineering (UG) & PG)/ Dean, Faculty of Engineering./ System -
Administrator (With a request to upload in the University website)/SF/DF/FC.

Forwarded/by Order

Sd/-
Section Officer.
UNIVERSITY OF CALICUT

SCHEME AND SYLLABUS FOR

M.TECH.

in

ENERGY SYSTEMS
Module I – Linear Algebra (13 Hours)

Module II – Non linear programming (13 Hours)

Module III- Partial Differential Equations (13 Hours)
First order PDEs, Linear equations, Lagrange method, Cauchy method, Charpits method, Jacobi method. Second order PDEs, Classifications, Formulation and method of solutions of Wave equation, Heat equation and Laplace equation.

Module IV – Numerical Solution of Differential Equations (13 Hours)

References:
Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be a minimum of two tests per subject. The assessment details are to be announced to students’ right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module

<table>
<thead>
<tr>
<th>Module 1</th>
<th>Module 2</th>
<th>Module 3</th>
<th>Module 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 1 : 20</td>
<td>Question 3 : 20</td>
<td>Question 5 : 20</td>
<td>Question 7 : 20</td>
</tr>
<tr>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
</tr>
<tr>
<td>Question 2 : 20</td>
<td>Question 4 : 20</td>
<td>Question 6 : 20</td>
<td>Question 8 : 20</td>
</tr>
<tr>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
</tr>
</tbody>
</table>

MES10 102 ADVANCED ENERGY CONVERSION SYSTEMS Credits: 4

Module I – (13 Hours)
Classification of energy sources- Utilization, economics and growth rates- Fossil fuels, nuclear fuels and solar energy – Combustion calculations – Conventional thermal power plant design and operation – Superheat, reheat and regeneration – Other auxiliaries of thermal plant – High – pressure boilers – Steam generator control.

Module II – (13 Hours)
Gas turbine and combined cycle analysis – Inter-cooling, reheating and regeneration-gas turbine cooling – design for high temperature – Combined cycles with heat recovery boiler – Combined cycles with multi-pressure steam – STAG combined cycle power plant – Influence of component efficiencies on cycle performance.

Module III- (13 Hours)

Module IV – (13 Hours)

References:

**Internal continuous assessment: 100 marks**
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be a minimum of two tests per subject. The assessment details are to be announced to students’ right at the beginning of the semester by the teacher.

**End semester Examination: 100 marks**

**Question pattern**
Answer any 5 questions by choosing at least one question from each module

<table>
<thead>
<tr>
<th>Module 1</th>
<th>Module 2</th>
<th>Module 3</th>
<th>Module 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 1 : 20</td>
<td>Question 3 : 20</td>
<td>Question 5 : 20</td>
<td>Question 7 : 20</td>
</tr>
<tr>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
</tr>
<tr>
<td>Question 2 : 20</td>
<td>Question 4 : 20</td>
<td>Question 6 : 20</td>
<td>Question 8 : 20</td>
</tr>
<tr>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
</tr>
</tbody>
</table>

**MES10 103 RENEWABLE ENERGY TECHNOLOGY Credits: 4**

**Module I – (13 Hours)**

**Module II – (13 Hours)**

**Module III- (13 Hours)**

**Module IV – (13 Hours)**
Wind energy – Principles of wind energy conversion – Site selection considerations – Wind power plant design – Types of wind power conversion systems – Operation, maintenance and economics – Geothermal energy – Availability, system development and limitations – Ocean thermal energy conversion – Wave and tidal energy – Scope and economics – Introduction to integrated energy systems.

References:


Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be a minimum of two tests per subject. The assessment details are to be announced to students’ right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module

<table>
<thead>
<tr>
<th>Module 1</th>
<th>Module 2</th>
<th>Module 3</th>
<th>Module 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 1 : 20 Marks</td>
<td>Question 3 : 20 Marks</td>
<td>Question 5 : 20 Marks</td>
<td>Question 7 : 20 Marks</td>
</tr>
<tr>
<td>Question 2 : 20 Marks</td>
<td>Question 4 : 20 Marks</td>
<td>Question 6 : 20 Marks</td>
<td>Question 8 : 20 Marks</td>
</tr>
</tbody>
</table>

Module I – (13 Hours)
Module II – (13 Hours)

Module III- (13 Hours)

Module IV – (13 Hours)

References:

6. UNESCAP- Guide Book on Promotion of Sustainable Energy Consumption (www.unescap.org/enrd/energy)

Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be a minimum of two tests per subject. The assessment details are to be announced to students’ right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module

<table>
<thead>
<tr>
<th>Module 1</th>
<th>Module 2</th>
<th>Module 3</th>
<th>Module 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 1 : 20</td>
<td>Question 3 : 20</td>
<td>Question 5 : 20</td>
<td>Question 7 : 20</td>
</tr>
<tr>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
</tr>
<tr>
<td>Question 2 : 20</td>
<td>Question 4 : 20</td>
<td>Question 6 : 20</td>
<td>Question 8 : 20</td>
</tr>
</tbody>
</table>
Module I – (13 Hours)

Module II – (13 Hours)

Module III- (13 Hours)
Energy conservation schemes – Statutory requirements of energy audit – Economic aspects of energy audit – Capital investments in energy saving equipment – Tax rebates – Advantages of 100% depreciation – India’s Plan for a domestic energy cap & trade scheme.

Module IV – (13 Hours)
Social cost benefit analysis – Computation of IRR and ERR – Advance models in energy planning – Dynamic programming models in integrated energy planning – Energy planning case studies – Development of energy management systems – Decision support systems for energy planning and energy policy simulation.

References:

4. Annual Energy Planning Reports of CMIE, Govt. of India.

Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be a minimum of two tests per subject.
assessment details are to be announced to students’ right at the beginning of the semester by the teacher.

**End semester Examination: 100 marks**

**Question pattern**
Answer any 5 questions by choosing at least one question from each module

<table>
<thead>
<tr>
<th>Module 1</th>
<th>Module 2</th>
<th>Module 3</th>
<th>Module 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 1 : 20</td>
<td>Question 3 : 20</td>
<td>Question 5 : 20</td>
<td>Question 7 : 20</td>
</tr>
<tr>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
</tr>
<tr>
<td>Question 2 : 20</td>
<td>Question 4 : 20</td>
<td>Question 6 : 20</td>
<td>Question 8 : 20</td>
</tr>
<tr>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
</tr>
</tbody>
</table>

**MES10 105(B)**  **ENERGY MODELING, ECONOMICS AND PROJECT MANAGEMENT**  **Credits: 4**

**Module I – (14 Hours)**


**Module II – (12 Hours)**

**Basic concept of econometrics and statistical analysis:** The 2-variable regression model; The multiple regression model; Tests of regression coefficients and regression equation; Econometric techniques used for energy analysis and forecasting with case studies form India; Operation of computer package Input – Output Analysis, Basic concept of Input-output analysis; concept of energy multiplier and implication of energy multiplier for analysis of regional and national energy policy; Energy and environmental Input – Output analyses using I-O model.

**Module III- (13 Hours)**

**Energy Modeling:** Interdependence of energy-economy-environent; Modeling concept, and application, Methodology of energy demand analysis; Methodology for energy forecasting; Sectoral energy demand forecasting; Interfuel substitution models; SIMA model, and I-O model for energy policy analysis; Simulation and forecasting of future energy demand consistent with macroeconomic parameters in India; Energy Economics and Policies: National and Sectoral energy planning; Integrated resources planning; Energy pricing.
Module IV – (13 Hours)

**Project Evaluation & Management:** Financial analysis: Project cash flows, time value of money, life cycle approach & analysis, conception, definition, planning, feasibility and analysis; Project appraisal criteria; Risk analysis; Project planning matrix; Aims oriented project planning; Social cost benefit analysis. Network analysis for project management; Time estimation; Critical path determination; PERT, CPM and CERT: Fuzzy logic analysis; Stochastic based formulations; Project evaluation techniques; Funds planning; Project material management, evaluation & analysis; Implementation and monitoring; Performance indices; Case studies.

2 Autonomous Fossil Fuel and renewable energy (RE) - based Power Systems.

**References:**


**Internal continuous assessment: 100 marks**

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be a minimum of two tests per subject. The assessment details are to be announced to students’ right at the beginning of the semester by the teacher.

**End semester Examination: 100 marks**

**Question pattern**

Answer any 5 questions by choosing at least one question from each module

<table>
<thead>
<tr>
<th>Module 1</th>
<th>Module 2</th>
<th>Module 3</th>
<th>Module 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 1 : 20</td>
<td>Question 3 : 20</td>
<td>Question 5 : 20</td>
<td>Question 7 : 20</td>
</tr>
<tr>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
</tr>
<tr>
<td>Question 2 : 20</td>
<td>Question 4 : 20</td>
<td>Question 6 : 20</td>
<td>Question 8 : 20</td>
</tr>
<tr>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
</tr>
</tbody>
</table>
Module I – (13 Hours)

Module II – (13 Hours)

Module III- (13 Hours)

Module IV – (13 Hours)

References:

Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be a minimum of two tests per subject. The assessment details are to be announced to students’ right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
In this course, students will be provided with an orientation programme on the following equipments/software. After this orientation, each student is expected to formulate and complete an activity of interest which has to be derived from the orientation programme under the guidance of a faculty. The details like background, problem definition, status of technology/knowledge in that area by a good literature review (5 latest papers), objectives, methodology, equipment that can be used (from the orientation programme), results from the experiments and their interpretation with respect to the assumption/background and a formal conclusion are expected in the report which is to be submitted at the end of the semester. This work is evaluated for the credit assigned.

**Topics for the Orientation Programme**

1. Experimental study of solar water heating systems.
2. Experimental study of solar PV pumping system.
3. Experimental study of solar lighting systems and system optimization.
4. Analysis and study of biomass gasifier based power plant.
5. Analysis and study of CHP/CCHP systems.
7. Design of measurement and control systems using virtual instrumentation software.
8. Life Cycle Analysis (LCA) using software.
13. Design of lighting system (Room).

**Internal continuous assessment: 100 marks**

- Regularity – 30%
- Record – 20%
Objective:
To assess the debating capability of the student to present a technical topic. Also to impart training to a student to face audience and present his ideas and thus creating in him self esteem and courage that are essential for an engineer.

Individual students are required to choose a topic of their interest from Energy/Renewable Energy systems and related topics preferably from outside the M.Tech syllabus and give a seminar on that topic about 30 minutes. A committee consisting of at least three faculty members (preferably specialized in Energy/Renewable Energy) shall assess the presentation of the seminar and award marks to the students. Each student shall submit two copies of a write up of this seminar topic. One copy shall be returned to the student after duly certifying it by the chairman of the assessing committee and the other will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.

Internal continuous assessment: 100 marks

SEMESTER 2

Module I – (12 Hours)

Module II – (13 Hours)
Heat exchanger design calculations – Evaporators and condensers temperature concentration pressure characteristics of binary solutions – Rectifiers – Cooling towers – Pressure drop and pumping power.

Module III – (13 Hours)
Pump characteristics – Manufacturer’s specifications – Relations among performance characteristics – Pump system operation – Cavitation prevention – Other system considerations, Fans and nozzles.

Module IV – (14 Hours)

References:


Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be a minimum of two tests per subject. The assessment details are to be announced to students’ right at the beginning of the semester by the teacher.

End Semester Examination: 100 Marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

<table>
<thead>
<tr>
<th>Module 1</th>
<th>Module 2</th>
<th>Module 3</th>
<th>Module 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 1 : 20 Marks</td>
<td>Question 3 : 20 Marks</td>
<td>Question 5 : 20 Marks</td>
<td>Question 7 : 20 Marks</td>
</tr>
<tr>
<td>Question 2 : 20 Marks</td>
<td>Question 4 : 20 Marks</td>
<td>Question 6 : 20 Marks</td>
<td>Question 8 : 20 Marks</td>
</tr>
</tbody>
</table>

MES10 202 ENERGY CONSERVATION IN THERMAL SYSTEMS Credits: 4

Module I – (14 Hours)

Module II – (14 Hours)

Module III – (12 Hours)

Module IV – (12 Hours)

References:


Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be a minimum of two tests per subject. The assessment details are to be announced to students’ right at the beginning of the semester by the teacher.

End Semester Examination: 100 Marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

<table>
<thead>
<tr>
<th>Module 1</th>
<th>Module 2</th>
<th>Module 3</th>
<th>Module 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 1 : 20 Marks</td>
<td>Question 3 : 20 Marks</td>
<td>Question 5 : 20 Marks</td>
<td>Question 7 : 20 Marks</td>
</tr>
<tr>
<td>Question 2 : 20 Marks</td>
<td>Question 4 : 20 Marks</td>
<td>Question 6 : 20 Marks</td>
<td>Question 8 : 20 Marks</td>
</tr>
</tbody>
</table>

MES10 203 ENERGY AND ENVIRONMENT Credits: 4

Module I – (14 Hours)
Module II – (12 Hours)
Air Pollution: Classification of air pollutants, sources of emission and air quality standards – Physical and chemical characteristics – Meteorological aspects of air pollutant dispersion – Temperature lapse rate and stability – Factors influencing dispersal of air pollutant – Air pollution dispersion models – Air pollution sampling and measurement – types – Ambient air sampling – Gaseous air pollutants – Particulate air pollutants – Analysis of air pollutants.

Module III – (14 Hours)

Module IV – (12 Hours)
Environmental impact assessment: Air quality and water quality standards – Pollution prevention and control acts – Principles and methodology of Environmental impact assessment, Air and water quality impacts by project types.

References:


Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be a minimum of two tests per subject. The assessment details are to be announced to students’ right at the beginning of the semester by the teacher.

End Semester Examination: 100 Marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.
Module I – (13 Hours)
Principles of modeling and similitude as applied to Turbo-machines-Euler’s turbine equation – Analysis of turbines – constructional features of Pelton, Francis and Kaplan turbines. Development of prototype systems. Power station operation and maintenance. Load control and controlling power distribution Reservoirs. Importance of Mini and micro-hydro power systems.

Module II – (13 Hours)

Module III – (13 Hours)

Module IV – (13 Hours)

References:

1. Principles of Turbo machinery, Shephered D.G., Macmillan Company, Newyork

Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be a minimum of two tests per subject. The assessment details are to be announced to students’ right at the beginning of the semester by the teacher.

End Semester Examination: 100 Marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.
Module I - (13 Hours)

Module II – (13 Hours)

Module III- (13 Hours)

Module IV – (13 Hours)

References:

2. Simmons D. M, Nonlinear Programming for Operations Research, PHI.

Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be a minimum of two tests per subject. The assessment details are to be announced to students’ right at the beginning of the semester by the teacher.
End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module

<table>
<thead>
<tr>
<th>Module 1</th>
<th>Module 2</th>
<th>Module 3</th>
<th>Module 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 1 : 20 Marks</td>
<td>Question 3 : 20 Marks</td>
<td>Question 5 : 20 Marks</td>
<td>Question 7 : 20 Marks</td>
</tr>
<tr>
<td>Question 2 : 20 Marks</td>
<td>Question 4 : 20 Marks</td>
<td>Question 6 : 20 Marks</td>
<td>Question 8 : 20 Marks</td>
</tr>
</tbody>
</table>

MES10 204(C) COMPUTATIONAL FLUID DYNAMICS Credits: 4

Module I – (13 Hours)

Module II – (13 Hours)

Module III – (13 Hours)

Module IV – (13 Hours)

References:

2. H. K Versteeg 7 Malalasekera: An Introduction to Computational Fluid Dynamics
5. T. Sundernajan: Narosa, Computational Fluid Flow and Heat Transfer
**Internal continuous assessment: 100 marks**
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be a minimum of two tests per subject. The assessment details are to be announced to students’ right at the beginning of the semester by the teacher.

**End Semester Examination: 100 Marks**

**Question pattern**
Answer any 5 questions by choosing at least one question from each module.

<table>
<thead>
<tr>
<th>Module 1</th>
<th>Module 2</th>
<th>Module 3</th>
<th>Module 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 1 : 20</td>
<td>Question 3 : 20</td>
<td>Question 5 : 20</td>
<td>Question 7 : 20</td>
</tr>
<tr>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
</tr>
<tr>
<td>Question 2 : 20</td>
<td>Question 4 : 20</td>
<td>Question 6 : 20</td>
<td>Question 8 : 20</td>
</tr>
<tr>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
</tr>
</tbody>
</table>

**MES10 205(A) WIND ENERGY AND ITS UTILIZATION**
Credits: 4

**Module I – (14 Hours)**
Historical developments, latest developments, state of art of wind energy technology, turbine rating, cost of energy, wind power plant economics, installation and operation costs, decommissioning, Indian scenario and worldwide developments, present status and future trends.
Nature of atmospheric winds; wind resource characteristics and assessment; anemometry; wind statistics; speed frequency distribution, effect of height, wind rose, Weibull distribution, atmospheric turbulence, gust wind speed, effect of topography.

**Module II – (14 Hours)**
Aerodynamics of aerofoil; lift; drag; stall; effect of Reynold’s number; actuator disc; momentum theory and Betz coefficient; design of wind turbine blade; effect of stall and blade pitch on coefficient of power vs tip speed ratio and cut-out wind speeds, blade materials. Vertical and horizontal axis turbines, design characteristics, multiple stream tube theory, vortex wake structure; tip losses; rotational sampling, wind turbine design programs, aerodynamic loads, tower shadow, wind shear, blade coning, gyroscopic, transient and extreme loads. Aerodynamic damping and stability, teetering motion, stiff and soft towers, Power train dynamics.

**Module III – (12 Hours)**
Pitch control, yaw control, Electrical and Mechanical aerodynamic braking, teeter mechanism. Wind turbine dynamics with DC and AC generators: induction and synchronous generators, variable speed operation, effect of wind turbulence. Power electronics Converter and Inverter interfaces for wind energy utilization system for isolated and grid connected system.

**Module IV – (12 Hours)**
Wind farm electrical design, Planning of wind farms, special application for developing countries, maintenance and operation, wind farm management, site selection. Environmental assessment; noise, visual impact etc. Instrumentation, data loggers, remote monitoring and control.

References:

Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be a minimum of two tests per subject. The assessment details are to be announced to students’ right at the beginning of the semester by the teacher.

End Semester Examination: 100 Marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

<table>
<thead>
<tr>
<th>Module 1</th>
<th>Module 2</th>
<th>Module 3</th>
<th>Module 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 1 : 20</td>
<td>Question 3 : 20</td>
<td>Question 5 : 20</td>
<td>Question 7 : 20</td>
</tr>
<tr>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
</tr>
<tr>
<td>Question 2 : 20</td>
<td>Question 4 : 20</td>
<td>Question 6 : 20</td>
<td>Question 8 : 20</td>
</tr>
<tr>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
</tr>
</tbody>
</table>

MES10 205(B) ADVANCED SOLAR THERMAL AND PV SYSTEMS Credits: 4

Module I – (13 Hours)

Module II – (16 Hours)

Module III – (13 Hours)
Solar cells & panels, performance of solar cell, estimation of power obtained from solar power, solar panels PV systems, components of PV systems, performance of PV systems, design of PV systems, application of PV systems, concentrating PV systems, PV power plants, Solar cell array system analysis and performance prediction; Shadow analysis: Solar cell array design concepts; Storage autonomy; Voltage regulation; Maximum tracking.

**Module IV – (10 Hours)**


**References:**


**Internal continuous assessment: 100 marks**

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be a minimum of two tests per subject. The assessment details are to be announced to students’ right at the beginning of the semester by the teacher.

**End Semester Examination: 100 Marks**

**Question pattern**

Answer any 5 questions by choosing at least one question from each module.

<table>
<thead>
<tr>
<th>Module 1</th>
<th>Module 2</th>
<th>Module 3</th>
<th>Module 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 1 : 20 Marks</td>
<td>Question 3 : 20 Marks</td>
<td>Question 5 : 20 Marks</td>
<td>Question 7 : 20 Marks</td>
</tr>
<tr>
<td>Question 2 : 20 Marks</td>
<td>Question 4 : 20 Marks</td>
<td>Question 6 : 20 Marks</td>
<td>Question 8 : 20 Marks</td>
</tr>
</tbody>
</table>

**MES10 205(C) EMERGING REFRIGERATION TECHNOLOGIES**

**Credits: 4**

**Module I – (13 Hours)**

Introduction to refrigeration systems, methods of refrigeration, units of refrigeration, COP. Introduction to nonconventional refrigeration technologies- Thermoelectric refrigeration, magnetic refrigeration, pulse tube refrigeration, acoustic refrigeration, steam jet refrigeration, vortex tube refrigeration. Review of vapour compression refrigeration system, vapour absorption system and adsorption systems.

**Module II – (12 Hours)**


**Module III – (13 Hours)**
Introduction to Magnetic refrigeration, magneto-caloric effect, magnetic materials, magnetic refrigeration near room temperature cooling, advantages over traditional refrigeration system, clean refrigeration in future-pulse tube refrigerator-principle-analysis.

Module IV – (14 Hours)
Principles and application of steam jet refrigeration system – performance analysis, vortex tube refrigeration system, system description, Applications.

References:


Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be a minimum of two tests per subject. The assessment details are to be announced to students’ right at the beginning of the semester by the teacher.

End Semester Examination: 100 Marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

<table>
<thead>
<tr>
<th>Module 1</th>
<th>Module 2</th>
<th>Module 3</th>
<th>Module 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 1 : 20 Marks</td>
<td>Question 3 : 20 Marks</td>
<td>Question 5 : 20 Marks</td>
<td>Question 7 : 20 Marks</td>
</tr>
<tr>
<td>Question 2 : 20 Marks</td>
<td>Question 4 : 20 Marks</td>
<td>Question 6 : 20 Marks</td>
<td>Question 8 : 20 Marks</td>
</tr>
</tbody>
</table>

MES10 206  POWER ELECTRONICS LABORATORY  Credits: 2

In this course, students will be provided with an orientation programme on the following equipments/software. After this orientation, each student is expected to formulate and complete an activity of interest which has to be derived from the orientation programme under the guidance of a faculty. The details like background, problem definition, status of technology/knowledge in that area by a good literature review (5 latest papers), objectives, methodology, equipment that can be used (from the orientation programme), results from the experiments and their interpretation with respect to the assumption/background and a formal conclusion are expected in the report which is to be submitted at the end of the semester. This work is evaluated for the credit assigned.
Topics for the Orientation Programme

2. Chopper Fed DC Drive.
3. DSP Controlled AC Drive.
4. Performance study of Stator Voltage Controlled Induction Motor Drive.
5. Analysis of Vector Controlled Induction Motor Drive.
7. IGBT Based Three Phase PWM Inverter.
9. Modelling and Simulation of Electric Drives using MATLAB.
10. Modelling and Simulation of Electric Drives using PSIM.

Internal continuous assessment: 100 marks
- Regularity – 30%
- Record – 20%
- Test and Viva – 50%

**MES10 207** | **SEMINAR** | **Credits: 2**
--- | --- | ---

**Objective:** To assess the debating capability of the student to present a technical topic. Also to impart training to a student to face audience and present his ideas and thus creating in him self esteem and courage that are essential for an engineer. Individual students are required to choose a topic of their interest from Energy/Renewable Energy systems and related topics preferably from outside the M.Tech syllabus and give a seminar on that topic about 30 minutes. A committee consisting of at least three faculty members (preferably specialized in Energy/Renewable Energy) shall assess the presentation of the seminar and award marks to the students. Each student shall submit two copies of a write up of this seminar topic. One copy shall be returned to the student after duly certifying it by the chairman of the assessing committee and the other will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.

**Internal continuous assessment: 100 marks**
Module I – (12 Hours)

Module II – (12 Hours)

Module III – (14 Hours)

Module IV – (14 Hours)

References:


Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be a minimum of two tests per subject. The assessment details are to be announced to students’ right at the beginning of the semester by the teacher.

End Semester Examination: 100 Marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.
<table>
<thead>
<tr>
<th>Module 1</th>
<th>Module 2</th>
<th>Module 3</th>
<th>Module 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 1 : 20 Marks</td>
<td>Question 3 : 20 Marks</td>
<td>Question 5 : 20 Marks</td>
<td>Question 7 : 20 Marks</td>
</tr>
<tr>
<td>Question 2 : 20 Marks</td>
<td>Question 4 : 20 Marks</td>
<td>Question 6 : 20 Marks</td>
<td>Question 8 : 20 Marks</td>
</tr>
</tbody>
</table>

### Module I - (14 Hours)

**Introduction**


### Module II – (12 Hours)


### Module III- (12 Hours)


### Module IV – (14 Hours)


### References:


**Internal continuous assessment: 100 marks**
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be a minimum of two tests per subject. The assessment details are to be announced to students’ right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module

<table>
<thead>
<tr>
<th>Module 1</th>
<th>Module 2</th>
<th>Module 3</th>
<th>Module 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 1: 20</td>
<td>Question 3: 20</td>
<td>Question 5: 20</td>
<td>Question 7: 20</td>
</tr>
<tr>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
</tr>
<tr>
<td>Question 2: 20</td>
<td>Question 4: 20</td>
<td>Question 6: 20</td>
<td>Question 8: 20</td>
</tr>
<tr>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
</tr>
</tbody>
</table>

MES10 301(C) ENERGY EFFICIENT BUILDINGS Credits: 4

Module I - (14 Hours)

Module II – (12 Hours)

Module III- (12 Hours)

Module IV – (14 Hours)

References:


**Internal continuous assessment: 100 marks**
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be a minimum of two tests per subject. The assessment details are to be announced to students’ right at the beginning of the semester by the teacher.

**End semester Examination: 100 marks**

*Question pattern*
Answer any 5 questions by choosing at least one question from each module

<table>
<thead>
<tr>
<th>Module 1</th>
<th>Module 2</th>
<th>Module 3</th>
<th>Module 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 1 : 20</td>
<td>Question 3 : 20</td>
<td>Question 5 : 20</td>
<td>Question 7 : 20</td>
</tr>
<tr>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
</tr>
<tr>
<td>Question 2 : 20</td>
<td>Question 4 : 20</td>
<td>Question 6 : 20</td>
<td>Question 8 : 20</td>
</tr>
<tr>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
</tr>
</tbody>
</table>

**MES10 302(A) **

**OPTIMAL DESIGN OF HEAT EXCHANGERS**

**Credits: 4**

**Module I - (14 Hours)**

**Module II – (14 Hours)**

**Module III- (12 Hours)**

**Module IV – (12 Hours)**

References:


Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be a minimum of two tests per subject. The assessment details are to be announced to students’ right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module

<table>
<thead>
<tr>
<th>Module 1</th>
<th>Module 2</th>
<th>Module 3</th>
<th>Module 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 1: 20</td>
<td>Question 3: 20</td>
<td>Question 5: 20</td>
<td>Question 7: 20</td>
</tr>
<tr>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
</tr>
<tr>
<td>Question 2: 20</td>
<td>Question 4: 20</td>
<td>Question 6: 20</td>
<td>Question 8: 20</td>
</tr>
<tr>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
</tr>
</tbody>
</table>

MES10 302(B) | SOFT COMPUTING TECHNIQUES | Credits: 4

Module I - (12 Hours)

Module II – (12 Hours)
Module III- (14 Hours)

Module IV – (14 Hours)

References:


Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be a minimum of two tests per subject. The assessment details are to be announced to students’ right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module
Module I - (13 Hours)
Introduction to nanotechnology, nanoscale, electromagnetic spectrum, top down and bottom up approach, particle size, chemistry and physics of nanomaterials, electronic phenomenon in nanostructures, optical absorption in solids, quantum effects.

Module II – (13 Hours)
Nanomaterials, preparation of nanomaterials like gold, silver, different types of nano-oxides, Al₂O₃, TiO₂, ZnO etc. Sol-gel methods, chemical vapour deposition, ball milling etc. Carbon nanotubes, preparation properties and applications like field emission displays. Different types of characterization techniques like SEM, AFM, TEM & STM.

Module III- (13 Hours)
Nanocomposites, nanofillers, high performance materials, polymer nanocomposites, nanoclays, nanowires, nanotubes, nanoclusters etc. Smart materials, self assembly of materials, safety issues with nanoscale powders.

Module IV – (13 Hours)
Nanomanipulation, Micro and nanofabrication techniques, Photolithography, E-Beam, FIB etc. Nanolithography, soft lithography, photoresist materials. Introduction to MEMS, NEMS and nanoelectronics. Introduction to bionanotechnology and nanomedicines.

References:


Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be a minimum of two tests per subject. The
assessment details are to be announced to students’ right at the beginning of the semester by the teacher.

**End semester Examination: 100 marks**

**Question pattern**

Answer any 5 questions by choosing at least one question from each module

<table>
<thead>
<tr>
<th>Module 1</th>
<th>Module 2</th>
<th>Module 3</th>
<th>Module 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 1: 20</td>
<td>Question 3: 20</td>
<td>Question 5: 20</td>
<td>Question 7: 20</td>
</tr>
<tr>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
</tr>
<tr>
<td>Question 2: 20</td>
<td>Question 4: 20</td>
<td>Question 6: 20</td>
<td>Question 8: 20</td>
</tr>
<tr>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
<td>Marks</td>
</tr>
</tbody>
</table>

**MES10 303(P) | INDUSTRIAL TRAINING | Credits: 1**

**Objective:** To enable the student to correlate theory and industrial practice.

The students have to arrange and undergo an industrial training for minimum two weeks in an industry giving emphasis to energy conservation/management/renewable energy/energy audit/measurement techniques and equipments during the semester break between semester 2 and semester 3 and complete within 15 calendar days from the start of semester 3. The students are requested to submit a report of the training undergone and present the contents of the report before the evaluation committee. Evaluation committee will award the marks of end semester based on training quality, contents of the report and presentation.

**End semester Examination: Marks 50**

**MES10 304(P) | RESEARCH PROJECT PHASE I | Credits: 15**

**Objective:** To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

The project work can be a design project/ experimental project and/or computer simulation project on any of the topics in the area of Energy/Renewable energy. The project work is allotted individually on different topics. The students shall be encouraged to do their project work in the parent institute itself. If found essential, they may be permitted to continue their project outside the parent institute, subject to the conditions in cause 10 of M.Tech regulations. Department will constitute an Evaluation Committee to review the project work. The Evaluation committee consists of at least three faculty members of which internal guide and another expert in the specified area of the project shall be two essential members.

The student is required to undertake the master research project phase 1 during the third semester and the same is continued in the 4th semester (Phase 2). Phase 1 consist of preliminary thesis work, two reviews of the work and the submission of preliminary report. First review would highlight the topic, objectives, methodology and expected results. Second review evaluates the progress of the work, preliminary report and scope of the work which is to be completed in the 4th semester.
Objective: To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

Master Research project phase 2 is a continuation of project phase 1 started in the third semester. There would be two reviews in the fourth semester, first in the middle of the semester and the second at the end of the semester. First review is to evaluate the progress of the work, presentation and discussion. Second review would be a pre-submission presentation before the evaluation committee to assess the quality and quantum of the work done. This would be a pre qualifying exercise for the students for getting approval by the departmental committee for the submission of the thesis. At least one technical paper is to be prepared for possible publication in journal or conferences. The technical paper is to be submitted along with the thesis. The final evaluation of the project will be external evaluation.

End Semester Examination:

Project Evaluation by external examiner: 150 Marks
Viva Voce by external / internal examiner: 150 Marks