

# Savitribai Phule Pune University

## Faculty of Science & Technology



Curriculum/Syllabus  
For  
**Honors in “Energy Management in Utility Systems”**  
**Bachelor of Engineering**  
**(Choice Based Credit System)**

Honors in Major Disciplines of Mechanical Engineering, Mechanical Engineering (Sandwich),  
Automobile Engineering and Electrical Engineering - (2019 Course)

**Board of Studies – Mechanical and Automobile Engineering**  
(With Effect from Academic Year 2021-22)

**Savitribai Phule Pune University**  
**Board of Studies - Automobile and Mechanical Engineering**  
**Undergraduate Program - Mechanical Engineering (2019 pattern)**  
**Honors in “Energy Management in Utility Systems”**

Course Code	Course Name	Teaching Scheme (Hrs./week)			Examination Scheme and Marks						Credit			
		TH	PR	TUT	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
<b>Semester-V</b>														
<a href="#">302021MJ</a>	Energy Management	4	-	-	30	70	-	-	-	100	4	-	-	4
<a href="#">302022MJ</a>	Energy Modelling Lab	-	2	-	-	-	50	-	-	50	-	1	-	1
	<b>Total</b>	<b>4</b>	<b>2</b>	<b>-</b>	<b>30</b>	<b>70</b>	<b>50</b>	<b>-</b>	<b>-</b>	<b>150</b>	<b>4</b>	<b>1</b>	<b>-</b>	<b>5</b>
<b>Semester-VI</b>														
<a href="#">302023MJ</a>	Energy Efficiency of Thermal Utilities	4	-	-	30	70	-	-	-	100	4	-	-	4
	<b>Total</b>	<b>4</b>	<b>-</b>	<b>-</b>	<b>30</b>	<b>70</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>4</b>	<b>-</b>	<b>-</b>	<b>4</b>
<b>Semester-VII</b>														
302024MJ	Electrical Energy Systems	4	-	-	30	70	-	-	-	100	4	-	-	4
302025MJ	Energy Audit Practice	-	2	-	-	-	50	-	-	50	-	1	-	1
	<b>Total</b>	<b>4</b>	<b>2</b>	<b>-</b>	<b>30</b>	<b>70</b>	<b>50</b>	<b>-</b>	<b>-</b>	<b>150</b>	<b>4</b>	<b>1</b>	<b>-</b>	<b>5</b>
<b>Semester-VIII</b>														
302026MJ	Sustainable Energy Conversion Systems	4	-	-	30	70	-	-	-	100	4	-	-	4
302027MJ	Case Study with Field Visit	-	-	2	-	-	50	-	-	50	-	-	2	2
	<b>Total</b>	<b>4</b>	<b>-</b>	<b>2</b>	<b>30</b>	<b>70</b>	<b>50</b>	<b>-</b>	<b>-</b>	<b>150</b>	<b>4</b>	<b>-</b>	<b>2</b>	<b>6</b>

**Abbreviations:** TH: Theory, PR: Practical, TUT: Tutorial, ISE: In-Semester Exam, ESE: End-Semester Exam, TW: Term Work, OR: Oral

### 1. Rules and Regulations for Honors / Minors Programs

**R1.1** It is absolutely not mandatory to any student to opt for Honours or Minors Program. Choice is given to individual student to undertake Honors/Minors programs from the third year engineering (Fifth Semester) to fourth year engineering (Eighth Semester). Honors/Minors programs will be opted from offered programs by SPPU. Once selected he/she will not be permitted to change the Honors/Minors program in forthcoming semesters.

**R1.2** The registration for Honors/Minors Programme will lead to gain additional credits to such students. The result of Honours/Minors Program will get reflected in ledgers to be maintained at University only. After the completion of the Honors/Minors program by concerned students, details of credits earned in Honors/Minors program be printed in the mark sheet of eighth semester. For those students, who will not be able to complete Honors/Minors program, details about the additional credits earned will not get printed.

**R1.3** Credits earned through registration and successful completion of the Honors/Minors Programme will **not** be considered for the calculation of SGPA or CGPA.

As per the standard practice, SGPA and CGPA calculations will be done with common base only by considering mandatory credits assigned for the Bachelor programme as per the structure approved by the Academic Council.

**R1.4** Students once registered for the programme need to complete all credits assigned for the specific Honors and Minors Programme in the period of 4 years from the Semester-V. Degree with

Honors/Minors will be awarded only after the completion of Honors/Minors Programme along with respective UG program degree.

Student may opt to cancel the registration for Honors/Minors within this period of 4 years. After 4 years expire automatically Bachelor's degree will be awarded to such a student provided he/she has earned the credits needed for graduation.

**R1.5** Backlog Honors/Minors courses will not contribute in the decision of A.T.K.T.

## **2. Examination Scheme:**

**R2.1** Examinations for Honors/Minors Program will get organized at the University Level. Question paper will be common for all students who had opted/registered for the specific Honors/Minors Program. Evaluation of answer books for Honors/Minors program will be done at the university level.

**R.2.2** Additional examination fees as per prevailing rules and regulations will be charged from those students who had registered for Honors/Minors Program to match the expenses for paper setting and the assessment of answer books at the CAP Centre.

### **Instructions:**

- Minimum number of Experiments/Assignments in PR/Tutorial shall be carried out **as mentioned in the syllabi** of respective courses.
- Assessment of tutorial work has to be carried out similar to term-work. The Grade cum marks for Tutorial and Term-work shall be awarded on the basis of **continuous evaluation**.

302021MJ: Energy Management					
Teaching Scheme		Credits		Examination Scheme	
Theory	4 Hrs./Week	Theory	4	In-Semester	30 Marks
				End-Semester	70 Marks
<b>Prerequisite Courses:</b> Systems in Mechanical Engineering, Basic Electrical Engineering, Engineering Thermodynamics, Applied Thermodynamics					
<b>Course Objectives:</b>					
<ol style="list-style-type: none"> <li>1. To familiarise Global and Indian energy scenario.</li> <li>2. To make student conversant with energy policies.</li> <li>3. To study energy audit methodology and energy economics.</li> </ol>					
<b>Course Outcomes:</b>					
On completion of the course the learner will be able to;					
CO1. DEMONSTRATE general aspects of Energy management					
CO2. ILLUSTRATE different energy policies.					
CO3. SUMMARIZE and explain need of energy audit and energy management.					
CO4. DEMONSTRATE energy audit instruments.					
CO5. ILLUSTRATE basics of energy economics and financial analysis techniques					
CO6. ILLUSTRATE environment impact of Energy systems and climate change.					
<b>Course Contents</b>					
<b>Unit 1</b>	<b>Global Energy scenario</b>				
Various Energy Sources, Overall Energy demand and availability, Energy Consumption in various sectors and its changing pattern, Exponential increase in energy consumption and Projected future demands. Depletion of energy sources and impact of exponential rise in energy consumption on economies of countries, Role of energy in economic development and social transformation: Energy & GDP, GNP and its dynamics.					
<b>Unit 2</b>	<b>Indian Energy scenario</b>				
Energy resources & Consumption: Fossil fuels, Renewable sources including Bio-fuels in India, their utilization pattern in the past, present and future projections of consumption pattern, Sector wise energy Consumption, Energy need of Growing economy, Status of Nuclear and Renewable Energy: Present Status and future promise, Need for use of new and renewable energy sources. Electricity pricing in India, Energy security, Energy conservation and its importance.					
<b>Unit 3</b>	<b>Energy Policy</b>				
Energy Conservation act-2001 & its features, Schemes of BEE under Energy conservation Act-2001- ECBC, S&L, DSM, BLY, SME's, Designated consumers, certification of Energy auditors and managers, PAT scheme, Electricity Act-2003, Integrated Energy policy, National Action Plan on Climate Change (NAPCC).					
<b>Unit 4</b>	<b>Energy Audit</b>				
Definition of Energy management and objectives, Energy audit- definition and need, Types of Energy audit, Energy audit methodology, Energy audit instruments, Energy audit reporting, Analysis and recommendations of energy audit, Benchmarking, Energy audit software.					

<b>Unit 5</b>	<b>Energy Economics</b>
Need of Investment, Costing of Utilities - Determination of cost of steam, natural gas, compressed air and electricity, Financial Analysis Techniques - Simple payback period, Time value of money, Net Present Value (NPV), Return on Investment (ROI), Internal Rate of Return (IRR), Risk and Sensitivity analysis.	
<b>Unit 6</b>	<b>Environmental Impact and climate change</b>
Energy and Environment, Global environmental issues- Acid rain, Ozone layer depletion, Global Warming and climate change, Loss of biodiversity. International agreements: United Nations Framework convention on climate change (UNFCCC), Conference of Parties (COP), The Kyoto Protocol, Clean Development Mechanism (CDM).	
<b>Books and other resources</b>	
<b>Text Books:</b>	
<ol style="list-style-type: none"> <li>1. Energy Management Principles, C.B.Smith, Pergamon Press</li> <li>2. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press</li> </ol>	
<b>References Books:</b>	
<ol style="list-style-type: none"> <li>1. TEDDY Year Book Published by Tata Energy Research Institute (TERI).</li> <li>2. World Energy Resources: Charles E. Brown, Springer2002.</li> <li>3. 'International Energy Outlook' -IEA annual Publication</li> <li>4. Energy Management Handbook, Wayne C. Turner, The Fairmont Press Inc., 5th Edition, Georgia.</li> <li>5. BEE Reference book: no.1/2/3/4.</li> </ol>	
<b>Web References:</b>	
<ol style="list-style-type: none"> <li>1. <a href="http://www.aipnpc.org">www.aipnpc.org</a></li> <li>2. <a href="http://www.beeindia.gov.in">www.beeindia.gov.in</a></li> </ol>	

302022MJ: Energy Modelling Lab					
Teaching Scheme		Credits		Examination Scheme	
Practical	2 Hrs./Week	Practical	1	Term Work	50 Marks
<b>Prerequisites:</b> Engineering Graphics, Solid Modelling & Drafting, Engineering Thermodynamics					
<b>Course Objectives:</b>					
<ol style="list-style-type: none"> <li>1. To aware about energy scenario of commercial buildings.</li> <li>2. To understand energy performance of buildings.</li> <li>3. To develop the essential skills for energy modeling of buildings through software like eQuest.</li> </ol>					
<b>Course Outcomes:</b>					
On completion of the course, learner will be able to					
CO1. DEVELOPE Energy model of building					
CO2. EXPLAIN factors involved in energy efficient buildings					
CO3. ASSESS energy performance of building					
<b>Guidelines for Laboratory Conduction</b>					
<b>Link to download eQuest open source software</b>					
<a href="https://www.doe2.com/equest">https://www.doe2.com/equest</a>					
<b>Term Work</b>					
The learner shall complete following activities as a Term-Work:					
Basic Energy modeling of minimum two floor building with Schematic Design (SD) Wizard in eQuest software and preparation of detailed report.					

302023MJ: Energy Efficiency of Thermal Utilities					
Teaching Scheme		Credits		Examination Scheme	
Theory	4 Hrs./Week	Theory	4	In-Semester	30 Marks
				End-Semester	70 Marks
<b>Prerequisite Courses:</b> Systems in Mechanical Engineering, Engineering Thermodynamics, Applied Thermodynamics.					
<b>Course Objectives:</b>					
<ol style="list-style-type: none"> <li>1. To provide detailed understanding of energy efficiency of Thermal utilities.</li> <li>2. To assess the energy performance of Thermal utilities.</li> <li>3. To make student conversant with energy conservation opportunities in Thermal Utilities.</li> </ol>					
<b>Course Outcomes:</b>					
On completion of the course the learner will be able to;					
CO1. EXPLAIN thermal utilities and their function.					
CO2. DEMONSTRATE energy efficiency of thermal utilities.					
CO3. ASSESS energy efficiency of thermal Utilities					
CO4. ILLUSTRATE energy conservation opportunities in thermal utilities.					
CO5. DEMONSTRATE best practices in Thermal Utilities.					
<b>Course Contents</b>					
<b>Unit 1</b>	<b>Fuels and Combustion</b>				
Introduction of fuels, Properties of solid, liquid and Gaseous fuels, Properties of Agro residues, combustion, Combustion of oil, coal and gas, Draft system and combustion control.					
<b>Unit 2</b>	<b>Boiler and Steam System</b>				
Boiler Systems, Boiler types and classification , Performance evaluation of boilers, Boiler water treatment, Boiler blow down, Properties of steam , Types of steam traps used in Industry, Steam distribution, Steam pipe sizing , Condensate and flash steam recovery system, Energy conservation opportunities in boiler and steam system.					
<b>Unit 3</b>	<b>Fluidized Bed Combustion Boilers</b>				
Introduction, Mechanism of Fluidized Bed Combustion , Types of Fluidized Bed Combustion Boilers, Retrofitting of FBC systems to Conventional Boilers, Advantages of Fluidized Bed Combustion Boilers					
<b>Unit 4</b>	<b>Furnaces</b>				
Types and classification, Performance evaluation, Various losses in furnace, Instruments required to monitor the furnace, General fuel economy measures in Furnace.					
<b>Unit 5</b>	<b>Insulation and Refractories</b>				
Purpose, Types of Application, Calculation of Insulation Thickness and simplified formula for heat loss, Economics Thickness of Insulation, Refractories classification, its properties, Typical refractories in Industrial Use, Selection of refractories, and Heat losses from Furnace walls.					
<b>Unit 6</b>	<b>Best Practices in Thermal Utilities</b>				
Cogeneration, Tri-generation, IOT application for chiller system, Waste heat recovery-Sources of waste heat and its potential applications, Waste heat survey and measurements, Data collection,					

Limitations and affecting factors, Heat recovery equipment and systems, Heat Exchangers, Incinerators, Regenerators and Recuperates, Waste Heat boilers, System Integration.

**Books and other resources**

**Text Books:**

1. Boilers – Types, Characteristics and functions – Carl D. Shields (Mcgraw Hill book )
2. Industrial Furnaces (Vol I & II) and M.H. Mawhinney, (John Wiley Publications)
3. Refractories and their Uses – Kenneth Shaw, (Applied Science Publishers Ltd.)

**References Books:**

1. Handbook on Energy Audit and Environment management, Abbi Y. A., Jain Shashank, TERI, Press, New Delhi, 2006
2. Boiler Operator's Guide Fourth Edition, Anthony L Kohan, McGraw Hill
3. BEE Reference book: no.1/2/3/4.

**Web References:**

1. [www.aipnpc.org](http://www.aipnpc.org)
2. [www.beeindia.gov.in](http://www.beeindia.gov.in)