Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information	
Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	Second Year M. Tech., Sem III
Course Code	5HP601
Course Name	Legal, Financial aspects of industrial project
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 2**			

Course Objectives	
1	To understand the economics of decision of making
2	To learn about taxes and profitability
3	To understand the factories act,1948
4	To know the labour laws
5	To introduce the legal aspects and cost management of engineering projects.

Course Outcomes (CO)		
At the end of the course, the students will be able to,		
CO1	To recognize the factories act,1948 and labour laws	Remember
CO2	To demonstrate the economical aspects in engineering projects	Apply
CO3	To explain the legal aspects and cost management of engineering projects	Analyze

Module	**Module Contents**	**Hours**
I	**Economic Decision Making** Introduction, Mathematics of Time Value of Money: Compound Interest, Cash Flow Diagram, Uniform Annual Series, Irregular Cash Flows, Cost Comparison: Present Worth Analysis, Annual Cost Analysis, Capitalized Cost Analysis	4
II	**Taxes and Profitability** Taxes, Profitability Of Investments: Rate of Return, Payback Period, Net Present Worth, Internal Rate of Return, Inflation, Sensitivity and Break-Even Analysis, Uncertainty in Economic Analysis	4
III	**Factories Act, 1948:** Health, Safety, Provisions relating to Hazardous Processes, Welfare, Working Hours of Adults, Employment of young persons, Annual Leave with wages. The Employees Provident Fund and Miscellaneous Provisions Act, 1952.	4
IV	**Constitution and Labour Laws:**	4

	labour laws, Equality before law and its application in Labour Laws, Equal pay for equal work; and Article-16 and reservation policies, Articles 19, 21, 23 and 24 and its implications.	
V	**Legal aspects of industrial projects** Indian Environment for Entrepreneurship: key regulations and legal aspects , MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Case studies on heat and power engineering projects	4
VI	**Cost Management of Engineering Projects** Introduction and Overview of the Strategic Cost Management Process, Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making, Cost Behavior and Profit Planning Marginal Costing, case studies related to heat and power engineering	4

Text Books	
1	P.L. Mehta, Managerial Economics Analysis, Problems and cases, S. Chand & Co. Ltd., 2001
2	Dieter G.E., Engineering Design, McGraw-Hill Education 5th edition, 2012.

References	
1	Peterson and Lewis: Managerial Economics, 4th Ed., Prentice Hall , 2004
2	Rangwala, Estimation, Costing and Valuation, Charotar Publishing House

Useful Links	
1	https://labour.gov.in/sites/default/files/Factories_Act_1948.pdf
2	https://labour.gov.in/labour-law-reforms

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1		2				
CO2		1				
CO3		1				
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment (for Theory Course)
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember		10	10	20
2	Understand				
3	Apply	10		10	20
4	Analyze	10	10	20	40
5	Evaluate			20	20
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

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AY 2021-22

Course Information

Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	Second Year M. Tech., Sem III
Course Code	5HP690
Course Name	Dissertation Phase I
Desired Requisites:	Concept knowledge of research methodology, project management, mechanical engineering

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	20 hrs/week				
Interaction	-	**Credits: 10**			

Course Objectives

1	To develop the student to apply the knowledge gained to identify problems for research and provide the solutions by self-study and interaction with stakeholders.
2	Acquire knowledge to tackle real world problems of societal concerns
3	Impart flexibility to the student to have increased control over his/ her learning
4	Teachers would serve as mentor/facilitator of inquiry and reflection rather than as an instructor
5	Enhance a students' learning through increased interaction with peers and colleagues.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, students will be able to,

CO1	Search the existing literature and identification of research problem	Analyze
CO2	Design and develop the solution for complex engineering problem	Evaluate
CO3	Create the new knowledge in the specialized field	Create

Course Content

Students are expected to carry out independent research work on the chosen topic. In this semester it is expected that the student has carried out substantial research work including exhaustive literature survey, formulation of the research problem, development/fabrication of experimental set-up (if any/required) and testing, and analysis of initial results thus obtained. In the fourth semester, the students continue their dissertation work. It is expected that the student has completed most of the experimental/computation works and analyzed the results so obtained as proposed in the synopsis. The work should be completed in all respects this semester. The students are required to submit the dissertation work in the form of report as per the institute rule.

Text Books

1	As per the research topic

References

1	National and International Journals

Useful Links	
1	https://nptel.ac.in/courses/121/106/121106007/
2	https://www.youtube.com/watch?v=mAVswCbz_jM&feature=emb_imp_woyt
3	https://nptel.ac.in/courses/110/104/110104073/
4	https://nptel.ac.in/courses/110/107/110107081/

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1			1		2
CO2	1		1		2	1
CO3		2				1
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.				
Assessment	**Based on**	**Conducted by**	**Typical Schedule (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.				

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand				
Apply				
Analyze	15	15	15	**45**
Evaluate	15	15	15	**45**
Create			10	**10**
Total Marks	**30**	**30**	**40**	**100**

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Course Information	
Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	Second Year M. Tech., Sem III
Course Code	5HP602
Course Name	Industry Orientation Course
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	-				
Interaction	1 Hr/Week	**Credits: 1**			

Course Objectives	
1	To provide a hands on experience of ANSYS FLUENT software

Course Outcomes (CO) with Bloom's Taxonomy Level At the end of the course, students will be able to,		
CO1	Use of the ANSYS FLUENT software effectively.	Apply
CO2	Develop the solution for mechanical engineering problems using the ANSYS FLUENT software.	Evaluate

Course Content

This course is based on computers as a tool to design and analyse the thermal system. In the modern day work environment, the thermal Engineer should be able to simulate and solve complex problems on computers. The thermal Engineer must be highly computer literate. The engineer with strong fundamentals in thermal Engineering and computer software proficiency is highly in demand from industry. Employability of the student can be enhanced by providing software training of ANSYS FLUENT softwares in mechanical engineering.

Text Books	
1	Suitable books based on the software selected.

References	
1	Suitable books based on the contents of software selected

Useful Links	
1	As per the need of the software training

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1						3

CO2						3
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.				
Assessment	**Based on**	**Conducted by**	**Typical Schedule (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.				

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand				
Apply	15	15	15	**45**
Analyze				
Evaluate	15	15	25	**55**
Create				
Total Marks	**30**	**30**	**40**	**100**

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Course Information	
Programme	M. Tech. (Heat Power Engineering)
Class, Semester	Second Year M. Tech., Sem III
Course Code	5HP611
Course Name	Design of Solar and Wind System
Desired Requisites:	Energy engineering

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 2**			

Course Objectives	
1	Acquire knowledge to tackle real world problems of societal concerns.
2	Impart flexibility to the student to have increased control over his/ her learning.
3	Teachers would serve as mentor/facilitator of inquiry and reflection rather than as an instructor.
4	Enhance student's learning through increased interaction with peers and colleagues.

Course Outcomes (CO)		
At the end of the course, the students will be able to,		
CO1	Search the existing literature and identification of research problem	Apply
CO2	Design and develop the solution for complex engineering problems.	Analyze
CO3	Create the new knowledge in the specialized field	Evaluate

Module	**Module Contents**	**Hours**
I	Energy scenario, Man and energy, World's production of commercial energy sources, India's production and reserves, Energy alternatives, The solar energy option	4
II	Thermal applications, Water heating, Space heating, Space cooling and refrigeration, Power generation, Distillation, Drying and Cooking, Concentrating collector, Central receiver system	4
III	Liquid flat plate collector, Performance analysis, Collection efficiency factor, Selective surfaces, Evacuated tube collector, BNL, Polymer and concrete collector, Solar air collector, types, performance analysis, Air heater with fins,	4
IV	Thermal energy storages, Sensible and latent heat storage, Solar ponds, Performance analysis, operational problems, Other solar pond concepts, Photovoltaic conversion, Performance characteristics, Commercial solar cell, cost and applications, prospects of PV cell for India	4
V	Wind energy fundamentals and applications, Merits, Limitations, Nature and origin of wind, Wind turbine theory, Power of wind turbine for given incoming wind velocity Vi, Wind to electric energy conversion system	5

VI	Classification and development of wind machines, Multi bladed type, Propeller type, wind machines, Wind data performance calculation, Concluding remarks, prospects of wind energy for India	5

Text Books	
1	S.Rao Dr.B.B.Parulekar, "Energy Technology – Nonconventional, Renewable & Conventional", Khanna Publishers
2	S.P. Sukhatme and J K Nayak, " Solar Energy"McGraw Hill Education
3	B. S. Mangal, " Solar Power Engineering", Tata McGraw Hill, New Delhi 1990
4	Spera D. A. 1994 "Wind Turbine Technology, Fundamentals of concept in wind turbine Engg." ASME ebook.
References	
1	Culp, Archie W, "Principles of Energy Conversion", McGraw Hill Book Company
2	Rabl. A. 1985, "Active solar collectors and their applications" Oxford University press
3	John A Duffie, W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley and Sons INC
4	Gary L. Johnson, "Wind Energy Systems", Prentice Hall New Jersey
5	Sathyajith, Mathew, "Wind Energy Fundamentals, Resource Analysis and Economics", springer verlag Berlin
6	Kloeffler R.G, Sitz E.L (1946), "Electric Energy from Winds" Kansas State College of Engg.,ManhattanKans

Useful Links	
1	https://nptel.ac.in/courses/103/103/103103206/

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1	1		2		
CO2					2	
CO3		2		2		
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment (for Theory Course)
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand				
3	Apply	10	10	20	40
4	Analyze	10	10	20	40

5	Evaluate			20	20
6	Create				
Total		**20**	**20**	**60**	**100**

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Course Information	
Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	Second Year M. Tech., Sem III
Course Code	5HP612
Course Name	Advanced mathematical methods in Engineering
Desired Requisites:	Engineering Mathematics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 2**			

Course Objectives	
1	To introduce to solution methods of ODE
2	To introduce to solution methods to PDE
3	To introduce to simple regression and correlations

Course Outcomes (CO)		
At the end of the course, the students will be able to,		
CO1	Apply statistical techniques to analyze multivariate functions and simple regression and correlation	Apply
CO2	Analyze engineering problems by using the knowledge of ordinary and partial differential equations.	Analyze
CO3	Solve Differential equations using different techniques	Evaluate

Module	**Module Contents**	**Hours**
I	**Introduction to Probability Theory** Probability Theory and Sampling Distributions. Basic probability theory along with examples. Standard discrete and continuous distributions like Binomial, Poisson, and Normal, Exponential etc.	5
II	**Testing of Statistical Hypothesis** Testing a statistical hypothesis, tests on single sample and two samples concerning means and Variances. ANOVA: One – way	4
III	**Ordinary Differential Equations** First-order equations (Linear, Separable Exact, Homogeneous,); Second Order linear differential equations (homogeneous and nonhomogeneous); Solution methods such as undetermined coefficients and variation of parameters.	4
IV	**Partial Differential Equations and Concepts in Solution to Boundary Value Problems** First order partial differential equations; Second order linear partial differential equations; Canonical forms; Fourier series, Second order equation (Parabolic, Elliptic and Hyperbolic) in rectangular	5
V	**Solution techniques for PDE's**	

	Solution techniques such as separation of variables, eigenfunction expansions, integral transforms (Fourier and Laplace transforms); D'Alembert's solution for the Wave equation	4
VI	**Simple Regression and Correlation** The simplest deterministic mathematical relationship between two variables x and y, A Linear Probabilistic Mode, Estimating model parameters, inferences about slope parameters, correlations.	4

Text Books	
1	Ronald E, Walpole, Sharon L. Myers, Keying Ye, Probability and Statistics for Engineers and Scientists (8th Edition), Pearson Prentice Hall, 07
2	J. B. Doshi, Differential Equations for Scientists and Engineers, Narosa, New Delhi, 10
References	
1	Douglas C. Montgomery, Design and Analysis of Experiments (7thEdition), Wiley Student Edition, 09.
2	S. P. Gupta, Statistical Methods, S. Chand & Sons, 37th revised edition, 08
3	William W. Hines, Douglas C. Montgomery, David M. Goldsman, Probability and Statistics for Engineering, (4th Edition), Willey Student edition, 06.
4	Advanced Engineering Mathematics (9th Edition), Erwin Kreyszig, Wiley India (13)

Useful Links	
1	https://nptel.ac.in/courses/111/104/111104031/
2	https://nptel.ac.in/courses/111/105/111105093/

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1		2		3	
CO2	1		2	3	2	
CO3	1					3
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment (for Theory Course)
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand				
3	Apply	10	10	20	40
4	Analyze	10	10	20	40

5	Evaluate			20	20
6	Create				
Total		**20**	**20**	**60**	**100**

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Course Information	
Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	Second Year M. Tech., Sem III
Course Code	5HP613
Course Name	Food preservation and cold chain management
Desired Requisites:	Refrigeration and air conditioning

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 2**			

Course Objectives	
1	To understand the importance microorganisms in food preservation
2	To introduce the basics of various food processing and preservation technologies
3	To know the need and importance of preservation in dairy and fishery industry.
4	To analyze the compositional and technological aspects of milk and fish and other food products
5	To apply study of food preservation for preservation of various food products.

Course Outcomes (CO)		
At the end of the course, the students will be able to,		
CO1	To understand the importance of microorganisms in food preservation. To introduce the basics of various food processing and preservation technologies	Apply
CO2	To apply study of food preservation for preservation of various food products and cold chain management	Analyze
CO3	To analyze the compositional and technological aspects of milk and fish and other food products during preservation.	Evaluate

Module	**Module Contents**	**Hours**
I	**Food Microbiology** Principles of Food Preservation, microorganisms associated with foods-bacteria, yeast and mold, Importance of bacteria, yeast and molds in foods. Classification of microorganisms based on temperature, pH, water activity, nutrient and oxygen requirements, typical growth curve of microorganisms. Classification of food based on pH, Food infection, food intoxication, definition of shelf life, perishable foods, semi perishable foods, shelve stable foods.	4
II	**Food Preservation by Low temperature** **Freezing and Refrigeration :** Introduction to refrigeration, cool storage and freezing, definition, principle of freezing, freezing curve, changes occurring during freezing, types of freezing i.e. slow freezing, quick freezing, introduction to thawing, changes during thawing and its effect on	4

	food. Freezing methods -direct and indirect, still air sharp freezer, blast freezer, fluidized freezer, plate freezer, spiral freezer and cryogenic freezing**.**	
III	**Food Preservation by high temperature** Commercial heat preservation methods: Sterilization, commercial sterilization, Pasteurization, and blanching.	4
IV	**Food Preservation by Moisture control** **Drying and Dehydration -** Definition, drying as a means of preservation, differences between sun drying and dehydration (i.e. mechanical drying), heat and mass transfer, factors affecting rate of drying, normal drying curve, names of types of driers used in the food industry. Drying methods and equipment, air convection dryer, tray dryer, tunnel dryer, continuous belt dryer, fluidized bed dryer, spray dryer, drum dryer, vacuum dryer, freeze drying ,foam mat drying**.** **Evaporation –** Definition, factors affecting evaporation, names of evaporators used in food industry.	5
V	**Food Preservation by Irradiation and chemicals** Introduction, units of radiation, kinds of ionizing radiations used in food irradiation, mechanism of action, uses of radiation processing in food industry, concept of cold sterilization. **Recent Trends** Pulsed electric fields, High pressure technology, Ohmic heating, Microwave heating, Hurdle technology.	5
VI	**Cold chain and Cold Chain Management** Freezing: requirements of refrigerated storage - controlled low temperature, air circulation and humidity, changes in food during refrigerated storage, progressive freezing, changes during freezing –concentration effect and ice crystal damage, freezer burn.Maintenance of controlled environment during transportation and sales outlets.	4

Text Books	
1	Potter NH, Food Science, CBS Publication, New Delhi, 1998.
2	Ramaswamy H and Marcott M, Food Processing Principles and Applications CRC Press,2006
References	
1	B. Srilakshmi, Food science, New Age Publishers,2002
2	Meyer, Food Chemistry, New Age,2004
3	Bawa. A.S, O.P Chauhanetal. Food Science. New India Publishing agency, 2013
4	Frazier WC and Westhoff DC, Food Microbiology, TMH Publication, New Delhi, 2004
5	Desrosier NW and Desrosier JN, The Technology of Food Preservation, CBS Publication, New Delhi, 1998
6	Paine FA and Paine HY, Handbook of Food Packaging, Thomson Press India Pvt Ltd, New Delhi- 1992
7	Toledo Romeo T, Fundamentals of Food Process Engineering, Aspen Publishers, 1999

Useful Links	
1	https://nptel.ac.in/courses/126/105/126105011/
2	https://nptel.ac.in/courses/126/103/126103017/

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1				2	3	
CO2				2	2	
CO3			2			
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment (for Theory Course)
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand				
3	Apply	10	10	20	40
4	Analyze	10	10	20	40
5	Evaluate			20	20
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

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AY 2021-22

Course Information	
Programme	M.Tech. (Mechanical Heat and Power Engineering)
Class, Semester	Second Year M. Tech., Sem III
Course Code	5HP651
Course Name	Activity Based Elective Lab 2: Design of Solar and Wind System
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	2 Hrs/week-				
Interaction		**Credits: 1**			

Course Objectives	
1	To provide an opportunity to a student to do work independently on a topic/ problem experimentation selected by him/her and encourage him/her to think independently on his/her own to bring out the conclusion under the given circumstances and limitations.
2	To encourage creative thinking processes to help students to get confidence by successfully completing the activity, through observations, discussions and decision making process.
3	To enable students for technical report writing and effective presentations.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, students will be able to,

CO1	Solve field problems by using different techniques in mechanical heat and power engineering	Apply
CO2	Design and develop suitable mechanical thermal systems	Evaluate
CO3	Prepare and present a detailed technical report based on the activity completed	Create

Course content

Creation of prototype/ apparatus/ small equipment/experimental set up/ innovation of existing product/ analysis or simulation of a process/ experimental verification of principles in thrust areas of Design of Solar and Wind System

The students will select the thrust area depending upon his/her professional elective 5

Text Books	
1	Suitable books based on the contents of the activity selected.

References	
1	Suitable books based on the contents of the activity selected and research papers from reputed national and international journals and conferences.

Useful Links	
1	As per the need of the activity.

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1		3				1
CO2		2	2			1
CO3			1			1
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.				
Assessment	**Based on**	**Conducted by**	**Typical Schedule (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.				

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand				
Apply	15	15	15	**45**
Analyze				
Evaluate	15	15	15	**45**
Create			10	**10**
Total Marks	**30**	**30**	**40**	**100**

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Course Information	
Programme	M.Tech. (Mechanical Heat and Power Engineering)
Class, Semester	Second Year M. Tech., Sem III
Course Code	5HP652
Course Name	Activity Based Elective Lab 2 : Advance mathematical methods in Engineering
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	2 Hrs/week-				
Interaction		**Credits: 1**			

Course Objectives	
1	To provide an opportunity to a student to do work independently on a topic/ problem experimentation selected by him/her and encourage him/her to think independently on his/her own to bring out the conclusion under the given circumstances and limitations.
2	To encourage creative thinking processes to help students to get confidence by successfully completing the activity, through observations, discussions and decision making process.
3	To enable students for technical report writing and effective presentations.

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, students will be able to,		
CO1	Solve field problems by using different techniques in mechanical heat and power engineering	Apply
CO2	Design and develop suitable mechanical thermal systems	Evaluate
CO3	Prepare and present a detailed technical report based on the activity completed	Create

	Course content
Creation of prototype/ apparatus/ small equipment/experimental set up/ innovation of existing product/ analysis or simulation of a process/ experimental verification of principles in thrust areas of Advance mathematical methods in Engineering The students will select the thrust area depending upon his/her professional elective 5	

Text Books	
1	Suitable books based on the contents of the activity selected.

References	
1	Suitable books based on the contents of the activity selected and research papers from reputed national and international journals and conferences.

Useful Links	
1	As per the need of the activity.

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1		3				1
CO2		2	2			1
CO3			1			1
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.				
Assessment	**Based on**	**Conducted by**	**Typical Schedule (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.				

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand				
Apply	15	15	15	**45**
Analyze				
Evaluate	15	15	15	**45**
Create			10	**10**
Total Marks	**30**	**30**	**40**	**100**

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Course Information	
Programme	M.Tech. (Mechanical Heat and Power Engineering)
Class, Semester	Second Year M. Tech., Sem III
Course Code	5HP653
Course Name	Activity Based Elective Lab 2 : Food preservation and cold chain management
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	2 Hrs/week-				
Interaction		**Credits: 1**			

Course Objectives	
1	To provide an opportunity to a student to do work independently on a topic/ problem experimentation selected by him/her and encourage him/her to think independently on his/her own to bring out the conclusion under the given circumstances and limitations.
2	To encourage creative thinking processes to help students to get confidence by successfully completing the activity, through observations, discussions and decision making process.
3	To enable students for technical report writing and effective presentations.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, students will be able to,

CO1	Solve field problems by using different techniques in mechanical heat and power engineering	Apply
CO2	Design and develop suitable mechanical thermal systems	Evaluate
CO3	Prepare and present a detailed technical report based on the activity completed	Create

	Course content
Creation of prototype/ apparatus/ small equipment/experimental set up/ innovation of existing product/ analysis or simulation of a process/ experimental verification of principles in thrust areas of Design of Solar and Wind System, Advanced mathematical methods in Engineering, Food preservation and cold chain management The students will select the thrust area depending upon his/her professional elective 5	

Text Books	
1	Suitable books based on the contents of the activity selected.

References	
1	Suitable books based on the contents of the activity selected and research papers from reputed national and international journals and conferences.

Useful Links	
1	As per the need of the activity.

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1		3				1
CO2		2	2			1
CO3			1			1
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.				
Assessment	**Based on**	**Conducted by**	**Typical Schedule (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.				

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand				
Apply	15	15	15	**45**
Analyze				
Evaluate	15	15	15	**45**
Create			10	**10**
Total Marks	**30**	**30**	**40**	**100**

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Course Information

Programme	M.Tech. (Mechanical Heat and Power Engineering)
Class, Semester	Second Year M. Tech., Sem IV
Course Code	5HP691
Course Name	Dissertation Phase II
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	24 hrs/week				
Interaction	-	**Credits: 12**			

Course Objectives

1	To develop the student to apply the knowledge gained to identify problem for research provide the solutions by self-study and interaction with stakeholders
2	Acquire knowledge to tackle real world problems of societal concerns
3	Impart flexibility to the student to have increased control over his/ her learning.
4	Teachers would serve as mentor/facilitator of inquiry and reflection rather than as an instructor
5	Enhance student's learning through increased interaction with peers and colleagues.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, students will be able to,

CO1	Search the existing literature and identification of research problem	Analyze
CO2	Design and develop the solution for complex engineering problem	Evaluate
CO3	Create the new knowledge in the specialized field	Create

Course Contents

Students are expected to carry out independent research work on the chosen topic. In this semester it is expected that the student has carried out substantial research work including exhaustive literature survey, formulation of the research problem, development/fabrication of experimental set-up (if any/required) and testing, and analysis of initial results thus obtained. In the fourth semester, the students continue their dissertation work. It is expected that the student has completed most of the experimental/computation works and analyzed the results obtained as proposed in the synopsis. The work should be completed in all respects this semester. The students are required to submit the dissertation work in the form of a report as per the institute rule.

Text Books

1	As per the research topic

References

1	National and International Journals

Useful Links	
1	https://nptel.ac.in/courses/110/104/110104073/

CO-PO Mapping							
		Programme Outcomes (PO)					
		1	**2**	**3**	**4**	**5**	**6**
	CO1	1			1		2
	CO2	1		1		2	2
	CO3		2				2
	The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.				
Assessment	**Based on**	**Conducted by**	**Typical Schedule (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.				

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand				
Apply				
Analyze	15	15	15	**45**
Evaluate	15	15	15	**45**
Create			10	**10**
Total Marks	**30**	**30**	**40**	**100**

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Course Information	
Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	Second Year M. Tech., Sem IV
Course Code	5HP671
Course Name	Techno-Socio Activity
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	-				
Interaction	1 hr/week	**Credits: -1**			

Course Objectives	
1	To record student performance in co-curricular and extracurricular activities over four years will be considered.
2	To encourage the students to participate in activities that help develop leadership skills, team integrity, coordination skills, Time management, Communications skills, Interviewing skills etc.
3	To highlight the importance of social responsibility. Become members of technical organizations.

Course Outcomes (CO) with Bloom's Taxonomy Level At the end of the course, students will be able to,		
CO1	Notice an improvement in his/her understanding and presentation skills by publishing papers in conference/journals	Apply
CO2	Understand and value the importance of working in a diversified team.	Analyze
CO3	Demonstrate the soft skills like presentation skills, technical report writing etc.	Evaluate

Course Contents

The guide will be mentoring a given student batch for the duration of two years. The students shall submit proof of their achievements in various extra and co-curricular activities related to technical, cultural and social causes from first year to second year. The faculty will evaluate the students' performance at the end of 4th semester, based on the rubrics provided by the department from time to time.

Text Books	
1	Not applicable

References	
1	Not applicable

Useful Links	
1	Not applicable

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1		2				
CO2		2				
CO3		2				
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.				
Assessment	**Based on**	**Conducted by**	**Typical Schedule (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates the starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.				

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand				
Apply	15	15	15	**45**
Analyze	15	15	15	**45**
Evaluate			10	**10**
Create				
Total Marks	**30**	**30**	**40**	**100**

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Course Information

Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	Second Year M. Tech., Sem IV
Course Code	5HP621
Course Name	Energy Conservation and Management
Desired Requisites:	Environment Studies,Thermodynamics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 3**			

Course Objectives

1	To introduce energy and power scenarios, electrical systems, energy auditing, energy conservation and energy impact on the environment.
2	To provide knowledge of energy management, energy auditing and energy conservation.
3	To develop skills to carry out energy audits and to suggest methodologies for energy savings.
4	To prepare the students for higher studies and research in the field of energy conservation and management.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	Explain: energy and power scenario, electrical, mechanical systems, energy auditing, energy conservation and energy impact on environment	Apply
CO2	Carryout energy accounting and balancing	Analyze
CO3	Exercise energy audit and suggest methodologies for energy savings	Evaluate

Module	Module Contents	Hours
I	**Introduction** Commercial and non-commercial energy, Primary energy resources, Commercial energy production, Final energy consumption, Indian energy scenario, Sectorial energy consumption, Energy needs of growing economy, Energy intensity on purchasing power parity (PPP) basis, Long term energy scenario, Energy pricing, Energy security, Energy strategy for the future, Energy conservation and its importance.	5
II	**Energy Management & Audit** Definition, energy audit, need, types of energy audit. Energy management (audit) approach – understanding energy costs, Bench marking, energy performance, matching energy use to requirements, maximizing systems efficiencies, optimizing the input energy requirements, fuel and energy, substitution, energy audit instruments and metering.	7
III	**Energy Economics** Financial Management – Investment need, Appraisal and criteria Financial Analysis techniques, Simple Payback Period, Return On Investment, Net Present Value,	7

	Interest rate of return, Risk and sensitivity analysis, Financing Options, ESCOS.	
IV	**Energy Conservation in Major Utilities** Energy Conservation in energy Intensive Industries. Cogeneration – Need, Principle, Technical Options for Cogeneration. Classification, Factors Influencing choice, Heat to Power ratios, Load Patterns, Prime movers used in Conservation. Advantages and Disadvantages of various systems. Case Studies.	8
V	**Energy conservation in Mechanical and Electrical systems** Energy conservation in compressed air systems, HVAC and refrigeration systems, Fans blowers, pumps and pumping systems, cooling towers, motors and lighting systems.	6
VI	**Energy and environment, air pollution, climate change** Energy and environment, Air pollution, Climate change, United Nations Framework Convention on Climate Change (UNFCCC), Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), CDM methodology and procedure, Sustainable Development.	6

Text Books	
1	Witte L.C. Schmidt P.S. and Brown D.R., Industrial Energy Management and Utilization, Hemisphere Publ., Washington, 1988.
2	Callaghn P.W., Design and Management for Energy Conservation, Pergamon Press, Oxford, 1981.
3	Murphy W.R. and McKay G., Energy Management, Butterworths, London, 1987. Energy Manager Training Manual , Bureau of Energy Efficiency (BEE) under Ministry of Power, GOI, 2004 (available at www.energymanager training.com).

References	
1	Recent reports of agencies: International Energy Agency (IEA), Ministry of New and Renewable energy (MNRE), Technology and Action for Rural Advancement (TARA)
2	Energy Conservation Guidebook, Dale R Patrick, Stephen W Fardo, 2nd Edition, CRC Press
3	Handbook of Energy Audits, Albert Thumann, 6th Edition, The Fairmont Press
4	Bureau of Energy Efficiency Reference book: No.1, 2, 3 4

List of Open Source Software/learning website	
1	http://nptel.iitm.ac.in/
2	www.bee.com
3	www.powermin.nic.in

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1		2		2	
CO2	1		2		2	2
CO3	1			3		3

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment (for Theory Course)

The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on

modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand				
3	Apply	10	10	20	40
4	Analyze	10	10	20	40
5	Evaluate			20	20
6	Create				
Total		**20**	**20**	**60**	**100**

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Course Information	
Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	Second Year M. Tech., Sem IV
Course Code	5HP622
Course Name	Design of Thermal Systems
Desired Requisites:	Thermodynamics, Heat Transfer, and thermal systems

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 3**			

Course Objectives	
1	Identify and describe thermal systems and their economical consideration
2	Apply fundamentals of science, engineering and simulate thermal systems.
3	Develop skills for the analysis of thermal systems in research or design.

Course Outcomes (CO)		
At the end of the course, the students will be able to,		
CO1	Describe different thermal systems.	Apply
CO2	Apply knowledge of mathematics, science, economics and engineering for the needs in design of thermal systems	Analyze
CO3	Analysing and interpret the analysis report in the field of design of thermal systems.	Evaluate

Module	**Module Contents**	**Hours**
I	**Engineering Design** Introduction, Decisions in an engineering Undertaking, Activities Designing a Workable System, Workable and optimum systems. Steps Involved in arriving at a workable system.	6
II	**Economics of Engineering Decision** Variable factors involved. Mathematical Modelling: Equation fitting, Modelling thermal equipment –counter-flow heat exchanger, evaporators and condensers, fans compressors and blowers.	7
III	**System Simulation** Description of simulation, Uses of simulation, Various Methods of simulation which will be useful in optimizing the thermal systems.	7
IV	**Optimization** Level of optimization, Mathematical representation of optimization, Optimization procedures. Mathematical Modelling of Thermodynamic Properties: Need, Form of the equation, Criteria for fidelity of representation. Linear and non-linear regression analysis. Thermodynamic properties. Internal energy and enthalpy. Clapeyron equation, Pressure	7

	temperature relationship at saturated conditions. Maxwell relations, p-v-T equations, Building a full set of data.	
V	**Steady-State Simulation of Large Systems** Newton-Raphson technique. Accelerating the solutions of linear equations. Quasi-Newton method. Influence coefficients.	6
VI	**Introduction to dynamic behaviour of thermal systems.** Introduction, Dynamic behaviour of thermal systems, failure analysis.	9
Text Books		
1	W.F.Stoecker. "Design of thermal system' McGraw hill International 3rd Edition 1989	
References		
1	Robert A. Ackermann, "Cryogenic Regenerative Heat Exchanger", Plenum Press, New Yorkedition,1st1997.	
2	Adrian bejan, George Tsatsaronis, MichelMoral"Thermal Design and Optimization" John Wileyand sons 1st edition 1996.	
3	Yogesh Jaluria, "Design and Optimization of Thermal Systems", CRC Press 2nd edition 2008.	
Useful Links		
1	https://nptel.ac.in/courses/112/106/112106064/	

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	3			2	
CO2	2	3	1	2	2	1
CO3	1	2	1	1		1
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment (for Theory Course)
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand				
3	Apply	10	10	20	40
4	Analyze	10	10	20	40
5	Evaluate			20	20
6	Create				
Total		**20**	**20**	**60**	**100**

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Course Information	
Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	Second Year M. Tech., Sem IV
Course Code	5HP623
Course Name	Waste to energy
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 3**			

Course Objectives	
1	Understand the grave problem of urban solid waste disposal and methods to tackle this problem.
2	Understand and apply various energy conversion methods using biomass.
3	Apply knowledge of landfill biogas systems and energy conversion equipment.
4	Apply and analyze methane generation systems and other biomass systems.
5	Study and analysis of different types of biomass systems and ocean biomass systems.
6	Study and analyze biogas energy conversion process.

Course Outcomes (CO)		
At the end of the course, the students will be able to,		
CO1	Describe various methods of conversion of waste to energy.	Understand
CO2	Examine various methods of energy generation using wast	Apply
CO3	Analyse the combustion mechanisms of various fuels.	Analyse

Module	**Module Contents**	**Hours**
I	Introduction – urban solid waste, Waste to energy by incineration process, Incineration plant furnaces & boilers.	7
II	Electrical scheme of urban waste to energy plant environmental consideration, Wood & wood waste in primary energy sources, Incineration co-generation plant	7
III	Urban waste to energy from landfill Biogas projects and pyrolysis plants, Application of landfill gas composition, Collection systems, Energy conversion equipment,	6
IV	Pyrolysis of urban waste to obtain methane, Pyrolysis of wood to gasification, Wood to oil processes, FBCB for burning solid biomass.	6
V	Biogas plants for urban and Rural, Introduction to waste to energy, Biogas plants- small, medium and large plants, Single stage and two stage plants, Dome type and dome less plants, Ocean biomass and biogas.	7
VI	Biomass energy resources and conversion process, Introduction photosynthesis and origin of biomass energy, Biomass energy resources- cultivated resources,	7

	Waste to energy concept, Some liquid and gases derived conversion process, Direct combustion (Incineration), Thermochemical biomass to energy-gasification anaerobic digestion and fermentation,	
Text Books		
1	S . P. Sukhatme, " Solar Energy", McGraw Hill Education, 3rd Edition,2015	
2	Energy Technology- S. Rao and B. B. Parulekar, Khanna Publication	
3	NIR Board 2004, Handbook on Biogas and its applications, NIIR, New Delhi.	
References		
1	Annual Report 2006, Ministry of new and renewable energy, Government of India, New Delhi.	
2	Energy Handbook, R. L. Loftness Van NOstrand Reinhold.	
3	H. Shah et al., Integrated renewable energy for rural development, 1990, Tata Mc Graw Hill.	
4	L..L. Anderson et al, Fuels from waste academic press, New york, 1977.	
Useful Links		
1	https://nptel.ac.in/courses/103/103/103103206/	

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1		2			
CO2		1			3	
CO3			2	3		
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment (for Theory Course)
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	10	10	20	40
3	Apply	10	10	20	40
4	Analyze			20	20
5	Evaluate				
6	Create				
Total		**20**	**20**	**60**	**100**

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Course Information	
Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	Second Year M. Tech., Sem IV
Course Code	5HP624
Course Name	Advanced finite element analysis
Desired Requisites:	Finite element method

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 3**			

Course Objectives	
1	Students will be able to develop their own FE formulation for static problems.
2	Students will be able to decide the best suited method for transient analysis.
3	Student will be able to appreciate the amount of computational efforts required to solve nonlinear problem
4	Student will understand mathematical modeling technique for beams and plate
5	Student will be able to apply various beam and plate theories to develop FE models

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to		
CO1	Solve non-linear problems using FEM.	Applying
CO2	Analyze structural analysis using beam, plate and shell elements.	Analyzing
CO3	Evaluate the given design problem using FEM	Evaluating

Module	**Module Contents**	**Hours**
I	Module 1: Linear static analysis Weighted residual formulation, shape functions, numerical integrations.	5
II	Module 2: Solution methods to solve linear transient problems Explicit and implicit methods, Newmark family of methods, conditional and unconditionally stable methods and determination of correct time step.	7
III	Module 3: Non-linear finite Element Method Ways of non-linearities, mathematical treatment, Picard‟s method, Newton‟s method, advantages and limitations of each method, snap through problems.	7
IV	Module 4: Analysis of beams Euler Bernoulli beam theory, Timoshenko beam theory, Formulation of beam element using both above theories, their advantages and limitations, solution strategies to overcome limitations.	7
V	Module 5: Analysis of plates and shells Basics of plate theory, thin and thick plates, FE formulation based on various plate theories, plate elements, continuity requirements.	7

VI	Module 6: Course Project – self learning The student is expected to define his/ her own problem which involves substantial complications in terms of geometry, boundary conditions etc. in any field and then try to solve the same either by developing own code or using commercially available softwares. Difficulties will be discussed in class in common or individually.	7
Text Books		
1	Cook, R. D., Malkus, D. D. and Plesha, M. E., "Concepts and Applications of Finite Element Analysis", 4th edition, 2001.	
2	Bathe, K. J., "Finite Element Procedures",1st edition,2008.	
References		
1	Hughes, T. J. R., "The Finite Element Method – Linear Static and Dynamic Finite Element Analysis",2012	
2	Belytschko, T., Liu, W. K. and Moran, B., "Nonlinear Finite Elements for Continua and Structures".	
3	Brebbia, C. A. and Dominguez J. "Boundary Elements an Introductory Course", freely available at Home (boundaryelements.com)	
Useful Links		
1	http://www.boundaryelements.com/	

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2		2	3		
CO2	3				3	
CO3						3
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment (for Theory Course)
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand				
3	Apply	10	10	20	40
4	Analyze	10	10	20	40

5	Evaluate			20	20
6	Create				
Total		**20**	**20**	**60**	**100**