	Information of every subject		
1	Unit name:	-Engineering Thermodynamics	
2	Code:	ME-31013	
3	Classification:	Engineering subject	
4	Credit value:	2.5	
5	Semester/ Year Offered:	1/2	
6	Pre-requisite:		
7	Mode of delivery:	Lecture, Practical, Tutorial, Viva	
8	Practical	20%	
	Tutorials	5%	
	Viva	5%	
	Mid-term/ final Examination	35% / 35%	
9	Academic staff teaching unit:		
10	Course outcome of unit:		
	In this course, students will be able		
	Semester (I)		
	a. To calculate the expressions for the	e thermal efficiencies and coefficients of	
	performance for reversible heat eng	ines, heat pumps and refrigerators.	
	b. To apply the entropy changes that ta	ake place during processes for pure	
	substances, incompressible substance	ces and ideal gases.	
	c. To calculate the thermal efficiency	y, quality of steam, mass flow rate of steam,	
	heat supply, heat rejected and pump	work.	
	Semester (II)		
	d. To apply the fuel chemistry, comb	ustion equations, air fuel ratio, percent	
	theoretical air and flue gas.		
	e. To calculate the free- air -delivery,	volumetric efficiency, actual and isothermal	
	work done per cycle and isotherma	l efficiency.	
	f. To explain heat and mass balance of	of the steam generator.	
	g. To calculate the power, work don	e, tangential thrust, axial thrust on the blade	
	and efficiency of steam turbine.		
11	Synopsis of unit:		
	This unit deals with the relationship	between the thermodynamic and transport	

	properties of pure substances and a discussion of some basic concepts such as closed		
	and open systems, isolated and adiabatic systems, working substance, continuum,		
	property state, path, process, cycle, equilibrium, pressure and temperature.		
12	Topic:		
	Semester (I)		
	6 SECOND LAW OF THERMODYNAMICS		
	6.1 Limitations of the first law of Thermodynamics		
	6.2 Thermal Reservoir		
	6.3 Heat Engine		
	6.4 Refrigerator		
	6.5 Heat Pump		
	6.6 Statements of the Second Law of Thermodynamics		
	6.6.1 Kelvin-Planck Statement		
	6.6.2 Clausius Statement		
	6.6.3 Equivalence of two statements		
	6.7 Perpetual motion machine of the second kind		
	6.8 Reversible process; ideal process		
	6.9 Irreversible process; actual processes		
	6.10 Carnot Cycle,(or) Carnot Engine		
	6.11 Reversed Carnot Cycle		
	6.12 Carnot Theorem		
	6.13 Thermodynamic temperature scale		
	6.13.1 The Carnot Refrigerator and Heat Pump		
	6.13.2 Effect of Temperature $T_H$ and $T_L$ on efficiency of Carnot Cycle		
	7 Entropy		
	7.1 Definition		
	7.2 Two Isentropic Lines cannot intersect each other		
	7.3 Clausius' Theorem		
	7.4 Clausius; Inequility		
	7.5 Entropy; A Property of the System		
	7.6 Change of the Entropy in a Reversible Process		
	7.7 Temperature Entropy Diagram		
	7.8 The Increase of Entropy Principle		

7.9 Entropy Transfer
7.10 Entropy generation
7.11 Entropy Balance
7.13 Tds relations
7.13.1 Entropy Change for an Ideal Gas
7.13.2 The Entropy change of Solid and Liquid
7.14 Third Law of Thermodynamics
12 Vapour Power Cycles
12.1 Modeling a Steam Power Plant
12.2 Performance parameters of vapour power cycle
12.2.1 Thermal Efficiency
12.2.2 Back work ratio
12.2.3 Work ratio
12.2.4 Steam rate
12.3 Carnot Vapour Power Cycle
12.3.1 Principal Components and Operation
12.3.2 Analysis of Carnot Vapour Power Cycle
12.3.3 Practical Difficulties Associated with Carnot Vapour Power Cycle
12.4 Rankine Cycle
12.4.1 Principal components of Vapour Power Plant
12.4.2 Operation of Rankine Cycle
12.4.3 Analysis Of Rankine Cycle
12.4.4 Relative Efficiency, or Efficiency Ratio
12.5 Comparison between Carnot and Rankine Cycles
12.6 Difference between Carnot and Rankine Cycles
12.7 Irreversibilities and Losses in Vapour Power Cycle
12.9 Reheating of Steam
12.9.1 Reheat Rankine Cycle
12.9.2 Reheat Factor
12.10 Super Critical Rankine Cycle
12.11 Mean Temperature Of Heat Addition
12.12 Regenerative Rankine Cycle
12.12.1 Principle of Regeneration: Ideal Regeneration

	12.12.2. Regeneration with Open Feed Water Heater
	12.12.2 Regeneration of Danking Cycle
	12.12.4 Degeneration with Closed Food Water Hester
	12.12.5 Decomposition with Multiple Food Water Heaters
	12.12.5 Regeneration with Multiple Feed water Heaters
	12.12.6 Advantages and Disadvantages of Regenerative Cycle over simple
	Rankine Cycle
	12.13 Modified Rankine Cycle
	12.14 Characteristics of the working fluid in Vapour Power Cycle
	12.15 Cogeneration
	12.16 Binary Vapour Cycle
	12.17 Combined Gas-Vapour Power Cycle
Sen	nester (II)
25	Reciprocating Air Compressor
	25.1 Uses of Compressed Air
	25.2 Classification
	25.3 Reciprocating Compressor Terminology
	25.4 Compressed Air Systems
	25.5 Reciprocating Air Compressor
	25.6 Minimizing Compression Work
	25.7 Clearance Volume in a Compressor
	25.8 Actual Indicator Diagram
	25.9 Volumetric Efficiency
	25.10 Free Air Delivery (FAD)
	25.11 Limitations of Single-Stage Compression
	25.12 Multistage Compression
	25.13 Cylinder Dimensions of a Multistage Compressor
17	Steam Generators
	17.1 Indian Boiler Regulation (IBR)
	17.2 Boiler Systems
	17.2.1 Classification of Boilers
	17.2.2 Principal Parts and their Functions
	17.2.3 Characteristics of a Good Boiler
	17.2.4 Factors Affecting the Selection of Boilers

17.3 Comparison between Fire Tube and Water Tube Boilers 17.4 Fire-Tube Boilers 17.4.1 Simple Vertical Boiler 17.4.2 Cochran Boiler 17.4.3 Lancashire Boiler 17.4.4 Cornish Boiler 17.4.5 Locomotive Boiler 17.4.6 Scotch Marine Boiler 17.5 Water Tube Boilers 17.5.1 Babcock and Wilcox Boiler 17.5.2 Stirling Boiler 17.6 Some Industrial Boilers 17.6.1 Packaged Boiler 17.6.2 Pulverized Fuel Boiler 17.6.3 Fluidised Bed Combustion Boiler 17.6.4 Supercharged Boiler 17.7 High-Pressure Boiler 17.7.1 Features of High Pressure Boilers 17.7.2 Advantages of High-Pressure Boiler 17.7.3 La Mont Boiler 17.7.4 Loeffler Boiler 17.7.5 Velox Boiler 17.7.6 Benson Boiler 17.7.7 Ramsin Boiler 17.7.8 Supercritical Boiler 22 Steam Turbines 22.1 History of Steam Turbines 22.2 Working Principle of a Steam Turbine 22.3 Classification of Steam Turbines 22.4 The Simple Impulse Turbine 22.5 Optimum Operating Conditions from Blade – Velocity Diagram 22.6 Effect of Blade Friction on Velocity Diagram 22.7 Condition for Axial Discharge

22.9 Reaction Turbine (Impulse Reaction Turbine)         22.10 Comparison between Impulse and Reaction Turbines         22.11 Losses in Steam Turbines         22.12 Governing of Steam Turbine         22.13 Special Forms of Turbines         16 Fuels and Combustion         16.1 Fuels         16.2 Characteristic of an Ideal Fuel         16.3 Coal         16.4 Liquid Fuels         16.5 Gaseous Fuel         16.6 Conversion of Volumetric Analysis to Gravimetric Analysis         16.7 Conversion of Gravimetric Analysis to Volumetric Analysis         16.8 Combustion         16.9 Composition of Dry Air         16.10 Amount of Air Required for Combustion         16.11 Air-Fuel Ratio         16.12 Air-Fuel Ratio from Analysis of Fuel Gases         16.13 Flue Gas Analysis- Orsat Apparatus         16.14 Heat Generated by Combustion         16.15 Calorific Value, or Heating Value of Fuel         16.16 Bomb Calorimeter         14         Main references:         "Thermal Engineering" by MAHESH M RATHORE         15         Additional references:         Thermodynamics         An Engineering Approach         Yunus A.Cengel Michael A.Boles         Basic And Applied Thermodynamics         Second Edition			22.8 Compounding of Impulse Turbine
22.10 Comparison between Impulse and Reaction Turbines         22.11 Losses in Steam Turbines         22.12 Governing of Steam Turbine         22.13 Special Forms of Turbines         16 Fuels and Combustion         16.1 Fuels         16.2 Characteristic of an Ideal Fuel         16.3 Coal         16.4 Liquid Fuels         16.5 Gaseous Fuel         16.6 Conversion of Volumetric Analysis to Gravimetric Analysis         16.7 Conversion of Gravimetric Analysis to Volumetric Analysis         16.8 Combustion         16.9 Composition of Dry Air         16.10 Amount of Air Required for Combustion         16.11 Air-Fuel Ratio         16.12 Air-Fuel Ratio from Analysis of Fuel Gases         16.13 Flue Gas Analysis- Orsat Apparatus         16.14 Heat Generated by Combustion         16.15 Calorific Value, or Heating Value of Fuel         16.16 Bomb Calorimeter         14         Main references:         "Thermal Engineering" by MAHESH M RATHORE         15         Additional references:         Thermodynamics         An Engineering Approach         Yunus A.Cengel Michael A.Boles         Basic And Applied Thermodynamics         Second Edition			22.9 Reaction Turbine (Impulse Reaction Turbine)
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<ul> <li>I 6.4 Liquid Fuels</li> <li>I 6.5 Gaseous Fuel</li> <li>I 6.6 Conversion of Volumetric Analysis to Gravimetric Analysis</li> <li>I 6.6 Conversion of Gravimetric Analysis to Volumetric Analysis</li> <li>I 6.7 Conversion of Gravimetric Analysis to Volumetric Analysis</li> <li>I 6.7 Conversion of Gravimetric Analysis to Volumetric Analysis</li> <li>I 6.7 Conversion of Gravimetric Analysis to Volumetric Analysis</li> <li>I 6.8 Combustion</li> <li>I 6.9 Composition of Dry Air</li> <li>I 6.9 Composition of Dry Air</li> <li>I 6.10 Amount of Air Required for Combustion</li> <li>I 6.11 Air-Fuel Ratio</li> <li>I 6.12 Air-Fuel Ratio from Analysis of Fuel Gases</li> <li>I 6.13 Flue Gas Analysis- Orsat Apparatus</li> <li>I 6.14 Heat Generated by Combustion</li> <li>I 6.15 Calorific Value, or Heating Value of Fuel</li> <li>I 6.16 Bomb Calorimeter</li> </ul> 14 Main references: <ul> <li>"Thermal Engineering" by MAHESH M RATHORE</li> </ul> 15 Additional references: <ul> <li>Thermodynamics</li> <li>An Engineering Approach</li> <li>Yunus A.Cengel Michael A.Boles</li> <li>Basic And Applied Thermodynamics</li> <li>Second Edition</li> </ul>			16.3 Coal
<ul> <li>I 16.5 Gaseous Fuel</li> <li>I 16.6 Conversion of Volumetric Analysis to Gravimetric Analysis</li> <li>I 16.7 Conversion of Gravimetric Analysis to Volumetric Analysis</li> <li>I 16.7 Conversion of Gravimetric Analysis to Volumetric Analysis</li> <li>I 16.8 Combustion</li> <li>I 16.9 Composition of Dry Air</li> <li>I 16.9 Composition of Dry Air</li> <li>I 16.10 Amount of Air Required for Combustion</li> <li>I 16.11 Air-Fuel Ratio</li> <li>I 16.12 Air-Fuel Ratio from Analysis of Fuel Gases</li> <li>I 16.13 Flue Gas Analysis- Orsat Apparatus</li> <li>I 16.14 Heat Generated by Combustion</li> <li>I 6.15 Calorific Value, or Heating Value of Fuel</li> <li>I 6.16 Bomb Calorimeter</li> </ul> 14 Main references: <ul> <li>"Thermal Engineering" by MAHESH M RATHORE</li> </ul> 15 Additional references: <ul> <li>Thermodynamics</li> <li>An Engineering Approach</li> <li>Yunus A.Cengel Michael A.Boles</li> <li>Basic And Applied Thermodynamics</li> <li>Second Edition</li> </ul>			16.4 Liquid Fuels
<ul> <li>I 6.6 Conversion of Volumetric Analysis to Gravimetric Analysis</li> <li>I 6.7 Conversion of Gravimetric Analysis to Volumetric Analysis</li> <li>I 6.7 Conversion of Gravimetric Analysis to Volumetric Analysis</li> <li>I 6.8 Combustion</li> <li>I 6.9 Composition of Dry Air</li> <li>I 6.9 Composition of Dry Air</li> <li>I 6.10 Amount of Air Required for Combustion</li> <li>I 6.11 Air-Fuel Ratio</li> <li>I 6.12 Air-Fuel Ratio from Analysis of Fuel Gases</li> <li>I 6.13 Flue Gas Analysis- Orsat Apparatus</li> <li>I 6.14 Heat Generated by Combustion</li> <li>I 6.15 Calorific Value, or Heating Value of Fuel</li> <li>I 6.16 Bomb Calorimeter</li> <li>Main references:</li> <li>"Thermal Engineering" by MAHESH M RATHORE</li> <li>Additional references:</li> <li>An Engineering Approach</li> <li>Yunus A.Cengel Michael A.Boles</li> <li>Basic And Applied Thermodynamics</li> <li>Second Edition</li> </ul>			16.5 Gaseous Fuel
<ul> <li>I 6.7 Conversion of Gravimetric Analysis to Volumetric Analysis</li> <li>I 6.8 Combustion</li> <li>I 6.8 Combustion of Dry Air</li> <li>I 6.9 Composition of Dry Air</li> <li>I 6.10 Amount of Air Required for Combustion</li> <li>I 6.11 Air-Fuel Ratio</li> <li>I 6.12 Air-Fuel Ratio from Analysis of Fuel Gases</li> <li>I 6.13 Flue Gas Analysis- Orsat Apparatus</li> <li>I 6.14 Heat Generated by Combustion</li> <li>I 6.15 Calorific Value, or Heating Value of Fuel</li> <li>I 6.16 Bomb Calorimeter</li> <li>Main references:</li> <li>Thermal Engineering" by MAHESH M RATHORE</li> <li>I Additional references:</li> <li>An Engineering Approach</li> <li>Yunus A.Cengel Michael A.Boles</li> <li>Basic And Applied Thermodynamics</li> <li>Second Edition</li> </ul>			16.6 Conversion of Volumetric Analysis to Gravimetric Analysis
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<ul> <li>16.12 Air-Fuel Ratio from Analysis of Fuel Gases</li> <li>16.13 Flue Gas Analysis- Orsat Apparatus</li> <li>16.13 Flue Gas Analysis- Orsat Apparatus</li> <li>16.14 Heat Generated by Combustion</li> <li>16.15 Calorific Value, or Heating Value of Fuel</li> <li>16.16 Bomb Calorimeter</li> </ul> 14 Main references: <ul> <li>"Thermal Engineering" by MAHESH M RATHORE</li> </ul> 15 Additional references: <ul> <li>Thermodynamics</li> <li>An Engineering Approach</li> <li>Yunus A.Cengel Michael A.Boles</li> <li>Basic And Applied Thermodynamics</li> <li>Second Edition</li> </ul>			16.11 Air-Fuel Ratio
<ul> <li>16.13 Flue Gas Analysis- Orsat Apparatus</li> <li>16.14 Heat Generated by Combustion</li> <li>16.15 Calorific Value, or Heating Value of Fuel</li> <li>16.16 Bomb Calorimeter</li> <li>Main references:</li> <li>"Thermal Engineering" by MAHESH M RATHORE</li> <li>Additional references:</li> <li>Thermodynamics</li> <li>An Engineering Approach</li> <li>Yunus A.Cengel Michael A.Boles</li> <li>Basic And Applied Thermodynamics</li> <li>Second Edition</li> </ul>			16.12 Air-Fuel Ratio from Analysis of Fuel Gases
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