



# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

## MECHANICAL ENGINEERING

### COURSE DESCRIPTION FORM

<b>Course Title</b>	<b>POWER PLANT ENGINEERING</b>			
<b>Course Code</b>	<b>A70353</b>			
<b>Regulations</b>	<b>R15-JNTUH, IV B-TECH, I-SEM.</b>			
<b>Course Structure</b>	<b>Lectures</b>	<b>Tutorials</b>	<b>Practicals</b>	<b>Credits</b>
	4	1	-	4
<b>Course Coordinator</b>	Mr. G. Sarat Raju, Assistant Professor, Department of Mechanical Engineering.			
<b>Team of Instructors</b>	Mr. G. Sarat Raju, Assistant Professor, Department of Mechanical Engineering. Mrs. G. Karunya, Assistant Professor, Department of Mechanical Engineering.			

#### I. COURSE OVERVIEW

The Present course concentrates on developing basic understanding about various requirements that are involved in establishment of power plants. This course enables the student to explore requirements for the establishment of various types of power plants, their economic analysis and pollution effects. The course focuses on all fundamentals in establishing various types of steam, internal combustion engine, hydro electric and nuclear power plants. Also, in this course; students will gain a broad understanding of the power plant economics and environmental considerations. Student can understand and get knowledge about key factors and features, advantages and disadvantages of various types of power plants.

#### II. PREREQUISITE(S)

Level	Credits	Periods	Prerequisite
UG	4	5	Thermal Engineering
UG	4	5	Mechanics of Fluids and Hydraulic Machines

#### III. MARKS DISTRIBUTION

Sessional Marks	University End Exam Marks	Total Marks
There shall be 2 midterm examinations. Each midterm examination consists of subjective type and Objective type tests. The subjective test is for 10 marks, with duration of 1 hour. Subjective test of each midterm exam shall contain 4 questions. The student has to answer 2 questions, each carrying 5 marks. The objective type test is for 10 marks with duration of 20minutes. It consists of 10 Multiple choice and 10 objective type questions. The student has to answer all the questions and each carries half mark. First midterm examination shall be conducted for the first 2 ½ units of syllabus and second midterm examination shall be conducted for the remaining 2 ½ units. Five marks are earmarked for assignments. There shall be two assignments in every theory course. Marks shall be awarded considering the average of two assignments in each course reason whatsoever, will get zero marks(s).	75	100

#### IV. EVALUATION SCHEME

S.No	Component	Duration	Marks
1	I Mid examination	80 minutes	20
2	I Assignment	--	05
3	II Mid examination	80 minutes	20
4	II Assignment	--	05
5	External examination	3 hours	75

#### V. COURSE OBJECTIVES

**The objectives of the course are to enable the student to:**

- I. Describe the basic principles of steam power plant and combustion process.
- II. Apply the principles of internal combustion engine plant, gas turbine plant and direct energy conversion.
- III. Analyze the hydro electric power plant, hydro projects, plants and power from non-conventional energy sources.
- IV. Demonstrate the nuclear power station and types of reactors
- V. Apply the power plant economics and environmental considerations.

#### VI. COURSE OUTCOMES

**After completing this course the student must demonstrate the knowledge and ability to:**

1. Remember the steam power plant layout, working of various circuits.
2. Understand the combustion process of coal, dust collectors, cooling towers.
3. Remember the concept of different types of ash handling methods.
4. Understand the process of corrosion and feed water treatment.
5. Apply the principles of layout, working and other features of diesel engine power plant.
6. Enumerate the principles of layout and working of gas turbine power plant.
7. Remember the energy conversion directly from solar energy, fuel cells, thermo ionic, thermo electric and MHD.
8. Analyze the layouts and working of hydro electric power plant.
9. Understand the concept of power from non-conventional energy sources i.e. Wind energy.
10. Remember the concept of power from solar energy and Tidal Energy.
11. Enumerate the principles and working of nuclear power station.
12. Understand and enumerate different types of reactors.
13. Remember different methods of Radio Active Disposal.
14. Evaluate the major principles and exercises of power plant economics and environmental considerations.
15. Understand and remember the different methods of Pollution control.

## VII. HOW PROGRAM OUTCOMES ARE ASSESSED

Program outcomes		Level	Proficiency assessed by
PO1	<b>Engineering Knowledge:</b> Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	S	Assignments
PO2	<b>Problem Analysis:</b> Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	N	Assignments
PO3	<b>Design/ Development of Solutions:</b> Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	S	--
PO4	<b>Conduct investigations of complex problems:</b> Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	S	Projects
PO5	<b>Modern tool usage:</b> Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	S	Tutorials
PO6	<b>The engineer and society:</b> Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	S	--
PO7	<b>Environment and sustainability:</b> Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	S	--
PO8	<b>Ethics:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	H	
PO9	<b>Individual and team work:</b> Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	S	Special Projects
PO10	<b>Communication:</b> Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	S	Mini Projects
PO11	<b>Project management and finance:</b> Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	S	Main Projects
PO12	<b>Life-long learning:</b> Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	N	--

## VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED

Program Specific Outcomes		Level	Proficiency Assessed by
PSO 1	<b>Professional Skills:</b> To produce engineering professional capable of synthesizing and analyzing mechanical systems including allied engineering streams.	H	Lectures, Assignments
PSO 2	<b>Practical implementation and testing skills:</b> An ability to adopt and integrate current technologies in the design and manufacturing domain to enhance the employability.	S	Projects
PSO 3	<b>Successful Career and Entrepreneurship:</b> To build the nation, by imparting technological inputs and managerial skills to become Technocrats.	H	Guest Lectures

N - None

S - Supportive

H – Highly Related

## IX. SYLLABUS

### UNIT-I

Introduction to the Sources of Energy –Resources and Development of Power in India.

**Steam Power Plant :** Plant Layout, Working of different Circuits, Fuel and handling equipments, types of coals, coal handling, choice of handling equipment, coal storage, Ash handling systems.

**Combustion Process:** Properties of coal – overfeed and underfeed fuel beds, travelling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, cyclone furnace, design and construction, Dust collectors, cooling towers and heat rejection. Corrosion and feed water treatment.

### UNIT-II

**Internal Combustion Engine Plant:**

**DIESEL POWER PLANT:** Introduction – IC Engines, types, construction– Plant layout with auxiliaries – fuel supply system, air starting equipment, lubrication and cooling system – super charging.

**Gas Turbine Plant:** Introduction – classification - construction – Layout with auxiliaries – Principles of working of closed and open cycle gas turbines. Combined Cycle Power Plants and comparison.

**Direct Energy Conversion:** Solar energy, Fuel cells, Thermo electric and Thermo ionic, MHD generation.

### UNIT-III

**Hydro Electric Power Plant:** Water power – Hydrological cycle / flow measurement – drainage area characteristics – Hydrographs – storage and Pondage – classification of dams and spill ways.

**Hydro Projects and Plant:** Classification – Typical layouts – plant auxiliaries – plant operation pumped storage plants.

**Power From Non-Conventional Sources:** Utilization of Solar- Collectors- Principle of Working, Wind Energy – types – HAWT, VAWT -Tidal Energy.

### UNIT-IV

**NUCLEAR POWER STATION:** Nuclear fuel – breeding and fertile materials – Nuclear reactor – reactor operation.

**Types Of Reactors:** Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, Homogeneous Reactor, Gas cooled Reactor, Radiation hazards and shielding – radioactive waste disposal.

### UNIT-V

**Power Plant Economics And Environmental Considerations:** Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, Load curves, load duration curve. Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor – related exercises. Effluents from power plants and Impact on environment – pollutants and pollution standards – Methods of Pollution control.

### TEXT BOOKS:

T1. P.C.Sharma, “Power Plant Engineering”, S.K.Kataria Pub, 1<sup>st</sup> Edition 2016.

T2. I.Arora and S. Domkundwar “A Course in Power Plant Engineering”, Dhanpat Rai, 1<sup>st</sup> Edition 2014.

### REFERENCE BOOKS:

R1. Rajput, “A Text Book of Power Plant Engineering “, Laxmi Publications, 5<sup>th</sup> Edition, 2014.

R2. Ramalingam, “Power plant Engineering”, Scietech Publishers.

R3. P.K.Nag, “Power Plant Engineering”, TMH, II Edition.

R4. G.D. Rai, “An Introduction to Power Plant Technology”.

R5. Elanchezhian, “Power plant Engineering”, I.K. International Publications.

## X. COURSE PLAN:

The course plan is meant as a guideline. There may probably be changes.

Lecture No.	CLO	Unit No.	Course Learning Outcomes	Topics to be covered	Reference
1-15	1	1	<p>Remember the steam power plant layout, working of various circuits.</p> <p>Understand the combustion process of coal, dust collectors, cooling towers.</p> <p>Remember the concept of different types of ash handling methods.</p> <p>Understand the process of corrosion and feed water treatment.</p>	Introduction to the Sources of Energy – Resources and Development of Power in India.	T1: 1.1- 1.2 & 1.6
	2,3			<p><b>Steam Power Plant:</b> Plant Layout, Working of different Circuits, Fuel and handling equipments, types of coals, coal handling, choice of handling equipment, coal storage, Ash handling systems.</p>	T1: 9.1-9.2 & 10.1-10.3
	4			<p><b>Combustion Process:</b> Properties of coal – overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, cyclone furnace, design and construction, Dust collectors, cooling towers and heat rejection. Corrosion and feed water treatment</p>	T1: 9.3-9.10
16-30	5	2	<p>Apply the principles of layout, working and other features of diesel engine power plant.</p> <p>Enumerate the principles of layout and working of gas turbine power plant.</p> <p>Remember the energy conversion directly from solar energy, fuel cells, thermo ionic, thermo electric and MHD.</p>	<p><b>Internal Combustion Engine Plant:</b> DIESEL POWER PLANT: Introduction – IC Engines, types, construction– Plant layout with auxiliaries – fuel supply system, air starting equipment, lubrication and cooling system – super charging.</p>	T1:14.1-14.9
	6			<p><b>Gas Turbine Plant:</b> Introduction – classification - construction – Layout with auxiliaries – Principles of working of closed and open cycle gas turbines. Combined Cycle Power Plants and comparison.</p>	T1: 15.1-15.17
	7			<p><b>Direct Energy Conversion:</b> Solar energy, Fuel cells, Thermo electric and Thermo ionic, MHD generation.</p>	T1: 1.4

31-42	8	3	Remember the energy conversion directly from solar energy, fuel cells, thermo ionic, thermo electric and MHD. Analyze the layouts and working of hydro electric power plant.	<b>Hydro Electric Power Plant:</b> Water power – Hydrological cycle / flow measurement – drainage area characteristics – Hydrographs – storage and Pondage – classification of dams and spill ways.	T1: 16.1- 16.7
	9		Understand the concept of power from non-conventional energy sources i.e. Wind energy.	<b>Hydro Projects And Plant:</b> Classification – Typical layouts – plant auxiliaries – plant operation pumped storage plants.	T1: 16.8-16.20
	10		Remember the concept of power from solar energy and Tidal Energy.	<b>Power From Non-Conventional Sources:</b> Utilization of Solar-Collectors- Principle of Working, Wind Energy – types – HAWT, VAWT - Tidal Energy.	T1:1.4
43-55	11	4	Enumerate the principles and working of nuclear power station.	<b>NUCLEAR POWER STATION:</b> Nuclear fuel – breeding and fertile materials – Nuclear reactor – reactor operation.	T1: 13.1-13.3
	12,13		Understand and enumerate different types of reactors. Remember different methods of Radio Active Disposal.	<b>Types Of Reactors:</b> Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, Homogeneous Reactor, Gas cooled Reactor, Radiation hazards and shielding – radioactive waste disposal.	T1: 13.3-13.13
56-65	14,15	5	Evaluate the major principles and exercises of power plant economics and environmental considerations. Understand and remember the different methods of Pollution control.	<b>Power Plant Economics And Environmental Considerations:</b> Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, Load curves, load duration curve. Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor – related exercises. Effluents from power plants and Impact on environment – pollutants and pollution	T1: 17.1-17.11, 21.1-21.6

				standards – Methods of Pollution control.	
Lecture No.	CLO	Unit No.	Course Learning Outcomes	Topics to be covered	Reference
1	1	1	Remember different sources of energy	Introduction to the Sources of Energy –	T1: 1.1- 1.2
2	1		Remember different resources in our country.	Resources and Development of Power in India.	T1: 1.6
3	1		Understand the steam power plant layout	<b>Steam Power Plant:</b> Plant Layout, Working of different Circuits	T1: 9.1
4	1		Enumerate Fuel and handling equipments	Fuel and handling equipments	T1: 9.2
5	2		Remember types of coals, coal handling	types of coals, coal handling, choice of handling equipment	T1: 10.1
6	2		Understand Ash handling systems.	coal storage, Ash handling systems.	T1: 10.3
7	2		Remember Properties of coal	<b>Combustion Process:</b> Properties of coal	T1: 9.3
8	2		Understand fuel beds	overfeed and underfeed fuel beds	T1: 9.4
9	3		Analyze traveling grate stokers	Overfeed fuel beds- traveling grate stokers	T1: 9.5
10	3		Remember spreader stokers, retort stokers	spreader stokers, retort stokers	T1: 9.5
11	3		Understand pulverized fuel burning system	pulverized fuel burning system and its components	T1: 9.6
12	3		Remember combustion needs and draught system	combustion needs and draught system	T1: 9.7
13	4		Understand cyclone furnace, design and construction, Dust collectors	cyclone furnace, design and construction, Dust collectors	T1: 9.8
14	4		Evaluate Cooling towers and heat rejection	Cooling towers and heat rejection.	T1: 9.9
15	4		Remember Corrosion and feed water treatment	Corrosion and feed water treatment	T1: 9.10
16	5	2	Understand IC Engines, types	<b>Internal Combustion Engine Plant:</b> DIESEL POWER PLANT: Introduction – IC Engines, types	T1:14.1-14.2

17	5		Remember Plant layout with auxiliaries	construction– Plant layout with auxiliaries	T1:14.3-14.4
18	5	2	Enumerate fuel supply system, air starting equipment	fuel supply system, air starting equipment	T1:14.5-14.6
19	5		Understand lubrication and cooling system	lubrication and cooling system	T1:14.7-14.8
20	5		Remember the process of super charging	super charging.	T1:14.9
21	6		Remember Gas Turbine power plant	<b>Gas Turbine Plant:</b> Introduction	T1: 15.1-15.2
22	6		Describe its classification - construction	classification - construction	T1: 15.3-15.4
23	6		Understand its Layout with auxiliaries	Layout with auxiliaries	T1: 15.5-15.6
24	6		Remember Principles of working of closed cycle	Principles of working of closed and open cycle gas turbines.	T1: 15.7-15.14
25	6		Discuss the Principles of working of closed cycle	Principles of working of closed and open cycle gas turbines.	T1: 15.7-15.14
26	6		Remember Principles of working of open cycle	Principles of working of closed and open cycle gas turbines.	T1: 15.7-15.14
27	6		Enumerate Combined Cycle Power Plants and comparison.	Combined Cycle Power Plants and comparison.	T1: 15.15-15.17
28	7		Remember function of Solar energy, Fuel cells	<b>Direct Energy Conversion:</b> Solar energy, Fuel cells	T1:1.4
29	7		Understand the concept Thermo electric and Thermo ionic	Thermo electric and Thermo ionic	T1:1.4
30	7		Remember working of MHD generation	MHD generation	T1:1.4
31	8		3	Describe Hydrological cycle Hydrographs	<b>Hydro Electric Power Plant:</b> Water power – Hydrological cycle Hydrographs
32	8	Enumerate flow measurement – drainage area characteristics		flow measurement – drainage area characteristics	T1: 16.3
33	8	Understand characteristics of storage and Pondage		storage and Pondage	T1: 16.4- 16.5
34	8	Remember different dams		Classification of dams and spill ways.	T1: 16.6- 16.7



35	8		Understand different dams and spillways	Classification of dams and spill ways.	T1: 16.6- 16.7
36	8	3	Remember different spillways	Classification of dams and spill ways.	T1: 16.6- 16.7
37	9		Remember different Hydro plants	<b>Hydro Projects And Plant:</b> Classification	T1: 16.8-16.10
38	9		Understand its layout	Typical layouts – plant auxiliaries	T1: 16.11-16.15
39	9		Discuss different storage plants	plant operation pumped storage plants.	T1: 16.16-16.20
40	10		Remember the principle of working from non-conventional sources	<b>Power From Non-Conventional Sources:</b> Utilization of Solar-Collectors- Principle of Working	T1: 1.4
41	10		Enumerate different types of wind energy	Wind Energy – types – HAWT, VAWT	T1: 1.4
42	10		Remember how we get power from tides.	Tidal Energy	T1: 1.4
43	11		4	Understand what is the use of nuclear fuel	<b>NUCLEAR POWER STATION:</b> Nuclear fuel – breeding
44	11	Remember different fertile materials		fertile materials	T1: 13.2
45	11	Discuss the operation of reactors.		Nuclear reactor – reactor operation.	T1: 13.3
46	12	Understand the function of PWR.		<b>Types Of Reactors:</b> Pressurized water reactor	T1: 13.4
47	12	Enumerate the working of BWR.		Boiling water reactor	T1: 13.5
48	12	Understand the function of SGR.		sodium-graphite reactor	T1: 13.6
49	12	Remember the working of FBR.		fast Breeder Reactor	T1: 13.7
50	12	Understand the function of HR.		Homogeneous Reactor	T1: 13.8
51	12	Analyze the function of GCR.		Gas cooled Reactor	T1: 13.9
52	13	Remember different hazards due to radiation		Radiation hazards and shielding	T1: 13.11-13.13
53	13	Understand effects caused		Radiation hazards and shielding	T1: 13.10-13.13
54	13	Remember the disadvantages		radioactive waste disposal	T1: 13.11-13.13

55	13		Understand its affects	Radioactive waste disposal.	T1: 13.11-13.13
56	14	5	Remember power plant economics	<b>Power Plant Economics And Environmental Considerations:</b> Capital cost	T1: 17.1-17.2
57	14		Analyze its costs	investment of fixed charges	T1: 17.3-17.4
58	14		Understand the cost economics incurred	operating costs	T1: 17.3-17.4
59	14		Remember the distribution of power	general arrangement of power distribution	T1: 17.5
60	14		Understand the effect of load	Load curves, load duration curve	T1: 17.6-17.7
61	14		Remember the definitions of different factors	Definitions of connected load, Maximum demand, demand factor	T1: 17.8-17.9
62	14		Apply the factors with related exercises	average load, load factor, diversity factor – related exercises	T1: 17.10-17.11
63	15		Remember emission of different effluents	Effluents from power plants	T1: 21.1-21.6
64	15		Understand its impact on environment	Impact on environment – pollutants and pollution standards	T1: 21.1-21.6
65	15		Remember different methods.	Methods of Pollution control.	T1: 21.1-21.6

**XI. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES**

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I	S		S		S	H		H		S	S		H	S	
II				S	S					S					
III		S						H	S		S	S			
IV	S		S		S										H
V				S		H			S			S	H		

N = None

S = Supportive

H = Highly related

**XII. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF TSHE PROGRAM OUTCOMES**

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1				S	S	H		H	S	S		S	H	S	
2	S	S	S								H				
3							S			H			H		
4			S	H										S	
5	S			S		H			S		H	S			H
6	S							S	H						H
7				H						S	H				
8		S			S		S					S		S	
9	H											H			
10			S			H				S					
11	S				S			S				S		H	S
12			H							H			S		
13	S						H				S				
14		S		H					S						S
15						S						H		S	

**N = None**

**S = Supportive**

**H = Highly related**

**Prepared by:**

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Mrs. G. Karunya, Assistant Professor.

**HOD, MECHANICAL ENGINEERING**