IV B.Tech II Semester

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16MEC421 POWER PLANT ENGINEERING

Course Educational Objectives:

CEO1: Describe the basic principles of steam power plant and combustion process.
CEO2: Demonstrate the nuclear power station and types of reactors
CEO3: Apply the principles of internal combustion engine plant, gas turbine plant and direct energy conversion.
CEO4: Analyze the gas turbine power plant, Renewable Energy Sources plants and power energy sources
CEO5: Apply the power plant economics and environmental considerations

UNIT – 1: STEAM POWER PLANT

Introduction to the sources of energy – Resources and development of power in India. **Steam Power Plant**: Plant layout – Working of different circuits – Types of coal – Properties of coal – Coal handling system – Ash handling system – Feed water treatment. **Combustion Process**: Stages of combustion – Overfeed and underfeed stoker firing – Stoker firing of coal – Pulverized coal firing system – Cyclone furnace – Fluidized bed combustion system – Cooling towers and heat rejection.

UNIT – 2: NUCLEAR POWER PLANT

Layout and subsystems – Fuels and nuclear reactions – Pressurized water reactor (PWR) – Boiling water reactor (BWR) – Gas cooled and liquid metal fast breeder reactor – Heavy water reactor – Working and comparison – Safety measures.

UNIT – 3: DIESEL AND HYDROELECTRIC POWER 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. **Hydroelectric Power Plant**: Water power – Hydrological cycle – Hydrographs – Storage and pondage – Classification of dams and spill ways – Classification of hydroelectric plant – Pumped storage power plants – Typical layout and associated components – Selection of turbines.

UNIT – 4: GAS TURBINE POWER PLANT AND RENEWABLE ENERGY SOURCES

Gas Turbine Power Plant: Introduction – Classification – Construction – Layout with auxiliaries – Principles of working of closed and open cycle gas turbines – Combined cycle power plants and comparison. **Renewable Energy Sources:** Principle, construction and working of solar energy, utilization of solar energy and solar energy collectors – Wind energy – horizontal and vertical axis wind turbine (HAWT & VAWT) – Geo thermal – Tidal energy – Ocean thermal – Biogas – Fuel cell, thermoelectric and thermionic generation.

UNIT – 5: ENERGY MANAGEMENT, ECONOMICS AND ENVIRONMENTAL ISSUES

Power tariff types – Load distribution parameters – Load curve – Comparison of site selection criteria – Capital and operating cost of different power plants – Pollution control technologies including waste disposal options for coal and nuclear power plants

Course Outcomes:

On successful completion of the course, students will be able to:

Course Outcomes		POs related to COs
CO1	Understand the concept of generation of power by using various types of fuels, layout of power plant, coal, fuel & ash handling equipments.	PO1, PO3
CO2	Acquire basic knowledge of different types of nuclear power plants, Reactors its operation advantages, disadvantage and application.	PO1, PO3
CO3	Understand of diesel power plants, construction, and fuel supply system and cooling systems its equipments and hydroelectric plants, classified the dams and their layouts.	PO1, PO2

CO4	Understand of gas turbine power plants, construction, and classified different types of layouts and Renewable Energy Sources power plants and their principles, construction and working.	PO1, PO2,PO3
CO5	Developed Capital and operating cost of different power plants and Pollution control technologies.	PO1,PO3.PO7

Text books:

1. Power Plant Engineering, P.K.Nag, 4/e, 2015, McGraw-Hill Education Pvt. Ltd., New Delhi.
2. A Course in Power Plant Engineering, Arora and S. Domkundwar, 6/e, 2012, Dhanpat Rai Publishing Company (P) Ltd., New Delhi.

Reference books:

1. Powerplant Technology, Mohamed Mohamed El-Wakil, 2010, Tata McGraw-Hill, New Delhi.
2. A Text Book of Power Plant Engineering, R.K.Rajput, 4/e, 2012, Laxmi Publications (P) Ltd., New Delhi.
3. Power Plant Engineering, K.K.Ramalingam, 1/e, 2010, Scitech Publishers, Chennai.
4. Power Plant Engineering, Nagpal G. R, n/e, 2004, Khanna Publisher, New Delhi.
5. Introduction to Power Plant Technology, G.D.Rai, 3/e, 2012, Khanna Publishers, New Delhi.

QUESTION BANK

Question No.	Questions	B T	PO Attainment
	UNIT 1 – STEAM POWER PLANT		
	PART-A (Two Marks Questions)		
1	What is meant by 'over feed' and 'under feed' principles of firing coal ?	**R**	**PO1**
2	What are the different methods of firing coal ?	**R**	**PO1**
3	Discuss the advantages of mechanical methods of firing coal.	**C**	**PO1**
4	Make neat sketch and explain the working of Chain grate stoker	**U**	**PO1**
5	Make neat sketch and explain the working of Spreader stoker	**U**	**PO1**
6	Make neat sketch and explain the working of Multi retort stoker.	**U**	**PO1, PO2**
7	Name the various methods of ash handling.	**R**	**PO1, PO2**
8	Why it is essential to quench the ash before handling ?	**R**	**PO1, PO2**
9	Name the different types of coal-pulverising mills.	**R**	**PO1**
10	Name various draught systems.	**R**	**PO1**
11	State the advantages of steel chimney.	**An**	**PO1**
12	State the advantages of pulverised fuel firing	**An**	**PO1, PO2**
13	What is the cause of smoke ?	**R**	**PO1**
14	Define the overall efficiency of a steam power plant.	**R**	**PO1**
15	List the four important circuits of the steam power plant.	**An**	**PO1**
16	What is meant by compounding of steam turbines?	**R**	**PO1**
17	What is a pulverized and why it is used?	**R**	**PO1**
18	Mention the various modern ash handling systems.	**R**	**PO1**
19	What is stoker? Classify it.	**R**	**PO1**
R	**PART-B (Ten Marks Questions)**		
1	What are the different methods of firing coal ? Discuss the advantages of mechanical Methods of firing coal.	**R**	**PO1, PO2, PO3**
2	Make neat sketch and explain the working of: (*i*) Chain grate stoker (*ii*) Spreader stoker. (*iii*) Multi retort stoker.	**C**	**PO1, PO2, PO3**
3	Describe the various types of grates used with hand fired furnaces.	**E**	**PO1, PO2, PO3**
4	Describe the various methods used to fire pulverised coal.	**E**	**PO1, PO2, PO4**
5	Make a neat sketch of ball and Race mill and explain its working.	**C**	**PO1, PO2, PO4**
6	Name the different types of coal-pulverising mills. Describe Ball-Mill.	**R**	**PO1, PO2, PO4**
7	Describe the various types of burners used to burn pulverised coal.	**E**	**PO1, PO2, PO4**
8	State the advantages and disadvantages of a steam power station as compared to hydroelectric power station and nuclear power station.	**An**	**PO1, PO2, PO4**
9	Draw a general layout of steam power plant with neat diagram and explain the working of different circuits.	**U**	**PO1, PO6, PO12**
10	Explain in detail the coal handling system with a suitable block diagram.	**U**	**PO1, PO7, PO12**

Question No.	Questions	BT	PO Attainment
	UNIT 2 – NUCLEAR POWER PLANT		
	PART-A (Two Marks Questions)		
1	What is critical mass of nuclear fuel?	**R**	**PO1**
2	What are isotopes?	**R**	**PO1**
3	Name the different types of fuels used in nuclear reactors.	**R**	**PO1,PO7**
4	What is known as binding energy?	**R**	**PO1,PO7**
5	How can nuclear fussion be caused?	**R**	**PO1**
6	Explain the function of nuclear reactor.	**U**	**PO1**
7	What are the essential components of a nuclear reactor?	**R**	**PO1**
8	Name the three moderators commonly used in nuclear power reactor.	**R**	**PO1,PO2**
9	Why is shielding of a Nuclear reactor necessary?	**R**	**PO1**
10	Define the term “Breeding”.	**R**	**PO1**
11	Why is a liquid metal the preferred coolant in a fast breeder reactor?	**R**	**PO1**
12	What are the components of pressurized water reactor nuclear power plant?	**R**	**PO1**
13	What are the criteria used for evaluation of nuclear plant safety?	**R**	**PO1**
14	List some of the disadvantages of Nuclear power plant	**R**	**PO1**
15	How do you cater for safety of Nuclear power plant?	**R**	**PO1**
16	What are the advantages and disadvantages of breeder reactor?	**R**	**PO1**
17	What are the essential components of a nuclear reactor?	**R**	**PO1**
18	What are the conditions to be satisfied to sustain nuclear fission process?	**R**	**PO1**
19	How are the nuclear reactors classifieds?	**R**	**PO1**
20	Distinguish between PHWR and LMFBR	**An**	**PO1**
	PART-B (Ten Marks Questions)		
1	Explain CANDU (Canadian-DeuteriumUranium) reactor with neat diagram also mention its merits and demerits.	**U**	**PO1**
2	What is meant by uranium enrichened? Describe some methods of Uraniurn enrichment	**R**	**PO1**
3	Explain the Construction and working of nuclear power plant with a layout.	**U**	**PO1**
4	Explain with a neat sketch a boiling water reactor.	**U**	**PO1**
5	Explain the different types of nuclear reactions and initiation of nuclear reactions	**U**	**PO1**
6	Explain the working of pressurized water reactor	**U**	**PO1**
7	Explain the working of gas cooled reactor	**U**	**PO1**
8	Explain the working of High temperature gas cooled reactor	**U**	**PO1**
9	Explain the working of Pressurized heavy water reactor	**U**	**PO1**
10	Discuss about the safety measures adopted in modern nuclear plants.	**E**	**PO1**

Question No.	Questions	BT	PO Attainment
	UNIT 3 – DIESEL AND HYDROELECTRIC POWER PLANT		
	PART-A (Two Marks Questions)		
1	What is the essential component of diesel power plants?	**R**	**PO1**
2	List the various Liquid Cooling Systems?	**R**	**PO1**
3	What is the purpose of super charging?	**R**	**PO1**
4	Define Flywheel?	**U**	**PO1**
5	Write the Disadvantages of over cooling of the Engine?	**R**	**PO1**
6	Write the function of Lubrication?	**R**	**PO1**
7	What are the classifications of Lubrication system?	**R**	**PO1**
8	Write a note on heat balance sheet.	**R**	**PO1**
9	What are the advantages of supercharger?	**R**	**PO1**
10	State the applications of a diesel power plant?	**R**	**PO1**
11	Write a short notes on super charging.	**R**	**PO1**
12	How does detonation affect engine performance in SI engines?	**R**	**PO1**
13	Define Surge tank?	**U**	**PO1**
14	Write the purpose of Draft tube?	**R**	**PO1**
15	What is the Element of Hydel Power Plant?	**R**	**PO1**
16	Write the Advantages of Hydro-electric power plants?	**R**	**PO1**
17	Define Governing Mechanism?	**U**	**PO1**
18	Define Francis water turbine?	**U**	**PO1**
19	Write the advantages of small Hydro-power plant (SHP)?	**R**	**PO1**
20	Differentiate propeller and Kaplan turbine?	**An**	**PO1**
	PART-B (Ten Marks Questions)		
1	Draw and explain the construction and working principle of layout of diesel power plant	**U**	**PO1**
2	Name and explain various types of fuel injection systems.	**U**	**PO1**
3	What are the basic types of I.C. Engine?	**R**	**PO1**
4	Discuss the advantage and disadvantage of a diesel engine	**An**	**PO1**
5	Write a note on fuel system of diesel power plant.	**R**	**PO1**
6	Draw a neat sketch of a power house and describe the main features of sub-structure and Superstructure.	**An**	**PO1**
7	Describe the advantages and disadvantages of underground power stations compared with Over ground power stations.	**An**	**PO1**
8	Discuss the differences between Pelton, Francis and Kaplan turbines and type of power plants they are suitable	**An**	**PO1**
9	Why the inward flow reaction turbines have superseded the outward flow turbines?	**R**	**PO1**
10	What effects the efficiency of a reaction turbine on part-load? Is the part load efficiency is a function of specific speed?	**R**	**PO1**

Question No.	Questions	BT	PO Attainment
	UNIT 4 – GAS TURBINE POWER PLANT AND RENEWABLE ENERGY SOURCES		
	PART-A (Two Marks Questions)		
1	Define – closed cycle gas turbine?	**R**	**PO1**
2	What are the methods to improving the thermal efficiency in open cycle gas turbine plant?	**R**	**PO1**
3	Define turbo charging in combined gas turbine and diesel cycles?	**R**	**PO1**
4	Define – open cycle gas turbine?	**R**	**PO1**
5	Give the advantages and limitations of gas turbine power plant.	**R**	**PO1**
6	Given the application of gas turbine power plants	**R**	**PO1**
7	Name the major components of a gas turbine plant.	**R**	**PO1**
8	Define Air-rate and work-ratio	**R**	**PO1**
9	What is regeneration?	**R**	**PO1**
10	Define "effectiveness" of regeneration.	**R**	**PO1**
11	Discuss combined steam and gas turbine power plants.	**An**	**PO1**
12	List various type of source of energy.	**R**	**PO1**
13	Write short notes on non-conventional energy.	**R**	**PO1**
14	Write short notes on geothermal energy.	**R**	**PO1**
15	What is tidal energy	**R**	**PO1**
16	Write short note on biogas plant.	**R**	**PO1, PO2**
17	Write short notes on water heater.	**R**	**PO1**
18	Write short notes on box type solar cooker.	**R**	**PO1, PO2**
19	Write short notes on nuclear energy generation.	**R**	**PO1, PO2**
20	List the advantage of liquid fuel.	**R**	**PO1, PO2**
1	Explain the working of gas turbine cycle with regenerator.	**U**	**PO1**
2	Explain the working of gas turbine cycle with inter cooling.	**U**	**PO1, PO2, PO4**
3	Draw and Explain the construction and working principle of Open cycle gas turbine power plant?	**U**	**PO1, PO2, PO4**
4	Draw and explain the construction and working principle of closed cycle gas turbine power plant?	**U**	**PO1, PO2, PO4**
5	What are solar cell technologies?	**R**	**PO1, PO2, PO4**
6	Briefly describe about ocean energy.	**U**	**PO1, PO2, PO4**
7	What is Wind energy and wind mill system	**R**	**PO1, PO2, PO3**
8	Write down working of solar cells.	**R**	**PO1, PO2, PO4**
9	Write down properties and formation of coal.	**R**	**PO1**
10	What are the features of biomass energy and describe what the source of biomass?	**R**	**PO1, PO2, PO4**

Question No.	Questions	BT	PO Attainment
	UNIT 5 - ENERGY MANAGEMENT, ECONOMICS AND ENVIRONMENTAL ISSUES		
	PART-A (Two Marks Questions)		
1	What do you know about environment pollution due to energy uses?	R	PO1
2	Define harmful effect of emission.	R	PO1
3	What are the step taken for reduce air pollution ?	R	PO1
4	Write short notes on Noise pollution and its control.	R	PO1
5	What is acid rain, explain?	R	PO1
6	Write short notes on stratospheric ozone depletion, Acid Fog.	R	PO1
7	Write on pollution due to combustion of fuel.	R	PO1
8	What do you understand by liquid fuel pollution?	R	PO1
9	What do you understand by solid fuel pollution?	R	PO1
10	Define load factor and utility factor?	R	PO1
11	Define plant operating factor and capacity factor?	R	PO1
12	Define demand factor and diversity factor?	R	PO1
13	What is the difference between demand factor and diversity factor?	R	PO1
14	How 'load duration curve' is obtained from 'load' curve ?	R	PO1
15	Define 'depreciation' and explain its significance.	R	PO1
16	Differentiate 'dump power', 'firm power' and 'prime power'.	R	PO1
17	What is 'diversity factor'? List its advantages in a power system.	R	PO1
18	Prove that the load factor of a power system is improved by an increase in diversity of load.	E	PO1
19	What is the concept of Power plant?	R	
	PART-B (Ten Marks Questions)		
1	Explain environment pollution due to industrial emissions.	U	PO1, PO2, PO3
2	Explain environment pollution due to road transport.	U	PO1, PO2, PO3
3	What is the green house gases and their effects? Explain.	R	PO1, PO2, PO4
4	Briefly explain fossil fuel pollution	U	PO1, PO2, PO4
5	What do you understand by thermal pollution, explain the bad effects of thermal pollution?	R	PO1, PO2, PO4
6	Explain how gas combustion polluted the atmosphere.	U	PO1, PO2, PO4
7	Prove that the load factor of a power system is improved by an increase in diversity of load.	E	PO1, PO2, PO4
8	Explain the sinking fund method of calculating the depreciation.	U	PO1, PO2, PO4
9	Discuss the factors to be considered for, 'plant selection' for a Power plant	R	PO1, PO2, PO4
10	What is meant by load curve? Explain its importance in power generation.	R	PO1, PO2, PO4

ALL THE BEST