Total No. of Questions :10]

SEAT No. :

**P3885**

[Total No. of Pages :3

# [5561]-541

## B. E. (Mechanical) (Mechanical Sandwich)

## ENERGY ENGINEERING

## (2015 Pattern) (Semester - II) (402047)

*Time : 2½ Hours]* *[Max. Marks : 70*

***Instructions to the candidates:***

1) ***Attempt Q.1 OR Q.2, Q.3 OR Q.4, Q.5 OR Q.6, Q.7 OR Q.8, Q.9 OR Q.10.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right of each question indicate full marks.***
4) ***Assume suitable data wherever necessary and mention the same clearly.***
5) ***Use of steam tables, Mollier chart and calculator is allowed.***

***Q1)*** a) Explain the concept of cascade efficiency. **[5]**

b) In thermal power plant steam turbine of 11 MW capacity requires 5.1 kg of steam per hour per kW. The quanitity of air leakage into the condenser is 1 kg per 1 ton of steam used by the turbine. The vacuum in the condenser is 71 cm of Hg and barometer reading is 760 mm of Hg. The temperature at the suction of air pump is 31 degree Celsius. The surface condenser is fitted with separate condensate extraction and air pump. The rise in the temperature of cooling water of condenser is 8 degree Celsius. The quality of steam entering condenser is 0.89 dry and no under cooling in the condenser. Determine : **[5]**

i) The capacity of air pump per minute basis

ii) Quantity of cooling water required in tones per minutes.

OR

***Q2)*** a) What is a purpose of coal benefication? Explain flow in this process with suitable diagram. **[5]**

b) Explain the methods used to control Nox in thermal power plant. **[5]**

***Q3)*** a) Write Note on following. **[5]**

Flow duration curve and its use.

b) What do you mean by Supercritical Boiler? Explain the advantages of the same. **[5]**

OR

***P.T.O.***

***Q4)*** a) What are different methods for disposal of Nuclear waste? **[5]**

b) Explain typical closed type condensing plant with simple diagram? **[5]**

***Q5)*** a) The air enters the compressor of a gas-turbine power plant at 1 bar, 30 degree Celsius and 162 tons per hour. The maximum cycle temperature, pressure are 650 degree Celsius, 5 bar respectively. The two stage expansion with reheating pressure of 2.24 bar is used in the plant. In the reheater gas is heated up to maximum cycle temperature. The isentropic efficiency of compressor, first turbine, and second turbine is 80%, 85%, 90% respectively. Take adiabatic index for air gas as 1.4, 1.33 respectively Take specific heat for air, gas as 1KJ/kg-K, 1.15 KJ/kg-K respectively. Neglect mass flow rate of fuel. Draw cycle arrangement and T-s diagram and determine. **[10]**

i) The thermal efficiency of cycle.

ii) Power out put of plant in MW.

b) Explain General Layout of Diesel Power Plant indicating different systems. **[8]**

OR

***Q6)*** a) Air enters the compressor of a gas-turbine power plant having capacity 12 MW at 1 bar and 27 degree Celsius. The maximum cycle temperature, pressure are 577 degree Celsius, 6.5 bar respectively. The two stage compression with perfect inter cooling arrangement is incorporated in the plant. The compression in both stages and expansion in turbine are isentropic. Take adiabatic index, specific heat for both air and gas as 1.4, 1 KJ/kg-K respectively. Assume calorific value of fuel as 45.5 MJ/Kg. Draw Cycle arrangement and T-s diagram and determine. **[10]**

i) Maximum work saved per kg of air compressed due to use of inter cooling.

ii) Fuel consumption in Tph (with inter cooling arrangement)

iii) The thermal efficiency of cycle with considering effect mass flow rate of fuel on air.

b) Explain the advantages, disadvantages and applications of diesel power plant. **[8]**

***Q7)*** a) Explain the superheated steam geothermal power plant with simple diagram. **[6]**

b) Explain the Claude cycle for OTEC with component arrangement diagram. **[6]**

c) What are applications of solar photovoltaic power systems? **[4]**

OR

***Q8)*** a) Explain the working of open cycle MHD generator with simple figure. **[6]**

b) Write Note on : Solar Chimney. **[6]**

c) How wind turbines are classified? **[4]**

***Q9)*** a) What is function of circuit breaker in supply system? Explain working of air circuit breaker with simple sketch and list out its limitations. **[8]**

b) Input output curve of 25 MW capacity generating power plant is given by $I=5\times10^6\ (7+0.2L+0.1L^2)$ [I in kJ/hr and L in MW] then **[8]**

Determine:

i) Average rate of heat supplied (heat supplied MW-hr) when plant operating at 25 MW load for 10 hours in a day and kept at zero load for 14 hours

ii) Saving in heat rate if same energy is produced for whole day at constant load.

OR

***Q10)***a) Write note on following : **[8]**

i) Generatar cooling ii) Effects of short circuits

b) Explain following terms with its significance. **[4]**

i) Plant capacity factor ii) Plant use factor

c) A steam power station has an installed capacity of 120 MW and average load of 50 MW. The coal consumption is 0.4 kg per kWh and cost of coal is Rs. 80 per ton. The annual expenses on salary bill of staff and other overhead charges excluding cost of coal are $Rs.50\times10^5$. The power station works at a load factor of 0.5 and the capital cost of the power station is Rs. $4\times10^5$. If the rate of interest and depreciation is 10%. Determine the cost of generating per kWh. **[4]**