sem VII / mech / 17-12-11 / Power plant Engg.

2nd Half-Exam.-11 mina (d):

Con. 6629-11. (REVISED COURSE) **MP-5533**

(3 Hours) [**Total Marks : 100**

N. B. : (1) Question No. **1** is **compulsory**.
(2) Answer any **four** questions from the remaining **six** questions.
(3) **Assumptions** made, if any, should be **justified**.
(4) **Use** illustrative diagrams where **possible**.
(5) You may use **steam** table, if **required**.

Q.1 Write short notes on **any four** of the following: 20
a) Tariff for an industrial consumer
b) Pressurized fluidized bed combustion
c) Multiplication factor in a nuclear reactor
d) Uses of diesel power plant
e) Causes and effects of global warming

Q.2
- A) Briefly discuss current energy scenario in Maharashtra. Answer should highlight power scenario in Mumbai. 10
- B) A reactor is fuelled with 50 tonnes of natural uranium (atomic mass: 238.05) in which the average thermal neutron flux is 2×10^{13} n/cm^2.s. The thermal neutron cross-sections of U-235 (atomic mass: 235.04) are σ_c: 101 barns, σ_f: 579 barns. The natural uranium contains 0.715% of U-235. 10
Calculate (i) the power of the reactor and
(ii) the fraction of U-235 consumed in one year of operation.

Q.3.
- A) Describe the various methods of flue gas desulfurization. 10
- B) The following are the observations made for a 30 minutes trial of a two stroke diesel engine: 10
Net brake load: 700 N; P_{mep} : 3 bar; N: 400 rpm
Total fuel consumption: 2 kg. Cooling water : 200kg
Water inlet temperature: 32^{0}C ; Water outlet temperature: 57^{0}C
Air used/ kg of fuel: 30kg; Room temperature: 27^{0}C
Exhaust gas temperature: 310^{0}C
Cylinder dimensions: 210mm × 290mm stroke
Brake diameter: 1m
Calorific value of fuel: 40MJ/kg
Steam formed per kg of fuel in the exhaust: 1.3kg
Sp. heat of steam in the exhaust: 2.093kJ/kgK
Sp. heat of dry exhaust gases: 1.01kJ/kgK
Calculate the indicated power, the brake power and the energy balance of the engine.

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4. • A) Answer **any two** of the following: **10**
   (i) Economic loading of plants in a power station
   (ii) Reactor shutdown systems
   (iii) Performance improvement in a steam power plant

   • B) The nature of load required for 24 hours is tabulated as follows: **10**

Time:	10 am-6pm	6pm-8pm	8pm-12pm	00am-6am	6am- 10am
Power(Mw)	150	80	40	20	100
η_{Th} (%)	30	20	15	10	30

   (i) Find the total input to the plant if the load is supplied by the single thermal power unit only.
   (ii) If the above load is taken by the combined thermal and pump-storage plant, then find the percentage saving in the input to the plant. Thermal efficiency at full load is 30%.
   (iii) Also, find the overall efficiencies in both the cases.
   Assume, overall efficiency of pump storage plant : 0·72.

5. • A) Describe the various methods of improving the performance in a gas turbine power plant. **10**

   • B) From the following data, estimate the generating cost and also find if any reserve is available. **10**
   Annual load factor: 60%
   Capacity factor: 50%
   Installed capacity of the plant: 140 Mw
   Capital cost of the plant: Rs.200×10^6
   Annual cost of coal, oil and salaries: Rs. 20×10^6
   Rate of interest: 5% of capital
   Rate of depreciation:5% of capital

Q.6

   • A) Explain in brief **any two** of the following: **10**
   (i) Regenerative type scrubber
   (ii) Different sub-systems in D.G. plant
   (iii) Social and environmental effects of a hydro power plant

   • B) Describe a BWR plant operating in India **10**

Q.7

   • A) Outline performance and operating characteristics of different types of conventional power plants. **10**

   • B) A combined cycle is designed to develop 150 Mw power. The air is taken by the compressor at 300K and 1 bar pressure. The maximum temperature of the gas turbine cycle is limited to 900^0C.The pressure ratio is 8. The data for the steam plant is given below: **10**
   The exhaust coming from the gas turbine is heated further to 800^0C before entering into the boiler. The steam is generated at 50bar and 600^0C.The exhaust gas temperature is limited to 200^0C to avoid the condensation of corrosive gases. The condenser pressure is 0.05bar. assuming the isentropic efficiencies of compressor and both the turbines are 100%, find the following:
   (i) Thermal efficiency of each plant and the combined plant
   (ii) Ratio of air to the compressor to the steam generated in the boiler.
   Neglect the pump work and consider the fuel masses in the plant.
   Take, C_p for air or gas : 1kJ/kg and γ for air or gas: 1.4
   Calorific value for fuel used: 40MJ/kg
   You may use the following enthalpy data for the working fluid in the steam turbine cycle:

Inlet to steam turbine:	3620kJ/kg
Inlet to condenser:	2220kJ/kg
Outlet from the condenser:	32.6kJ/kg