Total No. of printed pages = 3

ME 181 PE 13

Roll No. of candidate | | | | | | | | | | |

13/12/22 2021

B.Tech. 7th Semester End-Term Examination

Mechanical Engineering

POWER PLANT TECHNOLOGY

New Regulation (w.e.f. 2017-18) & New Syllabus (w.e.f. 2018-19)

Full Marks – 70 Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No. 1 and any *four* from the rest.

1. Answer the following (MCQ/ Fill in the blanks) : (10 × 1 = 10)

   (i) The problem of ash disposal does not exist in case of ———— fired boilers.

   (ii) The function of electrostatic precipitator in a coal-based thermal power plantis to ————

   (a) Collect dust from flue gas

   (b) Clean the turbine blades

   (c) Collect dust at the air inlet

   (d) Collect dust from the coal

   (iii) Propulsive efficiency is defined as the ratio of

   (a) Propulsive power to thrust power

   (b) Thrust power to change in kinetic energy between the inlet and exit

   (c) Thrust power to input fuel energy

   (d) None of the above

[Turn over

(iv) In a hydro-electric power station, a surge tank is provided to

(a) Reduce the length of the penstock pipes

(b) Augment water at the forebay

(c) Control the pressure variations in the penstock due to sudden load changes

(d) Control the water flow through the turbines.

(v) A diesel power station spends 0.30 kg/kWh fuel. If the calorific value is 10000 kcal/kg then overall efficiency of the power station will be ———%.

(vi) The material used for the construction of control rod in a nuclear reactor is:

(a) Copper (b) Cadmium

(c) Graphite (d) Silicon

(vii) The amount of energy available in wind is directly proportional to ——— of the wind speed.

(a) Square power

(b) Cube power

(c) Square root power of two

(d) Square power root of three

(viii) S.I unit of the solar constant is ———

(ix) Catalytic converters change unburnt hydrocarbons into

(a) Carbon dioxide and water

(b) Carbon monoxide and water

(c) Methane

(d) Carbon dioxide and methane

(x) The principle of thermoelectric cooling is based on ———

(a) Seebeck effect

(b) Thompson effect

(c) Peltier effect

(d) Faraday's law of electromagnetic induction

2. (a) Describe the layout of a thermal power plant with a neat sketch. (6)

(b) Differentiate between the boiler mountings and accessories. (5)

(c) State the factors to be considered in setting up ash handling plant. (4)

3. (a) Describe the methods used to avoid the cavitation in water turbine. (5)

(b) What are the factors for site selection of hydraulic power plant? (5)

(c) The average weekly discharge at the site of a hydel plant is 250 m^3/s. If the head at the installation is 30 m and the overall efficiency of the turbine and generator unit is 85%, find the maximum average power in MW which can be developed. (5)

4. (a) Discuss broadly about the various types of fuel used in gas turbine power plant. (5)

(b) Write advantages and disadvantages of gas turbine. (5)

(c) A gas turbine expands 4kg/s of air from 12 bar 900°C to 1 bar adiabatically with an isentropic efficiency of 87%. Calculate the exhaust temperature and the power output. $\gamma = 1.4, C_p = 1005\ J/kg\ K$. (5)

5. (a) Compare pressurized water reactor (PWR) plant with boiling water reactor (BWR) type nuclear power plant. (6)

(b) What is the use of control rods in nuclear reactors? (4)

(c) Find the U_{235} fuel used in one year in a 235 MW pressurized water reactor. Assume overall plant efficiency of 33 % and 100% load factor throughout the year. Number of fissions required for 1 watt-sec=3.1 × 10^{10}. Number of atoms in one gram of $U_{235} = 2.563 \times 10^{21}$. (5)

6. (a) Briefly discuss function of wind mills and its types. (5)

(b) The undisturbed wind speed of a location is $V_i = 15 m/s$, the speed at turbine rotor is 60% of this value and the speed at exit is 30% of V_i. The rotor diameter is 10 m, density of air = 1.253 kg/m^3. Calculate

(i) The power available in undisturbed wind at the turbine rotor

(ii) The power in the wind at outlet. (6)

(c) Differentiate between Photovoltaic cell and battery. (4)

7. Write short notes on: (any three) : (3 × 5 = 15)

(a) Governing mechanism in hydraulic turbine

(b) Nuclear emissions and pollutions

(c) Electrostatic Precipitators

(d) Waste heat boilers

(e) Magneto hydrodynamic (MHD) generator.