MANIPAL ACADEMY OF HIGHER EDUCATION

FIRST SEMESTER B.TECH. EXAMINATIONS – FEBRUARY-MARCH 2022

SUBJECT : MME 1051/MME_1051: BASIC MECHANICAL ENGINEERING (DTQ)

Friday, February 25, 2022

Time: 10:20 – 12:00 Hrs.   Maximum Marks: 40

PART – B

1A. 750 kg of dry saturated steam at a pressure of 160 N/cm^2 is generated in a boiler per hour. The temperature of feed water is 28°C and the steam from the boiler enters the super heater after a heat loss of 690 kJ/kg, where it is superheated such that the degree of superheat is 250°C. Determine
   i)   Dryness fraction of the steam at the entry point of the super heater
   ii) Heat absorbed per hour in the super heater
   iii) Total heat supplied to the inlet water in boiler

1B. A pharmaceutical company plans to install a solid fuel fired boiler for its daily usage. The desired capacity of the steam generation is 1.25 kg per second at pressure of 1.15 MPa and temperature 215°C. Feed water at average temperature of 25°C, is to be fetched from nearby reservoir. The consumption of the solid fuel having calorific value of 25.7 MJ/kg is 375 grams per second. Evaluate the enhancement of efficiency of boiler if the following boiler accessories are coupled with boiler.
   i)   Economizer that increases the inlet feed water temperature by 63°C and reduces the fuel consumption by 18%.
   ii) Air Preheater that reduces the fuel consumption by 26%.

(5+5 = 10 marks)

2A. The belt drive in which pulleys rotate in the same direction is used to transfer power. The pulley diameters are 1.74m and 0.833m and it connects two parallel shafts which are 3.25m apart. The initial tension in the belt when it is stationary is 4500N. The smaller pulley is rotating at 710 rpm and coefficient of friction between the belt and pulley is 0.29. Determine the power transmitted by the belt drive.

2B. The shaft from a DC motor is connected to gear A which rotates at 45rps in clockwise direction. Gears B and C are compound gears as well as gears D and E. Gear A meshes with gear B and gear C drives gear D. Gear E meshes with gear F which is mounted on the driven shaft. The number of teeth on gears A, B, C, D, E and F are 21, 35, 49, 63, 56 & 84 respectively. Sketch the arrangement and determine the speed (rpm) and direction of gear F? Calculate the centre distance between the driver and driven shafts if the module of gears is 2.3 mm.

(5+5 = 10 marks)

3A. From a test on diesel engine that produces power in two full revolutions of the crank shaft, following data is available:
Engine speed 25 rps; Net brake torque 69 N-m; Mean effective pressure 1.2 N/mm^2; Stroke 140 mm and bore 82.5% of the stroke; Rate of fuel consumption 0.825 g/s; Calorific value of fuel is 42 MJ/kg. Calculate the indicated thermal efficiency and brake thermal efficiency of the engine.

3B. A four-cylinder internal combustion engine completing its thermodynamic cycle in two revolutions of the crank shaft develops 40 kJ/sec at 2750 rpm. The mean effective pressure on each piston is 10 bar and the mechanical efficiency is 77.4%. Calculate the diameter and stroke of each cylinder with stroke to bore ratio as 1.63. Also calculate the fuel consumption of the engine and net torque, if the brake thermal efficiency is 32.5%. The calorific value of fuel is 43.9 MJ/ kg.

(5+5 = 10 marks)

4A. Explain the two methods of producing taper using lathe machines with neat sketch.

4B. Explain pressure compounding in a steam turbine with neat sketch.

4C. Draw and explain the three different types of flames that can be generated in oxyacetylene gas welding with their application.

(4+3+3 = 10 marks)