BTS-C 025(D) ME

X a) Derive an expression for effectiveness of a parallel flow heat exchanger in terms of NTU and C. (10)

b) An oil cooler for a lubrication system has to cool 1000 kg/hr. of oil (Cp = 2.09 KJ/KgK) from 80°C to 40°C by using a cooling water flow of 1000 kg/hr at 30°C. Give your choice for parallel flow or counter flow heat exchanger with reasons. Calculate surface area of heat exchanger if U = 24 w/m²°C. (10)

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B.Tech. Degree III Semester Examination
January 2002

ME303 THERMAL ENGINEERING I

Time: 3 Hours *Max. Marks: 100*

(Answer all questions)

I a) Explain the causes of entropy increase in a closed system. Prove that an isentropic process need not be adiabatic or reversible. (5)

b) A cyclic heat engine operates between a source temperature of 800°C and a sink temperature of 300°C. What is the least rate of heat rejection per kw net output of the engine? (10)

c) Explain the concept of available and non-available energy. Is the availability function same for non-flow and flow process? Explain. (5)

OR

II a) In a petrol engine the dry exhaust analysis gave 1.5% CO and negligible O_2. The fuel used was 84% carbon and 16% hydrogen on mass basis. Find the air fuel ratio. (7)

b) A gasoline engine delivers 150kw. The fuel used is $C_8 H_{18}$ (liquid) and it enters the engine at 25°C. 150% theoretical air is used and it enters at 45°C. The products of combustion leave the engine at 750K and the heat transfer from the engine is 205kw. Determine the fuel consumption per hour if complete combustion is achieved. (13)

III a) Explain the combustion stages of CI engines. (5)

(P.T.O)

III b) The pressure and temperature at the beginning of the compression stroke in ideal diesel cycle are 1 bar and 27°C. The maximum pressure in the cycle is limited to 48.5 bar. The pressure is 15 bar when the piston is moved 25% of the stroke volume during expansion stroke. Determine (i) compression ratio of the cycle (ii) maximum temperature in the cycle (iii) air standard efficiency (iv) percentage stroke at which cut-off occurs. (10)

c) Explain about heat balance test in IC engines. (5)

OR

IV a) What is meant by ignition delay? Describe two components of ignition delay period. (5)

b) Explain about Morse test. (5)

c) A perfect gas at 1 bar and 290k undergoes ideal diesel cycle. The maximum pressure of the cycle is 50 bar. The volume at the beginning of compression is $1m^3$ and after constant pressure heating is $0.1m^3$. Determine the temperature at all salient points of the cycle and also find out cycle efficiency. Take $\nu = 1.4$ for gas (10)

V a) What are the advantages of multi stage compression over a single stage compression for same pressure ratio? Why inter cooling is necessary in multi stage compression? (7)

b) A three stage compressor is used to compress H_2 from 1.04 bar to 35 bar. The compression in all stages follows the law $PV^{1.25}$ = constant. The temperature of air at the inlet of compressor is 288k. Neglecting clearance and assuming perfect inter cooling find out indicative power required in kw to deliver $14m^3$ of H_2 per minute required at inelt conditions and intermediate pressures. Take R = 4.12 KJ/KgK. (13)

OR

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VI a) Compare rotary and reciprocating compressors. (5)

b) Air at a temperature of 17°C flows into the centrifugal compressor running at 20,000 rpm, using the following data

(i) slip factor = 0.8
(ii) work input factor = 1
(iii) isentropic efficiency = 70%
(iv) outer diameter of blade + ip = 50 cm

Assuming absolute velocities of air entering and leaving compressor are same,

Find i) Temperature rise of air passing through compressors.
ii) Static pressure ratio. (15)

VII Derive an expression for general heat conduction equation in cartesian coordinates. Deduce an expression for temperature distribution. (20)

OR

VIII a) State and prove Kirchoffs law of radiation. (5)

b) Two concentric spheres 210 mm and 300mm diameter with space between them evacuated are to be used to store liquid air (−153°C) in a room at 27°C. The surfaces of the spheres are flushed with aluminium (emmissivity = 0.03) and latent heat of vapourisation of liquid air is 209 KJ/Kg. Calculate the rate of evaporation of liquid air. (15)

IX a) Explain about boundary layers. (8)

b) Calculate the heat transfer from a 60W incandesent bulb at 115°C to ambient air at 25°C. Assume the bulb as a sphere of 50mm diameter. Also find the percentage of power lost in free convection. (12)

OR

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