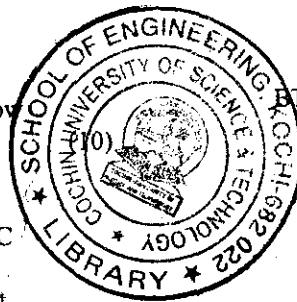


- X a) Derive an expression for effectiveness of a parallel flow heat exchanger in terms of NTU and C.
- b) An oil cooler for a lubrication system has to cool 1000 kg/hr. of oil ($C_p = 2.09 \text{ KJ/KgK}$) from 80°C to 40°C by using a cooling water flow of 1000 kg/hr at 30°C . Give your choice for parallel flow or counter flow heat exchanger with reasons. Calculate surface area of heat exchanger if $U = 24 \text{ w/m}^2\text{C}$.



BTS-C025(D)

ME

B.Tech. Degree III Semester Examination
January 2002

ME303 THERMAL ENGINEERING I

Time: 3 Hours

Max. Marks: 100

(10)

(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_8H_{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 1 m^3 and after constant pressure heating is 0.1 m^3 . Determine the temperature at all salient points of the cycle and also find out cycle efficiency. Take $\gamma = 1.4$ 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 $PV^{1.25} = \text{constant}$. 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 14 m^3 of H_2 per minute required at inlet conditions and intermediate pressures. Take $R = 4.12 \text{ KJ/KgK}$. (13)

OR

Contd....3

- 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. (15)
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 incandescent 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

Contd....4