CBCS SCHEME

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# Third Semester B.E. Degree Examination, Jan./Feb. 2023
## Engineering Thermodynamics

Time: 3 hrs. Max. Marks: 100

**Note: 1.** ***Answer any FIVE full questions, choosing ONE full question from each module.***
**2.** ***Use of Steam tables and thermodynamics data hand book permitted.***



### Module-1

1 a. Differentiate :
(i) Intensive and Extensive properties.
(ii) Cyclic and non-cyclic processes.
(iii) Macroscopic and microscopic approach.
(iv) Closed and open system.
(v) Work and heat **(10 Marks)**

b. State Zeroth law of thermodynamics and explain the temperature concept by using it. **(06 Marks)**

c. Define thermodynamic equilibrium. Explain its importance. **(04 Marks)**

**OR**

2 a. Derive an expression for work done during quasi static process. **(06 Marks)**

b. Two Celsius thermometers A and B agree at ice point and steam point and the related equation is $t_A = L + Mt_B + Nt_B^2$, where L, M and N are constants. When both thermometers are immersed in fluid 'A' registers 26°C while 'B' registers 25°C. Determine the reading of 'A' when 'B' reads 37.4°C. **(08 Marks)**

c. State the similarities and dissimilarities between heat and work. **(06 Marks)**

### Module-2

3 a. Explain Joule's experiment with neat sketch. **(05 Marks)**

b. Define Internal energy and prove that it is a property. **(05 Marks)**

c. Derive steady flow energy equation stating the assumptions made. **(10 Marks)**

**OR**

4 a. A reversible heat engine operating between two thermal reservoirs at 800°C and 30°C respectively. It drives a reversible refrigerator operating between −15°C and 30°C . The heat input to the heat engine is 1900 KJ and the network output from the combined plant (engine and refrigerator both) is 290 kJ. Calculate the heat absorbed by the refrigerant and the total heat transferred to 30°C reservoir. **(10 Marks)**

b. Derive Clausius Inequality. **(10 Marks)**

### Module-3

5 a. Describe diesel cycle with P-V and T-S diagrams and derive an expression for efficiency in terms of compression ratio, cut off ratio and ratio of specific heats. **(10 Marks)**

b. Explain briefly the following frictional power determination methods:
(i) Willian's line method.
(ii) Morse test method. **(10 Marks)**

**OR**

6 a. Explain the analysis of exhaust gases by Onsat apparatus with neat sketch. **(06 Marks)**

b. In a test on a three cylinder four-stroke internal combustion engine with 22 cm bore and 26 cm stroke the following were the observations during a trail period of one hour :
Fuel consumption = 8 kg; Calorific value = 45000 kJ/kg;
Total revolutions of Crankshaft = 12000; Mean effective pressure = 6 bar;
Net load on brake = 1.5 KN; Brake drum diameter = 1.8 m;
Rope diameter = 3 cm; Mass of cooling water = 550 kg;
Inlet temperature of water = 27°C; Exit temperature of water = 55°C;
Air consumed = 300 kg; Ambient temperature = 30°C; Exhaust gas temperature = 310°C;
Specific heat of exhaust gases = 1.1 kJ/kgK.
Calculate (i) Indicated power and brake power in kW. (ii) Mechanical efficiency (iii) Indicated thermal efficiency. Also draw a heat balance in kJ/min. **(14 Marks)**

## Module-4

7 a. What is refrigeration? Explain with the neat sketch the working principle of vapor absorption refrigeration system. **(08 Marks)**

b. What are the desirable properties of good refrigerants? **(06 Marks)**

c. With neat sketch, explain steam jet refrigeration system. **(06 Marks)**

**OR**

8 a. Describe summer air conditioning system for hot and dry weather with flow diagram and psychrometric chart. **(08 Marks)**

b. It is required to design an A/C for the following condition :
Outdoor condition 32°C DBT and 65% RH, Indoor conditions 25°C DBT and 60% RH, Amount of air circulated : 250 $m^3$/min, Coil dew temperature : 13°C. If the required condition is achieved first by cooling and dehumidifying and then by heating, calculate
(i) Cooling coil capacity and its by pass factor.
(ii) Heating coil capacity and its surface temperature if its by pass factor is 0.3.
(iii) Mass of water vapour removed per hour. **(12 Marks)**

## Module-5

9 a. Derive an expression for work supplied per kg of air for single stage reciprocating air compressor considering no clearance volume. **(10 Marks)**

b. A two stage air compressor with perfect intercooling takes in air at 1 bar and 27°C. The law of compression in both the stages is $P.V^{1.3}$ = constant. The compressed air is delivered at 9 bar. Calculate for unit mass flow rate of air, the minimum work done and the heat rejected to intercooler. Compare the values of compression is carried out in single stage compressor. **(10 Marks)**

**OR**

10 Write short notes on following with sketch :
a. Open cycle gas turbine.
b. Closed cycle gas turbine.
c. Turbo jet engine.
d. Turbo prop engine.
e. Rocket propulsion. **(20 Marks)**

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