CBCS SCHEME

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Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
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 Thermodynamics hand book permitted.

Module-1

1 a. Define the following terms with respect to thermodynamics: i) System ii) STATE iii) Property iv) Process v) CYCLE. **(05 Marks)**

b. State and explain Zeroth law of thermodynamics. **(07 Marks)**

c. Explain constant volume gas thermometer with a neat sketch. **(08 Marks)**

OR

2 a. Write thermodynamic definitions of work and heat. Also write similarities between them. **(05 Marks)**

b. Derive an expression for work done during quasistatic process with a P-V diagram. **(03 Marks)**

c. State whether the heat (Q) and the work (W) are positive, negative or zero in each of the following processes. The system to be considered are given in capital letters. Sketch the systems.

i) A rigid vessel containing STEAM at a temperature of 150°C is left standing in the atmosphere, which is at temperature 30°C.

ii) An electric current flows steadily through a RESISTER which is immersed in running water.

iii) 1kg of GAS contained in an insulated cylinder expands moving the piston slowly outwards.

iv) ONE KG OF AIR flows adiabatically from the atmosphere into an evacuated bottle through a valve. **(12 Marks)**

Module-2

3 a. Write the statements of first law of thermodynamics for a system undergoing i) a cycle ii) a process and iii) a steady flow process. **(06 Marks)**

b. Prove that internal energy a property of a system. **(05 Marks)**

c. $0.5m^3$ of air initially at a temperature of 210°C and a pressure of 400kPa are compressed according to the law $PV^{1.2} = C$ to a final volume of $0.05m^3$. Calculate:
i) Mass of gas ii) Final pressure iii) Work and heat transfer iv) Change in enthalpy. Take R = 287 J/kg K. **(09 Marks)**

OR

4 a. Write two statements of second law of thermodynamics. **(04 Marks)**

b Prove that entropy a property of a system. **(06 Marks)**

c. A heat engine is supplied with 278 kJ/s of heat of a constant fixed temperature of 283°C and the heat rejection takes place at 5°C. The following results were reported: i) 208 kJ/s are rejected ii) 139 kJ/s are rejected iii) 70 kJ/g are rejected. Draw the sketch and classify which of the results report a reversible cycle or irreversible cycle or impossible results. **(10 Marks)**

Module-3

5 a. Distinguish between: i) Theoretical air and actual air ii) Enthalpy of combustion and enthalpy of formation iii) Higher and lower calorific value. **(06 Marks)**

b. Derive an expression for thermal efficiency of Otto cycle interms of compression ratio. **(06 Marks)**

c. The compression ratio in an air standard Otto cycle is 8. At the beginning of compression process, the pressure is 1 bar and temperature is 300K. The heat transfer to the air per cycle is 1900 kJ/kg of air. Calculate: i) Thermal efficiency ii) The mean effective pressure. **(08 Marks)**

OR

6 a. Define the following terms with respect to I.C. engine: Brake power, Indicated power, Specific fuel consumption, Mechanical efficiency, Heat balance sheet. **(05 Marks)**

b. Describe how the I.P. of a multi-cylinder engine is measured through Morse test. **(05 Marks)**

c. A 4-cylinder petrol engine has an output of 52kW at 2000 rpm. A Morse test is carried out and the brake torque readings are 177, 170, 168 and 174 N-m respectively. For normal running at this speed the specific fuel consumption is 0.364 kg/kW-hr. The calorific value of fuel is 44200 kJ/kg. Calculate: i) Mechanical efficiency ii) Brake-thermal efficiency of the engine. **(10 Marks)**

Module-4

7 a. Explain the principle of working of vapour compression refrigeration system with flow, p-v and p-h diagrams. **(06 Marks)**

b. Explain the principle of operation of steam jet refrigeration system. **(05 Marks)**

c. A vapour compression refrigeration system uses Freon-12 as refrigerant, works on condenser temperature of 50°C and evaporator temperature of 0°C. The refrigeration capacity is 7 tons. Take enthalpy at the end of isentropic compression as 210 kJ/kg. Assume simple saturated cycle and determine: i) Mass flow rate of refrigerant ii) Power required iii) COP. **(09 Marks)**

OR

8 a. Describe following psychrometric processes and represent it on psychrometric chart.
i) Sensible heating or cooling of air
ii) Cooling with dehumidification of air. **(06 Marks)**

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

c. The atmospheric air conditions are 25°C DBT and specific humidity of 10 grams/kg of air. Determine: i) Partial pressure of water vapour in the air ii) Relative humidity of air iii) Dew point temperature of air. **(06 Marks)**

Module-5

9 a. Derive an expression for work supplied per kg of air for single stage air compressor considering no clearance and assuming the compression process to follow the law $PV^n = C$. **(06 Marks)**

b. Explain the necessity of multistage air compressor with the help of P-V diagram. **(06 Marks)**

c. A single stage reciprocating compressor takes $1m^3$ of air per minute at 1.013 bar and 15°C and deliver it at 7 bar. Assuming that the law of compression is $PV^{1.35}$ = constant, and the clearance is negligible, calculate the indicated power. **(08 Marks)**

OR

10 a. Explain open and closed cycle gas turbine cycles. **(08 Marks)**

b. Describe Brayton gas turbine cycle and derive an expression for its thermal efficiency. **(07 Marks)**

c. Explain the working of ram-jet engine with a neat sketch. **(05 Marks)**

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