(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 4072 Roll No. | | | | | | | | | | |

B. Tech.

(SEM. III) ODD SEMESTER THEORY EXAMINATION 2010-11

THERMAL ENGINEERING

Time : 3 Hours *Total Marks : 100*

Note :— (1) Attempt **all** questions.

(2) Assume missing data suitably, if any.

1. Attempt any **two** parts of the following : **(10×2=20)**

(a) Air initially at 75 kPa pressure, 1000 K temp and 1.2 m^3 volume, first compressed isothermally till its volume becomes half of the initial volume then further compressed at constant pressure till its volume becomes half of the volume before constant pressure compression. And then return to its original state following polytropic process. Find work transfer and heat transfer during each process.

(b) (i) Write Kelvin-Planck and Clausius statements of second law of thermodynamics.

(ii) A fluid undergoes a reversible adiabatic compression from 0.5 MPa, 0.2 m^3 to 0.05 m^3 according to law $pv^{1.3}$ = constant. Determine the change in enthalpy, internal energy, entropy and work transfer during the process.

(c) Write short notes on :

(i) Thermodynamic system

(ii) Concept of continuum

(iii) Carnot theorem.

2. Attempt any **two** parts of the following : **(10×2=20)**

(a) What are the assumptions made in the air standard cycles ? Show the Otto, Brayton and dual cycle on P-v and T-s diagram.

(b) (i) For the same compression ratio and heat rejection, which cycle is more efficient : Otto or Diesel ? Explain with the help of P-v and T-s diagrams.

(ii) Explain the effect of pressure ratio on the net work output and efficiency of Brayton cycle.

(c) What do you understand by multi stage compression ? What are its importance over single stage compression ? Obtain the condition for optimum pressure ratio for perfect intercooling in between two stages of compression, if the inlet and outlet pressure are P_1 and P_3.

3. Attempt any **two** parts of the following : **(10×2=20)**

(a) (i) What do you understand by triple point and critical point ? Show it on T-s diagram and write the value of pressure and temperature of water at critical point.

(ii) Show Rankine cycle on P-v, T-s and H-s diagram. How superheating improves the efficiency of rankine cycle ?

(b) What do you understand by choking in nozzle flows ? Discuss the effect of area change in subsonic and supersonic flow.

(c) Classify the jet propulsion system. Compare turbojet engine with other jet propulsion engines.

4. Attempt any **two** parts of the following : **(10×2=20)**

(a) Explain the working of simple vapour compression refrigeration cycle with neat schematic and also show the processes of T-s and P-h diagrams.

(b) (i) Define : Wet bulb temperature, dry bulb temperature and specific humidity.

(ii) What do you understand by heat pump ? Show that the performance of heat pump and refrigerator can be related as

$$COP)_{\text{heat pump}} = COP)_{\text{refrigerator}} + 1$$

(c) (i) Define Reynolds number, Prandtl number and Grashof number.

(ii) Define black body and gray body in reference to thermal radiation.

5. Attempt any **two** parts of the following : **(10×2=20)**

(a) (i) Explain why an insulated small diameter wire has a higher current carrying capacity than an uninsulated one.

(ii) Sheets of brass and steel, each of thickness 1 cm, are placed in contact. The outer surface of brass is kept at 100 °C and the outer surface of steel is kept at 0°C. What is temperature of common interface ? The thermal conductivities of brass and steel are in the ratio of 2:1.

(b) Define effectiveness and NTU of a Heat exchanger. Derive the expression for effectiveness for counter flow heat exchanger.

(c) What is Prandtl and Nusselt number ? Write the expressions of Nusselt number for laminar and turbulent flow over a flat plate.