Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 60530

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

Fourth Semester

Electronics and Instrumentation Engineering

EI 2254/EI 46/ME 1260/080300011/10133 EI 406 — APPLIED THERMODYNAMICS

(Common to Instrumentation and Control Engineering)

(Regulations 2008/2010)

Time : Three hours | Maximum : 100 marks

(Use of steam tables, refrigeration tables, psychrometric charts and heat and mass transfer tables are permitted)

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. What do you understand by path function and point function?

2. State carnot theorem.

3. Write the air standard efficiency of a Dual cycle.

4. What is the maximum compression ratio of an SI engine?

5. Compare impulse turbine with reaction turbine.

6. Define the term 'stage efficiency' for a reaction turbine.

7. List the advantage of multi-stage compressors.

8. Show the effect of subcooling on T-s diagram for an vapour compression refrigeration system.

9. A steam pipe 10 cm I.D. and 11 cm O.D is covered with an insulating substance (k =1 W/m K). If convective heat transfer coefficient between the insulation surface and, air is 8 W/m^2 K. Find the critical radius of insulation.

10. What is Gray body?

PART B — (5 × 16 = 80 marks)

11. (a) A gas undergoes a thermodynamic cycle consisting of the following processes :

(i) Process 1 – 2 : constant pressure with p = 1.4 bar to V_1 = 0.028 m^3, W_{12} = 690 kJ.

(ii) Process 2 – 3 : compression with pV = constant, $W_{23} = 0$, $U_3 = U_2$.

(iii) Process 3 – 1 : constant volume $U_1 - U_3 = -26.4$ kJ. There are no significant changes in KE and PE.

(1) Sketch the cycle on a p-v diagram

(2) Calculate the net work for the cycle in kJ.

(3) Calculate the heat transfer for process 1-2.

(4) Show that $\Sigma Q_{cycle} = \Sigma W_{cycle}$.

Or

(b) What is a steady flow process? Derive the steady flow Energy Equation.

12. (a) Derive the efficiency of a Diesel cycle. Also draw its – thermodynamic diagram. (16)

Or

(b) Explain the working of both 2-stroke engines and 4-stroke engines. (16)

13. (a) Consider a steam power plant operating on simple ideal Rankine cycle steam enters the turbine at 3 Mpa and 350°C and is condensed in condenser at pressure of 10 kPa. Determine :

(i) The thermal efficiency

(ii) The thermal efficiency if the boiler pressure is raised to 15 MPa while- the turbine inlet temperature is maintained at 600°C.

Or

(b) (i) Explain velocity and pressure compounding steam turbine, showing pressure and velocity variations along the axis of the turbine. (6)

(ii) Explain the working and layout of modern steam power plant. (10)

14. (a) The low pressure cylinder of a two-stage double-acting reciprocating air compressor running at 120 rpm has a 50-cm diameter and 75-cm stroke. It draws air at a pressure of 1 bar and 20°C and compresses it adiabatically to a pressure of 3 bar. The air is then delivered to the intercooler, where it is cooled at constant pressure to 35°C and is then further compressed polytropically (index n = 1.3) to 10 bar in high pressure cylinder. Determine the power required to drive the compressor. The mechanical efficiency of the compressor is 90 % and motor efficiency is 86%.

Or

(b) Sketch the layout of an air conditioning system and explain the functions of each component in it.

15. (a) (i) A mild steel tank of wall thickness 20 mm contains water 100°C. Estimate the loss of heat per square meter area of the tank surface, if the tank is exposed to an atmosphere at 20°C. Thermal conductivity of steel is 50 W/mK. White heat transfer coefficient for outside and inside the tank are 10 W/m² K and 2850 W/m² K respectively. What will be the temperature on the outside of the tank wall? (14)

(ii) What is extended surfaces and where it's employed? (2)

Or

(b) (i) Water at 50°C enters 50 mm diameter and 3 m long tube with a velocity of 0.8 m/s. The tube wall is maintained at a constant temperature of 90°C. Determine the heat transfer coefficient and the total amount of heat transfer if the exit water temperature is 70°C. (12)

(ii) Write a short note on thermoelectric cooling. (4)