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B.E. DEGREE EXAMINATIONS: NOVEMBER 2009

Fourth Semester

ELECTRONICS AND INSTRUMENTATION ENGINEERING

U07EI405: Applied Thermodynamics

Time: Three hours **Maximum Marks: 100**

(Use of Steam tables, Refrigeration tables and Heat transfer data book – Permitted)

Answer ALL the Questions:-

PART A (10 x 1 = 10 Marks)

1. Which of the following is not a point function

   a) Enthalpy b) Entropy c) Heat d) Pressure

2. During reversible adiabatic process, the constant parameter is

   a) Internal energy b) Temperature c) Entropy d) Enthalpy

3. The power produced inside the cylinder of an IC engine is known as

   a) Brake power b) Indicated power

   c) Frictional power d) Brake power – frictional power

4. A closed cycle gas turbine works on

   a) Rankine cycle b) Carnot cycle c) Joule's cycle d) Dual cycle

5. Which of the following is one of the boiler accessories

   a) Safety valve b) Stop valve c) Economizer d) Blow of cock

6. Stage efficiency of turbine is also called

   a) Diagram efficiency b) Blade efficiency

   c) Gross efficiency d) Mechanical efficiency

7. By employing intercooler in multi-stage compressor, compression obtained as

   a) Adiabatic b) Isothermal c) Polytrophic d) Isentropic

8. In summer Air-conditioning the process used is known as

   a) Heating and humidification b) Dehumidification

   c) Cooling and humidification d) Humidification

9. Fourier law of heat conduction says that,

   a) $Q = KA\left(\frac{dT}{dx}\right)$ b) $Q = -KA\left(\frac{dT}{dx}\right)$ c) $Q = \frac{1}{KA}\left(\frac{dT}{dx}\right)$ d) $Q = -KA\left(\frac{dx}{dT}\right)$

10. Nusselt number is given by

a) $\frac{UL}{\gamma}$ b) $\frac{UL}{k}$ c) $\frac{UL}{D}$ d) μvL

PART B (10 x 2 = 20 Marks)

11. Sketch the Kelvin plank's statement of second law.
12. Write the steady flow energy equation.
13. Name the thermodynamic processes in Brayton cycle.
14. List out any four application of IC engines.
15. What is the difference between saturated steam and super heated stem?
16. What is meant by velocity compounding in steam turbines?
17. What are the advantages of multi stage compressor?
18. Define the term 'COP'.
19. What are the dimensionless parameters used in force convection?
20. Write the Wien's law of radiation.

PART C (5 x 14 = 70 Marks)

21. (a) A reversible heat engine operates between two reservoirs at temperatures of 600°C and 40°C. The engine drives a reversible refrigerator which operates between reservoirs at temperature of 40°C and -20°C. The heat transfer to the engine is 2MJ and the net work output of the combined engine and the refrigerator is 360 kJ. Find the heat transfer to the refrigerant and the net heat transfer to the reservoir at 40°C.

(OR)

(b) One kg of air at a pressure of 7bar and a temperature of 363K undergoes a reversible polytropic process $pv^{1.2}$ = constant. The final pressure is 1.4bar. Calculate the final temperature of air, change in entropy, work done and heat transfer. Take γ=1.4 and R=0.287kJ/kg K

22. (a) Derive the air standard efficiency of Otto cycle in terms of compression ratio.

(OR)

(b) A gas turbine takes in air at 27°C and 1bar. The pressure ratio is 4 and maximum temperature of the cycle is 560°C. The compressor and turbine efficiency are 0.83 and 0.85 respectively. Determine the overall efficiency if the regenerator effectiveness is 0.75.

23. (a) A pressure cooker contains 1.5kg of saturated steam at a pressure of 5bar. Find the quantity of heat which must be rejected so as to reduce the quality of steam to 60% dry. Determine the pressure and temperature of the steam at the new state.

(OR)

(b) Draw the layout of steam power plant and explain its working principle.

24. (a) A double acting single cylinder reciprocating air compressor has a piston displacement of $0.015m^3$/rev. operates at 500rpm and has a 5% clearance. The air is received at 1bar and delivered at 6bar. The compression and expansion are polytropic with n=1.3. Find volumetric efficiency, power required, heat transferred and its direction during compression of air at inlet temperature of 20°C.

(OR)

(b) Explain the working principle of various types of air-conditioning system with sketch.

25. (a) A steel pipe with 50mm OD is covered with a 6.4mm asbestos insulation [k=0.166W/mK] followed by a 25mm layer of fiber–glass insulation [k=0.0485W/mK]. The pipe wall temperature is 393K and the outside insulation temperature is 311K. Calculate the interface temperature between the asbestos and fiber-glass.

(OR)

(b) A tube 5m long is maintained at 100°C by steam jacketing. A fluid flows through the tube at the rate of 175kg/hr at 30°C. The diameter of the tube is 2cm. Find out the average heat transfer coefficient. Take the properties of fluid:

[$\rho = 850kg/m^3$, $C_p = 2kJ/kg\ °C$, $v = 5.1 \times 10^{-6}\ m^2/s$ and $k = 0.12W/m°C$]

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