



B.E DEGREE EXAMINATIONS: MAY 2015

(Regulation 2009)

Fourth Semester

AUTOMOBILE ENGINEERING

AUE104: Applied Thermodynamics & Heat Transfer

(Use of HMT tables is permitted)

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Which process is included in air standard Diesel cycle?
 - a) Polytropic compression
 - b) Isochoric heat addition
 - c) Isobaric heat addition
 - d) Isochoric and Isobaric heat addition
2. For given compression ratio, among Otto, Diesel and dual cycles
 - a) Otto cycle is more efficient
 - b) Diesel cycle is more efficient
 - c) Dual cycle is more efficient
 - d) All cycles are equally efficient
3. Reciprocating compressor is
 - a) A positive displacement machine
 - b) A negative displacement machine
 - c) A dynamic action machine
 - d) A free displacement machine
4. Subcooling of refrigerant in vapour compression refrigeration cycle
 - a) Decreases COP
 - b) Increases COP
 - c) Decreases work input
 - d) Decreases refrigerating effect
5. Conduction heat transfer takes place in the medium due to
 - a) Temperature difference
 - b) Temperature gradient
 - c) Thermal conductivity
 - d) Surface area
6. Heat is conducted through a pure metal due to
 - a) Vibration of lattice structure
 - b) Flow of free electrons
 - c) Density difference
 - d) Momentum diffusivity
7. The Reynolds number is defined as
 - a) Buoyancy force / Viscous force
 - b) Inertia force / Viscous force
 - c) Buoyancy force / Inertia force
 - d) Viscous force / Inertia force
8. Buoyancy force is introduced by

- a) Viscosity difference
 - b) Energy difference
 - c) Pressure difference
 - d) Density difference
9. A grey body has one of the following properties
- a) It reflects all the energy falling on it
 - b) It transmits all the energy falling on it
 - c) It has constant emissivity
 - d) It absorbs all the energy falling on it
10. Radiation shields
- a) Reduce the radiation heat transfer
 - b) Increase the radiation heat transfer
 - c) Remove the heat from the system
 - d) Add heat into the system

PART B (10 x 2 = 20 Marks)

11. Illustrate the T-S diagram of Brayton cycle with inter cooling.
12. What do you mean by compression ratio?
13. Define isothermal efficiency of air compressors.
14. List four desirable properties of ideal refrigerant.
15. What is meant by lumped analysis in heat transfer?
16. How do you define thermal conductivity of materials?
17. What is the difference between free and forced convection?
18. What is the significance of Grash of number?
19. State Kirchoff's law of radiation.
20. What is thermal radiation?

PART C (5 x 14 = 70 Marks)

21. a) An engine working on Otto cycle has a volume of 0.45m^3 , pressure 1 bar and temperature 30°C at the beginning of compression stroke. At the end of compression stroke, the pressure is 11 bar. 210 kJ of heat is added at constant volume. Determine:
- (i) Pressures, temperatures and volumes at salient points in the cycle
 - (ii) Efficiency
 - (iii) Net work per cycle
 - (iv) Mean effective pressure
 - (v) Power developed if the number of working cycles per minute is 210.

(OR)

- b) Air enters the compressor of an ideal air standard Brayton cycle at 1 bar, 300 K and is compressed to 10 bar. The temperature at inlet to the first turbine is 1400

K. The expansion takes place isentropically in two stages with reheat to 1400 K between the two stages at a constant pressure of 3 bar. A regenerator having an effectiveness of 100 % is also incorporated in the cycle. Determine the thermal efficiency of the cycle.

22. a) A single stage, double acting reciprocating air compressor has a free air delivery of $14 \text{ m}^3/\text{min}$ measured at 1.013 bar and 15°C . The pressure and temperature in the cylinder during induction are 0.95 bar and 32°C . The delivery pressure is 7 bar and index of compression and expansion, $n = 1.3$. The clearance volume is 5 % of the swept volume. Estimate the indicated power required and volumetric efficiency.

(OR)

- b) Illustrate the components of ammonia-water vapour absorption refrigeration system and explain how the refrigerating effect is produced by the system. Also state the merits and demerits of the vapour absorption system over vapour compression system.

23. a) A 100 mm diameter pipe is covered by two layers of lagging. The inside layer is 40 mm thick and has a thermal conductivity of 0.07 W/mK . The outside layer is 25 mm thick and has a thermal conductivity of 0.07 W/mK . Another outside layer of 25mm thick has a thermal conductivity of 0.01 W/mK . The inside of pipe is maintained at 250°C and outside lagging is maintained at 25°C . If the pipe is 20 m long, evaluate the heat loss per hour and interface temperature of lagging.

(OR)

- b) A copper plate of 2 mm thick is heated upto 400°C and quenched into water at 30°C . Find the time required for the plate to reach the temperature of 50°C . Heat transfer coefficient is $100 \text{ W/m}^2\text{K}$. The plate dimension is 30 x 30 cm. Density and specific heat of copper are 8800 kg/m^3 and 0.36 kJ/kgK respectively.

24. a) A vertical plate of 0.4 m high and 1 m wide maintained at a uniform temperature of 120°C is exposed to atmospheric air at 30°C. Calculate the average heat transfer coefficient for natural convection and the total heat transfer from both the surfaces by natural convection to the air.

(OR)

- b) When 0.5 kg of water per minute is passed through a tube of 20 mm diameter, it is found to be heated from 20°C to 50°C. The heating is accomplished by condensing steam on the surface of the tube and subsequently the surface temperature of the tube is maintained at 85°C. Determine the length of the tube required for fully developed flow.

25. a) Calculate the following for an industrial furnace in the form of black body and emitting radiation at 2500°C.

- (i) Monochromatic emissive power of 1.2 μm wavelength
- (ii) Wavelength at which emission is maximum
- (iii) Maximum emissive power
- (iv) Total emissive power
- (v) Total emissive power with emissivity 0.9

(OR)

- b) A body at 1000°C in black surroundings at 500°C has an emissivity of 0.42 at 1000°C and an emissivity of 0.72 at 500°C. Calculate the rate of heat loss by radiation per m^2 ,

- (i) When the body is assumed to be grey with $\varepsilon = 0.42$
- (ii) When the body is not grey

Assume that the absorptivity is independent of the surface temperature.
