Register Number: ……..

B.E., DEGREE EXAMINATIONS: MAY/JUNE 2013

Fourth Semester

AUTOMOBILE ENGINEERING

AUE104 : Applied Thermodynamics And Heat Transfer

(Heat and Mass Transfer Data Book is Permitted)

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. For same compression ratio

   a) Thermal efficiency of Otto cycle is greater than that of Diesel cycle
   b) Thermal efficiency of Otto cycle is less than that of Diesel cycle
   c) Thermal efficiency of Otto cycle is same as that for Diesel cycle
   d) Thermal efficiency of Otto cycle cannot be predicted.

2. The efficiency of an Otto cycle is Compression ratio 4.18 and γ =1.4. What is the Air standard efficiency?

   a) 43.6%
   b) 40.6%
   c) 60.6%
   d) 55.2%

3. Volumetric efficiency

   a) Effective swept volume/Swept volume
   b) F.A.D/displacement of the compressor
   c) 1+k-k(V1/V2) [k=Clearance Volume]
   d) All the above

4. During a refrigeration cycle, heat is rejected by the refrigerant in a

   a) Compressor
   b) condenser
   c) evaporator
   d) expansion valve

5. The critical radius is the insulation radius at which the resistance to heat flow is

   a) Maximum
   b) Minimum
   c) zero
   d) none of these

6. The highest thermal diffusivity is of

   a) Iron
   b) lead
   c) concrete
   d) wood

7. In free convection heat transfer transition from laminar to turbulent flow is governed by the critical value of the

   a) Reynold's number
   b) Grashoff's number
   c) Reynold's number, Grashoff's number
   d) Prandtl number, Grashoff's number

8. The thickness of thermal and hydrodynamic boundary layer is equal if Prandtl number is

   a) equal to one
   b) greater than one
   c) less than one
   d) equal to Nusselt number

9. The amount of radiation mainly depends upon the

a) Nature of the body
b) temperature of the body
c) type of surface of the body
d) all of these

10. A perfect black body is one which

a) is black in colour
b) absorbs heat radiations of all wave lengths falling on it
c) reflects all the heat radiations
d) transmits the heat radiations

PART B (10 x 2 = 20 Marks)

11. Mention the various processes of dual cycle.
12. Which air standard cycle (Otto / Diesel / Dual) is more efficient for the same heat input? Justify.
13. Define Free Air Delivered (FAD) with regard to a compressor
14. What are the advantages of VCR system over Air Refrigeration System?
15. What is Fourier's Law of heat conduction?
16. Define: Fin Efficiency
17. Sketch formation of boundary layer and show laminar, transition & turbulent flow.
18. Define boundary layer thickness.
19. What is Stefan's Bolts Man law?
20. A black body emits radiation at 2000 K. calculate the monochromatic emissive power 1µm wave length.

PART C (5 x 14 = 70 Marks)

21. a) Derive and expression for Air standard efficiency of Otto cycle in terms of compression ratio.

(OR)

b) A Diesel engine working on dual combustion cycle has a stroke volume of $0.0085m^3$ and a compression ratio 15:1. The fuel has a calorific value of 43890 kJ/kg. At the end of suction, air is at 1 bar and 100^oC. The maximum pressure in the cycle is 65 bar and air fuel ratio is 21:1.Find for ideal cycle the thermal efficiency. Take for air Cp=1.0kJ/kg.K and Cv=0.71 kJ/kg.K

22. a) A two stage air compressor compresses air from 1 bar and 20^0C to 42bar. If the law of compression is $pV^{1.35} = C$ and the intercooling is complete to 20^0C,find per kg of air: 1. The work done is compressing and 2. The mass of water necessary for abstracting the heat in the intercooler,if the temperature rise of the cooling water is 25^oC. Take R = 287 J/kg.K Cp= 1 KJ/kg.K

(OR)

b) A vapour compression refrigerator uses methyl chloride(R-40) and operates between the temperature limits of -10^{o}C and 45^{o}C.At entry to the compressor, the refrigerant is dry saturated and after compression it acquires a temperature of 60^{o}C. Find the C.O.P of the refrigerator. The relevant properties of methyl chloride R-40 are as follows:

Saturation Temperature, in ^{0}C	Enthalpy, kJ/kg		Entropy, kJ/kg.K	
	Liquid	Vapour	Liquid	Vapour
-10	45.4	460.7	0.183	1.637
45	133.0	483.6	0.485	1.587

23. a) Fins, 12 in number, having k = 75 W/m K and 0.75 mm thickness protruded 25mm from a cylindrical surface of 50 mm diameter and 1 m length placed in an atmosphere of 40^{o} C. If the cylindrical surface is maintained at 15^{o} C and the heat transfer coefficient is 23 W/m^{2} K, calculate

a. The rate of heat transfer,

b. The percentage increase in heat transfer due to fins,

c. The temperature at the center of fins and

d. The fin efficiency and the fin effectiveness

(OR)

b) Derive the general differential equation for heat conduction for Cylindrical coordinates

24. a) Air at 20^{o} C and a pressure of 1 bar is flowing over a flat plate at a velocity of 3 m/s. If the plate is 280 mm wide and at 56^{o} C, estimate the following quantities at x = 280 mm, given the properties of air at the bulk mean temperature of 38^{o} C are. ρ=1.1374kg/m3 ,Cp=1.005 kJ/kg K, k= 0.02732 W/mK,

υ = 16.768 x 10^{-6} m^{2}/s

a. Boundary layer thickness
b. Local friction coefficient
c. Average friction coefficient
d. Sheering stress due to friction
e. Thickness of thermal boundary layer.
f. Local convective heat transfer coefficient

(OR)

b) With the help of Buckingham π – theorem, show that the force convection heat transfer $Nu_d = B\ Re_d^a Pr^b$

25. a) Assuming the sun to be a black body having a surface temperature of 5800 K, calculate

a. The total emissive power

b. The wavelength at which the maximum spectral intensity occurs

c. The maximum value of $E_{b\lambda}$

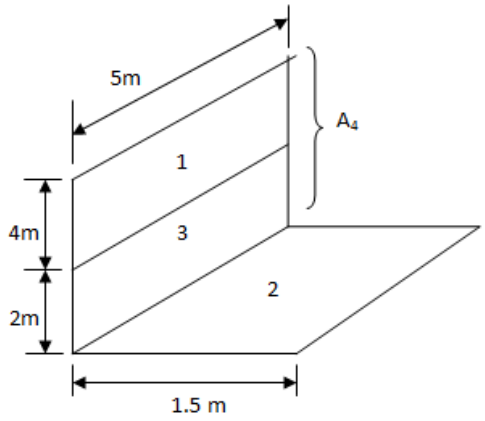
d. The percentage of total emitted energy that lies in the visible range of 0.35λ to 0.76λ and

e. The total amount of radiant energy emitted by the sun per unit time if its diameter can be assumed to be 1.391×10^9 m

(OR)

b) (i) Calculate the shape factor F_{12} fir the configuration shown in figure and the net radiant exchange Q_{12} , if (10)

$T_1 = 427^o$ C, $T_2 = 227^o$ C, $\varepsilon_1 = 0.8$ and $\varepsilon_2 = 0.9$



(ii) The overall heat transfer coefficient due to convection ad radiation for a steam main at 200 ^{o} C running in a large room at 30^o C is 17.95 W/m^2 K. Calculate the heat transfer coefficients and radiation taking the emissivity of the pipe surface as 0.8 (4)

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