3/5/2016 SE MECHATRONICS (CBSGS) Sem-III SWb :- THT

QP Code : 30637

(3 Hours) **[Total Marks : 80**

N. B. :

1. **Question no.1 is compulsory.**
2. Attempt any **THREE** from question no. 2 to 6.
3. Use illustrative diagrams wherever required.

Q. No.		Marks
Q1)	Attempt **ANY FOUR**	
a)	State first law of thermodynamics and give mathematical expression of it for a process and for a cycle	05
b)	Explain the principle of impulse turbine with a neat labeled diagram	05
c)	What is cut-off ratio? And explain the effect of compression ratio and cut-off ratio on the thermal efficiency of diesel cycle?	05
d)	What do you mean by 'fouling' in heat exchangers?	05
e)	Explain in brief Stefan Boltzman law and wein's displacement law in thermal radiation.	05
Q2) a)	State and explain Kelvin-plank and Clausius statements of second law of thermodynamics and prove their equivalence	08
b)	Explain the characteristic features of a fire tube boiler. How is it different from a water-tube boiler?	06
c)	Draw a neat boiling curve for water and mark the different regions. Explain in short	06
Q3) a)	Derive the expression of cycle efficiency for "Brayton cycle".	08
b)	What is conduction heat transfer? For transient heat conduction, with negligible internal resistance with usual notations show that, $\theta/\theta_i = \exp(-Bi.Fo)$	12
Q4) a)	Assuming an engine with 210 mm bore and 300 mm stroke on diesel cycle, with initial pressure and temperature of air as 1 bar and 27 °C and cut off occurs at 8% of stroke. If compression ratio is 15:1, find: I. Pressure and temperature at salient points. II. Heat added, heat rejected and net work done. III. Air standard efficiency. IV. Mean effective pressure. V. Power output if speed is 1000 rpm and mechanical efficiency is 85%.	08
b)	Derive general heat conduction equation in Cartesian coordinates. Deduce Fourier, Poissons, and Laplace equation from it	12

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Q5) a) A hot square plate 40 cm x 40 cm at 100°C is exposed to atmospheric air at 20°C. Find the heat losses from both the surfaces of the plate if: 10

i. The plate is held horizontal
ii. The plate is held in vertical plane

Properties of air at average temperature are: $\rho = 1.06$ kg / m^3 ; $\nu = 18.97 \times 10^{-6}$ m^2 / s ; $C_p = 1004$ J / kgK ; $k = 2.89 \times 10^{-2}$ W / mK ;

Following empirical relations may be used to find average heat transfer coefficients:

Case (I): $Nu = 0.13(Gr \cdot Pr)^{1/4}$

Case (II): For lower surface $Nu = 0.35(Gr \cdot Pr)^{1/4}$

For upper surface $Nu = 0.71(Gr \cdot Pr)^{1/4}$

b) Derive expression for LMTD for Parallel flow type heat exchanger 10

Q6) a) Under what condition the relation $W = \int pdv$ holds good. What is the difference between $\int pdv$ and $-\int vdp$? 05

b) Draw the combined velocity triangle for a single stage reaction turbine and derive an expression for workdone per stage 10

c) What is a 'black body'? How does it differ from a gray body? Expalin. 05
