Total No. of Questions : 7]

SEAT No. :

P4260

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[4860]-1065

M.E. (Mechanical) (Design Engineering)

MATERIAL SCIENCE AND MECHANICAL BEHAVIOR OF MATERIALS

(2013 Credit Pattern) (Semester - I) (502202)

Time :3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Answer any five questions.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic table slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.***
5) ***Assume Suitable data whenever necessary.***

Q1) A steel piece initially has a uniform carbon concentration of 0.25 wt% and is to be treated at 950°C. If the concentration of carbon at the surface is suddenly brought to and maintained at 1.20 wt %, how long will it take to achieve a carbon content of 0.80 wt% at a position 0.5mm below the surface? The diffusion coefficient for carbon in iron at this temperature is 1.6×10^{-11} m^2/s **[10]**

Assume that the steel piece is sem-infinite.

Given

Z	erf(z)
0.30	0.3286
0.35	0.3794
0.40	0.4284
0.45	0.4755

Q2) For the stress matrix given below, determine the principal stresses and directional cosines associated with the normals to the surfaces of each principal stress. **[10]**

$$[\sigma] = \begin{bmatrix} 3 & 1 & 1 \\ 1 & 0 & 2 \\ 1 & 2 & 0 \end{bmatrix} \text{MP}a$$

P.T.O.

Q3) To ensure that the neck in a tensile bar would occur at the middle of the gauge section, the machinist made the bar with a 50mm. diameter in the middle of the gauge section and machined the rest of it to a diameter of 50.5mm. After testing, the diameter away from the neck was 0.470 in. Assume that the stress-strain relation follows the power law, equation $\sigma = K\in^{n}$ What was the value of n? **[10]**

Q4) Explain the following terms: **[10]**

a) Isotropic hardening.

b) Kinematic hardening.

c) Independent hardening

d) Bauschinger effect

Q5) Explain residual bending stresses in a beam of rectangular cross section. **[10]**

Q6) Explain Elastic-plastic torsion of a solid circular shaft. **[10]**

Q7) What is viscoelasticity? Explain Kelvin model of viscoelesticity. **[10]**