Total No. of Questions : 7]

SEAT No. :

P4058

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M.E. (Mechanical) (Design Engineering)

MATERIAL SCIENCE AND MECHANICAL BEHAVIOR OF MATERIALS

(2013 Course) (502202) (Semester - I)

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 tables slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.***
5) ***Assume suitable data, if necessary.***

Q1) A steel piece initially has a uniform carbon concentration of 0.25 wt% and is to be treated at 950ºC. 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 0.5 mm below the surface? The diffusion coefficient for carbon in iron at this temperature is 1.6×10^{-11} m^2/s.

Assume that the steel piece is sem-infinite. **[10]**

Given :

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

Q2) The state of stress at a particular point relative to an xyz coordinate system is given by the stress matrix. **[10]**

$$[\sigma] = \begin{bmatrix} 14 & 7 & -7 \\ 7 & 10 & 0 \\ -7 & 0 & 35 \end{bmatrix} \text{MPa}$$

P.T.O.

Determine the normal stress and magnitude and direction of the shear stress on a surface intersecting the point and parallel to the plane given by equation $2x - y + 3z = 9$.

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 50 mm. diameter in the middle of the gauge section and machined the rest of it to a diameter of 50.5 mm. 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) a) Explain Bend test. **[5]**

b) Explain different models of uniaxial behavior of material in plasticity. **[5]**

Q5) Explain Elastic-plastic torsion of a solid circular shaft. **[10]**

Q6) Explain Residual stresses and Residual Strain in cylinder in torsion. **[10]**

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