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14MDE252

Second Semester M.Tech. Degree Examination, Dec.2015/Jan.2016
Theory of Plasticity

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Define the following :
i) Octahedral stresses ii) Representative stress iii) Effective stress iv) Stress invariants.
Show that : **(08 Marks)**

b. i) The normal stress on an octahedral plane is given by one third of the first invariant of stress
ii) The shear stress on the octahedral plane id given by

$$\tau_{oct} = \frac{1}{3}\sqrt{(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_3 - \sigma_1)^2}$$

where σ_1, σ_2, and σ_3 are the principal stresses. **(06 Marks)**

c. The state of stress at a point is given by

$$\sigma_{ij} = \begin{bmatrix} 1 & 2 & 1 \\ 2 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix} \text{MPa.}$$

Determine principal stresses. **(06 Marks)**

2 a. Explain the following:
i) Spherical and deviator strain
ii) Octahedral and representative strain **(08 Marks)**

b. Derive an expression for cubical dilatation strain. **(08 Marks)**

c. A tensile specimen with 15mm initial diameter and 80mm gauge length reaches a maximum load at 100kN and fractures at 88kN. The maximum diameter at fracture is 11.2mm. Determine true strain at fracture. **(04 Marks)**

3 a. What do you understand by a yield criterion? Explain the two yield criteria commonly used. **(10 Marks)**

b. Write a note on Haigh - westergaard stress space representation of yield criteria. **(10 Marks)**

4 a. Explain experimental verification of yield criteria using Quinny and Taylor's experiments. **(08 Marks)**

b. Explain the saint-venant's theory of plastic flow in detail. What are limitations of this theory. **(12 Marks)**

5 a. Explain the Prandtl-Reuss equation to determine the stress strain relations for an elastic perfectly plastic material. **(10 Marks)**

b. State and explain the upper and lower bound theorem. **(10 Marks)**

6 a. Assuming stress – strain for the material to be non – linear, derive the bending equation for the beam in the form

$$\frac{M}{I_n} = \frac{\sigma}{Y^n} = \frac{H}{R^n}$$ **(10 Marks)**

b. A hollow circular shaft of inner radius 30mm and outer radius 60mm is subjected to a twisting moment so that the outer 10mm deep shell yields plastically. The yield stress in shear for the shaft material is 160MPa and it is made of a non-linear material whose shear-stress-shear strain curve is given by $\tau = 300\ \gamma^{0.3}$. If this twisting moment is now released determine he residual stress distribution in the shaft.
Assume G = 80GPa for the shaft material **(10 Marks)**

7 a. A tube of aluminum has an outside diameter of 6cm and an inside diameter of 5.0cm. It is drawn over a stationary cylindrical mandrel and the final tube dimensions become 5.7cm and 5cm respectively. Find the drawing stress at the exit section under the condition that
i) $\sigma_0 = 40MPa, \mu = 0$
ii) $\sigma_0 = 40MPa, \quad \mu_1 = \mu_2 = 0.04$ and $\alpha = 30°$ **(10 Marks)**

b. A strip of initial width 6.25mm is drawn through tapered dies to a final width of 5.625mm in a state of plane strain. Considering thickness to be equal to 10mm semi die angle 10°, co-efficient of friction 0.03, determine the draw stress when
i) Backpull is zero
ii) Backpull is 150N
Yield stress for strip material is $250N/mm^2$ **(10 Marks)**

8 a. State the assumptions made in slip-line field theory **(05 Marks)**
b. Derive Geiringer's continuity equation **(10 Marks)**
c. List any five important properties of slip lines. **(05 Marks)**

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14MDE24

Second Semester M.Tech. Degree Examination, Dec.2015/Jan.2016
Advanced Theory of Vibrations

Time: 3 hrs. Max. Marks:100

Note: *Answer any FIVE full questions.*

1 a. A cylinder of mass m and radius r rolls without slipping on a circular surface of radius R. Find out the natural frequency of cylinder for small oscillations about the equilibrium point A. Use energy method. **(10 Marks)**

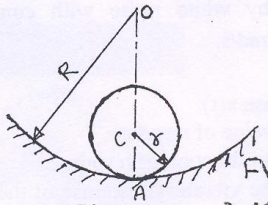

Fig. Q1 (a)

b. A system having rotating unbalance has total mass of 25 kg. The unbalanced mass 1 kg rotates with a radius 0.04 m. It has been observed that at a speed of 1000 rpm, the system and eccentric mass have a phase difference of 90° and the corresponding amplitude is 0.015 m. Find out: i) Natural frequency of the system ii) Damping factor iii) Amplitude at 1500 rpm and iv) Phase angle at 1500 rpm. **(10 Marks)**

2 a. Derive an expression for the response of a single degree of freedom spring-mass-damper system subjected to impulse excitation. **(10 Marks)**

b. A spring mass system is shown in Fig. Q2 (b) which is subjected to a harmonic force $F\cos\omega t$. Determine the response of the system. **(10 Marks)**

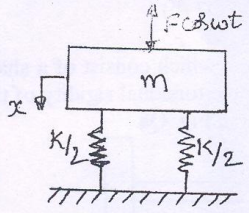

Fig. Q2 (b)

Given : $x(0) =$ [illegible]

$\dot{x}(0) = 0.04$ m/s

W = 30 rad/s

F = 1000 N

M = 10 kg

K = 500 N/m

3 a. Explain : (i) Vibration isolation and (ii) Shock isolation. **(10 Marks)**

b. What is dynamic vibration absorber? Show that for such a system, its natural frequency should be equal to the frequency of the applied force. **(10 Marks)**

4 a. Explain with neat sketches, piezoelectric transducer and linear variable differential transformer. **(10 Marks)**

b. Explain with neat sketches: i) Single – reed frequency measuring instruments.
ii) Electrodynamic vibration exciter. **(10 Marks)**

5 a. Explain the following machine maintenance techniques:
i) Breakdown maintenance. ii) Preventive maintenance.
iii) Condition based maintenance. **(10 Marks)**

b. Explain experimental modal analysis with reference to basic idea and necessary equipment. **(10 Marks)**

6 a. Explain at least five different comparisons between linear and non-linear systems. **(10 Marks)**

b. Explain stable and unstable oscillations. **(10 Marks)**

7 a. Define the following terms:

i) Auto correlation function.

ii) Power spectral density function.

iii) Mean value and variance.

iv) Probability distribution function. **(10 Marks)**

b. Consider the simplified single degree of freedom system shown in Fig. Q7 (b). Let m = 1200 kg, K = 68.22 kN/m and C = 3.62 kNs/m. The ground motion $x_g(t)$ is assumed to be represented by white noise with constant one sided PSD function is given by $S_g = 2 \times 10^{-5}$ m^2/rad/s.

Determine

i) PSD of response x(t).

ii) Mean square value of response.

iii) Autocorrelation function of response.

iv) 2σ limits of the vibratory response of the chassis mass relative to the ground, assuming the mean value $x_g(t) = 0$ **(10 Marks)**

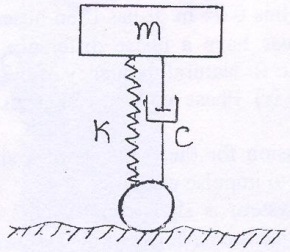

Fig. Q7 (b)

8 Determine the response of a torsional system which consist of a shaft having one end fixed and disc attached to the other end. Assume the torsional rigidity of the shaft as GJ and mass moment of inertia of the disc as I_0 as shown in Fig. Q8 **(20 Marks)**

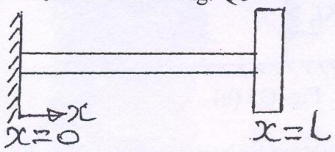

Fig. Q8

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