USN | | | | | | | | | | |

14MDE24

Second Semester M.Tech. Degree Examination, Dec.2018/Jan.2019
Advanced Theory of Vibrations

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions.*
2. Write neat sketches whenever required.

1 a. Free vibration records of one tonne machine mounted on an isolator is shown in Fig.Q.1(a). Determine:
- i) Logarithmic decrement
- ii) Damping factor
- iii) Damped natural frequency
- iv) Natural frequency
- v) Spring stiffness
- vi) Critical damping coefficient
- vii) Damping coefficient
- viii) Ratio of two successive amplitudes. **(10 Marks)**

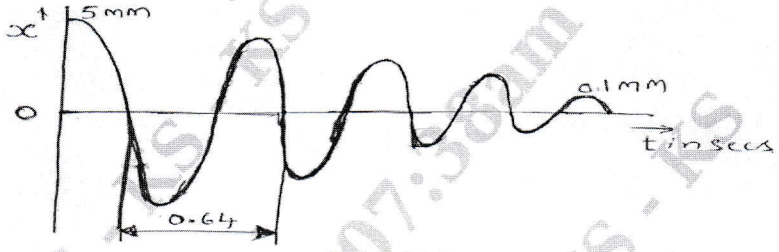

Fig.Q.1(a)

b. A flywheel having mass moment of Inertia 0.1 kg-m^2 is suspended from a thin wire of stiffness 1.2 N-m/rad. A periodic torque having maximum value of 0.6 N-m at 4 rad/s is impressed upon the flywheel. A viscous dashpot applies damping couple of 0.8N-m at an angular velocity of 2 rad/s. Find:
- i) Maximum angular displacement
- ii) Maximum couple applied to the das pot
- iii) Critical damping coefficients
- iv) Angle at which the angular displacement lags the torque. **(10 Marks)**

2 a. Determine the response of a single DOF system to the step excitation shown in Fig.Q.2(a). **(10 Marks)**

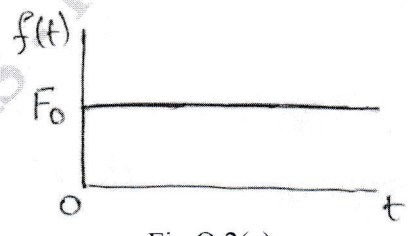

Fig.Q.2(a)

b. Formulate the Laplace transform solution of a viscously damped spring-mass system with initial conditions x(0) and $\dot{x}(0)$. **(10 Marks)**

3 a. Explain how vibration control can be achieved in different ways. **(08 Marks)**

b. A milling machine of mass 460kg operates at 1800 rpm and has an unbalance which causes a harmonic repeated force of magnitude 20,000N. Design an isolation system to limit the transmitted force to 4000N, the amplitude of vibration during operation to 1mm and the amplitude of vibration during start up to 10mm. Find the required stiffness of the isolator and the minimum mass that should be added to the machine. Assume $\xi = 0.05$. **(12 Marks)**

4 a. Explain the following with neat sketches: i) Accelerometer ii) Frahm Tachometer. **(10 Marks)**

b. Explain: i) Dynamic vibration absorbers ii) Vibration exciters. **(10 Marks)**

5 a. What is experimental modal analysis? Explain in detail the basic necessary equipments required for experimental modal analysis. **(10 Marks)**

b. With bath tub curve, explain the different machine maintenance techniques. **(10 Marks)**

6 a. Determine the isoclines for the simple pendulum. **(08 Marks)**

b. Explain the Jump phenomenon for softening and hardening springs. **(06 Marks)**

c. Enumerate the sources of non linearities. **(06 Marks)**

7 a. Explain: i) Expected value ii) Mean square value iii) Variance and standard deviation. **(06 Marks)**

b. Define power spectrum and power spectral density. **(04 Marks)**

c. A single DOF system with natural frequency W_n and damping factor $\xi = 0.2$ is excited by the force.

$$F(t) = F\cos\frac{1}{2}w_n t + F\cos w_n t + F\cos\frac{3}{2}w_n t$$

$$= \sum_{m=\frac{1}{2},1,\frac{3}{2}} F\cos m\, w_n t.$$

Determine mean square response of the system. **(10 Marks)**

8 a. Derive an expression for longitudinal vibration of rod. **(08 Marks)**

b. Derive the Euler equation for beams. **(12 Marks)**

* * * * *

USN | | | | | | | | | | |

14MDE252

Second Semester M.Tech. Degree Examination, Dec.2018/Jan.2019
Theory of Plasticity

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions.***
2. ***Assume missing data if any suitably.***

1 a. Explain stress strain curve in detail and show the idealized stress-strain diagrams for different materials with corresponding mechanical models and equations. **(10 Marks)**

b. What is the relationship between true stress and engineering stress and true strain and engineering strain? Justify engineering strain is to be considered or true strain is to be considered. **(10 Marks)**

2 a. What is stress invariant? Explain and estimate the three stress invariants from the stress tensor. **(10 Marks)**

b. The state at stress at a point is given by the following stress tensor:

$$\tau_{ij} = \begin{vmatrix} 50 & 50 & -40 \\ 50 & -30 & 30 \\ -40 & 30 & -100 \end{vmatrix} \text{MPa}$$

(i) Calculate the stress invariants. **(03 Marks)**
(ii) Magnitude and direction at principal stresses. **(04 Marks)**
(iii) Spherical and deviator stress tensor. **(03 Marks)**

3 a. What is flow stress, how it is determined? **(08 Marks)**

b. Explain the two theories of yielding criteria. **(04 Marks)**

c. The state of stress at a point is given by $\sigma_x = 100$ MPa, $\sigma_y = 200$ MPa and $\tau_{xy} = 250$ MPa. If the yielding stress of the material is 475 MPa, determine in a uniaxial test whether yielding will occur and if so according to which criteria? **(08 Marks)**

4 a. Derive an equation for the two principal stresses acting on a arbitrary plane in two dimensional stress system. **(10 Marks)**

b. The principal strains at a point in a body are given by,
$\in_1 = 0.002$, $\in_2 = 0.0002$, $\in_3 = -0.001$
Determine the octahedral normal and shearing strains. **(10 Marks)**

5 a. Explain various theories plastic flow. **(10 Marks)**

b. The initial gauge length, width and thickness of the tensile test piece are 50, 12.5 and 0.8 mm respectively. The initial yield load is 1.791 kN. At point 'A' the load is 2.059 kN and the corresponding extension is 1.22 mm. The maximum load is 2.94 kN and this occurs at an extension to 13.55 mm. The test piece fails at an extension to 22.69 mm. Determine the following:
(i) Initial yield stress.
(ii) Tensile strength.
(iii) percentage of total elongation.
(iv) True stress at maximum load.
(v) True strain at A. **(10 Marks)**

6 a. Derive the bending relationship for a material following non-linear stress-strain law in the form,

$$\frac{M}{I_n} = \frac{\sigma}{Y^n} = \frac{H}{R^n}.$$

(10 Marks)

b. Determine the drawing load for a cylindrical rod through a conical die from local stress evaluation. **(10 Marks)**

7 a. Determine by stress-evaluation of the load for forging a flat circular disc. **(10 Marks)**

b. Mention the important properties of slip lines. **(10 Marks)**

8 Write short notes on any four:

a. Upper bond theorem.

b. Factors affecting plastic deformation.

c. Variables of Drawing.

d. Effect of strain rate and temperature on stress strain curve.

e. Flow stress.

f. Stresses on a tetrahedron. **(20 Marks)**

* * * * *