



SF-8354

B. E. - III (Sem - VI) (Mech.) Examination

May / June - 2011

**Dynamics of Machinery
(New Syllabus)**

Time : 3 Hours]

[Total Marks : 100

Instructions :

(1)

नीचे दृशावेव निशानीवाणी विगतो उत्तरवडी पर अवश्य लपवी. Fillup strictly the details of signs on your answer book.	Seat No. :
Name of the Examination :	<input type="text"/>
<input type="text" value="B. E. 3 (Sem - 6) (Mech.)"/>	<input type="text"/>
Name of the Subject :	<input type="text"/>
<input type="text" value="Dynamics of Machinery"/>	<input type="text"/>
Subject Code No. : <input type="text" value="8"/> <input type="text" value="3"/> <input type="text" value="5"/> <input type="text" value="4"/>	<input type="text"/>
Section No. (1, 2,.....) : <input type="text" value="Nil"/>	
Student's Signature	

- (2) Attempt all questions
- (3) Figures to the right indicate full marks.
- (4) Assume suitable data, if necessary.
- (5) Use programmable calculator.

- 1 (a) Answer the following : 10
 - (i) What do you mean by state balancing ?
 - (ii) Define "Hammer Blow" ?
 - (iii) Explain following terms :
 - (1) Resonance
 - (2) Amplitude
 - (iv) Classify "Mechanical Vibration".
 - (v) What is unbalanced force ?
 - (b) Explain 'Direct and Reverse Crank' method in radial direction. 6
 - (c) Explain the analytical method of balancing of several masses rotating in the same plane. 4
-
- 2 Attempt the following : (any two) 16
 - (a) A, B, C and D are the four masses carried by a rotating shaft a radii 100, 125, 200, and 150 mm resp. The planes in which the masses revolve are spaced 600 mm apart and the mass of B, C and D are 10 Kg, 5 Kg, and 4

Kg. respectively. Find the required mass 'A' and relative angular settings of the four masses so that the shaft shall be in complete balance.

- (b) An inside cylinder locomotive has its cylinder centre line 0.7m apart and has a stroke of 0.6m. The rotating masses per cylinder are equivalent to 150 Kg at the crank pin and the reciprocating masses per cylinder to 180 kg. The wheel centre lines are 1.5m apart. The cranks are at right angles.

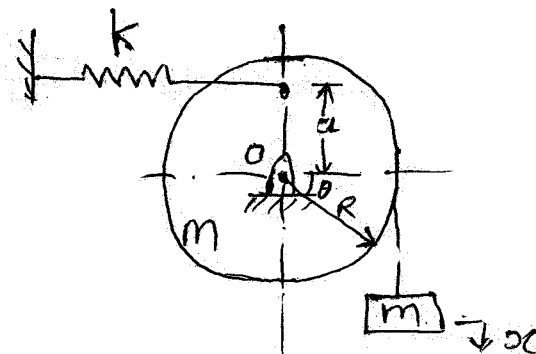
The whole of the rotating and $\frac{2}{3}$ of the reciprocating masses are to be balanced by masses placed at a radius of 6m. Find magnitude and direction of the balancing mass.

- (c) A four cylinder vertical engine has cranks 150 mm long. The planes of rotation of the first, second and fourth cranks are 400 mm, 200 mm and 200 mm resp. from the third crank and their reciprocating masses are 50 kg, 60 kg and 50 kg resp. Find the masses of the reciprocating parts for the third cylinder and the relative angular position of the cranks in order that the engine may be in complete primary balance.

- 3 (a) Derive the differential equation for a single degree of freedom spring-mass system. 4

OR

- (a) Derive an expression of displacement of critically damped 4 vibrating system.
- (b) Attempt the following : (any two) 10
- (i) Find the natural frequency of spring-mass-pulley system as shown in Fig.



- (ii) A vibrating system is defined by following parameters. $m = 3 \text{ kg}$, $k = 100 \text{ Ns/m}$, $C = \text{Ns/m}$. Determine : (i) damping factor (ii) Natural frequency of damped vibration (iii) ratio of two consecutive amplitudes.

(iii) Derive
$$\delta = \frac{2\pi q}{\sqrt{1-q^2}}$$

4 Answer the following : 20

(a) Attempt any **five** : (Each of equal marks) 10

- (i) Write down materials used in vibration isolation.
- (ii) Define transmissibility.
- (iii) Write down materials used in vibration isolation.
- (iv) Explain in brief reciprocating unbalance with single degree of freedom system.
- (v) Write down the wave equation and boundary conditions pertaining to vibration analysis of beam.
- (vi) Explain in brief Whirling speed of shaft.
- (vii) Define longitudinal vibration of bar.

(b) Attempt any **one** : 10

- (i) The vibration of cantilever are given by

$$y = y_l \left(1 - \cos \frac{\pi x}{2l} \right)$$

Calculate the frequency with following data for the cantilever using Rayleigh's method. Modulus of elasticity of the material $2 \times 10^{11} \text{ N/m}^2$.

Second moment of area about bending axis 0.02 m^4 .

Mass = $6 \times 10^4 \text{ Kg}$, length = 30 m .

- (ii) Determine the natural frequency of the spring-mass system shown in Fig. 1. Take $m_1 = m_2 = m_3 = m$ and $K_1 = K_2 = K_3 = K$.

Use Stodola's method.

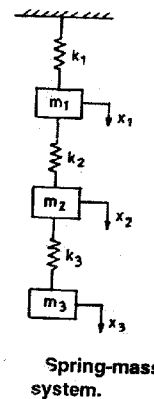


Fig. 1

- 5 Attempt any two : 14
- (a) Write down short note on amplitude measuring instrument of vibration.
- (b) Two bodies having equal masses as 60 Kg each and radius of gyration 0.3 m are keyed to both ends of a shaft 0.80 m long. The shaft is 0.08 m in diameter for 0.30 m length, 0.10 m diameter for 0.20 m length and 0.09 m diameter for rest of the length. Find the frequency of torsional vibrations.
- Take $G = 9 \times 10^{11} \text{ N/m}^2$
- (c) A shaft of 2.5 cm diameter, freely supported by bearings 75 cm apart, carries a single concentrated load of 196.2 N midway between the bearings. Determine the first critical speed. Assume the shaft material has a density of 8 gm/cm³ and E is $2.1 \times 10^6 \text{ Kg/cm}^2$.
- 6 Attempt any two : 16
- (a) A machine of mass one tonne is acted upon by an external force of 2450 N at a frequency of 1500 r.p.m. To reduce the effects of vibration, isolator of rubber having a static deflection of 2mm under the machine load and an estimated damping $\xi = 0.2$ are used.
- Determine :
- (a) The force transmitted to the foundation.
- (b) The amplitude of vibration of machine.
- (c) The phase lag.
- (b) The weight of an electric motor is 125 N and it runs at 1500 r.p.m. The armature weights 35 N and its centre of gravity lies 0.05 cm from the axis of rotation. The motor is mounted on five springs of negligible damping so that the force transmitted is one-eleventh of the impressed force. Assume that the weight of the motor is equally distributed among the five springs.
- Determine :
- (i) Stiffness of each spring.
- (ii) Dynamic force transmitted to the base at operating speed.
- (iii) Natural frequency of the system.
- (c) A shaft of negligible weight 6 cm diameter and 5 meters long is simply supported at the ends and carries four weights 50 kg each at equal distance over the length of the shaft. Find the frequency of vibration by Dunkerley's method.
- Take $E = 2 \times 10^6 \text{ Kg/cm}^2$