Theory of Vibrations VTU CBCS Question Paper Set 2018

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10AE65

Sixth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Theory of Vibrations

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Explain longitudinal, transverse and torsional vibrations with the help of neat sketches. **(06 Marks)**

b. Represent the periodic motions given in Fig. Q1 (b) by harmonic series. **(14 Marks)**

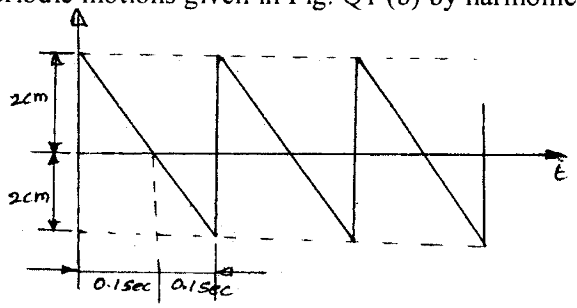

Fig. Q1(b)

2 a. Derive the differential equation of one dof spring mass system. Also obtain its solution applying suitable boundary conditions. **(08 Marks)**

b. Find the natural frequency of vibration of the system shown in Fig.Q2(b) for small amplitudes. If K1, K2, a and b are fixed, determine the value of b for which the system will not vibrate. Find maximum acceleration of the mass. **(12 Marks)**

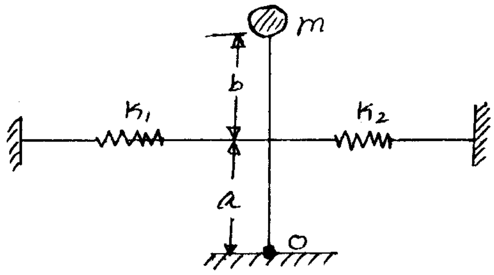

Fig. Q2 (b)

3 a. Explain the following: (i) Viscous damping (ii) Coulomb damping (iii) Structural damping. **(06 Marks)**

b. The single pendulum is pivoted at point O as shown in Fig. Q3 (b). If the mass of the rod is negligible for small oscillation, find the damped natural frequency of the pendulum. **(14 Marks)**

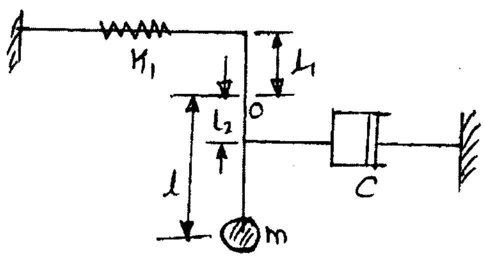

Fig. Q3 (b)

4 a. Explain the following:
(i) Vibration isolation (ii) Transmissibility **(06 Marks)**

b. A vibratory body of mass 150 kg supported on springs of total stiffness 1050 kN/m has a rotating unbalance force of 525 N at a speed of 6000 rpm. If the damping factor is 0.3, determine
(i) the amplitude caused by the unbalance and its phase angle.
(ii) the transmissibility and
(iii) the actual force transmitted and its phase angle. **(14 Marks)**

PART – B

5 a. With the help of neat sketch, explain working of vibrometer. Derive the necessary conditions for the same. **(08 Marks)**

b. The rotor of a turbo super charger weighing 9 kg is keyed to the centre of a 25 mm diameter steel shaft 40 cm between bearings. Determine :
(i) the critical speed of shaft
(ii) the amplitude of vibration of the rotor at a speed of 3200 rpm, if the eccentricity is 0.015 mm and
(iii) the vibratory force transmitted to the bearings at this speed.
Assume the shaft material to be simply supported and that the shaft material has a density of 8 gm/cm^3. Take $E = 2.1 \times 10^6$ kg/cm^2. **(12 Marks)**

6 a. Explain the following:
(i) Modes of vibration (ii) Co-ordinate coupling (iii) Vibration absorber. **(06 Marks)**

b. Solve the problem shown in Fig. Q6 (b). $m_1 = 10\,kg$, $m_2 = 15\,kg$ and $K = 320$ N/m. **(14 Marks)**

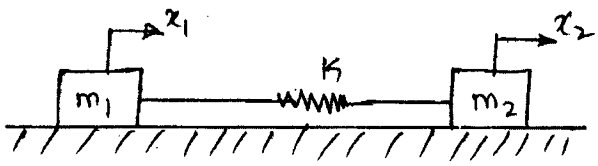

Fig. Q6 (b)

7 a. Obtain the general equation for transverse vibration of beam (Euler's equation for beams). Also obtain its solution. **(14 Marks)**

b. Derive suitable expression for longitudinal vibrations for a rectangular uniform cross-section bar of length l fixed at one end and free at the other end. **(06 Marks)**

8 Use Holzer's method, to find the natural frequencies of the system shown in Fig. Q8. **(20 Marks)**

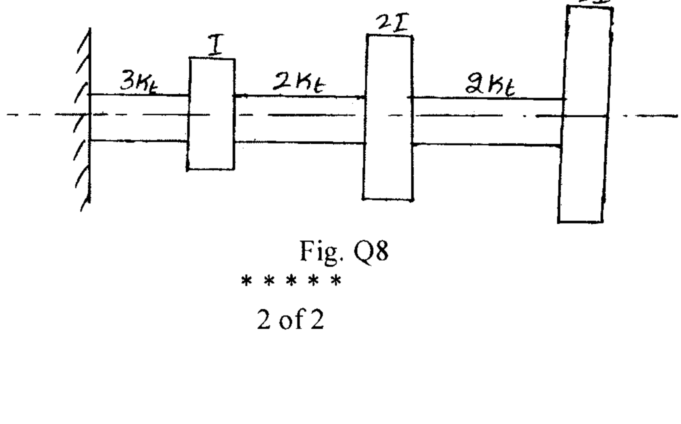

Fig. Q8

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Sixth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Theory of Vibrations

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Add the following harmonic motions, analytically and check the solution graphically, $x_1 = 2\cos(\omega t + 0.5)$; $x_2 = 5\sin(wt + 1.0)$ **(10 Marks)**

b. Define the following terms:
(i) Simple harmonic motion
(ii) Damping
(iii) Degrees of freedom.
(iv) Natural frequency
(v) Torsional vibration. **(10 Marks)**

2 a. Determine the natural frequency of a compound pendulum. **(10 Marks)**

b. Derive the differential equation of one degrees of freedom spring mass system. Also obtain its solution applying suitable boundary conditions. **(10 Marks)**

3 a. Find the equation of motion for the system shown in Fig. Q3 (a), when (i)Damping ratio=1.0 (ii) damping ratio=0.3 and (iii) Damping ratio = 2.0, if the mass 'M' is displaced by a distance of 3 cm and released. **(12 Marks)**

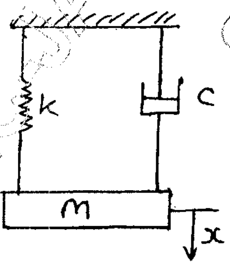

Fig. Q3 (a)

b. Define logarithmic decrement and show that $\delta = \frac{1}{n}\ln\left(\frac{x_0}{x_n}\right)$ with usual notations. **(08 Marks)**

4 a. Derive an expression for the forced vibration due to bars excitation of the support. **(10 Marks)**

b. A 75 kg machine is mounted on springs of stiffness $K = 11.76 \times 10^5$ N/m with an assumed damping factor of 0.2. A 2 kg piston within machine has a reciprocating motion with a stroke of 0.08 m and a speed of 300 CPM. Assuming the motion of the piston is harmonic. Determine the amplitude of vibration of the machine and the vibration force transmitted to the foundation. **(10 Marks)**

PART – B

5 a. Obtain an expression for the critical speed of a shaft with damping. **(10 Marks)**

b. A rotor of mass 12 kg is mounted midway on a 25 mm diameter horizontal shaft supported at the ends by 2-bearings. The span between the bearings is 900 mm. Because of some manufacturing defect the C.G. of the rotor is 0.02 mm away from the geometric centre of the rotor. If the system rotates at 3000 rpm, determine the amplitude of steady state vibrations and the dynamic forces on the bearings. Take E = 200 GPa. **(10 Marks)**

6 a. Write short notes on:
   (i) Dynamic vibration absorber.
   (ii) Principal modes and normal modes of vibration. **(08 Marks)**

b. Determine the natural frequency of the system shown in Fig. Q6 (b). **(12 Marks)**

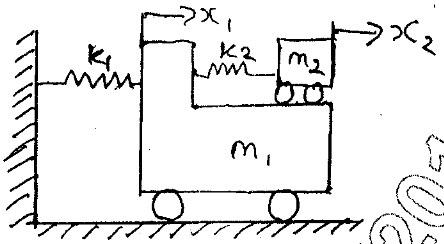

Fig. Q6 (b)

7 a. Obtain the expression for longitudinal vibration of rods or bars. **(12 Marks)**

b. What are continuous systems? Derive the one dimensional wave equation for lateral vibration of a string. **(08 Marks)**

8 a. Using Stodola method, find fundamental frequency and mode for the system shown in Fig. Q8 (a). **(12 Marks)**

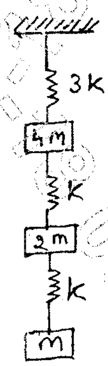

Fig. Q8 (a)

b. A shaft of 50 mm diameter and 3 long is supported at the ends and carrying 3 weights of 1000 N, 1500 N and 750 N at 1 m, 2 m and 2.5 m from left support. Taking E = 200 GPa find the frequency of transverse vibration. **(08 Marks)**

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Sixth Semester B.E. Degree Examination, June / July 2014
Theory of Vibrations

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Define the following terms:
i) Natural frequency ii) Degree of freedom iii) SHM **(03 Marks)**

b. Add the following harmonic motions analytically,

$x_1 = 4\cos(\omega t + 20°)$

$x_2 = 7\sin(\omega t + 45°)$ **(07 Marks)**

c. A periodic motion observed on an oscilloscope is shown in Fig. Q1 (c). Represent this motion by a harmonic series. **(10 Marks)**

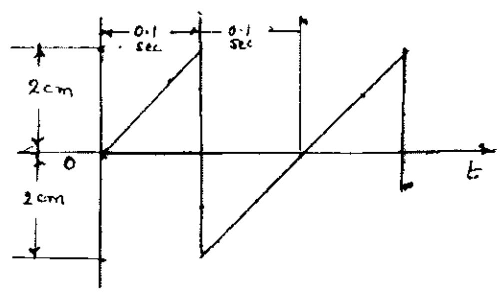

Fig. Q1 (c)

2 a. Obtain an expresion for the natural frequency of a compound pendulum subjected to small oscillation with usual notations. **(06 Marks)**

b. Determine the natural frequency of the system shown in Fig. Q2 (b) assuming the bar to be weightless and rigid. **(07 Marks)**

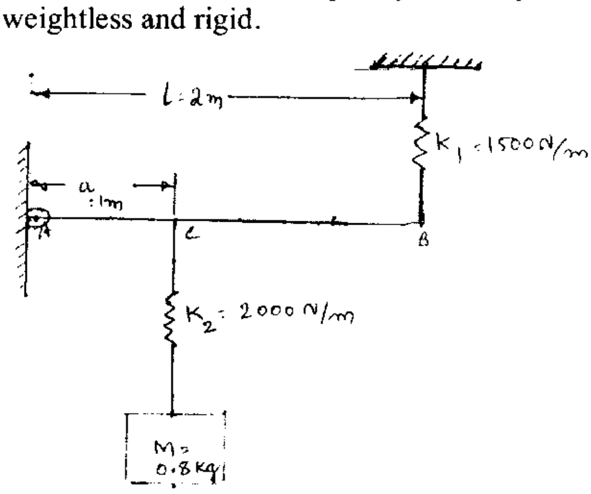

Fig. Q2 (b)

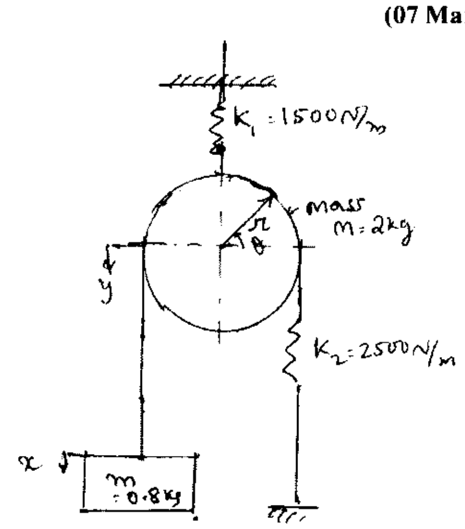

Fig. Q2 (c)

c. Using energy method, determine the natural frequency of the system shown in Fig. Q2 (c). Assume the cord to be unextensible and there is no slip. **(07 Marks)**

3 a. Derive an expression for the displacement x(t) of a mass-spring-dashpot system having a characteristic equation $m\ddot{x}+c\dot{x}+kx=0$ for underdamped case in terms of x_0, ω_n, α **(12 Marks)**

b. The measurement on a mechanical vibrating system having a mass of 8 kg shows that the equivalent spring stiffness is 6200 N/m. It also has a dashpot attached to it which exerts a force of 50 N when the mass has a velocity of 0.6 m/sec. Determine i) Critical damping coefficient (C_C) ii) Damping ratio (α) iii) Logarithmic decrement (δ) iv) Ratio of consecutive amplitudes v) Ratio of amplitudes after 4 cycles. **(08 Marks)**

4 a. Obtain the complete response equation for the motion of a spring-mass-dashpot system subjected to a harmonic force $F_0 \sin\omega t$ starting from differential equation of motion. **(10 Marks)**

b. A TV set of 30 kg mass must be isolated from a machine vibrating with an amplitude of 0.001 m at 1500 rpm. The set is mounted on 5 isolators (mounted in parallel) each having certain stiffness and damping constant values. If the amplitude of vibration of the TV set is measured as 0.0004 m, determine the damping constant values and the stiffness of each isolator assuming that they are connected in parallel and the damping ratio of the system is 0.048. Also determine the dynamic load on each isolator. **(10 Marks)**

PART – B

5 a. Define "critical speed" of a shaft. Derive an expression for the critical speed of a light shaft having a single disc at the centre considering the damping effect with a neat sketch. State the assumptions you have made. **(10 Marks)**

b. A rotor of mass 5 kg is mounted midway on a 10 mm dia horizontal shaft simply supported over a span of 0.6 m. The C.G. of the rotor is displaced 2.5 mm from the geometric centre. The equivalent viscous damping at the centre of the rotor shaft is 50 N-sec/m. The shaft rotates at 750 rpm calculate the maximum stress in shaft and power required to drive the shaft. Take E = 210 GPa. **(10 Marks)**

6 a. Briefly explain the concepts of first and second principal modes of vibration for a system with two degrees of freedom. **(04 Marks)**

b. A machine runs at 5000 rpm. Its forcing frequency is very near to its natural frequency. If the nearest frequency of the machine is to be at least 20% from the forced freqeuncy design a suitable vibration absorber for the system assuming the mass of the machine to be 30 kg. **(08 Marks)**

c. Two rotors A and B attached to the ends of a 0.5 m long shaft have weights 300 N and 500 N respectively. Their radii of gyrations are 0.3 m and 0.45 m. The diameter of the shaft is 7 cms for first 25 cm, 12 cm for next 10 cms and 10 cms for the remaining length. Take Gas 80 GPa for the shaft material. Determine i) The position of the node ii) Frequency of torsional vibrations. **(08 Marks)**

7 a. Derive frequency equation for a beam with
i) both ends free and having transverse vibrations.
ii) one end free and other end fixed and having transverse vibrations. **(12 Marks)**

b. A bar of uniform cross section having length l is fixed at both ends. The bar is subjected to longitudinal vibrations, having a constant velocity V_0 at all points. Derive mathematical expressions of longitudinal vibrations in bar. **(08 Marks)**

8 a. Determine the natural frequency of the system shown in Fig. Q8 (a) using Stodola method. **(10 Marks)**

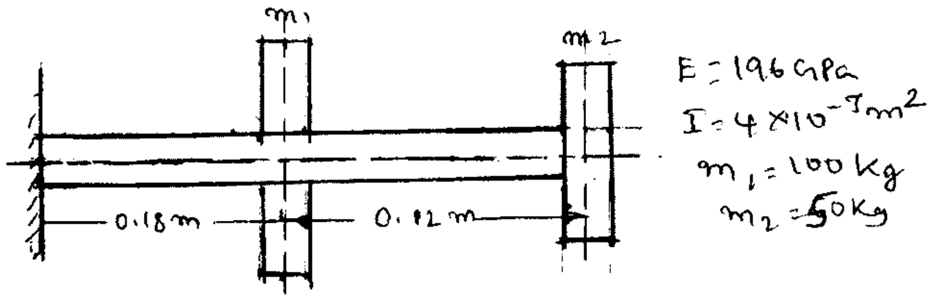

Fig. Q8 (a)

b. A solid steel shaft of uniform diameter which carries discs of weights 600 N and 1000 N is represented by a simply supported beam as shown in Fig. Q8 (b). Determine the fundamental natural frequency of the system assuming E of the material as 196 GPa and mass moment of inertia = 40×10^{-8} m^4. Use Dunkerley's method. **(10 Marks)**

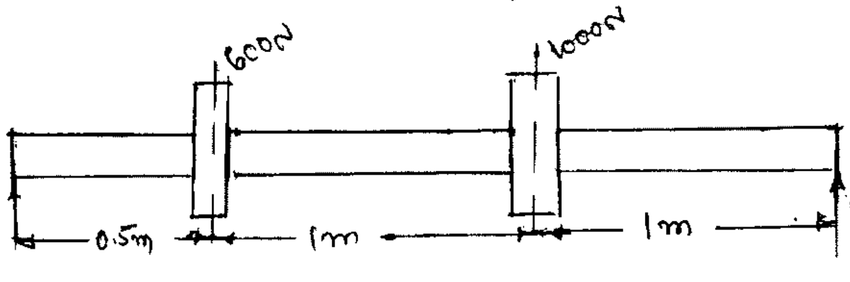

Fig. Q8 (b)

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Sixth Semester B.E. Degree Examination, June/July 2015
Theory of Vibrations

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

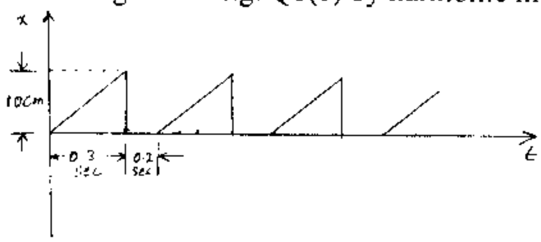
PART – A

1 a. Explain the following terms with a neat sketch : i) phase difference ii) SHM. **(06 Marks)**

b. Split the harmonic motion $x = 10 \sin (wt + \pi/6)$ into two harmonic motions, one having a phase angle of zero and the other of 45^0, by graphical method. **(04 Marks)**

c. Represent the periodic motions given in fig. Q1(c) by harmonic motion. **(10 Marks)**

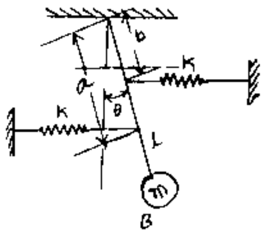
Fig.Q1(c)



2 a. What is undamped free vibration? Obtain the solution of differential equation $m\ddot{x} + kx = 0$, applying the initial boundry conditions. **(04 Marks)**

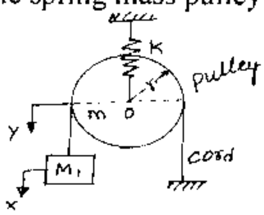
b. Calculate the natural frequency of the system shown in the fig. Q2(b), if the mass of the rod is negligible compared to the mass 'm'. **(06 Marks)**

Fig.Q2(b)



c. Using energy method, find the natural frequency of system shown in fig. Q2(c). The cord may be assumed inextensible in the spring mass pulley system and no slip. **(10 Marks)**

Fig.Q2(c)

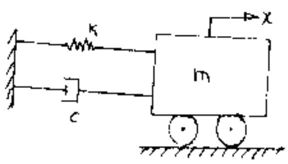


3 a. What is Damping? What are the uses of critical damping? Explain. **(04 Marks)**

b. What is damped natural frequency? Sketch the time – displacement plot for the three cases of damped free vibration. **(04 Marks)**

c. Find the equation of motion for the system shown in fig. Q3(c) when
i) damping ratio = 1.0 ii) damping ratio = 0.3 and iii) damping ratio = 2.0 , if the mass 'M' is displaced by a distance of 3cm and released. **(12 Marks)**

Fig.Q3(c)



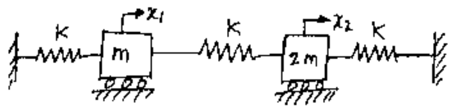
4 a. Explain vibration isolation with its basic requirements. (04 Marks)
b. What are the materials used for vibration isolation? Enumerate the properties of these materials. (06 Marks)
c. The weight of an electric motor is 125kg and it runs at 1500 rpm. The armature weighs 35kg and its centre of gravity lies 0.05cm from its 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. (10 Marks)

PART - B

5 a. Obtain an expression for the critical speed of a shaft with damping. (10 Marks)
b. The rotor of a turbo super charger weighing 9 kg is keyed to the centre of a 25mm diameter steel shaft of length 40cm, between bearings. Determine
i) the critical speed of shaft ii) the amplitude of vibration of the rotor at a speed of 3200 rpm, if the eccentricity is 0.015mm iii) the vibratory force transmitted to the bearing at this speed. Assume the shaft to be simply supported and that the shaft material has a density of $8 gm/cm^3$. Take $E = 2.1 \times 10^6 kg/cm^2$. (10 Marks)

6 a. Write short notes on : (06 Marks)
i) Dynamic vibration absorber ii) Principal modes and normal modes of vibration.
b. Find the natural frequency and amplitude ratio of the system shown in fig. Q6(b). (14 Marks)

Fig.Q6(b)



7 a. What are continuous systems? Derive the one dimensional wave equation for lateral vibration of a string. (10 Marks)
b. Find the frequency equation of a uniform beam fixed at one end and free at the other for transverse vibration. (10 Marks)

8 a. Determine the influence co-efficients of the spring mass system shown in fig. Q8(a). (04 Marks)

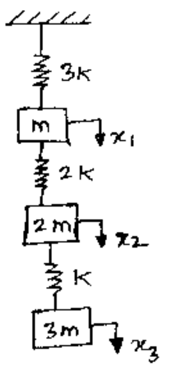


Fig.Q8(a)

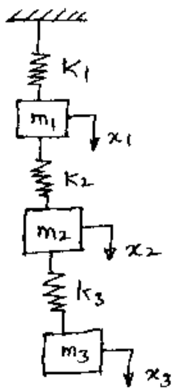


Fig.Q8(b)

b. Determine the natural frequency of the spring mass system shown in fig. Q8(b). Take $m_1 = m_2 = m_3 = m$ and $k_1 = k_2 = k_3 = k$. Use Stodola's method. (16 Marks)

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Sixth Semester B.E. Degree Examination, June/July 2016
Theory of Vibrations

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Define the term vibration, explain the types of vibration. **(10 Marks)**

b. Find the Fourier series for the saw-tooth curves as shown in Fig.Q.1(b). **(10 Marks)**

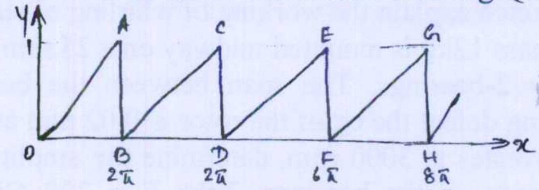

Fig.Q.1(b)

2 a. Determine the natural frequency of a compound pendulum. **(10 Marks)**

b. Determine the natural frequency of two masses m_1 and m_2 connected to the light stiff rod as shown in Fig.Q.2(b). **(10 Marks)**

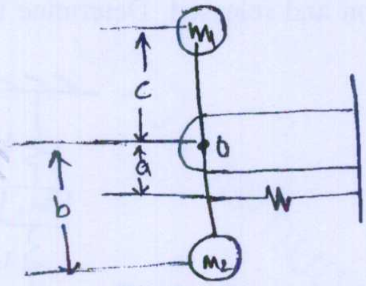

Fig.Q.2(b)

3 a. A machine of mass 20kg is mounted on spring and dash pot as shown in Fig.Q.3(a). The total spring stiffness is 10N/mm and the total damping is 0.15 N/m m/sec. If the system is initially at rest and a velocity of 100 mm/s is imparted to the mass, then determine:

i) Displacement and velocity of mass as a function of time.

ii) Displacement and velocity at time equal to one second. **(10 Marks)**

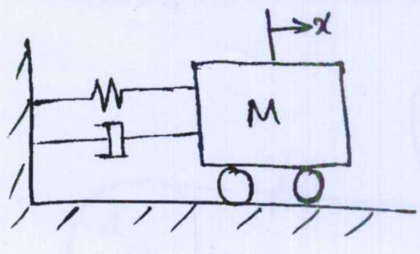

Fig.Q.3(a)

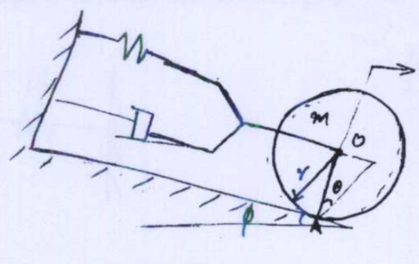

Fig.Q.3(b)

b. Obtain the differential equation governing the motion of the one degree of freedom system shown in Fig.Q.3(b). Also determine the undamped natural frequency of the system. **(10 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

4 a. Obtain the complete response equation for the motion of a spring mass damper system subjected to a harmonic force F_o sinwt. **(10 Marks)**

b. A mass of 100kg been mounted on a spring dashpot system having spring stiffness of 19,600 N/m and damping coefficient of 100N-sec/m. The mass is acted upon by a harmonic force of 39 N at the undamped natural frequency of the system. Determine:

i) Amplitude of vibration of the mass.
ii) Phase difference between force and displacement.
iii) Force transmissibility ratio.

Given: M = 100kg; K = 19,600 N/m; C = 100 N-sec/m; F_o = 39 N. **(10 Marks)**

PART – B

5 a. With neat sketch explain the working of whirling of shafts without air damping. **(10 Marks)**

b. A rotor of mass 12kg is mounted midway on a 25 mm diameter horizontal shaft supported at the ends by 2-bearings. The span between the bearings is 900mm. Because of some manufacturing defect the cg of the rotor is 0.02 mm away from geometric centre of rotor. If the system rotates at 3000 rpm, determine the amplitude of steady state vibrations and the dynamic forces on the bearings. Take E = 200 GPa. Given: m = 12kg; d = 25 mm; L = 900 mm; e = 0.02 mm and N = 3000 rpm. **(10 Marks)**

6 a. Figure Q.6(1) shows a spring mass system. If the mass m_1 is displaced 20 mm from its static equilibrium position and released. Determine the resulting displacements $x_1(t)$ and $x_2(t)$ of the masses. **(10 Marks)**

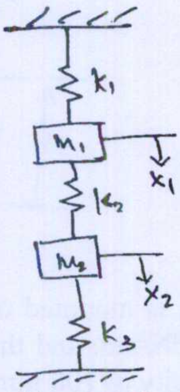

Fig.Q.6(1)

b. Determine the natural frequency of the system shown in Fig.Q.6(b). **(10 Marks)**

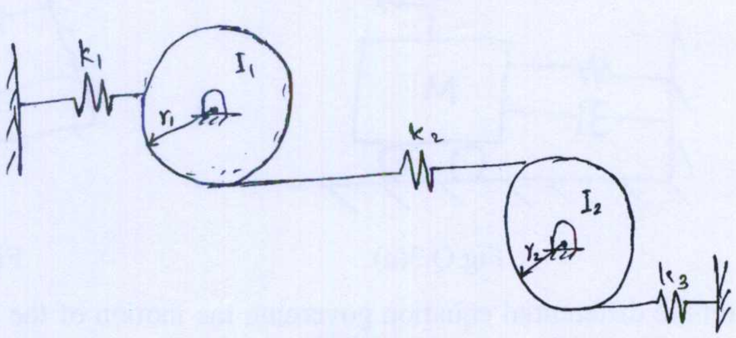

Fig.Q.6(b)

7 a. Derive expressions for amplitudes of vibrations of the two masses shown in Fig.Q.7(a). **(10 Marks)**

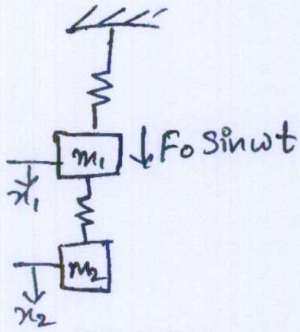

Fig.Q.7(a)

b. A torsional three rotor system is shown in Fig.Q.7(b). Determine i) Differential equation of motion; ii) Frequency equation. **(10 Marks)**

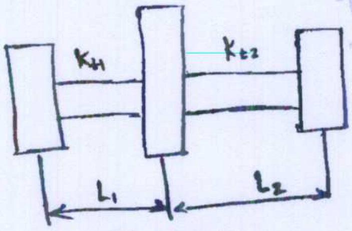

Fig.Q.7(b)

8 a. Explain Dunkerley's method. **(08 Marks)**

b. A shaft of 50 mm diameter and 3 m long is supported at the ends and carries three weights of 1000N, 1500N and 750N at 1m, 2m and 2.5m form the left support. Taking E = 200 GPa, find the frequency of transverse vibrations. **(12 Marks)**

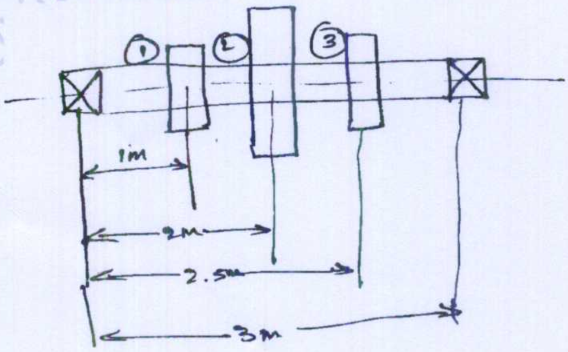

Fig.Q.8(b)

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Sixth Semester B.E. Degree Examination, June/July 2017
Theory of Vibrations

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Explain difference between:
(i) Deterministic and Random vibration.
(ii) Linear and non linear vibration.
(iii) Damped and undamped vibration. **(06 Marks)**

b. Add the following harmonic motion analytically and check the solution graphically :
$x_1 = 4\cos(wt + 10^\circ)$ and $x_2 = 6\sin(wt + 60^\circ)$ **(08 Marks)**

c. Derive an expression for equation of motion of a vibratory system by,
(i) Energy method (ii) Rayleigh's method. **(06 Marks)**

2 a. Define and find an expression for undamped natural frequency of a compound pendulum. **(08 Marks)**

b. Find the natural frequency of a effect of mass of spring system as shown in Fig. Q2 (b). **(07 Marks)**

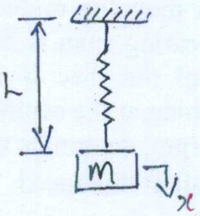

Fig. Q2 (b)

c. Find the natural frequency of the system shown in Fig. Q2 (c). Take $K = 2\times10^5$ N/m and m = 20 kg. **(05 Marks)**

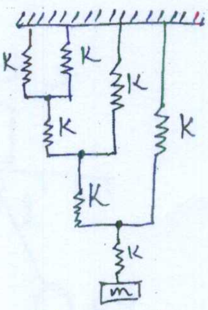

Fig. Q2 (c)

3 a. A door 200 cm high, 75 cm wide and 4 cm thick and weighing 35 kg is fitted with an automobile door closer. The door opens against a spring with a modulus of 1 kg-cm/radian. If the door is opened 90° and released, how long will it take the door to be within 1° of closing? Assume the return spring of the door to be critically damped. **(10 Marks)**

b. Derive an expression for logarithmic decrement of an under damped system. **(06 Marks)**

c. What is damping? Mention different types of damping. **(04 Marks)**

4 a. Obtain the complete response equation for the motion of a spring-mass-doshpot system subjected to a harmonic force $F_0 \sin \omega t$ starting from differential equation of motion. **(10 Marks)**

b. Consider the spring mass system shown in Fig. Q4 (b). The mass is given a velocity of 0.1 m/sec. What will be the subsequent displacement and velocity of the mass if C = 100 N-sec/m, K = 3000 N/m, m = 20 kg, $F \sin \omega t = 0$. Assume initial velocity of the mass as zero. Calculate the steady state response of the mass if $F \sin \omega t = 5 \sin 10t$. **(10 Marks)**

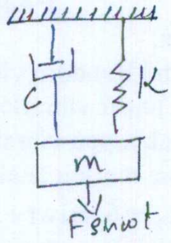

Fig. Q4 (b)

PART – B

5 a. Explain the working of a seismic instrument with a neat sketch. State the conditions for which the instrument functions as
(i) Vibrometer (ii) Accelerometer **(10 Marks)**

b. A disc of mass 4 kg is mounted midway between bearings which may be assumed to be simple supports. The bearing span is 50 cm. The steel shaft is of 10 mm diameter and is horizontal. The C.G. of the disc is displaced 2 mm from the geometric centre. The equivalent viscous damping at the centre of the disc-shaft may be assumed as 50 N-sec/m. If the shaft rotates at 250 rpm, determine the maximum stress in the shaft. Also find the power required to drive the shaft at this speed. Take $E = 1.96 \times 10^{11}$ N/m². **(10 Marks)**

6 a. Find the frequencies of the system shown in Fig. Q6 (a). Take $K = 90$ N/m, $l = 0.25$ m, $m_1 = 2$kg, $m_2 = 0.5$ kg **(10 Marks)**

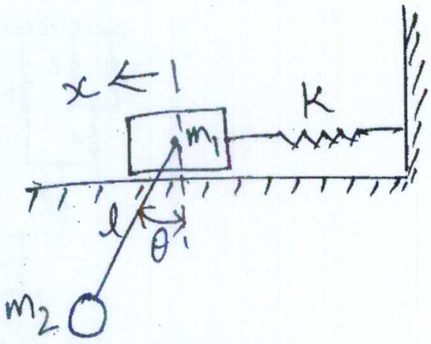

Fig. Q6 (a)

b. Determine the natural frequencies of a co-ordinate coupled system. **(10 Marks)**

7 a. A bar of uniform cross-section having length l is fixed at both ends. The bar is subjected to longitudinal vibrations having a constant velocity V_0 at all points. Derive suitable mathematical expression of longitudinal vibration in the bar. **(10 Marks)**

b. What are continuous systems? Derive the one dimensional wave equation for lateral vibration of a string. **(10 Marks)**

8 a. Use stodola method to find the fundamental mode of vibration of the system shown in Fig. Q8 (a) **(10 Marks)**

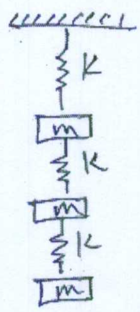

Fig. Q8 (a)

b. A steel shaft of diameter 10 cm is carrying three masses 2.5 kg, 3.75 kg and 7 kg respectively as shown in Fig. Q8 (b). The distances between the rotors are 0.70 m. Determine the natural frequencies of torsional vibrations. The radii of gyration of three rotors are 0.20, 0.30 and 0.40 m respectively. Take $G = 9 \times 10^8$ N/m^2 **(10 Marks)**

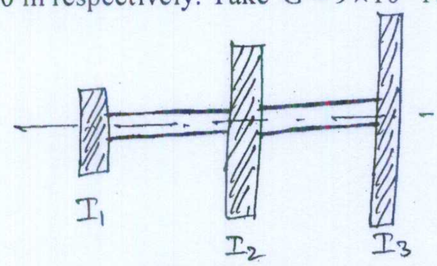

Fig. Q8 (b)

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Sixth Semester B.E. Degree Examination, Dec.2015/Jan.2016
Theory of Vibrations

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

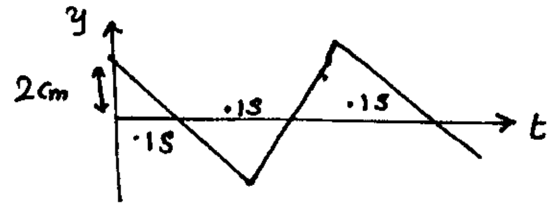
PART – A

1 a. Define the following terms
i) Simple Harmonic motion ii) Damping iii) Degrees of freedom iv) Natural frequency **(08 Marks)**

b. An oscillating system with natural frequency of 3.98Hz starts with critical displacement of 10mm and velocity 125mm/sec. Calculate all the vibratory parameter. **(04 Marks)**

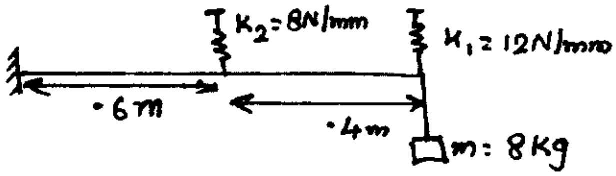
c. Find the harmonic series of Periodic motion shown. **(08 Marks)**

Fig. Q1(c)



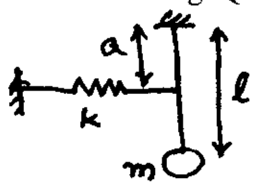
2 a. Find the natural frequency of the system. Shown in Fig. Q2 (a) **(10 Marks)**

Fig. Q2(a)



b. Find the natural frequency for system shown in Fig. Q2(b). **(10 Marks)**

Fig. Q2(b)



3 a. Define logarithmic decrement and show $\delta = \frac{2\pi\xi}{\sqrt{1-\xi^2}}$ with usual notation. **(08 Marks)**

b. A gun barrel of mass 600kg has a recoil spring of stiffness 294,000N/m. If the barrel recoils 1.3m on firing, determine
i) Initial velocity of barrel
ii) Critical damping co-efficient of the dash pot engaged at the end of recoil stroke.
iii) Equation of motion of the barrel **(07 Marks)**

c. A spring mass dash pot system is given an initial velocity of magnitude w_n from equilibrium position. Find equation of motion when $\xi = 2$. **(05 Marks)**

4 a. What is Dynamic Magnification factor? Derive an expression for it and discuss its variation with frequency ratio and damping ratio. **(10 Marks)**

b. Discuss the response of a single D.O.F system under a forcing function F_0e^{iwt}. **(05 Marks)**

c. Determine the power required to vibrate a spring mass damper with amplitude of 15mm at a frequency 100Hz. The system has a damping factor of 0.05 and damped natural frequency of 22Hz. The mass of system is 0.5kg. **(05 Marks)**

PART – B

5 a. Derive an expression for critical speed of shaft. Explain the situation through which shaft deformation goes, when shaft speed is increased gradually to speed much above critical speed from rest. **(12 Marks)**

b. Simply supported shafts at its 2 ends carry a mass at its centre with an eccentricity of 0.4mm. Determine the critical speed of shaft and permissible range of speed, if maximum stress permitted for shaft material is 70Mega Pascals. **(08 Marks)**

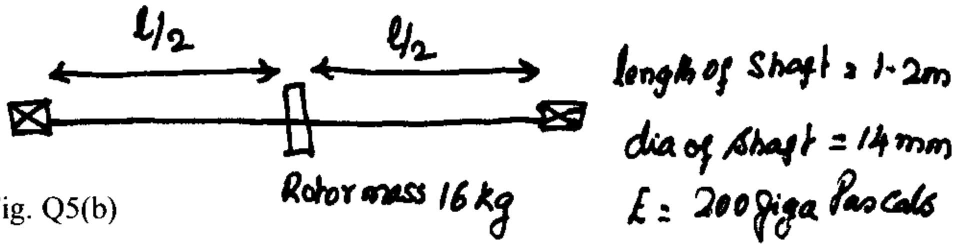


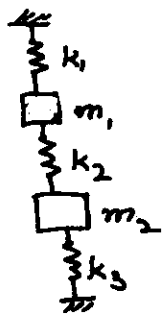
Fig. Q5(b)

6 For the system shown, If mass m_1 is displaced 20mm from its static equilibrium position, determine resulting displacement equation

Given $m_1 = m_2 = m$

$k_1 = k_2 = k_3 = k$ **(20 Marks)**

Fig. Q6

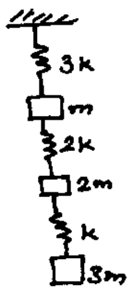


7 a. A uniform string of length ℓ stretched with initial large tension between two supports is displaced laterally through a distance a_0 at the centre and released. Find the equation of motion. **(12 Marks)**

b. Form the differential equation for string, mentioning the assumptions made. **(08 Marks)**

8 a. Using Stodola method, find fundamental frequency and mode for the system shown in Fig.Q8 (a) **(12 Marks)**

Fig. Q8 (a)



b. A shaft 180mm dia is supported at 2.5m apart. It carries three discs of weight 2500N, 500N and 2000N at 0.6m, 1.5m and 2m from left end. Assume shaft weight to be 1900N/m and E = 200GPa. Determine the natural frequency of transverse vibration. **(08 Marks)**

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