(vii) The effect of gyroscopic torque on the naval ship when it is rolling and the rotor is spinning about the longitudinal axis is
(a) to raise the bow and lower the stern
(b) to lower the bow and raise the stern
(c) to turn the ship to one side
(d) no effect.

(viii) The effect of the mass of the spring can be accounted for by adding the following fraction of its mass to the vibrating mass:
(a) $\frac{1}{2}$ (b) $\frac{1}{3}$ (c) $\frac{4}{3}$ (d) $\frac{3}{2}$.

(ix) The secondary inertia force in slider of mass m in a slider crank mechanism with crank radius r, and crank angle θ, link ratio n, angular velocity ω will be
(a) $m\,\omega^2 r\cos\theta$ (b) $m\omega^2 r\cos 2\theta$
(c) $(m\omega^2 r\cos 2\theta)/n$ (d) $(m\omega^2 r\cos\theta)/n$

(x) The equation of motion of a machine (rotating at frequency ω) of mass M, with an unbalanced mass m, at radius e, is given by
(a) $m\ddot{x} + c\dot{x} + sx = me\omega^2 \sin\omega t$
(b) $m\ddot{x} + c\dot{x} + sx = Me^{\ 2} \sin\omega t$
(c) $M\ddot{x} + c\dot{x} + sx = me^{\ 2} \sin\omega t$
(d) $M\ddot{x} + c\dot{x} + sx = Me\omega^2 \sin\omega t$

Group – B

2. (a) A slider crank mechanism shown in Figure 1 is subjected to two forces: P = 3kN and Q = 1000kN. The dimensions of various links are: AB = 250mm, BC = 600mm, BD = 250mm, crank angle = 45^0. Determine the torque applied in the crank.

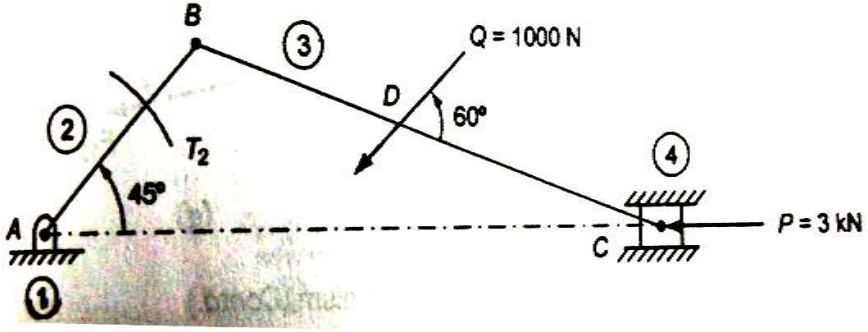

Figure 1

masses, (ii) the fluctuation in rail pressure under one wheel, (i variation of tractive effort and (iv) the magnitude of swaying c at a crank speed of 300 rpm.

6 + 2 + 2 + 7

7. (a) Four masses A, B, C and D are completely balanced. Masses C make angles of 90^0 and 210^0 respectively with B in the same The planes containing B and C are 300 mm apart. Masses A, B, D can be assumed to be concentrated at radii of 360, 480, 24 300 *mm* respectively. The masses B, C and D are 15 *kg*, 25 *kg* a *kg* respectively. Determine the (i) mass A and its angular po (ii) positions of planes A and D.

(b) Deduce the expressions for variation in tractive force, swaying c and hammer blow for an uncoupled two cylinder locomotive eng

(4 + 3) + 5

Group – E

8. (a) Each arm of a porter governor is 300 *mm* long and is pivoted a axis of rotation. Each ball has a mass of 6 *kg* and the sleeve we 18 *kg*. The radius of rotation of the ball is 200 *mm* when the gov begins to lift and 250 *mm* when the speed is maximum. Determi maximum and minimum speeds. Determine the maximun minimum speeds and the range of speed of the governor.

(b) What do you mean by centrifugal governor and inertia gove Write short notes on isochronous governor and characteristic of governor.

6 + (3 + 3

9. (a) Explain in what way the gyroscopic couple affects the motion aircraft while taking a turn.

(b) Each road wheel of a motor cycle is of 600 mm diameter and moment of inertia of 1.1kg.m^2. The motor cycle and the together weight 220 kg and the combine centre of mass is 62 above the ground level when the motor cycle is upright. The m of inertia of the rotating parts of the engine is 0.18 kg m^2. The e rotates at 4.5 times the speed of road wheels in the same sense the angle of heel necessary when the motor cycle is taking a t 35 m radius at a speed of 72 km/h.

5 + 7

B.TECH/ME/5TH SEM/MECH 3101/2016

DYNAMICS OF MACHINES
(MECH 3101)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) The maximum fluctuation of energy in a flywheel is equal to (all symbols have their usual meaning)
(a) $I\omega(\omega_1 - \omega_2)$ (b) $I\omega^2 K$
(c) $2EK$ (d) all of these.

(ii) Which of the following governor is spring loaded
(a) Watt governor (b) Porter governor
(c) Proell governor (d) Hartnell governor.

(iii) If the ball masses of a governor have same equilibrium speed for all the radii of rotation, it is said to be
(a) stable (b) hunting
(c) isochronous (d) sensitive.

(iv) For a critically damping system, the motion will be:
(a) periodic (b) aperiodic
(c) harmonic (d) random.

(v) Static force balancing involves balancing of
(a) forces (b) couples
(c) forces as well as couples (d) masses.

(vi) In a locomotive, the maximum magnitude of the unbalanced forces along the perpendicular to the line of stroke, is known as
(a) tractive force (b) swaying couple
(c) hammer blow (d) none of the above.

(b) Find the relation among coefficient of fluctuation of speed and maximum fluctuation of energy and kinetic energy of the flywheel at mean speed.

9 + 3 = 12

3. (a) Compare in detail free un-damped vibration and an over damped vibration with displacement v/s time curve. Also discuss the logarithmic decrement.

(b) Three springs and a mass are attached to a rigid, weightless bar PQ as shown in Figure 2. Find the natural frequency of vibration of the system.

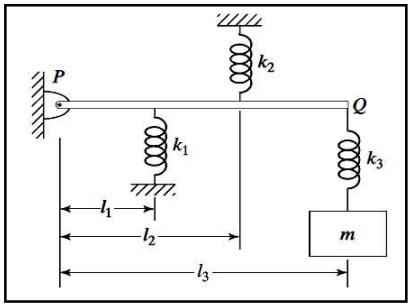

Figure 2

5 + 7 = 12

Group – C

4. (a) A weight W is supported by three frictionless and massless pulleys and a spring of stiffness k, as shown in Figure 3 below. Find the natural frequency of vibration of weight W for small oscillations.

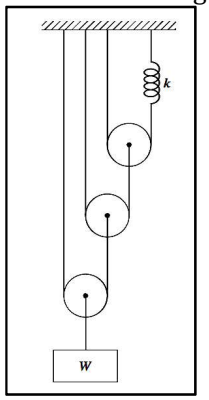

Figure 3

B.TECH/ME/5TH SEM/MECH 3101/2016

(b) Find the relation among coefficient of fluctuation of spee maximum fluctuation of energy and kinetic energy of the flywh mean speed.

9 + 3

3. (a) Compare in detail free un-damped vibration and an over da vibration with displacement v/s time curve. Also discus logarithmic decrement.

(b) Three springs and a mass are attached to a rigid, weightless b as shown in Figure 2. Find the natural frequency of vibration system.

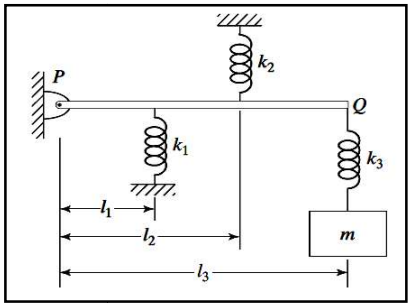

Figure 2

5 +

Group – C

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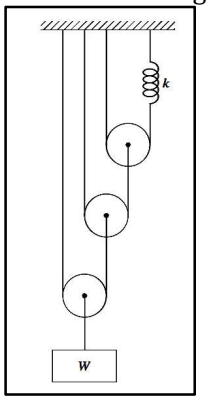

Figure 3

(b) For a spring-mass-damper system, m = 5 *kg* and k (stiffness) = 5000 *N/m*. Find the following: (i) critical damping constant c_c (ii) damped natural frequency when $c = c_c/2$ and (iii) logarithmic decrement.

6 + (2 + 2 + 2) = 12

5. (a) A machine part having a mass of 2.5 kg vibrates in a viscous medium. A harmonic exciting force of 30 N acts on the part and causes a resonant amplitude of 14 mm with a period of 0.22 second. Find the damping coefficient. If frequency of exciting force is changed to 4 Hz, determine the increase in the amplitude of the forced vibrations upon the removal of the damper.

(b) The shaft as shown in the figure 4 below carries two masses. The mass A is 300 kg with a radius of gyration of 0.75 m and mass B is 500 kg with a radius of gyration of 0.9 m. Determine the frequency of the torsional vibrations. It is desired to have a node at the mid-section of the shaft of 120 mm diameter by changing the diameter of the section having a 90-mm diameter. What will be the new diameter?

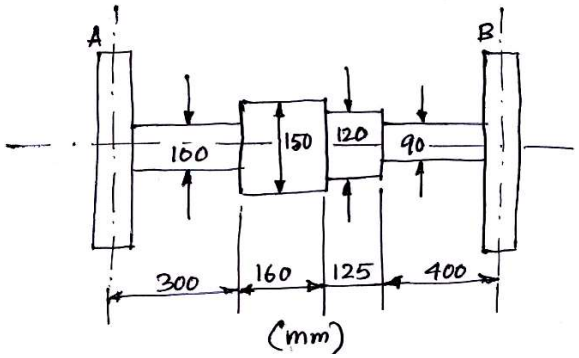

Figure 4

7 + 5 = 12

Group – D

6. An inside cylinder locomotive has its cylinder center lines 0.8 m apart and has a stroke of 0.6 m. The rotating masses are equivalent to 150 kg at the crank pin and the reciprocating masses per cylinder are 300 kg. The wheel center lines are 1.8 m apart. The cranks are at right angles. The whole of the rotating and 2/3 rd of the reciprocating masses to be balanced by masses placed at a radius of the 0.5 m. find (i) the magnitude and direction of the balancing

B.TECH/ME/5TH SEM/MECH 3101/2016

(b) For a spring-mass-damper system, m = 5 *kg* and k (stiffness) = *N/m*. Find the following: (i) critical damping constant c_c (ii) da natural frequency when $c = c_c/2$ and (iii) logarithmic decremen

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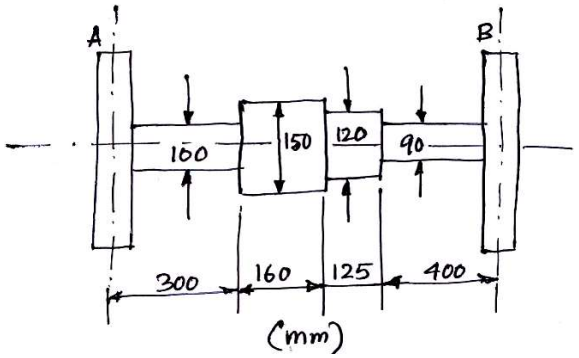

Figure 4

7 + 5

Group – D

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