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Question Paper Code: 41751

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2017

Fifth Semester

Mechanical Engineering

14UME501 - DYNAMICS OF MACHINERY

(Regulation 2014)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. In Reciprocating engine primary forces

   (a) are completely balanced (b) are partially balanced
   (c) are balanced by secondary force (d) cannot be balanced

2. A System of masses rotating in different parallel planes is in dynamic balance if the resultant

   (a) Force is equal to zero
   (b) Couple is equal to zero
   (c) Force and the resultant couple are both equal to zero
   (d) Force is numerically equal to the resultant couple but neither of then need necessarily be zero

3. Balancing of a rigid rotor can be achieved by appropriately placing balancing weights in

   (a) Single plane (b) Two plane (c) Three plane (d) Four plane

4. For balancing a single disturbing mass, the minimum number of balance mass required to be introduced in a plane parallel to the plane of rotation of the disturbing mass will be

   (a) Single plane (b) Two plane (c) Three plane (d) Four plane

5. The ratio of actual damping co-efficient to the critical damping co-efficient is known as

   (a) Critical damping (b) Damping factor
   (c) Magnification factor (d) Logarithmic decrement

6. Whirling speed of a shaft coincides with the natural frequency of its

(a) Longitudinal vibration (b) Transverse vibration
(c) Torsion vibration (d) Coupled bending torsion vibration

7. For a vibrating body under steady state forced vibration, if ratio ω/ωn is very low, the phase angle would tend to approach

(a) 0° (b) 90° (c) 180° (d) 270°

8. Rotating shafts tend to of vibrate violently at whirling speeds because

(a) the shaft are rotating at vary speeds
(b) Bearing centerline coincide with the shaft axis
(c) the system is un balanced
(d) Resonance is caused due to the heavy weight of the rotor

9. A Porter governor has a maximum and minimum equilibrium speeds of 200 rpm and 150 rpm respectively. If the effective load on the sleeve is 30 kgf, the governor effort would be

(a) 1.67 kgf (b) 5.83 kgf (c) 7.5 kgf (d) 10.0 kgf

10. A bicycle remains stable in running through a bend because of

(a) gyroscopic action (b) carioles' acceleration
(c) Centrifugal action (d) Radius of curved path

PART - B (5 x 2 = 10 Marks)

11. Define D " Alembert Principle.

12. What are the effects of partial balancing in locomotive?

13. Define Degree of freedom.

14. Difference between harmonic forcing and periodic forcing.

15. What is the governor and their types.

PART - C (5 x 16 = 80 Marks)

16. (a) The crank and connecting rod of a vertical petrol engine, running at 1800 rpm are 60mm and 270 mm respectively. The diameter of the piston is 100 mm and the mass of the reciprocating parts is 1.2 kg. During the expansion stroke when the crank has turned 20° from the top dead centre, the gas pressure is 650 KN/m^2. Determine (i) The net force on the piston (ii) The net load on the gudgeon pin (iii) The thrust on the cylinder walls (iv) The speed at which the gudgeon pin load is reversed in direction. (16)

Or

(b) The turning moment diagram for a multi-cylinder engine has been drawn to a scale of 1 *mm* to 500 *N-m* torque and 1 *mm* to 6° of crank displacement. The intercepted areas between output torque curve and mean resistance line taken in order from one end, in *sq. mm* are – 30, + 410, – 280, + 320, – 330, + 250, – 360, + 280, – 260 *sq.mm*, when the engine is running at 800 *r.p.m*. The engine has a stroke of 300 *mm* and the fluctuation of speed is not to exceed ± 2% of the mean speed. Determine a suitable diameter and cross-section of the flywheel rim for a limiting value of the safe centrifugal stress of 7 *MPa*. The material density may be assumed as 7200 kg/m^3.The width of the rim is to be 5 times the thickness. (16)

17. (a) Four masses A,B,C and D are completely balanced. Masses C and D make angle of 90° and 195° respectively with that of mass B in the counter- clockwise direction. The rotating masses have following properties: m_b = 25 kg, m_c = 40 kg, m_d = 35 kg, r_a =150 mm, r_b = 200 mm, r_c = 100 mm, r_d = 180mm. Planes B and C are 250 mm apart. Determine (i) the mass A and its angular position with that of mass B (ii) the position of all the planes relative to plane of mass A. (16)

Or

(b) A four cylinder in-line engine running at 2000 r.p.m is having crank and connecting rod lengths of 60 mm and 240 mm respectively. The mass of reciprocating parts of each cylinder is 2 kg. The cylinders are spaced 160 mm apart and the cranks appear at 90^0 intervals in an end view. If the firing order of the engine is 1-4-2-3, Determine: (i) The unbalanced primary and secondary forces; (ii) The unbalanced primary and secondary couples. (16)

18. (a) A machine of mass 75 *kg* is mounted on springs and is fitted with a dashpot to damp out vibrations. There are three springs each of stiffness 10 *N/mm* and it is found that the amplitude of vibration diminishes from 38.4 *mm* to 6.4 *mm* in two complete oscillations. Assuming that the damping force varies as the velocity, determine: (i) The resistance of the dashpot at unit velocity; (ii) The ratio of the frequency of the damped vibration to the frequency of the undamped vibration; and (iii) The periodic time of the damped vibration. (16)

Or

(b) A machine weights 18 kg and is supported on springs and dashpots. The total stiffness of the spring is 12 N/mm and damping is 0.2 N/mm/s. The system is initially at rest and a velocity of 120 mm/s is imparted to the mass. Determine (i) the displacement and velocity of mass as a function of time (ii) The displacement and velocity after 0.4s. (16)

19. (a) A machine supported symmetrically on four spring has a mass of 80 kg. The mass of the reciprocating parts is 2.2 kg which move through a vertical stroke of 100 mm with simple harmonic motion. Neglecting damping, determine the $1/20^{th}$ of the impressed force. The machine crankshaft rotates at 800 rpm. If under actual working conditions, the damping reduces the amplitudes of successive vibration by 30/-, find (i) The force transmitted to the foundation at 800 rpm (ii) The force transmitted to the foundation at resonance, and The amplitude of the vibration at resonance. (16)

Or

(b) A single-cylinder engine of total mass 200 *kg* is to be mounted on an elastic support which permits vibratory movement in vertical direction only. The mass of the piston is 3.5 *kg* and has a vertical reciprocating motion which may be assumed simple harmonic with a stroke of 150 *mm*. It is desired that the maximum vibratory force transmitted through the elastic support to the foundation shall be 600 *N* when the engine speed is 800 *r.p.m*. and less than this at all higher speeds. (i) Find the necessary stiffness of the elastic support, and the amplitude of vibration at 800 *r.p.m*., and (ii) If the engine speed is reduced below 800 *r.p.m*. at what speed will the transmitted force again becomes 600 N? (16)

20. (a) Each arm of a Porter governor is 250 mm long. The upper and lower arms are pivoted to links of 40 mm and 50 mm respectively from the axis of rotation. Each ball has a mass of 5 kg and the sleeve mass is 50 kg. The force of friction on the sleeve of the mechanism is 40 N. Determine the range of speed of the governor for extreme radii of rotation of 125 mm and 150 mm. (16)

Or

(b) A 2.2 tone racing car has a wheel base of 2.4 m and a track of 1.4 m. The center of mass of the car lies at 0.6 m above the ground and 1.4 m from the rear axle. Equivalent mass of engine parts is 140 kg with radius of gyration of 150 mm. The back axle ratio is 5. The engine shaft and flywheel rotate clockwise when viewed from front. Each wheel has a diameter of 0.8 m and a moment of inertia of 0.7 $kg.m^2$. Determine the load distribution on the wheel when the car is rounding a curve of 100 m radius at a speed of 72 km/hr to the (i) left (ii) right. (16)

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