Reg. No. : | | | | | | | | | | |

Question Paper Code: 45701

B.E. / B.Tech. DEGREE EXAMINATION, APRIL 2019

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 a turning moment diagram, the variations of energy above and below the mean resisting torque line is called

   (a) maximum fluctuation of energy (b) coefficient of fluctuation of energy
   (c) fluctuation of energy (d) Total potential energy

2. When the crank is at the inner dead center, in the horizontal reciprocating steam engine, then the velocity of piston will be

   (a) Maximum (b) Minimum (c) Zero (d) Constant

3. 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

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. During transverse vibrations, shaft is subjected to which type of stresses?

   (a) Tensile stresses (b) Torsional shear stress
   (c) Bending stresses (d) none of these

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. State the function of governor. Can fly wheel also carry out the function of governor?

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) A shaft carries four masses *A, B, C* and *D* of magnitude 200 *kg*, 300 *kg*, 400 *kg* and 200 *kg* respectively and revolving at radii 80 *mm*, 70 *mm*, 60 *mm* and 80 *mm* in planes measured from *A* at 300 *mm*, 400 *mm* and 700 *mm*. The angles between the cranks measured anticlockwise are *A* to *B* 45°, *B* to *C* 70° and *C* to *D* 120°. The balancing masses are to be placed in planes *X* and *Y*. The distance between the planes *A* and *X* is 100 *mm*, between *X* and *Y* is 400 *mm* and between *Y* and *D* is 200 *mm*. If the balancing masses revolve at a radius of 100 *mm*, find their magnitudes and angular positions. (16)

Or

(b) A four cylinder oil engine is in complete primary balance. The arrangement of the reciprocating masses in different planes is as shown in Fig. The stroke of each piston is 2r mm. Determine the reciprocating mass of the cylinder 2 and the relative crank position. (16)

18. (a) In a single degree of damped vibrating system, a suspended mass of 7.5 kg makes 60^o oscillations in 35 seconds when disturbed from its equilibrium position. The amplitude decreases to 0.4 of the initial value after 7 oscillations. Determine: (i) stiffness of the spring, (ii) the logarithmic decrement, (iii) damping factor and (iv) damping coefficient. (16)

Or

(b) A steel shaft 1.5 *m* long is 95 *mm* in diameter for the first 0.6 *m* of its length, 60 *mm* in diameter for the next 0.5 *m* of the length and 50 *mm* in diameter for the remaining 0.4 *m* of its length. The shaft carries two flywheels at two ends, the first having a mass of 900 *kg* and 0.85 *m* radius of gyration located at the 95 *mm* diameter end and the second having a mass of 700 *kg* and 0.55 *m* radius of gyration located at the other end. Determine the location of the node and the natural frequency of free torsional vibration of the system. The modulus of rigidity of shaft material may be taken as 80 GN/m^2. (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)

———————