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**Reg. No. :**

**Question Paper Code: 45071**

B.E. / B.Tech. DEGREE EXAMINATION, NOV 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. 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

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

(a) fluctuation of energy (b) maximum fluctuation of energy (c) coefficient of fluctuation of energy (d) none of the these

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. In a locomotive, the ratio of the connecting rod length to the crank radius is kept very large in order to

(a) minimize the effect of primary forces (b) minimize the effect of secondary forces (c) have perfect balancing (d) start the locomotive quickly

5. 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

6. 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

7. The frequency of damped vibrations with viscous damping is \_\_\_\_\_\_\_\_ the frequency of undamped vibrations.

(a) More than (b) Less than (c) Equal to (d) Zero

8. The ratio of the maximum displacement of the forced vibration to the deflection due to the static force, is known as

(a) damping factor (b) damping coefficient (c) logarithmic decrement (d) magnification factor

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. Which of the following governor is used to drive a gramophone

(a) Watt governor (b) Porter governor (c) Pickering governor (d) Hartnell governor

PART - B (5 x 2 = 10 Marks)

11. Differentiate between static force analysis and dynamic force analysis.

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

13. What is over damping and under damping of a system?

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 lengths of an engine are 125 mm and 500 mm respectively. The mass of the connecting rod is 60 kg and its centre of gravity is 275 mm from the crosshead pin centre, the radius of gyration about centre of gravity being 150 mm. If the engine speed is 600 r.p.m. for a crank position of 45° from the inner dead centre, determine, using Klien’s or any other construction

(i) The acceleration of the piston;

(ii) The magnitude, position and direction of inertia force due to the mass of the

connecting rod. (16)

Or

(b) The turning diagram for a multi cylinder engine has been drawn to a scale 1 cm =

2500 Nm torque and 1 cm = of crank rotation respectively. The intercepted areas

between the output torque curve and mean resistance line take in order from one end

are:= +0.6, -8.2, +5.6,-6.4,+6.6,-5.0,+7.2,-5.6, and +5.2 sq.cm, when the engine runs at

600 rpm.If the fluctuation of speed of the flywheel is not to exceed 1 % of the mean

speed and the hoop stress in the flywheel is limited to 25x106N/m2, find the suitable

diameter and the cross- section of the flywheel required. Assume density of flywheel

material ρ = 7200 kg/, thickness of rim t= 0.4 x b width of the flywheel. (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

60o oscillations in 35 seconds when disturbed from its equilibrium position. The

amplitude decreases to 0.4 of the initial value after 7 oscillations. Determine:

1. stiffness of the spring,
2. the logarithmic decrement,

(iii) damping factor and (iv) damping coefficient. (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) Tthe displacement and velocity of mass as a function of time

(ii) The displacement and velocity after 0.4s. (16)

19. (a) A machine part of mass 2 *kg* vibrates in a viscous medium. Determine the damping coefficient when a harmonic exciting force of 25 *N* results in resonant amplitude of 12.5 *mm* with a period of 0.2 second. If the system is excited by a harmonic force of frequency 4 *Hz* what will be the percentage increase in the amplitude of vibration when damper is removed as compared with that with damping. (16)

Or

(b) An electric motor is supported on a spring and dashpot. The spring has stiffness 5000 N/m and dashpot offers a resistance of 300 N at 2.5 m/s. The unbalanced mass of 1.5 kg rotates at 50 mm radius and total mass of electric motor is 50 kg. if the motor runs at 340 r.p.m, determine:

(a) The damping factor ;

(b) The amplitude of steady-state vibrations ; and

(c) The phase angle ;

(d) The resonance speed ;

(e) The amplitude at resonance ; and

(f) The resultant force exerted by spring and dashpot on the motor. (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 two wheeler motor vehicle and its rider weigh 130 kg and their combined centre of

gravity is 750 mm above the ground level when the vehicle is upright. Each road wheel is 600 mm diameter and has M.I of 1.2 kg-. About its axis of rotation. The rotating parts of the engine have M.I of 0.4 kg-. The engine rotates at 5 times the speed of the road wheels and in the same sense. When the vehicle is rounding the curve of 130 m radius at a speed if 60 km/hr. Determine:

1. Magnitude of total gyroscopic couple acting on vehicle.

(ii) Angle of banking so that there will be no tendency of side slip. (16)