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B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2009

FIFTH SEMESTER

MECHANICAL ENGINEERING

ME1301 DYNAMICS OF MACHINERY

(REGULATION 2007)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define Inertia force.

2. What is meant by turning moment diagram or crank effort diagram?

3. Why balancing of dynamic forces is necessary?

4. What is swaying couple?

5. What are the causes of vibration?

6. Define critical or whirling or whipping speed of a shaft.

7. What is meant by transmissibility?

8. Define logarithmic decrement.

9. What is the principle of Inertia governors?

10. Define Gyroscopic torque.

PART B — (5 × 16 = 80 marks)

11. A horizontal gas engine running at 210 rpm has a bore of 220 mm and stroke of 440mm. The connecting rod is 924 mm long and the reciprocating parts weighs 20 kg. When the crank has turned through an angle of 30° from the inner dead centre, the steam pressure on the cover and crank sides are 500 KN/m^2 and 60 KN/m^2 respectively. The diameter of piston rod is 40 mm. Determine

(a) The turning moment on the crank shaft

(b) Thrust on the bearing

(c) Acceleration of the flywheel which has a mass of 8 kg and radius of gyration of 600 mm while the power of the engine is 22 KW.

Or

12. The connecting rod of a vertical steam engine is 2 m long between centres and weighs 250 kg. The mass centre is 800 mm from the big end bearing. When suspended as pendulum from gudgeon pin axis, it makes 8 complete oscillations in 22 seconds. Calculate the radius of gyration of the rod about an axis through its mass centre. The crank is 400 mm long and rotates at 200 rpm. Find the inertia torque exerted on the crankshaft when the crank has turned through 40° from the top dead centre and the piston is moving downwards.

13. A shaft carries four masses A, B, C and D of magnitude 200 kg, 300 kg, 400 kg and 200 kg respectively are revolving at radii of 80mm, 70 mm, 60 mm and 80 mm in planes measured from A at 300 mm, 400 mm and 700 mm. The angle between the cranks measured anticlockwise are A to B is 45°, B to C 75° and C to D 120°. The balancing masses are to be placed in planes X and Y. The distance between plane 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 magnitude and angular positions.

Or

14. The firing order of a six cylinder vertical four stroke in line engine is 1-4-2-6-3-5. The piston stroke is 80 mm and the length of each connecting rod is 180 mm. The pitch distance between the cylinder centre lines are 80 mm, 80 mm, 120 mm,80 mm and 80 mm respectively. The reciprocating mass per cylinder is 1.2 kg and the engine speed is 2400 rpm. Analyze the engine for secondary forces and couples only.

15. A vibrating system consists of a mass of 8 kg, spring of stiffness 20KN/m and a dash of damping coefficient of 40 N/m/sec. Find

(a) Damping factor (b) Logarithmic decrement and

(c) Ratio of two consecutive amplitudes.

Or

16. The mass of a single degree damped vibrating system is 7.5 kg and makes 24 free oscillations in 14 seconds when disturbed from its equilibrium position. The amplitude of vibration reduces to 0.25 of its initial value after five oscillations. Determine

(a) Stiffness of the spring (b) Logarithmic decrement and

(c) Damping factor.

17. A mass of 50 kg is supported by an elastic structure of total stiffness 20 KN/m. The damping ratio of the system is 0.2. A harmonic force of 60 cos10t, Newton acts on it. Find the amplitude of vibration and phase angle caused by the damping.

Or

18. A machine of mass 75 kg is mounted on springs of stiffness 1200 kN/m and with an assumed damping factor of 0.2. A piston within the machine of mass 2 kg has a reciprocating motion with a stroke of 80 mm and a speed of 3000 cycles/min. Assuming the motion to be simple harmonic, find,

(a) The amplitude of motion of the machine,

(b) The phase angle with respect to the existing force,

(c) The force transmitted to the foundation and

(d) The phase angle of transmitted force respected to the exciting force.

19. A Hartnell governor having a central sleeve spring and two right angled bell crank levers operates between 290 rpm and 310 rpm for a sleeve lift of 15 mm. The sleeve and bell arms are 80 mm and 120 mm respectively. The levers are pivoted at 120 mm from the governor axis and mass of each ball is 2.5 kg. The ball arms parallel at lowest equilibrium speed. Determine

(a) Loads on the spring at maximum and minimum speeds

(b) Stiffness of the spring.

Or

20. The rotor of a turbine yacht rotates at 1200 rpm clockwise when viewed from stern. The rotor has a mass of 750 kg and radius of gyration of 250 mm. Find the maximum gyroscopic couple transmitted to the hull when yacht pitches with a maximum angular velocity of 1 ras/sec. What is the effect of this couple?
