C 26791 (Pages : 3) Name.....

Reg. No.....

SIXTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION, MAY 2012

PTME/ME 09 601—DYNAMICS OF MACHINERY

Time : Three Hours Maximum : 70 Marks

Part A

Answer **all** *questions.*

1. Explain the principle of virtual work.
2. Why balancing is necessary for rotors of high speed engines ?
3. What are the factors responsible for the critical speed in shaft ?
4. What is meant by dynamic coupling ?
5. Why the linear systems tend to become non-linear with larger vibration amplitudes ?

(5 × 2 = 10 marks)

Part B

Answer any **four** *questions.*

6. Derive the expression for angular velocity of connecting rod.
7. A horizontal gas engine running at 210 r.p.m. has a bore of 220 mm. and a stroke of 440 mm. The connecting rod is 924 mm. long and the reciprocating parts weigh 20 kg. When the crank has turned through an angle of 30° from the IDC, the gas pressure on the cover and the crank sides are 500 kN/m^2 and 60 kN/m^2 respectively. Diameter of the piston rod is 40 mm. Find the piston effort.
8. A flywheel fitted to a steam engine has a mass of 1000 kg and radius of gyration 350 mm. The starting torque of the engine is a constant which is equal to 580 Nm. Find the kinetic energy of the flywheel after 10 seconds.
9. A uniform disc of diameter 30 cm. and weighing 5 N is mounted on one end of an arm of length 60 cm. The other end of the arm is free to rotate in a universal bearing. If the disc rotates about the arm with a speed of 300 r.p.m. clockwise, looking from the front, with what speed will it precess about the vertical axis.
10. Derive the natural frequency of a spring mass system by energy method.
11. A stepped shaft carries two masses at its both ends. The shaft has 100 mm. diameter for first 100 mm. length, 150 mm. diameter for next 200 mm. length and 90 mm. diameter for the last 400 mm. length. Find the length of the torsionally equivalent shaft.

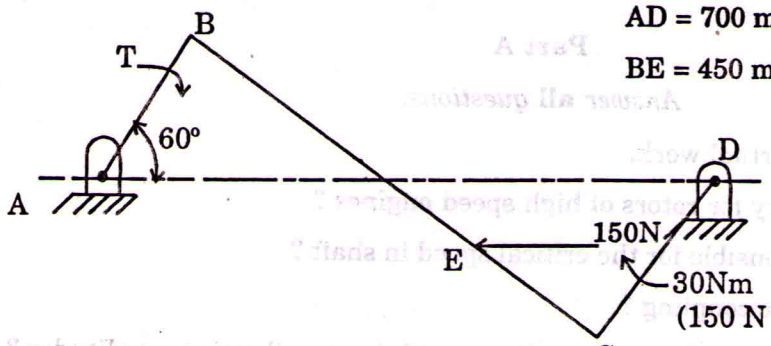
(4 × 5 = 20 marks)

Turn over

Part C

12. Determine the torque to be applied to the link AB of a four bar link mechanism shown below to maintain static equilibrium at the given position.

AB = 200 mm., BC = 700 mm,
AD = 700 mm, CD = 400 mm,
BE = 450 mm.



Or

13. A single cylinder vertical engine has a bore of 30 cm. and a stroke of 40 cm. The connecting rod is 100 cm. long. The mass of the reciprocating parts is 140 kg. On the expansion stroke with the crank at 30° from TDC the gas pressure is 0.7 MPa. If the engine runs at 250 r.p.m. determine (i) net force acting on the piston, (ii) resultant load on the gudgeon pin (iii) thrust on the cylinder walls and (iv) the speed above which, other things remaining the same, the gudgeon pin load would be reversed in direction.

14. A shaft carries four masses in parallel planes A, B, C and D in this order along its length. The masses at B and C are 18 kg. and 12,5 kg. respectively and each has an eccentricity of 60 mm. The masses A and D have an eccentricity of 80 mm. The angle between the masses B and C is 100° and that between the masses at B and A is 190°, both being measured in same direction. The axial distance between the planes A and B is 100 mm. and between B and C is 200 mm. If the shaft is in complete dynamic balance, determine the magnitudes of masses A and D and angular position of the mass D.

Or

15. A motor cycle and its rider together have a mass of 200 kg. and their combined centre of gravity is 0.6 m. above the ground level when the motor cycle is upright. Each road wheel is of 0.6 m. diameter and has a moment of inertia 1 kgm^2. The rotating parts of the engine have moment of inertia 0.17 kgm^2. The engine rotates at 5 times the speed of the road wheels and in the same sense. Determine the angle of heel necessary when the motor cycle is rounding a curve of 30 m. radius at a speed of 55 km/hr.

16. A body of 5 kg is supported on a spring of stiffness 200 N/m and has a dashpot connected to it which produces a resistance of 0.002 N at a velocity of 1 cm./sec. In what ratio will the amplitude of vibration be reduced after 5 cycles?

Or

17. A body of mass 20 kg. is suspended from a spring which deflects 15 mm. under this load. Calculate the frequency of free vibrations and verify that a viscous damping force amounting to approximately 1000 N at a speed of 1 m/s is just sufficient to make the motion aperiodic. If when damped to this extend, the body is subjected to a disturbing force with a maximum value of 125 N making 8 cycles, find the amplitude of the ultimate motion.

18. An automobile weighs 2000 N and has a wheel base of 3 m. Its centre of gravity is located 1.4 m. behind the front wheel axis and has a radius of gyration about its C.G as 1.1 m. The front springs have a combined stiffness of 6×10^6 N/m and rear springs 6.5×10^6 N/m. Find the principle mode of vibration of the automobile and locate the nodal points for each mode.

Or

19. Three rotors A, B and C having moment of inertia of 2000 kgm^2, 6000 kgm^2, and 3500 kgm^2 respectively are carried on a uniform shaft of 0.35 m. diameter. The length of the shaft between the rotors A and B is 6 m. and between B and C is 32 m. Find the natural frequency of torsional vibrations. Take G = 80 GPa.

(4 × 10 = 40 marks)