Registration No. :

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B. Tech

PCME 4301

Fifth Semester Examination – 2013

MACHINE DYNAMICS

BRANCH : MECH

QUESTION CODE : C-381

Full Marks – 70

Time : 3 Hours

Answer Question No. 1 which is compulsory and any five from the rest.
The figures in the right-hand margin indicate marks.

1. Answer the following questions :   2×10

    (a) What is correct steering ?

    (b) What are the gyroscopic effect on a ship ?

    (c) How is the shape of the involute tooth profile ?

    (d) What do you understand by the term 'interference' as applied to gears ?

    (e) Define the following terms as applied to cam :

        (i)   Base circle,

        (ii) Pitch circle.

    (f) What is a turning moment diagram ?

    (g) How a governor is different from that of a flywheel ?

    (h) Define 'static balancing' and 'dynamic balancing'.

    (i) What is partial balance of engines ?

    (j) Explain about 'Logarithmic decrement'.

P.T.O.

2. (a) Describe about Davis steering gear. 5

   (b) Two shafts are connected by a Hooke's joint. The driving shaft revolves uniformly at 500 r.p.m. If the total permissible variation in speed of a driven shaft is not to exceed 6% of the mean speed, find the greatest permissible angle between the centre lines of the shafts. Also determine the maximum and minimum speed of the driven shaft. 5

3. (a) What do you understand by gyroscopic couple ? Derive a formula for its magnitude. 4

   (b) An aeroplane makes a complete half circle of 50 meters radius, towards left, when flying at 200 km per hour. The rotary engine and the propeller of the plane have a mass of 400 kg with a radius of gyration of 300 mm. The engine runs at 2400 r.p.m. clockwise, when viewed from the rear. Find the gyroscopic couple on the aircraft and state its effect on it. What will be the effect, if the aeroplane turns to its right instead of to the left ? 6

4. (a) State and prove the law of gearing. 5

   (b) Two mating involute spur gear of 20° pressure angle have a gear ratio of 2. The number of teeth on the pinion is 20 and its speed is 250 r.p.m. The pinion to be the driver. The module pitch of the teeth is 12 mm. If the addendum on each wheel is such that the path of approach and the path of recess on each side are half the maximum possible length, find : (i) the length of the arc of contact ; and (ii) the maximum velocity of sliding during approach and recess. 5

5. A cam rotating clockwise at a uniform speed of 100 r.p.m. is required to give motion to knife-edge follower as below : (a) Follower to move outwards through 25 mm during 90° of cam rotation, (b) Follower to dwell for the next 60° of cam rotation, (c) Follower to return to its starting position during next 120° of cam rotation, and (d) Follower to dwell for the rest of the cam rotation.

The minimum radius of the cam is 50 mm and the line of stroke of the follower passes through the axis of the cam shaft. If the displacement of the follower takes place with uniform and equal acceleration and retardation on both the outward and return strokes, draw the cam profile. Also find the maximum velocity and acceleration during outstroke and return stroke. 10

6. (a) Define and explain the following terms relating to governors : 4

   (i) Stability,

   (ii) Sensitiveness,

   (iii) Isochronism and

   (iv) Hunting.

   (b) A Porter governor has links 150 mm long and is attached to pivots at a radial distance of 30 mm from the vertical axis of the governor. The mass of each ball is 1.75 kg and the mass of the sleeve is 25 kg. The governor sleeve begins to rise at 300 r.p.m. when the links are at 30° to the vertical. Assuming the friction force to be constant, find the minimum and maximum speed of rotation when the inclination of the links is 45° to the vertical. 6

7. (a) In a turning moment diagram, the areas above and below the mean torque line taken in order are 4400, 1150, 1300 and 4550 mm² respectively. The scales of the turning moment diagram are: Turning moment, 1 mm = 100 N-m ; Crank angle, 1 mm = 1°. Find the mass of the flywheel required to keep the speed between 297 and 303 r.p.m., if the radius of gyration is 0.525 m. 5

   (b) Four masses A, B, C and D are attached to a shaft and revolve in the same plane. The masses are 6 kg, 5 kg, 9 kg and 7 kg respectively and their radii of rotations are 40 mm, 50 mm, 60 mm and 34 mm. The angular position of the masses B, C and D are 60°, 150° and 240° from the mass A. Find the magnitude and position of the balancing mass at a radius of 100 mm. 5

8   (a)   Explain the terms 'under damping, critical damping' and 'over damping' with suitable example.   3

     (b)   A mass of 7.5 kg hangs from a spring and makes damped oscillations. The time for 60 oscillations is 35 seconds and the ratio of the first and seventh displacement is 2.5. Find :   7

       (i)   the stiffness of the spring,

       (ii)   the damping factor and

       (iii)   logarithmic decreament.