Registration No. :

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B. Tech

PCME 4301

Fifth Semester Regular Examination – 2014

MACHINE DYNAMICS

BRANCH : MECH

QUESTION CODE : H 135

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) Why Ackerman steering gear mechanism is preferred to the Davis steering gear mechanism ?

    (b) What will be the effect of gyroscopic couple, if the rotor of a ship rotates in counter clockwise direction when viewed from the stern and the ship takes a right turn ?

    (c) Explain the term 'interference' as applied to gears.

    (d) What are the advantages and disadvantages of the gear drive as compared to belt, rope and chain drives ?

    (e) Why a roller follower is preferred to that of a knife-edged follower for a cam ?

    (f) What is the function of a governor ? Is it same as that of a flywheel ?

    (g) State D-Alembert's principle. Where it can be used ?

    (h) Using revolving mass, only a part of the unbalanced force due to reciprocating masses is balanced. Why ?

P.T.O.

(i) Describe the nature of displacement with time in case of 'under damping, critical damping' and 'over damping'.

(j) Explain the term 'whirling speed' or 'critical speed' of a shaft.

2. (a) Is Davis steering gear obeys the condition for correct steering ? Explain. 5

(b) Two inclined shafts are connected by means of a universal joint. The speed of the driving shaft is 600 r.p.m. If the speed of the driven shaft must lie between 540 to 660 rpm, what is the maximum possible inclination between the two shafts ? With this angle, what will be the maximum acceleration to which the driven shaft is subjected ? 5

3. The mass of a turbine rotor of a ship is 8 tonnes and has a radius of gyration 0.6 m. It rotates at 1800 r.p.m. clockwise when looking from the stern. Determine the gyroscopic effects in the following cases : 10

(i) If the ship traveling at 100 km / h and steers to the left in a curve of 75 m radius,

(ii) If the ship is pitching and the bow is descending with maximum velocity. The pitching is simple harmonic, the periodic time being 20 seconds and the total angular movement between the extreme positions is 10°, and 3°. If the ship is rolling and at a certain instant has an angular velocity of 0.03 rad/s clockwise when looking from stern.

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

(b) A pinion having 20 involute teeth of module pitch 6 mm rotates at 200 r.p.m. and transmits 1.5 kW to a gear wheel having 50 teeth. The addendum on both the wheels is 1/4 of the circular pitch. The angle of obliquity is 20°. Find 6

(i) the length of the path of approach ;

(ii) the length of the arc of approach.
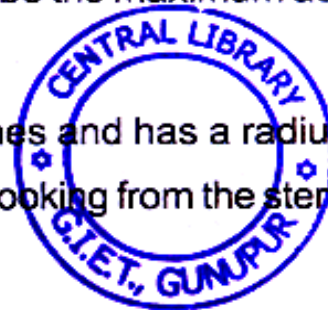
5. For a radial cam the following data are given, the follower moves with simple harmonic motion during ascent while it moves with uniformly accelerated motion during descent :

Least radius of cam = 60 mm ; Angle of ascent = 45° ; Angle of dwell between ascent and descent = 45° ; Angle of descent = 60° ; Lift of follower = 40 mm ; Diameter of roller = 25 mm ; The cam rotates at 360 r.p.m. anticlockwise.

Draw the profile of the cam and determine the maximum velocity and the acceleration of the follower during outstroke and the return stroke. 10

6. (a) A Hartnell governor has two rotating balls, of mass 2.7 kg each. The ball radius is 125 mm in the mean position when the ball arms are vertical and the speed is 150 r.p.m. with the sleeve rising. The length of the ball arms is 140 mm and the length of the sleeve arms 90 mm. The stiffness of the spring is 7 kN/m and the total sleeve movement is 12 mm from the mean position. Allowing for a constant friction force of 14 N acting at the sleeve, determine the speed range of the governor in the lowest and highest sleeve positions. Neglect the obliquity of the ball arms. 5

   (b) The turning moment diagram for a multicylinder engine has been drawn to a scale of 1 mm = 4500 N-m vertically and 1 mm = 4° horizontally. The intercepted areas between output torque curve and mean resistance line taken in order from one end are 342, 23, 245, 303, 115, 232, 227, 164 mm², when the engine is running at 150 r.p.m. If the mass of the flywheel is 1000 kg and the total fluctuation of speed does not exceed 3% of the mean speed, find the minimum value of the radius of gyration. 5

7. A rotating shaft carries four masses A, B, C and D which are radially attached to it. The mass centres are 30 mm, 38 mm, 40 mm and 35 mm respectively from the axis of rotation. The masses A, C and D are 7.5 kg, 5 kg and 4 kg respectively.

The axial distances between the planes of rotation of A and B is 400 mm and between B and C is 500 mm. The masses A and C are at right angles to each other. Find for a complete balance,   10

(i)   the angles between the masses B and D from mass A,

(ii)   the axial distance between the planes of rotation of C and D,

(iii)   the magnitude of mass B.

8.   (a)   Write short notes on Vibration Isolation and Transmissibility.   5

     (b)   A body of mass of 50 kg is supported by an elastic structure of stiffness 10 kN/m. The motion of the body is controlled by a dashpot such that the amplitude of vibration decreases to one-tenth of its original value after two complete vibrations. Determine :   5

        (i)   the damping force at 1 m/s ;

        (ii)   The damping ratio, and 3. the natural frequency of vibration.

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