Seat No: - _____

Ganpat University
B. Tech. Sem. IV Mechanical Engineering
CBCS Regular Examination May/June - 2013
2ME404 Dynamics of Machines

[Time: 3 Hour] [Total marks: 70]

Instructions:

(1) Attempt all questions.
(2) Figure to the **right** indicate full marks.
(3) Assume suitable data if necessary.
(4) Only scientific calculator is allowed.
(5) Draw neat sketch wherever essential.

SECTION-I

Que.1

(A) Why double Hooke's joint is used in automobile? [2]

(B) Derive an expression for the ratio of shafts velocities for Hooke's joint. [4]

(C) Two shafts of a Hooke's coupling have their axes inclined at 20°. The shaft A rotates at a uniform speed of 1000 rpm. The shaft B carries a flywheel of mass 30 kg. if the radius of gyration of the flywheel is 100 mm, find the maximum torque in shaft B. [6]

OR

Que.1

(A) Sketch a polar velocity diagram of a Hooke's joint. [2]

(B) What do you mean by intermittent motion mechanism? List out such mechanisms and explain any one with neat sketch. [4]

(C) The driving shaft of a Hooke's joint runs at a uniform speed of 240 rpm and the angle α between the shafts is 20°. The driven shaft with attached masses has a mass of 55 kg at a radius of gyration of 150 mm. [6]

(i) If a steady torque of 200 N-m resists rotation of the driven shaft, find the torque required at the driving shaft, when θ = 45°.

(ii) At what of 'α' will the total fluctuation of speed of the driven shaft be limited to 24 rpm?

Que.2

(A) Define the terms: (i) Module (ii) Addendum. [2]

(B) Derive an expression for the minimum number of teeth required on wheel in order to avoid interference in involute gear teeth when it messes with pinion. [4]

(C) A pair of involute spur gears with 16° pressure angle and pitch of module 6 mm is in mesh. The number of teeth on pinion is 16 and its rotational speed is 240 rpm. When the gear ratio is 1.74, find in order that the interference is just avoided; [6]

(i) the addendum on pinion and gear wheel,
(ii) the length of path of contact; and
(iii) the maximum velocity of sliding of teeth on either side of the pitch point.

OR

Que.2

(A) State the advantages of involute profile as a gear tooth profile. [2]

(B) Prove that the velocity of sliding is proportional to the distance of contact from the pitch point. [4]

(C) A pair of gears, having 40 and 20 teeth respectively, are rotating in mesh, the speed of smaller being 2000 rpm. Determine the velocity of sliding between the gear teeth faces at the point of engagement, at the pitch point and at the point of disengagement if the smaller gear is the driver. The gear teeth are 20° involute form, addendum length is 5 mm an the module is 5 mm. [6]

Also find the angle through which the pinion turns while any pairs of teeth are in contact.

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Que.3

(A) What is the condition of isochronism in governors? In what type of governors can it be achieved? [2]

(B) Sketch a hartnell governor. Describe its function and deduce a relation to find the stiffness of the spring. [4]

(C) Each ball of a porter governor has a mass of 3 kg and the mass of sleeve is 15 kg. The governor has equal arms, each of 200 mm length and pivoted on the axis of rotation. When the radius of rotation of the balls is 120 mm, the sleeve begins to rise up 160 mm at the maximum speed. Determine the, [5]

(i) range of speed
(ii) lift of the sleeve
(iii) effort of the governor
(iv) power of the governor

What will be the effect of friction at the sleeve if it is equivalent to 8 N?

OR

(C) A proell governor has equal arms of length 300 mm. The upper and lower ends of the arms are pivoted on the axis of the governor. The extension arms of the lower links are each 80 mm long and parallel to the axis when the radii of rotation of the balls are 150 mm and 200 mm. The mass of each ball is 10 kg and the mass of the central load is 100 kg. Determine the range of the governor.

SECTION – II

Que.4

(A) What is the principle of virtual work? Explain. [4]

(B) Determine the torque T_2 required to keep the mechanism shown in **figure - 1** in equilibrium. [8]
AD = 60 mm, AB = BC = CD = 30 mm, CQ = 19 mm, BP = 15 mm.

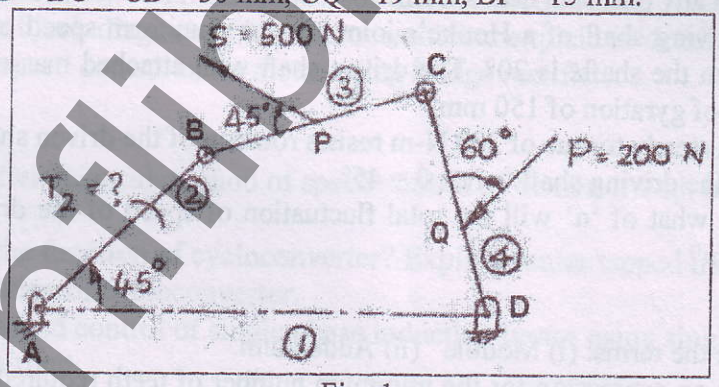

Fig.-1

OR

Que.4

(A) What are the conditions for a body to be in equilibrium under the action of three forces and four forces? [2]

(B) What are free body diagrams of a mechanism? How are they helpful in finding the various forces acting on various members of the mechanism? [4]

(C) Determine torque T_2 to keep the mechanism shown in **figure - 2** in equilibrium. AC = 70 mm, AB = 150 mm, O_2A = 40 mm. [6]

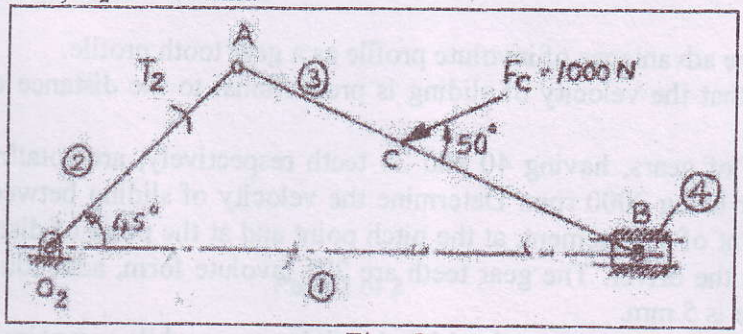

Fig.- 2

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Que.5

(A) What do you mean by equivalent offset inertia force? Explain. [3]

(B) When and why is the correction couple applied while considering the inertia of the connecting rod of a reciprocating engine? [3]

(C) For slider crank mechanism derive the formulas for: [6]

(i) Piston displacement
(ii) Velocity of Piston,
(iii) Acceleration of Piston,
(iv) Angular velocity and angular acceleration of connecting rod.

OR

Que.5

(A) Describe the classification of synthesis problem. [3]

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

(C) The rotor of a ship has mass of 2000 kg and its radius of gyration is 0.4 m. The rotor rotates at 3400 rpm in clockwise direction when viewed from front end. Determine the gyroscopic couple and its effect when: [6]

(i) the ship takes left turn at a radius of 350 m with a speed of 35 km/h,
(ii) the ship pitches with the bow rising at an angular velocity of 1 rad/s,
(iii) the ship rolls at an angular velocity of 0.15 rad/s.

Que.6 The dimensions of a four link mechanism are AB = 500 mm, BC = 660 mm, CD = 560 mm and AD = 1000 mm. The link AB has an angular velocity of 10.5 rad/s counter clockwise and an angular retardation of 26 rad/s^2 at the instant when it makes an angle of 60° with AD, the fixed link. The mass of links BC and CD is 4.2 kg/m length. The link AB has a mass of 3.54 kg, the centre of which lies at 200 mm from A and a moment of inertia of 88,500kg.mm^2. [11]

Neglecting gravity and friction effects, determine the instantaneous value of the drive torque required to be applied on AB to overcome the inertia forces.

END OF PAPER

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