Fifth Semester B.E. Degree Examination, Jan./Feb. 2023
Dynamics of Machines

Time: 3 hrs.   Max. Marks:100

Note: *Answer any FIVE full questions, selecting at least TWO full questions from each part.*

PART – A

1 a. Explain the equilibrium of two force members and three force members with sketches.
                                                                                (06 Marks)
   b. Explain the principle of virtual work, considering a slider crank mechanism.   **(06 Marks)**
   c. Explain the procedure for static force analysis of slider-crank mechanism with one known force on slider.   **(08 Marks)**

2 a. Explain turning moment diagram of a 4-stroke IC Engine.   **(04 Marks)**
   b. The turning moment diagram of a multi cylinder engine has been drawn to scale of 1mm = 500N-m torque and 1mm to 6° of crank displacement. The intercepted areas between output torque curve and mean resistance line, taken in order from one end, in square millimeter are: -30, +410, -280, +320, -330, +250, -360, +280 and -260. If the mean speed is 800rpm and fluctuation of speed is not to exceed 2% of mean speed, determine: i) mass of the flywheel   ii) Mean diameter of the flywheel, if the centrifugal stress in the flywheel rim is limited to 8N/mm^2 iii) Dimensions of the rectangular cross-section of the rim by taking the width of rim as 5 times the thickness. The density of cast iron is 7200kg/mm^3. Neglect the effect of hubs and arms of the flywheel.   **(16 Marks)**

3 a. Derive an expression for the ratio of tensions in a flat belt drive.   **(06 Marks)**
   b. A leather belt is required to transmit 9kW from a pulley 120cm in diameter running at 200rpm. The angle embraced is 165° and the co-efficient of friction between leather belt and pulley is 0.3. If the safe working stress for the leather belt is 140×10^4N/m^2, the mass of the leather belt is 1gm/cm^3 and the thickness of the belt is 10mm, determine the width of the belt taking centrifugal tension into account.   **(14 Marks)**

4 a. Explain balancing of several masses rotating in the same plane.   **(06 Marks)**
   b. A rotating shaft carries four radial masses A = 8kg, B = unknown, C = 6kg and D = 5kg. The mass centers are 30mm, 40mm and 50mm respectively from the axis of shaft. The axial distance between the planes of rotation of A and B is 400mm and between B and C is 500mm. The masses A and C are at right angles to each other. Find for a complete balance:
   i)   The angle between the masses and 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.   **(14 Marks)**

PART – B

5   a. A single cylinder reciprocating engine has the following data: speed of engine = 120rpm, stroke = 320mm, mass of reciprocating parts = 45kg, mass of revolving parts = 35kg at crank radius. If 60% of the reciprocating parts and all revolving parts are to be balanced, then find: i) The balance mass required at radius of 300mm,   ii) Unbalanced force when the crank has rotated 60° from top dead centre.   **(10 Marks)**

    b. A 90° - V engine has two cylinders which are placed symmetrically. The two connecting rods operate a common crank. The length of connecting rods are 320mm each and crank radius is 80mm. The reciprocating mass per cylinder is 12kg. If the engine runs at 600rpm, then determine primary and secondary resultant forces. Also find the maximum resultant secondary force.   **(10 Marks)**

6   a. Explain sensitiveness, isochronisms, effort and power of Governer.   **(08 Marks)**

    b. The mass of each ball of a spring controlled governer is 1.4kg. The bell crank lever has its vertical arm 90mm and horizontal arm 40mm. The distance of fulcrum from axis of rotation is 45mm. The sleeve has a mass of 7.5kg. The sleeve begins to raise at 220rpm. The rise of the sleeve for 6% rise in speed is 8mm. Find the initial thrust on the spring and its stiffness.   **(12 Marks)**

7   a. With usual notations and diagrams, derive an expression for the gyroscopic couple, produced by a rotating disc.   **(08 Marks)**

    b. The rotor of the turbine of a ship has a mass of 5000kg and rotates at a speed of 2100rpm clockwise when viewed from stern. The rotor has a radius of gyration of 0.5m. Determine the gyroscopic couple and its effect when,

    i)   The ship steers to the left in a curve of 60m radius at a speed of 16 knots [1 knot = 1860m/hr].

    ii) The ship pitches 6° above and 6° below the horizontal position and the bow is descending with its maximum velocity. The pitching motion is simple harmonic with a periodic time of 20 seconds.   **(12 Marks)**

8   A straight sided cam has both sides tangential to the base circle, with a radius of 25mm. The total angle of action = 120°. A lift of 10mm is given to the roller 20mm diameter, the centre of which moves along a straight line, passing through the axis moves along a straight line passing through the axis of the cam. The camshaft has a speed of 240rpm. Determine:

    i)   The radius of the nose arc.

    ii) The velocity and acceleration of the roller centre when the roller is in contact with the cam at the end of one of the straight flanks adjacent to the nose.

    iii) The acceleration of roller centre at the peak.   **(20 Marks)**

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