USN

10AE53

Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Dynamics of Machines

Time: 3 hrs. Max. Marks:100

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

PART – A

1 For the static equilibrium of Quick Return mechanism shown in Fig Q1, find the required input torque T_2 for a force of 300N on the slider (link 6). Neglect friction. Take $O_2A = 200mm$, $O_4B = 650mm$, $BC = 400mm$, $\theta = 30°$.

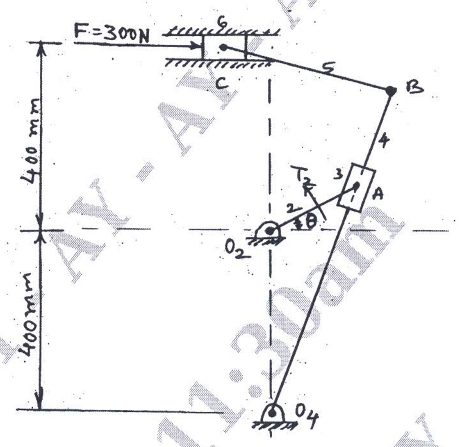

Fig Q1 **(20 Marks)**

2 a. The two mass system (m_1, m_2) is dynomically equivalent to a rigid body of mass (m). Then prove that

$$m_1 = \frac{m \times \ell_2}{\ell_1 + \ell_2}, \; m_2 = \frac{m \times \ell_1}{\ell_1 + \ell_2} \text{ and } \ell_1 \times \ell_2 = k^2$$

Where ℓ_1 = distance of mass m_1 from the CG of the body

ℓ_2 = distance of mass m_2 from the CG of the body

k = Radius of gyration **(08 Marks)**

b. A constant torque 4kW motor drives a rivetting machine. A flywheel of mass 140kg and radius of gyration of 0.5m is fitted to the rivetting machine. Each rivetting operation takes 1 second and requires 9000Nm of energy. If the speed of fly wheel is 420 rpm before revetting, then find :

i) The fall in speed of the flywheel after the revetting

ii) The number of riverts closed per hour. **(12 Marks)**

3 a. Derive an expression for the ratio of the tension in case of flat belt drive. **(08 Marks)**

b. A leather belt is required to transmit 8.5kW from a pulley 1.5m in diameter running at 300rpm. The angle of lap is 165° and the coefficient of friction between leather belt and pulley is 0.3. If the safe working stress for the leather belt is 1.4 N/mm^2, the mass of leather is 1000kg/m^3 and the thickness of belt is 10mm, determine the width of the belt taking the centrifugal tension into account. **(12 Marks)**

4 a. Explain static and Dynamic balancing. **(05 Marks)**

b. A rotating shaft carries four revolving masses in the planes A, B, C and D. The centre of masses are at distance of 32mm, 40mm, 42mm and 36mm respectivly from the axis of rotation. The masses A, C and D are 7kg, 5kg and 4kg respectively. The distance between planes A and B is 450mm and between B and C is 550mm. The centricities of A and C are 90° to each other. For complete balance find

i) Angular position of B and D
ii) The axial distance between planes C and D
iii) The mass of B **(15 Marks)**

PART – B

5 a. Show that in the partial primary balancing of reciprocating engine, the unbalanced force at any instant is equal to $m w^2 r\sqrt{(1-c)^2 \cos^2\theta + c^2 \sin^2\theta}$ with the usual notations. **(08 Marks)**

b. A 90° - V engine has two cylinders which are placed symmetrically. The two connecting rods operates a common crank. The length of connecting rods are 300mm each and crank radius is 80mm. The reciprocating mass per cylinder is 10kg. If the engine speed is 600rpm, then find the resultant primary and resultant secondary forces, also find the maximum resultant secondary force. **(12 Marks)**

6 a. Explain the following terms as related to governors
i) Sensitiveness ii) Effort iii) Controlling force. **(06 Marks)**

b. The length of upper and lower arms of porter governor are 367.6mm and 250mm repsectively. The upper arms are pivoted on the axis of rotation and lower arms are attached to the sleeve at a distanced of 50mm from the axis of rotation. The mass of each ball is 2.5kg and mass of sleeve is 25kg. The force of frication on the sleeve 20N. The masses revolve at a radious of 125mm and 150mm. Determine the range of speed. **(14 Marks)**

7 a. Derive an expression for the gyroscopic couple. **(06 Marks)**

b. A ship is propelled by a turbine rotor which has a mass of 6 tonnes and a speed of 2000rpm. The rotor has a radius of gyration of 0.5m and rotates in a clockwise direction when viewed from stren. Find the gyroscopic effects in the following conditions.

i) The ship sailes at a speed of 30km/hour and steers to the left in a curve having 60m radius
ii) The ship pitches 6 degree above and 6° below the horizontal position. The bow is descending with its mass velocity. The motion due to pitching is simple harmonic and the periodic time is 20 seconds.
iii) The ship rolls and at a certain instant it has an angular velocity of 0.03 rad/s clockwise when viewed from stern.

Determine also the maximum angular accelation during pitching. Explain how the direction of motion due to gyroscopic effect is determined in each case. **(14 Marks)**

8 The following particular relates to symmetrical circular cam operating a flat faced follower

Least radious	=	20mm
Nose radious	=	4mm
Distance between of shaft centre and nose centre	=	40mm
Angle of action of cam	=	150° and cam shaft speed of 600rpm.

Assuming that there is no dwell between ascent or decent, determine the lift of the valve, the flank radius and the acceleration and retardation of the follower at a point where circular nose mergers into circular flank. **(20 Marks)**

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