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Fifth Semester B.E. Degree Examination, June/July 2019
Dynamics of Machines

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Explain with diagram condition for static equilibrium of
(i) 2 force member (ii) 3 force member. **(06 Marks)**

b. For a mechanism shown in Fig.Q1(b), find the required input torque for static equilibrium. The lengths of OA and AB are 250mm, F = 500N. **(14 Marks)**

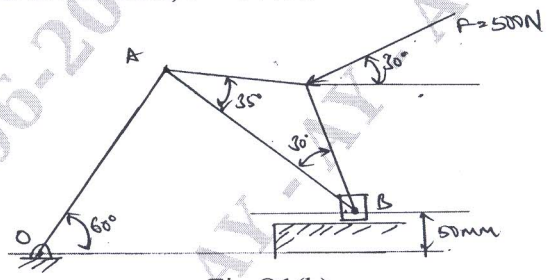
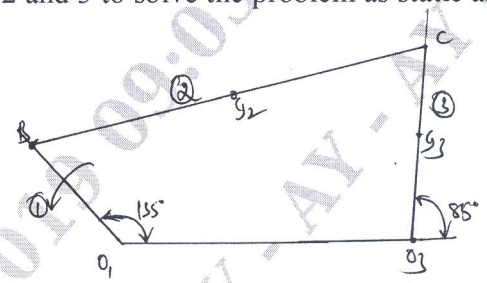


Fig.Q1(b)

2 A four bar linkage shown in figure along with dimensions of each link. G refers to centre of mass and the links have the following properties $M_1 = 0.1$ kg, $I_{G_1} = 20$ kg mm^2, $M_2 = 0.20$kg, $I_{G_2} = 400$ kg mm^2, $M_3 = 0.30$kg, $I_{G_3} = 20$ kg mm^2, angular velocity of driving link is W = 95 rad/s, CCW and input angular acceleration $a_1 = 0$ for the position shown in Fig.Q2. Neglect gravity and friction effects. Find the equivalent offset inertia force and offset from G for the links 2 and 3 to solve the problem as static analysis problem.



$O_1O_3 = 70$mm, $O_1B = 30$mm, $BC = 100$mm, $BG_2 = 50$mm, $O_3G_3 = 25$mm, $O_3C = 25$mm.

Fig.Q2 **(20 Marks)**

3 a. Comparing a 6 cylinder and single cylinder diesel engines which will need a larger flywheel. Substantiate your answer with reasons. **(03 Marks)**

b. Make atleast 3 comparisons between a flywheel and governor. **(03 Marks)**

c. The areas the turning moment curve for one revolution of a multicylinder engine above and below the line of mean resisting torque are given by –32, +408, – 267, +333, – 310, +226, –374, +260 and – 244mm^2. The vertical and horizontal scales are 1mm = 650 Nm and 1mm = 2.4° respectively. The fluctuation of speed is limited to ±1.5% of the mean speed which is 300 rpm. The hoop stress on the rim material is limited to 5.6 MPa. Neglecting the effect of bars and arms, determine suitable diameter and cross section of the flywheel rim-Density of the rim material is 7200 kg/m^3. Assume width of rim equal to four times its thickness. **(14 Marks)**

4 a. Deduce an expression for determining the displacement, velocity and acceleration of the follower when flat face of the follower has contact on the circular flank. **(08 Marks)**

b. A symmetrical circular arc cam operating a flat faced follower has the following particulars. Least radius of cam = 30 mm, lift = 20 mm, angle of lift = 75°, Nose radius = 5mm, speed = 600 rpm. Find (i) The principal dimensions of the cam (ii) The acceleration of the followers at the beginning of lift and at the end of contact with the circular flank, at the beginning of contact with nose and at the apex of nose. **(12 Marks)**

PART – B

5 a. Explain static and dynamic balancing with examples. **(04 Marks)**

b. A shaft carries four masses A, B, C and D of magnitude 200kg, 300kg, 400kg and 200kg respectively and revolving at radii 80mm, 70mm, 60mm and 80mm in planes measured from A at 300mm, 400mm and 700mm. The angles between the cranes measures anticlockwise are A to B, 45°, B to C 70° and C to D 120°. The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100mm, between X and Y is 400mm and between Y and D is 200mm. If the balancing masses revolve at a radius of 100mm, find their magnitudes and angular positions for complete balance. **(16 Marks)**

6 a. Give reasons why a single cylinder reciprocating engine cannot be completely balanced. **(04 Marks)**

b. The firing order in a 6 cylinder vertical four stroke in-line engine is 1-4-2-6-3-5. The piston stroke is 100 mm and length of the connecting rod is 200mm. The pitch distance between the cylinder centre lines are 100mm, 100mm, 150mm, 100mm and 100mm respectively. The reciprocating mass per cylinder is 1 kg, and the engine runs at 3000 rpm. Determine the out-of-balance primary and secondary forces and couples in this engine taking a plane midway between the cylinder 3 and 4 as the reference plane. **(16 Marks)**

7 a. Derive the expression for equilibrium speed of a porter governor with usual notations, taking friction into account. **(08 Marks)**

b. Each arm of a porter governor is 200mm long and is pivoted on the axis of the governor. The radii of the rotation at the minimum and maximum speeds are 120mm and 160mm respectively. The mass of the sleeve is 24kg and each revolving mass is 4kg. Find the range of speed of the governor assuming that (i) There is no friction (ii) The friction at the sleeve is equivalent to 18N. **(12 Marks)**

8 a. Derive an expression for gyroscopic couple with usual notations. **(05 Marks)**

b. An automobile with its engine axis mounted parallel to the wheels rotating in the same sense as the wheels is travelling in a track of 100 metres radius. Each of the four wheels has a moment of inertia of 2.5 kg.m^2 and an effective diameter of 0.6m. The rotating parts of the engine have a moment of inertia of 1.2 kg.m^2. The ratio of engine speed to wheel speed is 3:1. The automobile has a mass of 1600kg and has its centre of gravity 0.5m above the road level. The width of the track of the vehicle is 1.5m.

Determine the limiting speed of the vehicle around the curve for all the four wheels to maintain contact with the road surface. Assume that the road surface is not cambered and the centre of gravity of the automobile lies centrally with respect to the four wheels. **(15 Marks)**

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