ACHARYA INSTITUTE OF TECHNOLOGY
Bangalore - 560090

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Fifth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Dynamics of Machines

Time: 3 hrs. Max. Marks:100

Note: *1. Answer FIVE full questions, selecting at least TWO questions from each part.*
2. Graphical solutions must be on drawing sheets only.
3. Missing data if any, may suitably assumed and stated.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 For the static equilibrium of the mechanism shown in Fig.Q.1(a), determine the required torque input T_2, given AB = 30mm, BC = 80mm, CD = 50mm, AD = 70mm, BE = 60mm, EC = 30mm, CF = 20mm. **(20 Marks)**

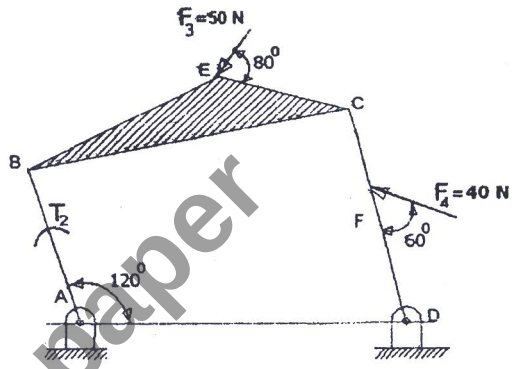

Fig.Q.1

2 a. Explain dynamically equivalent mass. **(05 Marks)**

b. A petrol engine of 90 mm diameter and 120 mm stroke, has a connecting rod of 240 mm long. The piston has a mass of 1 kg and the speed of engine is 1800 rpm. On expansion stroke, the crank at 30° from inner dead centre, the gas pressure is 0.5 N/mm^2. Calculate: i) Net force on the piston; ii) Net load on gudgeon pin; iii) Thrust on cylinder wall; iv) Crank effort; v) Speed at which the gudgeon pin load is reversed in direction. **(15 Marks)**

3 a. Derive the expression to determine the size of flywheel. **(05 Marks)**

b. The turning moment diagram for a multicylinder engine is drawn to a scale 1mm = 500 Nmm and 1mm = 6° of crank displacement. The intercepted area in the order from one end is in mm^2 are -30, 410, -280, 320, -330, 250, -360, 280 and -260 mm^2 when engine is running at 800rpm. The engine has stroke of 300mm and fluctuation of speed is not to exceed ± 2% of the mean speed. Calculate the diameter and cross section of the flywheel for a limiting value of safe centrifugal stress of 7MPa. The density of the material is 7200 kg/m^3. The width of rim is 5 times the thickness. **(15 Marks)**

4 a. Derive an expression for displacement, velocity and acceleration of the flat faced follower when in contact with nose. **(08 Marks)**

b. A symmetrical arc cam using flat faced follower has the following particulars. Total lift = 25mm; least radius = 35 mm; Angle of lift = 90°, flank radius = 105mm and cam speed = 1200 rpm. Calculate: i) Principal dimensions of cam; ii) Acceleration of the follower at the beginning of lift, at the end of contact with flank, at the beginning of contact with nose and at the apex. **(12 Marks)**

PART – B

5 Four masses of 200 kg, 300 kg, 240 kg and 360 kg revolve at radii 90, 70, 100 and 120mm respectively in planes P, Q, R and S respectively. The axial distance of planes Q, R and S from P are 270, 420 and 720 mm respectively. The angle between masses P and Q is 45°, Q and R is 75° and between R and S is 130°. Balancing masses are to be placed 120 mm and 100 mm from 'S' and 'P' respectively. The distance between them being 500 mm. Determine the balancing masses and their angular positions, if they are placed at radii of 100 mm. **(20 Marks)**

6 The crank and connecting rods of a 4 cylinder in-line engine running at 1800 rpm are 60mm and 240mm each respectively and cylinder centre lines are 150mm apart. If the cylinder are numbered 1 to 4 in sequence from one end, the cranks appear at interval of 90° in an end view in order 1 – 4 – 2 – 3. The reciprocating mass corresponding to each cylinder is 1.5kg. Calculate: i) Unbalanced primary and secondary forces; ii) Unbalanced primary and secondary couples with reference to central plane of the engine. **(20 Marks)**

7 a. Explain controlling force, sensitiveness and hunting of governor. **(05 Marks)**

b. All the arms of governor have equal length of 250mm each and pivoted on the axis of rotation. Each ball has a mass of 5kg and central load is 25kg. The radius of rotation of ball is 150mm when the governor begins to lift and 200mm when the governor is at maximum speed. Determine: i) The range of speed; ii) The effort and power of governor for 1% speed change, when the sleeve is highest position. **(15 Marks)**

8 a. Derive an expression for stability of two wheeler negotiating a curve. **(08 Marks)**

b. A four wheeled motor car weighing 2 tonnes has height of C.G. of 0.6m above the ground surface. The mass of the engine and transmission parts are equivalent to 80kg with the radius of gyration 150mm and their axis is parallel to the axis of wheel of vehicle. The car negotiates a curve of 60m radius at 72 kmph with overall gear ratio 4:1. The radius of road wheel is 300 mm and moment of inertia is 3 kg-m^2. Assuming wheel track as 1.5m, determine reaction on each inner and outer wheels. **(12 Marks)**

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