USN | | | | | | | | | | |

10ME54

Fifth Semester B.E. Degree Examination, Dec.2013/Jan.2014
Dynamics of Machines

Time: 3 hrs. Max. Marks:100

Note:1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. Assume missing data suitably.

PART – A

1 a. What are the free body diagrams of a mechanism? **(05 Marks)**

b. For a mechanism shown in Fig. Q1 (b), find the required input torque for the static equilibrium. The lengths OA and AB are 250 mm and 650 mm respectively. F = 500 N. **(15 Marks)**

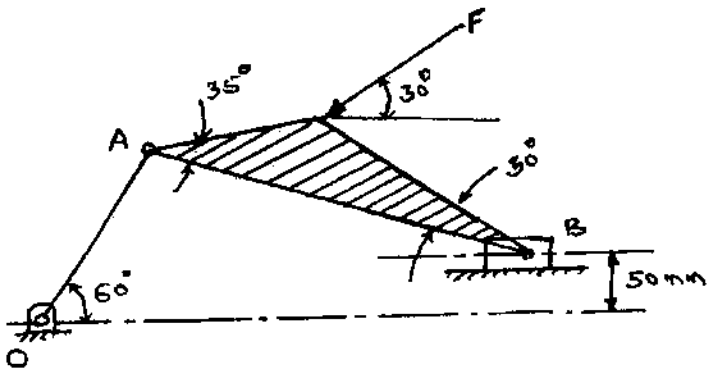

Fig. Q1 (b)

2 a. Derive an equation for the maximum fluctuation of energy of a flywheel in terms of mean kinetic energy and coefficient of fluctuation of speed. **(06 Marks)**

b. A punching press is driven by a constant torque electric rotor. The press is provided with a flywheel that rotates at a maximum speed of 225 rpm. The radius of gyration of the flywheel is 0.5 m. The press punches 720 holes per hour, each punching operation takes two seconds and requires 15 kN-m energy. Find the power of the motor and the minimum mass of the flywheel if speed of the same is not to fall below 200 rpm. **(14 Marks)**

3 a. Derive an equation to calculate the centrifugal tension in a flat belt drive. **(05 Marks)**

b. Determine the width of a 9.75 mm thick belt required to transmit 15 kW from a motor running at 900 rpm. The diameter of the driving pulley of the motor is 300 mm. The driven pulley runs at 300 rpm and distance between centres of two pulleys is 3 mts. The density of leather is 1000 kg/m^3. The maximum allowable stress in leather is 2.5 MPa. The coefficient of friction between leather and pulley is 0.3. Assume open belt drive and neglect slip in belt drive. **(15 Marks)**

4 A shaft is supported in bearings 1.8 meter apart and projects 0.45 meter beyond bearings at each end. The shaft carries three pulleys one at each end and one at middle of its length. The mass of end pulleys 48 kg and 20 kg and their centre of gravity are 15 mm and 12.5 mm respectively from the shaft axis. The centre pulley has the mass of 56 kg and its centre of gravity is 15 mm from shaft axis. If the pulleys are so arranged as to give static balance, determine (i) The relative angular position of the pulleys. (ii) And dynamic forces produced on the bearings when the shaft rotates at 300 rpm. **(20 Marks)**

PART – B

5 a. Define primary unbalanced force and secondary unbalanced force for a reciprocating engine mechanism. **(04 Marks)**

b. The firing order in a six cylinder four stroke inline engine is 1–4–2–6–3–5. The piston stroke is 100 mm and length of each connecting rod is 200 mm. The pitch distance between cylinder centre lines are 100 mm, 100 mm, 150 mm, 100 mm and 100 mm respectively. The reciprocating mass per cylinder is 1 kg and engine runs at 300 rpm. Determine the output of primary and secondary forces and couples on the engine, taking a plane midway between the cylinders 3 and 4 as reference plane. **(16 Marks)**

6 a. Establish the relationship between speed and height of a watt Governor. **(04 Marks)**

b. In a portor governor the upper and lower arms are each 250 mm long and pivoted on the axis of rotation. The mass of each rotating ball is 3 kg and mass of the sleeve is 20 kg. The sleeve is in its lowest position when the arms are inclined at 30° to governor axis. The lift of the sleeve is 36 mm. Find the force of friction at the sleeve, if the speed at the moment it rises from the lowest position is equal to the speed at the moment it falls from the highest position. Also find the range of speed of the governor. **(16 Marks)**

7 a. With neat sketches, explain the effect of gyroscopic couple on steering, pitching and rolling of ship. **(06 Marks)**

b. A rear engine automobile is traveling along a track of 100 meters mean radius. Each of four road wheels has a moment of inertia of 2.5 kg-m^2 and an effective diameter of 0.6 m. The rotating parts of the engine have a moment of inertia of 1.2 kg-m^2. The engine axis is parallel to rear axle and the crankshaft rotates in the same sense as the road wheels. The ratio of engine speed to back axle speed is 3 : 1. The automobile has a mass of 1600 kg and has its centre of gravity 0.5 m above road level. The width of track of vehicle is 1.5 m. 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 centre of gravity of the automobile lies centrally with respect to four wheels. **(14 Marks)**

8 For a symmetrical tangent cam operating a roller follower, the least radius of cam is 30 mm and roller radius is 15 mm. The angle of ascent is 60°, the total lift is 15 mm and speed of the camshaft is 300 rpm. Calculate : (i) Principal dimensions of the cam (i.e. the distance between the cam centre and nose centre, nose radius and angle of contact of cam with straight flank). (ii) Acceleration of the follower at the beginning of the lift, where the roller just touches the nose and at the apex of circular nose. Assume that there is no dwell between ascent and descent. **(20 Marks)**

* * * * *