B. Tech. Sem-III (2021 course) Robotics.
Winter-2022

BACHELOR OF TECHNOLOGY (C.B.C.S.) (2021-COURSE)
B. Tech. Sem - III Robotics & Automation Engineering : WINTER- 2022
SUBJECT : THEORY OF MACHINES

Day : Friday | Time : 10:00 AM-01:00 PM
Date : 09-12-2022 | **W-25353-2022** | Max. Marks : 60

N.B.:
1) All questions are **COMPUSLROY**.
2) Figures to the right indicate **FULL** marks.
3) Use of non-programmable scientific **CALCULATOR** is allowed.
4) Assume suitable data if necessary.

Q.1 State and prove the conditions of correct steering for four wheeled vehicle. **[10]**
Compare Davis steering gear with Ackermann's steering gear.

OR

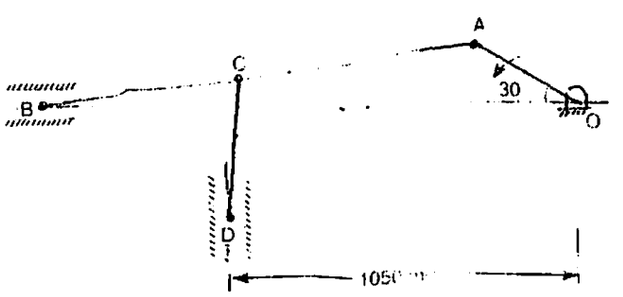
Q.1 The angle between the axes of two shafts connected by universal joint is 30°. **[10]**
The driving shaft rotates at uniform speed of 240 r.p.m. The driven shaft carries a steady load of 9 kW. Calculate the radius of gyration of the flywheel of the driven shaft having mass 50 kg and the output torque of the driven shaft does not vary by more than 20% of the input shaft.

Q.2 The connecting rod of an engine has a length equal to 200 mm between centres and has a mass equal to 2.5 kg. Its centre of gravity is at 80 mm from the big end (crank pin), and the radius of gyration about an axis through the centre of gravity perpendicular to the plane of motion is 100 mm. Find: **[10]**
a) The two-mass dynamically equivalent system when one mass is placed at the small end.
b) The correction couple, if the two masses are placed at the two ends and the angular acceleration of the connecting rod is 100 rad/sec^2 clockwise.

OR

Q.2 A connecting rod is suspended from a point 25 mm above the centre of small end, and 650 mm above its centre of gravity, its mass being 37.5 kg. When permitted to oscillate, the time period is found to be 1.87 seconds. Find the dynamical equivalent system constituted of two masses, one of which is located at the small end centre. **[10]**

Q.3 In the mechanism, as shown in figure the crank OA rotates at 20 r.p.m. anticlockwise and gives motion to the sliding blocks B and D. The dimensions of the various links are OA = 300 mm; AB = 1200 mm; BC = 450 mm and CD = 450 mm. **[10]**



For the given configuration, determine :
a) Velocities of sliding at B and D
b) Angular velocity of CD
c) Linear acceleration of D
d) Angular acceleration of CD

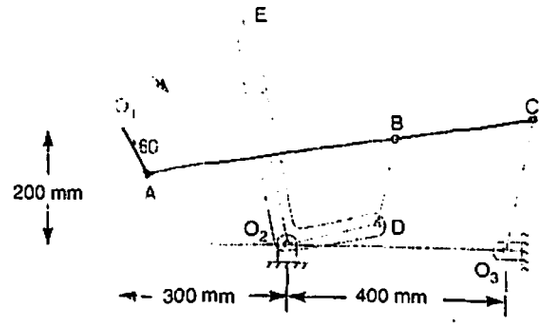
P.T.O.

OR

Q.3 The mechanism of a wrapping machine, as shown in figure has the following dimensions: **[10]**

$O_1A = 100$ mm; $AC = 700$ mm; $BC = 200$mm; $O_3C = 200$ mm; $O_2E = 400$ mm; $O_2D = 200$ mm and $BD = 150$ mm.

The crank O_1A rotates at a uniform speed of 100 rad/s. Find the velocity of the point E of the bell crank lever by instantaneous centre method.



Q.4 Derive an expression for the centre distance of helical gears in terms of number of teeth of gears, normal module and helix angle. **[10]**

OR

Q.4 Two 20° involute spur gears have module of 8 mm. The addendum is one module. The pinion has 13 teeth and the wheel 50 teeth. Does the interference occur? If it occurs, to what value should the pressure angle be changed to eliminate interference? **[10]**

Q.5 A shaft carries four masses in parallel planes A, B, C and D in this order along its length. The masses at B and C are 18 kg and 12.5 kg respectively, and each has an eccentricity of 60 mm. The masses at A and D have an eccentricity of 80 mm. The angle between the masses at B and C is 100° and that between the masses at B and A is 190°, both being measured in the same direction. The axial distance between the planes A and B is 100 mm and that between B and C is 200 mm. If the shaft is in complete dynamic balance, determine: **[10]**

a) The magnitude of the masses at A and D.
b) The distance between planes A and D.
c) The angular position of the mass at D.

OR

Q.5 The three cranks of a three cylinder locomotive are all on the same axle and are set at 120°. The pitch of the cylinders is 1 metre and the stroke of each piston is 0.6 m. The reciprocating masses are 300 kg for inside cylinder and 260 kg for each outside cylinder and the planes of rotation of the balance masses are 0.8 m from the inside crank. If 40% of the reciprocating parts are to be balanced, find: **[10]**

a) The magnitude and the position of the balancing masses required at a radius of 0.6 m.
b) The hammer blow per wheel when the axle makes 6 r.p.s.

Q.6 The turbine rotor of a ship having a mass of 200 kg rotates at 2000 r.p.m. and its radius of gyration is 0.30 m. If the rotation of the rotor is clockwise looking from the aft, determine the gyroscopic couple set by the rotor when **[10]**

a) Ship takes a left hand turn at a radius of 300 metres at a speed of 30 km/hr.
b) Ship pitches with the bow rising at an angular velocity of 1 rad/sec.
c) Ship rolls at an angular velocity of 0.1 rad/sec.

OR

Q.6 What is stability of ship? Why it is necessary? How it is achieved? **[10]**

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