Printed Pages—7 **EME502**

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 2102 **Roll No.** | | | | | | | | | | |

B.Tech.

(SEM. V) ODD SEMESTER THEORY EXAMINATION 2012-13

THEORY OF MACHINES—I

Time : 3 Hours *Total Marks : 100*

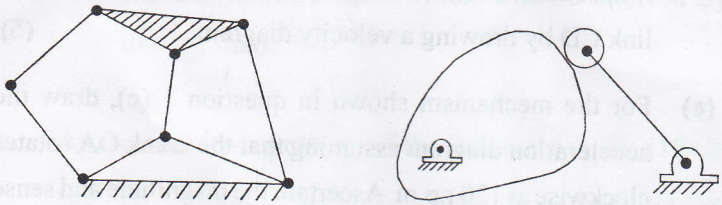
Note : *(1) Attempt **ALL** questions.*

(2) All questions carry marks as shown against each.

1. Answer any **four** parts of the following :— **(5×4=20)**

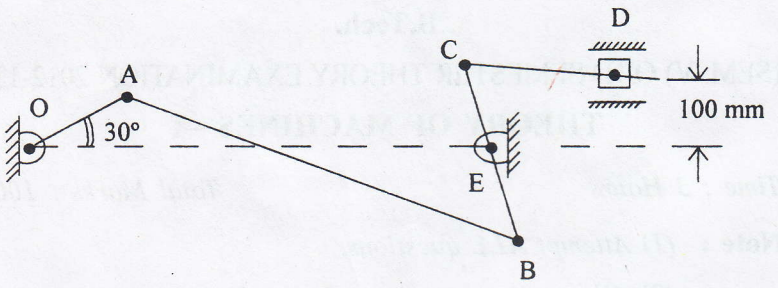
(a) (i) What is the difference between higher and lower pairs ? **(1)**

(ii) Ascertain the degree of freedom for the two mechanisms shown : **(4)**



(b) Draw a sketch of one inversion of slider-crank mechanism in which the crank is made stationary. Describe the use and special features of this mechanism. **(5)**

(c) A mechanism is shown below. It has following dimensions :



OA = 200 mm, AB = 1·5 metres, BC = 600 mm, CD = 500 mm, BE = 400 mm, OE = 1·35 metres.

Locate all instantaneous centres for this mechanism. **(5)**

(d) If in the mechanism shown in question 1 (c), crank OA rotates clockwise at 120 rpm; find the angular velocity of link CD by drawing a velocity diagram. **(5)**

(e) For the mechanism shown in question 1 (c), draw the acceleration diagram assuming that the crank OA rotates clockwise at 120 r.p.m. Ascertain the magnitude and sense of the acceleration of slider D. **(5)**

(f) Draw a sketch and explain the working of Oldham's coupling. **(5)**

2. Attmept any **two** parts out of the following :— **(10×2=20)**

(a) What do you understand by Coriolis component acceleration ? Under what circumstances, is it produced ? Show that the magnitude of Coriolis component acceleration is 2 $w.V_{pq}$, where the symbols have their usual meaning. How is the sense and direction of this acceleration determined ? **(10)**

(b) Describe HART's exact straight line mechanism with proof that it generates an exact straight line. In what respects is this mechanism considered superior to PEAUCELLIER's mechanism ? **(10)**

(c) A Hooke's joint connects two shafts whose axes intersect at 150°. The driving shaft rotates uniformly at 120 r.p.m. The driven shaft carries a flywheel of mass = 45 kg and radius of gyration of 150 mm. Find the maximum torque which will be exerted by the driving shaft. **(10)**

3. Attempt any **two** parts out of the following :— **(10×2=20)**

(a) (i) Draw a sketch of a single plate clutch and label its various parts. Why is "uniform wear theory" adopted for calculating the power which may be transmitted through this clutch ? **(5)**

(ii) A thrust shaft of a ship has 6 collars of 600 mm external diameter and 300 mm internal diameter. The total thrust is 100 kN. If $\mu = 0{\cdot}12$ and speed of rotation of shaft is 90 r.p.m., find the power loss due to friction. Assume uniform pressure on thrust bearing surfaces. **(5)**

(b) (i) Differentiate between a FLAT BELT, a V-Belt and a TIMING belt. **(3)**

(ii) A shaft rotating at 90 r.p.m. is to transmit 10·5 kW to another shaft by a (weightless) flat belt of 11·5 cm width and 12 mm thickness by open belting arrangement. The driven shaft is to run at 225 r.p.m. The distance between shaft centres is 2·75 metres. Smaller pulley dia = 60 cm. Calculate the stress in belt, assuming μ to be 0·25. **(7)**

(c) (i) Differentiate between brakes and dynamometers. Name some common brakes. **(3)**

(ii) Show that for a band and block brake, the ratio of tensions is given by the expression

$$\left(\frac{1+\mu \tan\theta}{1-\mu \tan\theta} \right)^n$$

, where the symbols have their usual meaning. **(7)**

4. Answer any **two** parts of the following :— **(10×2=20)**

(a) Draw the profile of a cam with roller reciprocating follower. Axis of the follower passes through axis of the cam. Roller diameter is 5 mm and minimum radius of cam equals 20 mm. Total lift is 25 mm. The cam has to lift the follower with S.H.M. during 180° of cam rotation and then allow the follower to drop with uniform velocity during remaining 180° of cam rotation.

Determine the maximum velocity and maximum acceleration on the outward stroke. Cam rotates at uniform r.p.m. of 100 r.p.m. **(10)**

(b) In a symmetrical tangent cam with roller reciprocating follower, the minimum radius of cam is 25 mm. Roller diameter equals 25 mm. Angle of ascent is 60° and total lift is 12·5 mm. Cam shaft speed is 100 rad/sec.

Determine :—

(i) Main dimensions of cam, and

(ii) Velocity and acceleration of the follower at the beginning and end of lift.

There is no dwell period between ascent and descent. **(10)**

(c) Analyse the movement of a flat faced mushroom follower on a circular arc cam. Find expressions for the velocity and acceleration of the follower, when the follower is on the flank portion and also when the follower is on the nose portion of the cam.

Complete your analysis by drawing graphs of stroke, velocity and acceleration of follower versus angle of cam rotation. **(10)**

5. Answer any **two** of the following :— **(10×2=20)**

(a) (i) What do you understand by the term epicycloid, hypocycloid and involute ? **(3)**

(ii) Draw a base circle of 40 mm radius and construct the exact profile of an involute teeth (one side only) on it. The details of the construction may be explained step by step.

What are the properties of the involute curve, which make it suitable for adoption as gear-tooth profile ? **(5)**

(iii) What is the importance of pressure-angle in gears ? **(2)**

(b) A pair of gears, having 40 and 20 teeth respectively, are rotating in mesh, the speed of smaller being 2000 r.p.m. Determine the velocity of sliding between the gear teeth faces at the point of engagement, at the pitch point and at the point of disengagement if the smaller gear is the driver. Assume that the gear teeth are 20° involute form. Assume further that addendum length is 5 mm and the module is also 5 mm.

Also find the angle through which the pinion turns while any pair of teeth remain in contact. **(10)**

(c) Two shafts A and B are coaxial as shown. A gear C (50 teeth) is rigidly mounted on shaft A. A compound gear D.E. gears with 'C' and an internal gear 'G'. D has 20 teeth and E has 35 teeth. Gear G is fixed and is concentric with shaft axis. Compound gear DE is mounted on a pin which projects from an arm keyed to shaft B. All gears have same module. If shaft A rotates at 110 rpm (CW), find the speed of shaft B. **(10)**