(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 2010-11

THEORY OF MACHINES—I

Time : 3 Hours *Total Marks : 100*

Note :—(1) There are total **five** questions. Attempt all questions.

(2) Marks are indicated against each question.

(3) Assume missing data suitably, if any.

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

(a) Define the followings :—

Link, resistant body, kinematic pair, mechanism and inversion of mechanism.

(b) Describe the function of crank and slotted lever mechanism.

(c) State and prove the Kenedy's theorem as applicable to instantaneous centres of rotations of three bodies.

(d) Explain the procedures to construct Klein's construction to determine the velocity and acceleration of a slider crank mechanism.

(e) Show that a pantograph can produce paths exactly similar to the ones traced out by a point on a link on an enlarged and reduced scale.

(f) The ratio between the width of the front axle and that of the wheel base of a steering mechanism is 0.44. At the instant when the front inner wheel is turned by 18°, what should be the angle turned by the outer front wheel for perfect steering ?

2. Attempt any **two** of the following :—

(a) Show that an Ackermann steering gear does not satisfy the fundamental equation of steering gear at all positions. Why is it widely used ? **(10)**

(b) (i) What is velocity of rubbing ? How is it found ? **(3)**

(ii) For the position of the mechanism shown in Fig. 1, calculate the angular velocity of link AR. OA is 300 mm and rotates at 20 rad/s in the clockwise direction. **(7)**

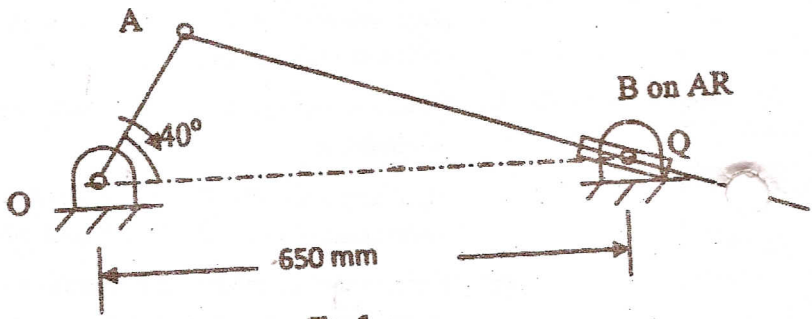

Fig. 1

(c) For the inverted slider crank mechanism shown in Fig. 2, find the angular acceleration of link QR. The crank OA is 300 mm long and rotates at 20 rad/s in clockwise direction. **(10)**

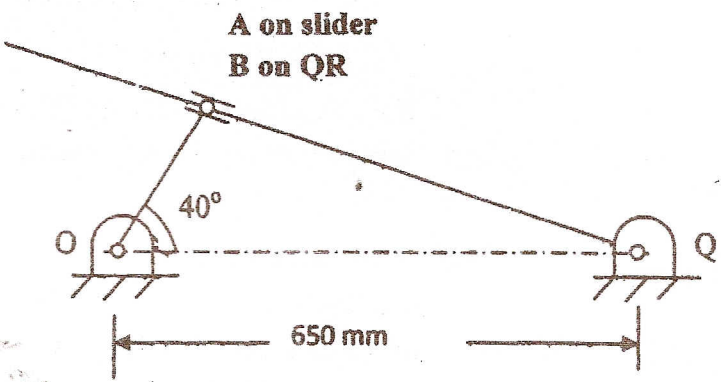

Fig. 2

Attempt any two of the following :—

(a) A thrust bearing of a propeller shaft consists of a number of collars. The shaft is of 400 mm diameter and rotates at a speed of 90 rpm. The thrust on the shaft is 300 kN. If the intensity of the pressure is to be 200 kN/m^2 and coefficient of friction is 0.06, determine external diameter of the collars. The power lost in friction is not to exceed 48 kW. **(10)**

(b) Determine the maximum power that can be transmitted through a flat belt having the following data :—

Cross-section of the belt is = 300 mm × 12 mm

Ratio of friction tensions = 2.4

Maximum permissible tension in belt = 2 MPa

Mass density of the belt material = 1.1×10^{-3} g/mm^3. **(10)**

4 (c) Fig. 3 shows a simple band brake which is applied to a shaft carrying a flywheel of mass 300 kg and radius of gyration 280 mm. The drum diameter is 220 mm and the shaft speed 240 rpm. The coefficient of friction is 0.3. Find the brake torque when a force of 100 N is applied at the lower end. Also determine the number of turns of the flywheel and time taken by it before coming to rest. All dimensions are in mm. **(10)**

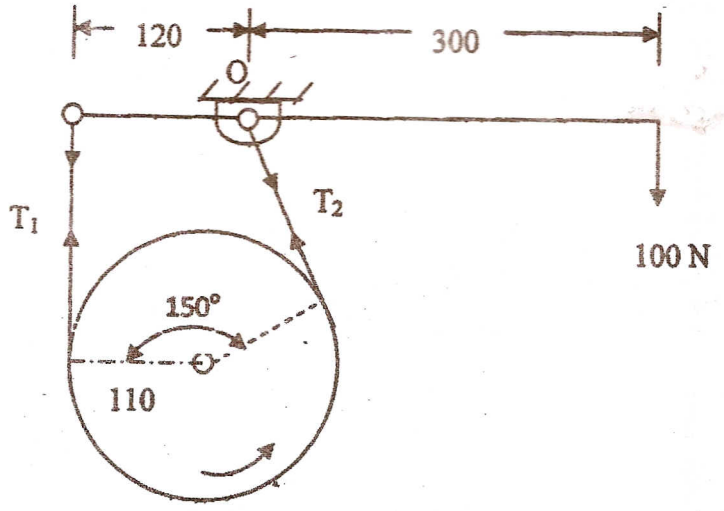

Fig. 3

5. Attempt any **two** of the following :—

(a) (i) State and derive the law of gearing. (7)

(ii) What are the differences between a simple gear train and reverted gear train ? Explain with the help of sketches. (3)

(b) A pinion of 20° involute teeth rotating at 275 rpm meshes with a gear and provides a gear ratio of 1.8. The number of teeth on the pinion is 20 and the module is 8 mm. If the interference is just avoided, determine :

(i) the addenda on the wheel and the pinion

(ii) the path of contact, and

(iii) the maximum velocity of sliding on both sides of the pitch point. **(10)**

(c) An epicyclic gear consists of a pinion, a wheel of 40 teeth and an annulus with 84 internal teeth concentric with the wheel. The pinion gears with the wheel and the annulus. The arm that carries the axis of the pinion rotates at 100 rpm. If the annulus is fixed, find the speed of the wheel; if the wheel is fixed, find the speed of the annulus. **(10)**

5. Attempt any **two** of the following :—

(a) (i) Deduce the expressions for the velocity and acceleration of the follower when it moves with simple harmonic motion. Why simple harmonic motion program is not suitable for high speed cams ? **(7)**

(ii) What do you understand by undercutting of the cam ? **(3)**

(b) Use the following data in drawing the profile of a cam in which a knife-edged follower is raised with uniform acceleration and deceleration and is lowered with simple harmonic motion :

Least radius of cam = 60 mm

Lift of follower = 45 mm

Angle of ascent = 60°

Angle of dwell between ascent and descent = 40°

Angle of descent = 75°

If the cam rotates at 180 rpm, determine the maximum velocity and acceleration during ascent and descent. **(10)**

(c) A tangent cam with straight working faces tangential to a base circle of 120 mm diameter has a roller diameter of 48 mm diameter. The line of stroke of the roller follower passes through the axis of the cam. The nose circle radius of the cam is 12 mm and the angle between the tangential faces of the cam is 90° If the speed of the cam is 180 rpm, determine the acceleration of the follower when :

(i) During the lift, the roller just leaves the straight flank

(ii) The roller is at the outer end of its lift, i.e. at the top of the nose. **(10)**