Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E SEMESTER-IV EXAMINATION SUMMER-2015

Subject Code:143401 **Date: 28/05/2015**

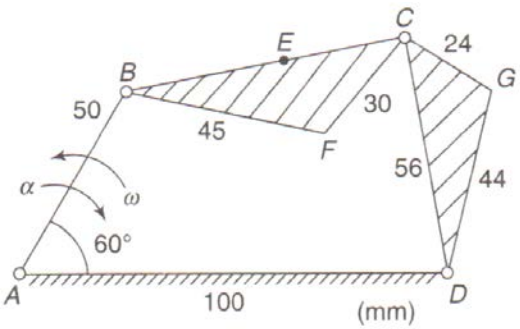
Subject Name: Machines and Mechanisms

Time: 10.30am-01.00pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** The following figure shows the configuration diagram of a four link mechanism along with the lengths of the links in mm. the link AB has an instantaneous angular velocity of 10.5 rad/s and retardation of 26 rad/s2 in counter clockwise direction. Find the angular accelerations of links BC and CD also find the linear acceleration of points E and F. **08**



$BE = 40$ mm
$BC = 66$ mm

(b)

1. What is Kutzback's criterion for degree of freedom of plane mechanisms? In what way Gruebler's criterion is different from it? **03**
2. Define (i) Mechanism (ii) Machine (iii) kinematic pair. **03**

Q.2 **(a)**

1. Derive an expression for the ratio of angular velocities of the shaft of a hooke's joint. **05**
2. What is fundamental equation of steering gears? Which steering gear fulfils this condition? **02**

(b) Derive the expression for the ratio of tension in tight and slack side of flat belt. Also derive the condition for maximum power transmission in flat belt drive. **07**

OR

(b) A cam rotating at 150 rpm, operates a reciprocating roller follower of radius 25 mm. the follower axis is offset by 25 mm to right. The least radius of the cam is 50mm and stroke of the follower is 50 mm. Ascent and descent both take place by uniform acceleration and retardation. Ascent takes place during 75° and descent during 90° of cam rotation. Dwell between ascent and descent is 60°. Draw the cam profile. **07**

Q.3 **(a)** Following data relate to two meshing involute gears: **07**

Number of teeth on gear wheel = 60

Pressure angle =20°

Gear ratio = 1.5

Speed of the gear wheel = 100 rpm

Module = 8 mm

The addendum on each wheel is such that the path of approach and the path of recess on each side are 40% of the maximum possible length each. Determine the addendum for the pinion and gear and the length of the arc of contact.

(b) Draw the displacement, velocity and acceleration diagrams for cam follower when it moves with simple harmonic motion and uniform acceleration and deceleration motion. **07**

OR

Q.3 **(a)**

1. What do you understand by 'gear train'? Discuss the various types of gear trains. **03**
2. How the velocity ratio of epicyclic gear train is obtained by tabular method? **04**

(b) Determine the nature of gyroscopic effect in four wheeler while taking a turn. Also find a method to evaluate the limiting speed of a four wheeler, when taking a turn. **07**

Q.4 **(a)** A screw jack has a square thread, 7.5 cm mean diameter and 1.5 cm pitch. The load on the jack revolves with screw. The co-efficient of friction at the screw threads is 0.05. **03**

(i) Find the tangential force to be applied to the jack at 36 cm radius so as to lift a load of 600 N. **04**

(ii) State whether the jack is self-locking. If it is, find the torque necessary to lower the load. If not, find the torque, which must be applied to keep the load from descending.

(b)

1. Explain clearly the terms 'static balancing' and 'dynamic balancing'. State the necessary conditions to achieve them. **03**
2. Explain the primary and secondary balancing of reciprocating mass. **02**
3. Explain why only a part of the unbalanced force due to reciprocating masses is balanced by revolving mass. **02**

OR

Q.4 **(a)** A friction clutch is used to rotate a machine from a shaft rotating at a uniform speed of 250 rpm. The disc type clutch has both of its sides effective, the coefficient of friction being 0.3. The outer and the inner diameters of the friction plate are 200 mm and 120 mm respectively. Assuming uniform wear of the clutch, the intensity of the pressure is not to be more than 100 kN/m^2. If the moment of inertia of the rotating parts of the machine is 6.5 kg.m^2, determine the time to attain the full speed by the machine and the energy lost in the slipping of the clutch. **07**

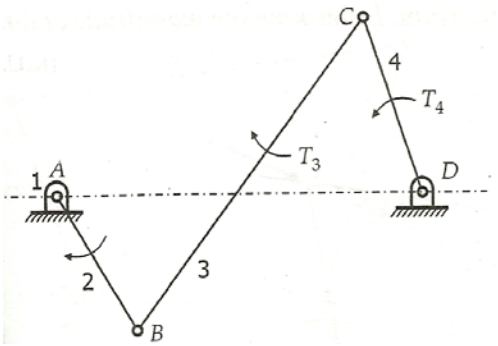
What will be the intensity of pressure, if the condition of uniform pressure of the clutch is considered? Also determine the ratio of power transmitted with uniform wear to that with uniform pressure.

(b) A four cylinder vertical engine has cranks 150 mm long. The planes of rotation of the first, second and fourth cranks are 400 mm, 200 mm, and 200 mm respectively from the third crank and their reciprocating masses are 50 kg, 60 kg and 50 kg respectively. Find the mass of reciprocating parts of the third cylinder and the relative angular positions of the cranks order that the engine may be in complete dynamic balance. **07**

Q.5 **(a)**

1. What is the function of a flywheel? How does it differ from governor? Discuss the turning moment diagram of four stroke cycle internal combustion engine. **04**
2. Explain the effect of gyroscope on aero plane. **03**

(b) In the four bar chain shown in following figure, the torque T_3 and T_4 have magnitudes of 50 Nm and 40 Nm respectively. For the static equilibrium of mechanism, determine the required input torque T_2. AB = 30 mm, BC = 74 mm, CD = 35 mm, AD = 70 mm. **07**



OR

Q.5 **(a)** What do you understand by equivalent dynamical system? Determine the equivalent dynamical system of two masses by graphical method. **07**

(b) Describe the analytical method to determine the inertia torque of crank shaft of horizontal reciprocating engine. **07**

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