

GUJARAT TECHNOLOGICAL UNIVERSITY**B.E. Sem-IV Examination June- 2010****Subject code: 141902****Subject Name: KINEMATICS OF MACHINE****Date: 19/06/2010****Time: 10.30 am – 01.00 pm****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) (i) A crank and slotted lever mechanism used in a shaper has a centre distance of 300mm between the centre of oscillation of the slotted lever and the centre of Rotation of the crank. The radius of the cranks is 120mm. Find the ratio of the Time of cutting to the time of return stroke. **03**
- (ii) Explain the following terms: **04**
 (i) Lower pair (ii) Higher pair (iii) Kinematics Chain (iv) Inversion
- (b) (i) Write notes on complete and incomplete constraints motion in lower and Higher Pairs, illustrate your answer with neat sketches. **03**
- (ii) Sketch and describe the working of Whitworth Quick return motion mechanism. **04**
- Q.2** (a) (i) Explain the following terms: **03**
 (i) Slip of belt (ii) Creep of belt (iii) Fast and loose pulley drive
- (ii) A shaft rotating at 200 r.p.m drives another shaft at 300 r.p.m. and transmits 6 Kw Through a belt. The belt is 100mm wide and 10mm thick. The distance between the shafts is 4m. The smaller pulley is 0.5m in diameter. Calculate the stress in the belt, If it is (1) an open belt drive, and 2. a cross belt drive
 Take $\mu = 0.3$ **04**
- (b) (i) Explain what do you understand by 'initial tension in a belt'? **01**
- (ii) Derive the condition for transmitting the maximum power in a flat belt drive **03**
- (iii) Explain the following: **03**
 (i) Limiting friction (ii) Angle of friction and (iii) Co-efficient of friction
- OR**
- (b) (i) A compressor requiring 90 K.w is to run at about 250 r.p.m. The drive is by V-belts from an electric motor running at 750 r.p.m. The diameter of the pulley on the compressor shaft must not be greater than 1 metre while the centre distance between the pulleys is limited to 1.75 metre. The belt speed should not exceed 1600m/min. Determine the number of V-belts required to transmit the power if each belt has a cross-sectional area of 375mm², density 1000kg/m³ and allowable tensile stress of 2.5Mpa. The groove angle of the pulley is 35°. The Co-efficient of friction between the belt and pulley is 0.25. Calculate also the length required of each belt. **04**
- (ii) Power is transmitted using a V-belt drive. The included angle of V-groove is 30°. The belt is 20mm deep and maximum width is 20mm. If the mass of the belt is 0.35Kg. per metre length and maximum allowable stress is 1.4Mpa. Determine the maximum power transmitted when the angle of lap is 140°. $\mu = 0.15$ **03**
- Q.3** (a) Two bevel gears A and B having 40 teeth and 30 teeth are rigidly mounted on two Co-axial shafts X and Y. A bevel gear C having 50 teeth meshes with A and B and rotates freely one end of an arm. At the other end of the arm is welded a sleeve and the sleeve is riding freely loose on the axes of the shafts X and Y. Sketch the arrangement. If the shaft X rotates at 100 r.p.m. clockwise and arm rotates at 100 r.p.m. anticlockwise Find the speed of shaft Y. **07**
- (b) A cam with a minimum radius of 25mm rotating clockwise at a uniform speed is to be designed to give a roller follower, at the end of a valve rod, motion described below: **07**
- (1) To raise the valve through 50mm during 120° rotation of the cam.
 - (2) To keep the valve fully raised through next 30°;
 - (3) To lower the valve during next 60°; and
 - (4) To keep the valve closed during rest of the revolution i.e. 150°;

The diameter of the roller is 20mm and the diameter of the cam shaft is 25mm. Draw the profile of the cam when the line of stroke of the valve rod passes through the axis of the cam shaft. The displacement of the valve while being raised and lowered is to take place with simple harmonic motion. Determine the maximum Acceleration of the valve rod when the cam shaft rotates at 100 r.p.m. Draw The displacement, the velocity and the acceleration diagram for one complete Revolution of the cam.

OR

- Q.3 (a)** Draw a cam profile to drive an oscillating roller follower to the specifications given below. **07**

(1) Follower to move outwards through an angular displacement of 20° during the first 120° rotation of the cam;

(2) Follower to return to its initial position during next 120° rotation of the cam.

(3) Follower to dwell during the next 120° of cam rotation.

The distance between pivot centre and roller centre = 120mm; distance between Pivot centre and cam axis = 130mm; minimum radius of cam = 40mm; radius of roller = 10mm Inward and outward strokes take place with simple harmonic motion.

- (b)** An epicyclic gear train consists of sun wheels S, a stationary internal gear E and three identical planet wheels P carried on a star-shaped planet carrier C. The size of Different toothed wheels are such that the planet carrier C rotates at $1/5^{\text{th}}$ of the speed Of the sunwheel S. The minimum number of teeth on any wheel is 16. The driving Torque On the sun wheel is 100N-M. Determine **07**
1. Numbers of teeth on different wheels of the train.
 2. Torque necessary to keep the internal gear stationary

- Q.4 (a)** The crank and connecting rod of a steam engine are 0.5 and 2m long respectively. The cranks makes 180 rpm in the clockwise direction. When it has turned 45° from the inner Dead centre determine: **07**

(1) Velocity of Piston.

(2) Angular velocity of connecting rod.

(3) Velocity of point E on the connecting rod 1.5m from the gudgeon pin.

(4) The velocity of rubbing at the pins of the crank shaft, crank and cross head when the Diameter of their pins are 5cm, 3cm, 6cm respectively,

(5) Position and linear velocity of any point G on the connecting rod which has the least Velocity relative to crank shaft.

- (b)** Derive an expression for the magnitude and direction of Coriolis component of acceleration. **07**

OR

- Q.4 (a)** An effort of 1500N is required to just move a certain body up an inclined plane of angle 30° , force acting parallel to the plane. If the angle of inclination is increased to 15° , then the effort required is 1720N. to just move body down. Find the weight of the body and the co-efficient of friction **07**

- (b)** Derive an expression for the ratio of shafts velocities for Hooke's joint and draw the polar diagram depicting the salient features of driven shaft speed. **07**

- Q.5 (a)** A multiple-disc clutch has three disc on the driving shaft and two on the driven Shaft. The outside diameter of the contact surfaces is 240mm and inside diameter 120mm. Assuming uniform wear and co-efficient of friction as 0.3, find the maximum axial intensity of pressure between the discs for transmitting 25Kw at 1575 rpm. **07**

- (b)** Describe with a neat sketch a centrifugal clutch and deduce an equation for the total Torque transmitted **07**

OR

- Q.5 (a)** Prove that the maximum efficiency of square threaded screw moving in a nut is $1 - \sin \phi / 1 + \sin \phi$, where ϕ is the friction angle. Neglecting collar friction, **07**

- (b)** What is the condition for correct steering? Sketch and show the two main types of steering gears and discuss their relative advantages. **07**
