

# C.U.SHAH UNIVERSITY

## Summer Examination-2018

**Subject Name: Kinematics and Dynamics of Machines**

**Subject Code: 4TE03KDM1**

**Branch: B.Tech (Automobile)**

**Semester: 3**

**Date: 26/03/2018**

**Time: 02:30 To 05:30**

**Marks: 70**

**Instructions:**

- (1) Use of Programmable calculator & any other electronic instrument is prohibited.
- (2) Instructions written on main answer book are strictly to be obeyed.
- (3) Draw neat diagrams and figures (if necessary) at right places.
- (4) Assume suitable data if needed.

**Q-1**

**Attempt the following questions:**

**(14)**

- a) In a kinematic chain, a quaternary joint is equivalent to
  - (a) one binary joint
  - (b) two binary joints
  - (c) three binary joints
  - (d) four binary joints
- b) The relation between the number of pairs ( $p$ ) forming a kinematic chain and the number of links ( $l$ ) is
  - (a)  $l = 2p - 2$
  - (b)  $l = 2p - 3$
  - (c)  $l = 2p - 4$
  - (d)  $l = 2p - 5$
- c) The total number of instantaneous centres for a mechanism consisting of  $n$  links are
  - (a)  $\frac{n}{2}$
  - (b)  $n$
  - (c)  $\frac{n-1}{2}$
  - (d)  $\frac{n(n-1)}{2}$
- d) In a pantograph, all the pairs are
  - (a) turning pairs
  - (b) sliding pairs
  - (c) spherical pairs
  - (d) self-closed pairs
- e) Due to slip of the belt, the velocity ratio of the belt drive
  - (a) decreases
  - (b) increases
  - (c) does not change
  - (d) becomes zero
- f) The power transmitted by a belt is maximum when the maximum tension in the belt ( $T$ ) is equal to
  - (a)  $T_C$
  - (b)  $2T_C$
  - (c)  $3T_C$
  - (d)  $4T_C$

Where  $T_C$  = Centrifugal tension.
- g) Law of gearing is satisfied if
  - (a) two surfaces slide smoothly
  - (b) common normal at the point of contact passes through the pitch point on the line joining the centres of rotation
  - (c) number of teeth = P.C.D. / module
  - (d) addendum is greater than dedendum
- h) The type of gears used to connect two non-parallel non-intersecting shafts are
  - (a) spur gears
  - (b) helical gears
  - (c) spiral gears
  - (d) none of these
- i) When the pitching of a ship is upward, the effect of gyroscopic couple acting on it will be



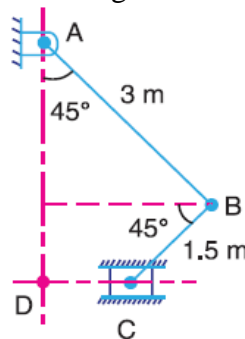
- (a) to move the ship towards port side      (b) to move the ship towards star-board  
 (c) to raise the bow and lower the stern      (d) to raise the stern and lower the bow
- j) In an automobile, if the vehicle makes a left turn, the gyroscopic torque  
 (a) increases the forces on the outer wheels  
 (b) decreases the forces on the outer wheels  
 (c) does not affect the forces on the outer wheels  
 (d) none of the above
- k) For a given lift of the follower of a cam follower mechanism, a smaller base circle diameter is desired.  
 (a) because it will give a steeper cam and higher pressure angle.  
 (b) because it will give a profile with lower pressure angle  
 (c) because it will avoid jumping  
 (d) None of the above.
- l) A radial follower is one  
 (a) that reciprocates in the guides  
 (b) that oscillates  
 (c) In which the follower translates along an axis passing through the cam centre of rotation.  
 (d) none of the above
- m) A disturbing mass  $m_1$  attached to a rotating shaft may be balanced by a single mass  $m_2$  attached in the same plane of rotation as that of  $m_1$  such that  
 (a)  $m_1.r_2 = m_2.r_1$       (b)  $m_1.r_1 = m_2.r_2$       (c)  $m_1.m_2 = r_1.r_2$       (d) None of these
- n) Longitudinal vibrations are said to occur when the particles of a body moves  
 (a) perpendicular to its axis      (b) parallel to its axis  
 (c) in a circle about its axis      (d) None of these

**Attempt any four questions from Q-2 to Q-8.**

**Q-2**

**Attempt all questions**

- (a) Differentiate between a machine and a structure. **03**
- (b) Give classification of Kinematic pairs according to type of relative motion between the elements. **04**
- (c) In the mechanism shown in Figure below, the slider C is moving to the right with a velocity of 1 m/s and an acceleration of 2.5 m/s. The dimensions of various links are  $AB = 3$  m inclined at  $45^\circ$  with the vertical and  $BC = 1.5$  m inclined at  $45^\circ$  with the horizontal. Determine: 1. The magnitude of vertical and horizontal component of the acceleration of the point B, and 2. The angular acceleration of the links AB and BC. **07**



**Q-3**

**Attempt all questions**

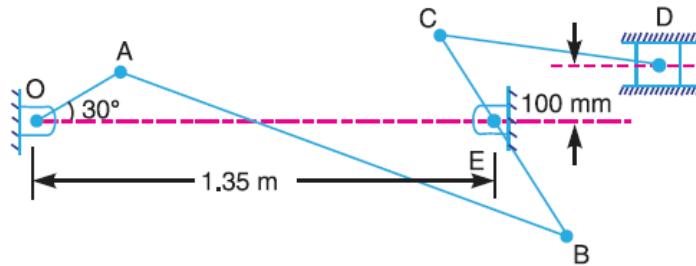
- (a) What is inversion of Mechanism? Explain inversions of double slider crank chain mechanism with neat sketches. **07**
- (b) A mechanism, as shown in Fig., has the following dimensions: **07**



OA = 200 mm; AB = 1.5 m; BC = 600 mm; CD = 500 mm and BE = 400 mm. Locate all the instantaneous centres.

If crank OA rotates uniformly at 120 r.p.m. clockwise, find

1. The velocity of B, C and D
2. The angular velocity of the links AB, BC and CD.



**Q-4**

**Attempt all questions**

- (a) What is gear train? Explain reverted gear train with neat sketch. **04**
- (c) A cam, with a minimum radius of 50 mm, rotating clockwise at a uniform speed, is required to give a knife edge follower the motion as described below : **10**
1. To move outwards through 40 mm during  $100^\circ$  rotation of the cam;
  2. To dwell for next  $80^\circ$ ;
  3. To return to its starting position during next  $90^\circ$ , and
  4. To dwell for the rest period of a revolution i.e.  $90^\circ$ .

Draw the profile of the cam when the line of stroke of the follower passes through the centre of the cam shaft. The displacement of the follower is to take place with uniform acceleration and uniform retardation. Determine the maximum velocity and acceleration of the follower when the cam shaft rotates at 900 r.p.m.

**Q-5**

**Attempt all questions**

- (a) Explain different types of cam followers. **07**
- (b) A pinion having 18 teeth engages with an internal gear having 72 teeth. If the gears have involute profiled teeth with  $20^\circ$  pressure angle, module of 4 mm and the addendum on pinion and gear are 8.5 mm and 3.5 mm respectively, find the length of path of contact. **07**

**Q-6**

**Attempt all questions**

- (a) With neat schematic diagrams discuss the effect of gyroscopic couple on a naval ship during steering, pitching, and rolling. **07**
- (b) A, B, C and D are four masses carried by a rotating shaft at radii 100, 125, 200 and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the mass of B, C and D are 10 kg, 5 kg, and 4 kg respectively. Find the required mass A and the relative angular settings of the four masses so that the shaft shall be in complete balance. **07**

**Q-7**

**Attempt all questions**

- (a) Define the terms “Static balancing” and “Dynamic balancing”. State the necessary conditions to achieve them. **07**
- (b) An aeroplane makes a complete half circle of 50 m radius, towards left, when flying at 200 km per hr. The rotary engine and the propeller of the plane have a mass of 400 kg and a radius of gyration of 0.3 m. The engine rotates at 2400 r.p.m. clockwise when **07**



viewed from the rear. Find the gyroscopic couple on the aircraft and state its effect on it.

**Q-8**

**Attempt all questions**

- (a) Define natural frequency of vibration and obtain equation of natural frequency for spring mass system. **07**
- (b) Derive expression for length of belt for open belt drive. **07**

