

**B. E. MECHANICAL ENGINEERING (PART TIME) FIRST  
YEAR SECOND SEMESTER EXAM 2018 (OLD)**

**KINEMATICS OF MACHINES**

Time: 3 hours

Full Marks: 100

(Answer any **five**)  
(Assume data if required)

(Give answer to the different parts of a question together)

1. Explain Kutzbach's criteria.  
Describe different types of kinematic pairs.  
Sketch and describe Whitworth quick return mechanism. Why is it called quick return mechanism?

4+4+12=20

2. State and describe any one of the inversions of double slider crank mechanism with proper sketch.  
Explain Grashoff's criteria.  
Show that the slider crank mechanism is a modification of the basic four bar linkage.

6+8+6=20

3. Find the degrees of freedom of the following mechanisms shown in the figure 1.

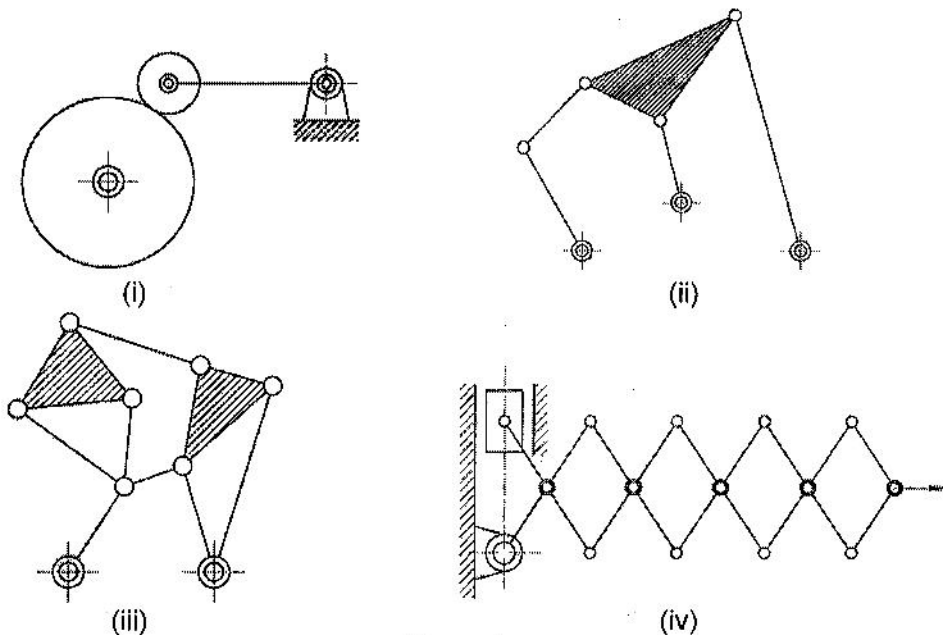


Figure 1

Derive the expression of transmission angle as a function of crank rotational angle and length of the links with respect to a typical four bar chain. Also find the maximum and minimum transmission angles.

10+10=20

[ Turn over

4. Derive the expression of belt length in open belt drive.  
A shaft rotating at 200 rpm drives another shaft at 300 rpm and transmits 6 kW of power through a belt. The belt is 100 mm wide and 10 mm thick. The distance between the shafts is 4 m. The smaller pulley is 0.5 m in diameter. Calculate the stress in the belt if it is an open belt drive. Take  $\mu = 0.3$ .  
10+10=20
5. State and derive the laws of gearing.  
Define pressure angle of a gear tooth profile.  
A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gears is Involute with  $20^\circ$  pressure angle, 12 mm module and 10 mm addendum. Find the length of path of contact, arc of contact and contact ratio.  
8+2+10=20
6. Explain different types of gear train with sketches.  
Explain with sketches: Involute tooth profile; Cycloidal tooth profile;  
Derive the expression of minimum no. of teeth to avoid interference while two spur gears with involute profile in mesh.  
8+4+8=20
7.  $Q_2B$  is 37.5 mm;  $Q_2Q_4$  is 87.5 mm;  $Q_4C$  is 44 mm;  $BC$  is 50 mm. Angular speed of the crank  $Q_2B$  is 1 rad/sec CCW. Find velocities of C and P with reference to instantaneous axis or relative velocity method (Refer figure 2).

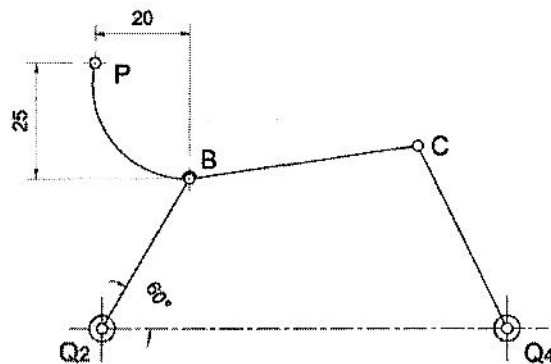


Figure 2

Locate instantaneous centers of a typical four bar chain.

12+8=20

8. Describe different types of cam and follower with sketches. Classify different types of follower motion.  
For the gear train in the figure 3, shaft A rotates at 300 rpm and shaft B at 600 rpm in the directions shown. Determine the speed and the direction of rotation of shaft C.

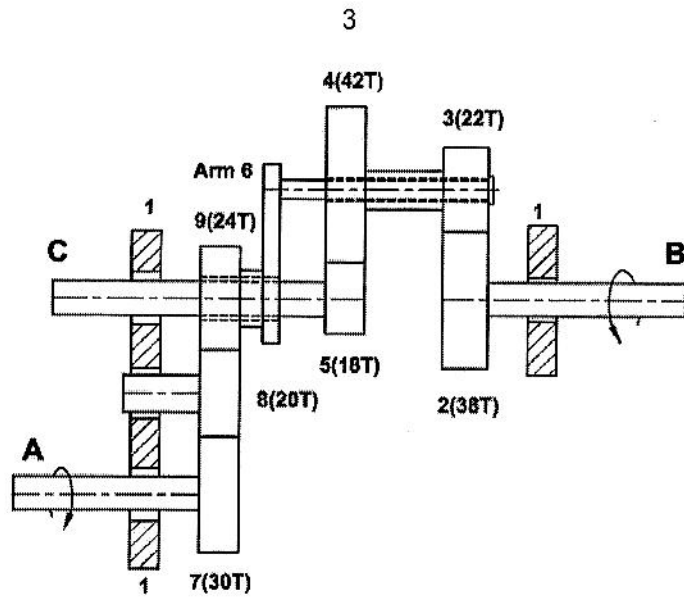


Figure 3

10+10=20

9. Write short notes on (any four):

- Toggle mechanism
- Resolution and composition method
- Polygonal effect in chain drive
- Paucellier mechanism
- Instantaneous center

5+5+5+5=20