



Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/B.TECH/(ME/PE/AUE-NEW)/SEM-4/ME-402/2013**

**2013**

**MECHANISM**

Time Allotted : 3 Hours

Full Marks : 70

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words  
as far as practicable.*

**GROUP – A**

**( Multiple Choice Type Questions )**

1. Choose the correct alternatives for the following :  $10 \times 1 = 10$ 
  - i) In a four-link mechanism, the sum of the shortest and the longest link is less than the sum of the other two links. It will act as a drag-crank mechanism if
    - a) the longest link is fixed
    - b) the shortest link is fixed
    - c) the link opposite to the shortest link is fixed
    - d) any link adjacent to shortest link is fixed.
  - ii) In a four-link mechanism, torque transmitted to the output link is maximum when transmission angle is
    - a) zero
    - b)  $180^\circ$
    - c)  $45^\circ$
    - d)  $90^\circ$ .

- 2



- viii) A differential gear in automobile is used to
- reduce the speed
  - help in turning
  - assist in changing speed
  - provide jerk-free movement of vehicle.
- ix) The contact ratio of gears is always
- more than one
  - one
  - less than one
  - zero.
- x) Which of the following is an inversion of double-slider crank chain ?
- Whitworth quick return mechanism
  - Reciprocating compressor
  - Scotch Yoke
  - Rotary engine.

### GROUP – B

#### ( Short Answer Type Questions )

Answer any *three* of the following.  $3 \times 5 = 15$

2. a) State the Gruebler's criterion for ascertaining the 'degree of freedom' of a planar mechanism for turning pairs only.
- b) Determine the degree of freedom (DOF) of the mechanism shown in the following figures :  $2 + 3$

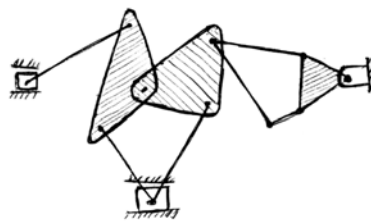


Fig. 1(a)

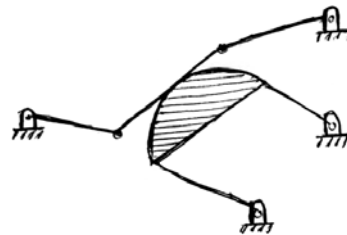
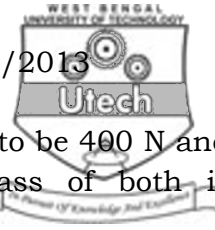


Fig. 1(b)



3. The initial tension in a both deriver is found to be 400 N and the ratio of friction tension 1.7. The mass of both is 0.072 kg/m length. Determine the following :
- The velocity of belt for maximum power transmission
  - Tension on the tight side of the belt when it is ready to start
  - Tension on the tight side of the belt when running at maximum speed.
4. a) What is Kutzbach's criterion for degree of freedom of plane mechanisms ?  
b) In what way Grubler's creation is different from it ?
- 3 + 2
5. a) How does Whitworth quick return mechanism differ from crank and slotted lever mechanism ?  
b) Figure 2(a) and 2(b) indicate the 4 link mechanism. Indicate the type of each mechanism whether crank rocker, double crank or double rocker. Dimensions are in standard units.
- 2 + 3

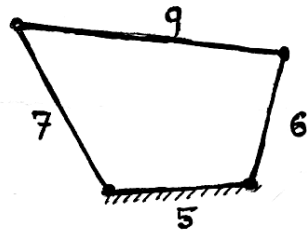


Fig. 2 (a)

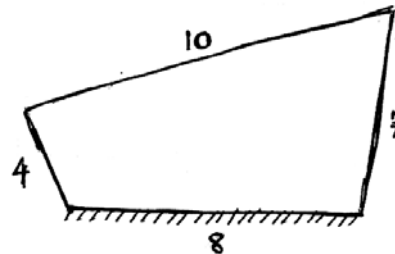


Fig. 2(b)

6. a) Describe the fundamental law of gearing.  
b) Derive an expression for length of the path of contact in a pair of involute gear teeth.
- 3 + 2
7. Show that for the maximum power transmission condition 1/3rd of the maximum tension is absorbed as centrifugal tension for a belt drive.



**GROUP – C**

**( Long Answer Type Questions )**

Answer any *three* of the following.  $3 \times 15 = 45$

8. a) What is meant by interference in involute gear ? Explain. 2
- b) Two  $14.5^\circ$  involute spur gears mesh externally and give a velocity ratio 3.5. Module is 4 mm and the addendum is equal to 1.3 modules. If the pinion rotates at 320 rpm, determine —
  - i) the minimum number of teeth on each wheel to avoid interference
  - ii) the number of pairs of teeth in contact. 8
- c) In an epicyclic gear (Fig. 3) the wheel A fixed to  $S_1$  has 30 teeth and rotates at 500 rpm. B gear with A and is fixed rigidly to C, both being free to rotate on  $S_2$ . the wheel B, C and D have 50, 70 and 90 teeth respectively. If D rotates at 80 rpm in a direction opposite to that of A, find the speed of the shaft. 5

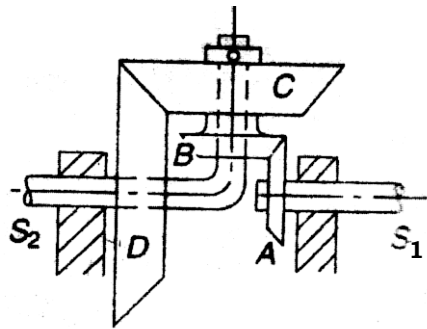
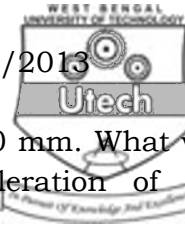


Fig. 3

9. a) Draw the profile of a cam operating a knife-edge follower having a lift of 30 mm. The cam raises the follower with SHM for  $150^\circ$  of the rotation follower by a period of dwell for  $60^\circ$ . The follower descends for the next  $100^\circ$  rotation of the cam with uniform velocity, again followed by a dwell period. The cam rotates at a uniform velocity



of 120 rpm and has a least radius of 20 mm. What will be the maximum velocity and acceleration of the follower during the lift and the return ? 7

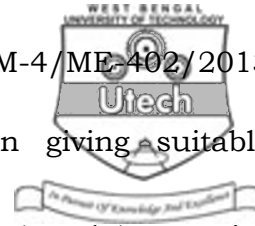
- b) A shaft which rotates at a constant speed of 160 rpm is connected by belting in a parallel shaft 72 cm apart which has to run at 60, 80 and 100 rpm. The smallest pulley on the driver shaft is 4 cm in radius. Determine the remaining radii of the two stepped pulleys for (i) an open belt, (ii) a cross belt. Neglect belt thickness and slip. 8

10. a) Design a four link mechanism if the motions of the input and output links are governed by a function  $y = x^{1.5}$  and  $x$  varies from 1 to 4. Assume  $\theta$  to vary from  $30^\circ$  to  $120^\circ$  and  $\Phi$  from  $60^\circ$  to  $130^\circ$ . The length of the fixed link is 30 mm. Use Chebychev spacing of accuracy points.

- b) A four-bar mechanism is required such that the input and output angles are co-ordinate as given in the table. Synthesis the four bar mechanism applying Freudenstein approach. 7 + 8

Input link angle	$30^\circ$	$50^\circ$	$80^\circ$
Output link angle	$0^\circ$	$30^\circ$	$60^\circ$

11. a) Explain the terms 'Function generation' and 'Path generation'.
- b) Distinguish between higher pair and lower pair.
- c) In a quick-return motion mechanism of crank and slotted lever type, the ratio of maximum velocities is 2. If the length of the stroke is 25 cm, find (i) the length of the slotted lever, (ii) the ratio of times of cutting and return stroke, and (iii) the maximum cutting velocity per second, if the crank rotates at 30 rpm. 3 + 3 + 9



12. a) Describe inversions of 4-bar chain giving suitable sketches.
- b) Define the terms 'degrees of freedom' and 'constraint motion' of a mechanism.
- c) Find out degrees of freedom of mechanism shown in Fig. 4.
- d) "Slider crank mechanism is a special case of 4-bar mechanism." Justify the statement.

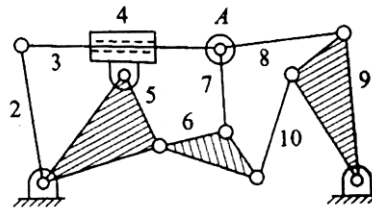


Fig. 4

$$4 + 4 + 3 + 4$$

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