



**MAULANA ABUL KALAM AZAD UNIVERSITY OF
TECHNOLOGY, WEST BENGAL**

Paper Code : ME-402

MECHANISMS

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 × 1 = 10

i) Cam sizes depend on

- a) Base circle b) Pitch circle
c) Prime circle d) Outer circle.

ii) The minimum no. of teeth in rack & pinion for a
20° pressure angle teeth is

- a) 20 b) 18
c) 22 d) 24.

iii) The Gruebler's criteria for determining the degree of
freedom (F) of a mechanism having n links & p
pairs is given by

- a) $F = 3(n-1) - 2P$ b) $F = 6(n-1) - 2P$
c) $F = 5n - 2P$ d) $F = 3(n+1) - 2P$.

- iv) A slider-crank mechanism is a special case of a
a) 3-bar mechanism b) 2-bar mechanism
c) 6-bar mechanism d) 4-bar mechanism.

- v) Due to creep of belts, there is
a) Loss of motion
b) Loss of power to be transmitted
c) Some length of belt poses off the flower
without any contact with it
d) all of these.

- vi) Unconstrained rigid link in a plane has
a) One degree of freedom
b) Two degree of freedom
c) Three degree of freedom
d) Zero degree of freedom.

- vii) Offset is provided in Cam-follower mechanism to
a) minimize the side thrust
b) accelerate
c) avoid jerk
d) none of these.

- viii) A differential gear in automobiles is used to
a) reduce speed
b) assist in changing speed
c) provide jerk-free movement of vehicle
d) help in turning.

- ix) The product of diametral pitch and circular pitch is
equal to

- a) 1 b) $\frac{1}{\pi}$
c) π d) 2π .

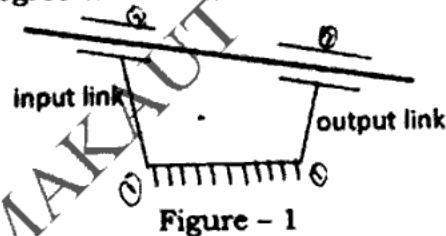
- x) The train value of gear is
- equal to velocity ratio of the gear train
 - reciprocal to velocity ratio of the gear train
 - always greater than unity
 - always less than unity.

GROUP - B

(Short Answer Type Questions)

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

2. a) What is machine ? How does it differ from a mechanism ? 2
- b) For the kinematic linkage shown in figure-1 below determine the types of links and their numbers and the degree of freedom. 3



3. What is backlash of a gear ? A spur gear has 30 teeth and a module of 1.4 mm. It rotates at 360 rpm. Determine its circular pitch and pitch line velocity.

$1 + 2 + 2$

4. With a suitable sketch differentiate between the Device Steering Gear mechanism and Ackerman Steering Gear mechanism.
5. For $y = x^{1.2}$ in the range $1 \leq x \leq 4$. Determine three Chebyshev precision points ($n = 3$).

6. For the four bar linkages below, indicate whether they are crank-rocker, double-crank or double rocker mechanisms, if the shortest link (disregarding the fixed link) is the driver. (all dimensions are in cm) Also state about the class of linkage (class I/class II/class III) with proper justification.

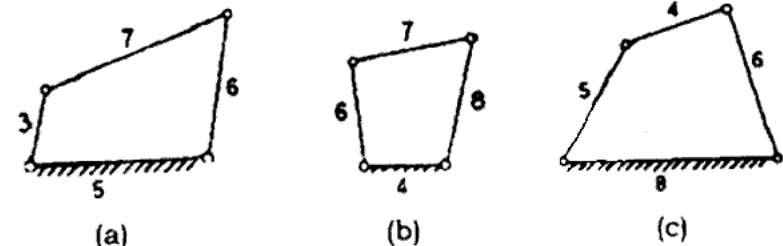
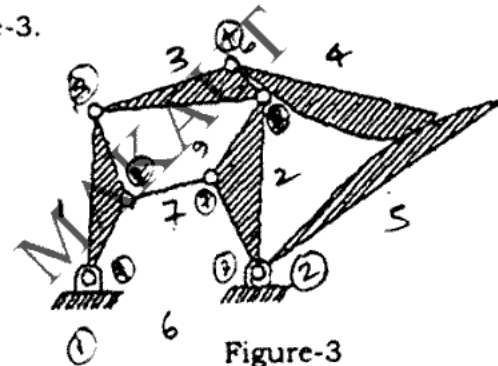


Figure - 2

7. Determine the DOF of the mechanism shown in Figure-3.



GROUP - C

(Long Answer Type Questions)

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

8. a) What is inversion ? Write down different inversions of 4-bar link Mechanisms.

- b) What is Grashof's law of a four bar link mechanism ?
- c) What do you mean by "under-cutting" of a cam ?
What is interference of a gear ?
- d) Find the degree of freedom of the following mechanism shown in Figure-4. $2 + 3 + 2 + 2 + 2 + 4$

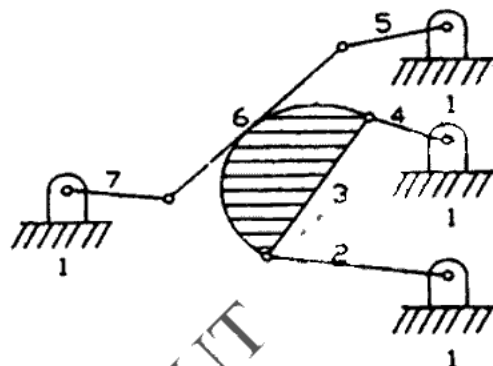


Figure-4

9. a) Two shafts A and B are co-axial. A gear C (50 teeth) is rigidly mounted on shaft A. A compound gear D-E gears with C and an internal gear G. D has 20 teeth and gears with C and E has 35 teeth and gears with an internal gear G. The gear G is fixed and is concentric with the shaft axis. The compound gear D-E is mounted on a pin which projects from an arm keyed to the shaft B. Sketch the arrangement and find the number of teeth on internal gear G assuming that all gears have the

http://www.makaut.com

same module. If the shaft A rotates at 110 r.p.m., find the speed of shaft B.

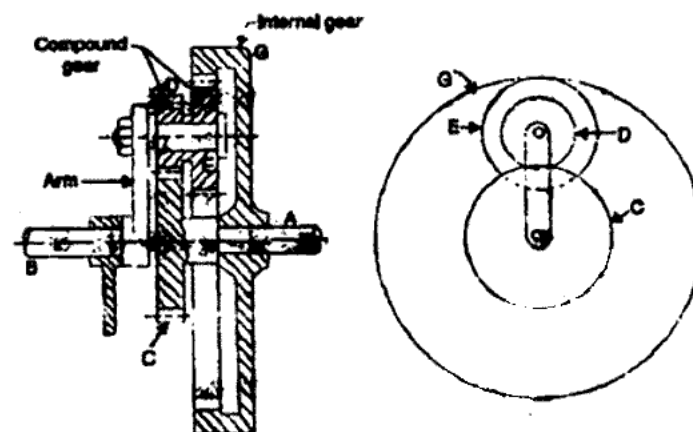


Figure-5

- b) A pair of 20° full depth involute spur gears having 30 and 50 teeth respectively of module 4 mm are in mesh. The smaller gear rotates at 1000 r.p.m. Determine: (i) Sliding velocities at engagement and at disengagement of pair of a teeth, and (ii) contact ratio. 8 + 7

10. 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

11. A cam is to be designed for a knife edge follower with the following data :

- Cam lift = 40 mm during 90° of cam rotation with simple harmonic motion.
- Dwell for the next 30° .
- During the next 60° of cam rotation, the follower returns to its original position with simple harmonic motion.
- Dwell during the remaining 180° .

Draw the profile of the cam when

- the line of stroke of the follower passes through the axis of the cam shaft, and
- the line of stroke is offset 20 mm from the axis of the cam shaft.

The radius of the base circle of the cam is 40 mm. Determine the maximum velocity and acceleration of the follower during its ascent and descent, if the cam rotates at 240 r.p.m.

12. a) Figure 6 shows the mechanism of a radial valve gear. The crank OA turns uniformly at 150 r.p.m. and is pinned at A to rod AB. The point C in the rod is guided in the circular path with D as centre and DC as radius. The dimensions of the various links are :

OA = 150 mm, AB = 550 mm, AC = 450 mm, DC = 500 mm, BE = 350 mm. Determine :

- the velocity and acceleration of the ram E for the given position of the mechanism.
- velocity at points B and C. 10

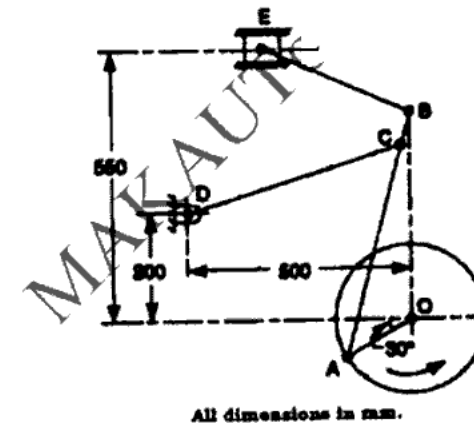


Figure-6

- What do you mean by instantaneous centre method? Illustrate "Aronhold-Kennedy's Theorem of three centres". 2 + 3