

2013

THEORY OF MACHINES

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 kinematic pair, when the elements have surface contact while in motion, it is known as
- a) higher pair b) lower pair
c) closed pair d) unclosed pair.
- ii) The instantaneous centre of a slider moving in a curved surface lies
- a) at centre of curvature
b) at their point of contact
c) at infinity
d) at pin point.
- iii) Initial tension in belts, when stationary, is
- a) T_1 b) T_2
c) $T_1 + T_2$ d) $(T_1 + T_2)/2$
- are the tensions in the tight side and
slack side of the belt respectively.
- iv) The most suitable follower motion programme for high speed engine is
- a) uniform acceleration and deceleration
b) uniform velocity
c) simple harmonic motion

- d) cycloidal.
- v) The module of spur gear is the ratio of
- the pitch circle diameter to the number of teeth
 - the number of teeth to the pitch circle diameter
 - the circumference of pitch circle to the number of teeth
 - the circumference of pitch circle to the diameter of pitch circle.
- vi) A gear train in which axes of gears have motion is called gear train.
- simple
 - compound
 - reverted
 - epicyclic.
- vii) The efficiency of a screw jack depends on
- pitch of threads
 - load
 - both pitch and load
 - neither pitch nor load.
- viii) Static balancing involves balancing of
- masses
 - forces
 - couples
 - forces as well as couples.
- ix) In free vibrations, the acceleration vector leads the displacement vector by
- π
 - $\pi/2$
 - $\pi/3$
 - $2\pi/3$.
- x) A torsional vibratory system having two rotors connected by a shaft has
- one node
 - two nodes
 - three nodes
 - no nodes.

GROUP – B

(Short Answer Type Questions)

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

2. State Grashoff's law. Explain its significance in classifying the four-bar mechanism into different types.
3. An engine shaft running at 120 r.p.m is required to drive a machine shaft by means of a belt. The pulley on the engine shaft is of 2 m diameter and that of the machine shaft is 1 m diameter. If the belt thickness is 5 mm, determine the speed of the machine shaft, when there is a slip of 3%.
4. Distinguish between the pressure angle of a radial cam and that of a spur gear, with the help of a sketch.
5. Name the different types of gears and their application.
6. Deduce the relationship to determine the natural frequency of a spring mass system for longitudinal vibration.
7. With a neat sketch describe a centrifugal clutch.

GROUP – C

(Long Answer Type Questions)

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

8. a) Explain the meaning of 'degrees of freedom' of a linkage. State the Gruebler's criterion for ascertaining the degree of freedom of a planar mechanism for turning pair only. $2 + 2$
- b) Give at least one example of a kinematic pair having degree of freedom one, two and three. 3
- c) In a four bar chain $ABCD$, AD is fixed and is 125 mm long. The crank AB is 62.5 mm long and rotates at a uniform speed of 10 r.p.m. in the clockwise direction, while the link $CD = 75$ mm oscillates about D . BC and CD are of equal length. Locate all the instantaneous centres and determine the angular velocity of the link CD when angle $BAD = 60^\circ$. 8
9. a) Differentiate between mechanism and machine. Give an example of a machine derived from the slider-crank

mechanism. 2 + 1

b) State Kennedy's theorem of three instantaneous centres. Explain its application in locating the

instantaneous centres of a mechanism. 2 + 2

c) Draw and explain Klein's construction for determining the velocity and acceleration of the piston in a slider crank mechanism. 8

10. a) Compare the performance of knife-edge, roller and mushroom followers. 3

b) A cam operating a knife-edged follower has the following data :

i) Follower moves outwards through 40 mm during 60° of cam rotation

ii) Follower dwells for the next 45°

iii) Follower returns to its original position during next 90°

iv) Follower dwells for the rest of the rotation.

The displacement of the follower is to take place with simple harmonic motion during both the outward and return strokes. The least radius of the cam is 50 mm.

Draw the profile of the cam when the axis of the follower passes through the cam axis. 12

11. a) Explain the phenomenon 'creep' in a belt drive. State its effect on velocity ratio in a belt drive. 3

b) List the advantages and disadvantages of V-belt drive over flat belt drive. 4

c) The power transmitted between two shafts 3.5 m apart by a cross belt drive round the two pulleys 600 mm and 300 mm in diameters, is 6 kW. The speed of the larger pulley (driver) is 220 r.p.m. The permissible load on the belt is 25 N/mm width of the belt which is 5 mm

thick. The coefficient of friction between the smaller pulley surface and the belt is 0.35. Determine

- i) necessary length of the belt
- ii) width of the belt and
- iii) necessary initial tension in the belt. 8

12. a) Discuss the method of balancing of rotating masses. 7

b) Discuss the reasons for calculating the natural frequency of vibration for different machine parts.

Discuss the effects of vibration on the life and performance of machine parts. 8

13. Write short notes on any *three* of the following : 3×5

- a) Anti-friction bearings
- b) Flywheel
- c) Hooke joint
- d) Method of balancing of different masses revolving in a same plane.

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