2012

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) According to the Kennedy's theorem, if three bodies

have plane motion, their instantaneous centres lie on

a) a point b) a straight line

c) three lines d) a triangle.

ii) Quick return mechanism is an inversion of

a) double slider crank chain

b) crossed slider crank chain

c) four bar chain

d) single slider crank chain.

iii) In a spring mass system, if the mass is halved and the

spring stiffness is double, the natural frequency is

a) halved b) doubled

c) unchanged d) quadrupled.

iv) Antifriction bearings are

a) ball and roller bearings

b) thin lubricated bearings

c) sleeve bearings

d) hydrodynamic bearings.

v) When the frictional force helps the applied force in

applying the brake, the brake is

a) self-locking b) automatic

c) self-energising d) all of these.

vi) Which one of the following belt drives is considered as

positive drive to transmit the motion ?

a) V-belt b) Flat crossed belt

c) Flat tangential belt d) Timing belt.

vii) Large ratio of speed reduction can be done by using

a) bevel gear b) helical gear

c) worm gear d) spiral gear.

viii) The knife edge follower results

a) considerable side thrust and excessive wear

b) reduced side thrust and wear

c) rolling and less wear

d) sliding and less wear.

ix) For high speed machines the cam follower should move

with

a) uniform velocity

b) simple harmonic motion

c) uniform acceleration and retardation

d) cycloidal motion.

x) The size of the cam depends on

a) base circle b) pitch circle

c) prime circle d) pitch curve.

GROUP – B

(Short Answer Type Questions)

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

2. Define cylindrical cam with reciprocating follower, pressure

angle, prime circle and knife edge follower with suitable

diagram.

3. Make the classification followers with suitable diagram.

4. Explain with a schematic diagram the effective pulley diameter of a vee belt system. How much extra power is transmitted using this system compared to flat belt system ?

$$4 + 1$$

5. Define kinematic pairs. Distinguish between lower and higher pairs. $2 + 3$

6. Explain the method of balancing of several masses rotating in different planes.

7. A shaft of length 75 cm, supported freely at the ends, is carrying a body of mass 90 kg at 25 cm from one end. Find the natural frequency of transverse vibration. Assume $E = 200$ GPa and shaft diameter is 50 mm.

GROUP – C

(Long Answer Type Questions)

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

8. a) For what purpose is a pantograph used ? Sketch one form of pantograph and show that it satisfies the required conditions. 6
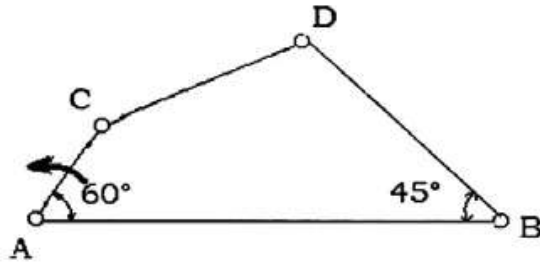
b) A schematic diagram of a four-bar mechanisms is shown in the figure. The length of various links are $AB = 100$ mm, $AC = 25$ mm, $BD = 50$ mm. The angular velocity of link AC is 50 rad/s.

i) Locate all the instantaneous centres for $\theta = 60°$ and linkages as shown in figure.

ii) Determine the velocities of the ends of joints C and D and the angular velocities of the links CD and BD. 9

9. a) In a screw jack, the helix angle of thread is α and the angle of friction is ?. Derive the expression for its efficiency. Show that its efficiency is maximum, when $2\alpha = 90° - ?$.   8

b) Explain the term 'friction circle' of a journal bearing.   2

c) Describe in brief the working of a multi-plate clutch with the help of a neat sketch.   5

10. a) In motion transmission, discuss the effectiveness of chain and sprocket drive with its mechanism and advantages. Point out the limitation of this drive if any.

                                                              5 + 2

b) In a flat belt drive system, a motor is running on 1200 rpm. A motor pulley of diameter 40 cm is connected to a machine pulley of 60 cm via a flat belt of 5 mm thick. Find out the % error if the thickness of belt is ignored for an ideal condition. If the actual rpm of the machine shaft is 788 rpm, find out the slippage % of the system. What modification is required if the machine shaft has to be run in 800 rpm ?   8

11. a) Make a classification of different types of gears along with their applications and functions in textile and apparel machineries.   7

b) What are the two basic applications of planetary or epicyclic gear mechanism ? Give a simple example of

this mechanism for calculating value of epicyclic

train (e). 3 + 5

12. A cam in textile machines with a minimum radius of 25 mm

rotating clockwise at a uniform speed to be designed to give a

roller follower at the end of a valve rod motion described

below :

i) to raise the follower through 50 mm during 120 deg

rotation of the cam

ii) to keep the follower fully raised through next 30 deg

iii) to lower the follower fully during next 60 deg

iv) to keep the follower stationary during rest of the

revolution 150 deg. The diameter of the roller is 20 mm

and the diameter of the cam shaft is 25 mm.

Draw the cam profile of the cam when the line of stroke of

the follower rod passes through the axis of the cam shaft.

The displacement of the valve while being raised and lowered

is to take simple harmonic motion. Determine the maximum

acceleration of the follower rod when the cam shaft rotates at

100 rpm.

Draw the displacement, velocity and acceleration diagram for

one complete revolution of the cam. 7 + 3 + 5

13. Describe the roller follower, knife edge follower and flat faced

follower used in textile machines. What types of follower is

used in zigzag stitch ? Define parabolic and linear cam.

Explain the displacement, velocity and acceleration diagram

of the cyclodial cam from its equation. 2 + 2 + 3 + 8

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