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Question Paper Code: 53105

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2017

Third Semester

Agricultural Engineering

15UAG305 - FUNDAMENTALS OF THEORY OF MACHINES

(Regulation 2015)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. A kinematic pair is a joint of
 - (a) Two links which are fixed
 - (b) Two links having same velocity
 - (c) Two links having relative motion between them
 - (d) Two links moving opposite direction
2. A pantograph mechanism is used to produce
 - (a) Exactly similar to the one traced by a point on the linkage
 - (b) Exact straight line motion
 - (c) Circular motion
 - (d) Helical motion
3. Friction always acts _____ the direction of motion of an object.
 - (a) In the same direction as
 - (b) Perpendicular to
 - (c) Opposite to
 - (d) At 45° angle to
4. On which of the following toy car will travel the farthest?
 - (a) Wet marble floor
 - (b) Newspaper
 - (c) Dry marble floor
 - (d) Carpet
5. The gear used to connect two intersecting shafts is
 - (a) Spur gear
 - (b) Bevel gear
 - (c) Worm and wheel
 - (d) Helical gear

6. Gear teeth formed on the flat surface are called this
 - (a) Pinion
 - (b) Spur
 - (c) Rack
 - (d) Worm
7. A gear train having the input and output gears mounted on the same axle is called
 - (a) Compound
 - (b) Simple
 - (c) Epicyclic
 - (d) Reverted
8. Which gear train is used for higher velocity ratios in a smaller space?
 - (a) Compound
 - (b) Simple
 - (c) Epicyclic
 - (d) Reverted
9. The cam and follower without a spring forms a
 - (a) Lower pair
 - (b) Higher pair
 - (c) Self closed pair
 - (d) Force closed pair
10. Throw of a cam is the maximum distance of the follower from
 - (a) Root circle
 - (b) Pitch circle
 - (c) Prime circle
 - (d) Base circle

PART - B (5 x 2 = 10 Marks)

11. What are the important kinematic chains with four kinematic pair?
12. Define the following terms: Co-efficient of friction and angle of friction.
13. What are the different forms of a tooth?
14. What do you mean by gear train? Mention the different types of gear train.
15. Name the different motions that a follower can have.

PART - C (5 x 16 = 80 Marks)

16. (a) A four bar kinematic chain is represented by a quadrilateral ABCD in which AD is fixed and is 400 mm long. The crank AB 75 mm long rotates in a clockwise direction at 120 rpm and drives the link CD 125 mm long by means of the connecting link BC 350 mm long. Determine the angle through which CD oscillates and find the angular velocities of the links BC and CD in one of the positions when BC is perpendicular to AB. (16)

Or

- (b) A Hooke's joint connects two shafts which are having 165° as the included angle. The driving shaft rotates uniformly at 1000 rpm. Find the maximum angular acceleration of the driven shaft and the maximum torque required if the driven shaft carries a flywheel of mass of 10 kg and 100 mm radius of gyration. (16)
17. (a) A man wishing to slide a stone block of 1000 N over a horizontal concrete floor, ties a rope to the block and pulls in a direction inclined upward at an angle of 20° to the

horizontal. Calculate the minimum pull necessary to slide the block if the coefficient of friction is 0.6. Calculate also the pull required if the inclination of the rope with the horizontal is equal to the angle of friction and prove that this is the least force required to slide the block. (16)

Or

(b) A screw-jack is used to lift a load of 3 kN. The screw of the screw-jack is square threaded with two threads to 1.2 cm. If the co-efficient of friction between the nut and screw is 0.09 and the outer diameter of the screw is 6 cm, find the force required at the end of the handle of length 60 cm to lift the load. (16)

18. (a) Find an expression for the length of the path of contact between two mating spur gears. (16)

Or

(b) Find an expression for the minimum number of teeth on a pinion which is in mesh with a rack in order to avoid interference. (16)

19. (a) In an epicyclic gear train a gear C is keyed to the driving shaft A which rotates at 900 rpm. Gears D and E are fixed together and rotate freely on a pin carried by the arm M which is keyed to the driven shaft B. Gear D is in mesh with gear C while the gear E is in mesh with a fixed annular wheel F. The annular wheel is concentric with the driven shaft B. If the shafts A and B are collinear and number of teeth on gears C, D, E and F are 21, 28, 14 and 84 respectively. Determine the speed and sense of rotation of the driven shaft B. (16)

Or

(b) An epicyclic gear train consists of a sun wheel S, a stationary internal gear E and three identical planet wheels P carried on a star shaped planet carrier C. The size of different toothed wheels are such that the planet C rotates at $1/5$ of the speed of the sun wheel S. The minimum number teeth on any wheel is 16. The driving torque on the sun wheel is 100 Nm. Determine: (i) number of teeth on different wheels of the train and (ii) torque necessary to keep the internal gear stationary. (16)

20. (a) Draw the profile of a cam operating a knife-edged follower when the axis of the follower passes through the axis of the cam shaft from the following data:

- (i) Follower to move outwards through 40 mm during 60° of cam rotation,
- (ii) Follower to dwell for the next 45° ,
- (iii) Follower to return to its original position during next 90° ,
- (iv) Follower to dwell for the rest of the cam rotation.

The displacement of the follower is to take with simple harmonic motion during the outward and return strokes. The least radius of cam is 50 mm. If the cam rotates at 300 rpm, determine the maximum velocity and acceleration of the follower during the outward and return strokes. (16)

Or

(b) Draw the profile of a cam to give the following motion to the reciprocating follower with a flat or mushroom contact face.

- (i) Follower to move outwards through a distance of 20 mm during 120° of cam rotation,
- (ii) Follower to dwell for 45° of cam rotation,
- (iii) Follower to return to its original position during 120° of cam rotation,
- (iv) Follower to dwell for the rest of the cam rotation.

The minimum radius of cam is 25 mm and the flat face is at the right angles to the line of stroke of the follower. The outward and return strokes of the follower are to take place with simple harmonic motion. (16)
