

Roll No.

Total No. of Pages : 02

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B.Tech. (Agriculture Engg.) (Sem.-4)

**THEORY OF MACHINES**

Subject Code : BTAG-402-19

M.Code : 80015

Date of Examination : 05-07-22

Time : 3 Hrs.

Max. Marks : 60

**INSTRUCTIONS TO CANDIDATES :**

1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
2. SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.
3. SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.

**SECTION-A**

**1. Write briefly :**

- a) Calculate the degrees of freedom for a plane mechanism with 5 number of links, where one link is fixed, while the remaining ones are connected through binary revolute joints.
- b) Calculate the degrees of freedom in an automobile differential mechanism.
- c) Show the various instantaneous centres in a 4-bar mechanism.
- d) With the help of a suitable diagram, show the difference between the base circle and prime circle.
- e) With the help of a suitable diagram, highlight the difference between compound and reverted gear trains.
- f) Determine the gear ratio of a simple gear train comprising of three gears, where the input, intermediate and output gears have 20,13 and 40 teeth, respectively.
- g) Enlist the different methods for preventing slippage in belt drives.
- h) Mention any two merits and two demerits of chain drives, in comparison to flat belt drives.
- i) Explain, how the Porter governor design makes an improvement over the Watt governor?
- j) What do you understand by the problem of hunting in a governor system?

## SECTION - B

2. In a single-cylinder reciprocating engine running at 2400 rpm, length of stroke is 200mm while the connecting rod is 400mm long between the centers. Determine the velocity of the piston when it has moved 80mm from the inner dead centre.
3. An epicyclic gear train is composed of a fixed annular gear A having 150 internal teeth. Meshing with gear A is gear B which drives gear D through an idler gear C; D being concentric with A. Wheels B and C are carried on an arm, which revolves clockwise at 100 rpm about the common axis of A and D. If the gears B and D have 25 and 40 teeth, respectively, find the number of teeth, speed and sense of rotation of wheel C.
4. Calculate the length of an open flat belt required for connecting two shafts, which are 3m apart and are required to have a velocity ratio of 1:4. The smaller pulley has a diameter of 400mm.
5. A car wheel has an unbalanced mass of 30g at radius  $r = 240\text{mm}$ , angular position  $\theta = 90^\circ$  and distance,  $a = 40\text{mm}$  from the plane of bearing. This unbalanced weight is to be balanced for couple and force by attaching two balancing weights: B2 on the horn lying in the bearing plane and B1 on the other horn which is at a distance of  $w = 150\text{mm}$  from the plane of bearing. The radius at which the balancing weight is attached on either horn is,  $b = 160\text{mm}$ . Determine the magnitude and angular positions of B1 and B2.
6. A Porter governor has equal arms of length 200 mm each. The arms are pivoted on the rotation axis. The balls have a mass of 4 kg each, while the mass of the central load on the sleeve is 10 kg. The radius of rotation of the balls is 120 mm when the governor begins to lift and is 150 mm when the governor is at maximum speed. Find the minimum and maximum speeds and range of speed of the governor.

## SECTION - C

7. Writing various steps in the construction, construct the displacement diagram for a DRDR cam, which has to displace the follower by 20mm through uniform acceleration / retardation over a rise angle of  $120^\circ$ , followed by dwell of  $60^\circ$  and then return through SHM over a cam angle of  $90^\circ$ . The follower remains at rest for the remaining rotation of the cam. Also, draw the cam profile if the cam has a least circle of 40mm diameter and is supposed to operate a roller follower of 16mm diameter, whose line of stroke passes through the cam axis.
8. A flat belt is used for transmitting power from a pulley, 0.6m diameter and running at 400 rpm, to another pulley, which is 1.5m in diameter. Determine the speed lost by the driven pulley as a result of creep, if the stress on the tight and slack sides of the belt is 1.2 and 0.6 MPa, respectively. Take  $E = 80\text{ MPa}$  for the material of the belt.
9. With the help of a labelled diagram, explain the construction and working of a Watt governor and derive the relationship between angular velocity and vertical height of its balls.

**NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.**