Sub Code: AG304

Paper Id: 180324 Roll No:

B. TECH.
(SEM-III) THEORY EXAMINATION 2019-20
THEORY OF MACHINE

Time: 3 Hours *Total Marks: 100*

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 10 = 20

a. Explain difference between flywheel and Governor.
b. In what way a mechanism different from a machine?
c. What is the significance of degrees of freedom of a kinematic chain when it functions as a mechanism?
d. Define rubbing velocity at a pin joint.
e. Discuss briefly the various types of belts used for the transmission of power.
f. Explain the phenomenon of slip and creep in a belt drive.
g. Discuss various types of gear train in brief.
h. State different type of governor.
i. Why a roller follower is preferred to that of a knife-edge follower?
j. What are the different type of motion with which a follower can move?

SECTION B

2. Attempt any *three* of the following: 10 x 3 = 30

a. Fig 1 shows a Whiteworth quick return motion mechanism. The various dimensions in the mechanism are as follows: OQ = 100 mm; OA = 200 mm; QC =150 mm: and CD = 500 mm. The crank OA makes an angle of 60° with the vertical and rotates at 120 rpm in the clockwise direction. Locate all the instantaneous centre and find the velocity of ram D.

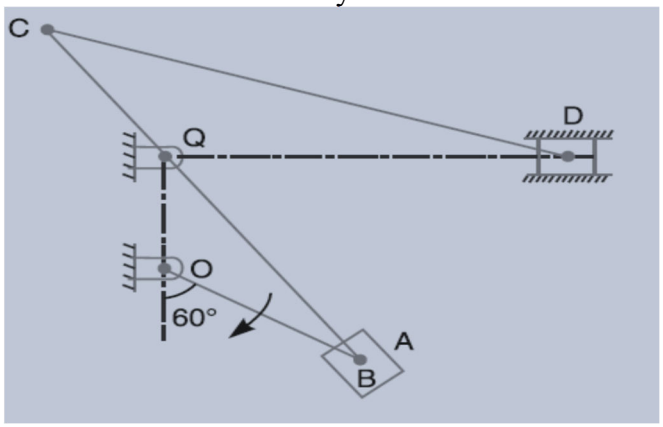

Fig 1

b. Derive an expression for the length of cross belt drive.
c. Construct the profile of a cam to suit the following specifications :
Cam shaft diameter = 40 mm ; Least radius of cam = 25 mm ; Diameter of roller = 25 mm; Angle of lift = 120° ; Angle of fall = 150° ; Lift of the follower = 40 mm ; Number of pauses are two of equal interval between motions.
During the lift, the motion is S.H.M. During the fall the motion is uniform acceleration and deceleration. The speed of the cam shaft is uniform. The line

of stroke of the follower is off-set 12.5 mm from the centre of the cam.

d. A porter governor has equal arm each 250 mm long and pivoted on the axis of rotation. Each ball has the mass of 5 kg and the mass of central load on the sleeve is 25 kg. The radius of rotation of the ball is 150 mm when the governor being lifted and 200 mm when the governor is at maximum speed? Find the minimum and maximum speeds and range of the governor.

e. The following data refer to two cylinder locomotive with cranks at 90° : Reciprocating mass per cylinder = 300 kg ; Crank radius = 0.3 m ; Driving wheel diameter = 1.8 m ; Distance between cylinder centre lines = 0.65 m ; Distance between the driving wheel central planes = 1.55 m. Determine : **1.** the fraction of the reciprocating masses to be balanced, if the hammer blow is not to exceed 46 kN at 96.5 km. p.h. ; **2.** the variation in tractive effort ; and **3.** the maximum swaying couple.

SECTION C

3. Attempt any *one* part of the following: 10 x 1 = 10

(a) (i) Explain Whitworth quick return motion mechanism.
(ii) Explain types of joints.

(b) (i) Discuss the balancing of mass in single plane
(ii) Discuss three types on instantaneous centres for a mechanism.

4. Attempt any *one* part of the following: 10 x 1 = 10

(a) An open belt drive connects two pulleys 1.2 m and 0.5 m diameter, on parallel shafts 4 m apart. The mass of the belt is 0.9 kg per meter length and the maximum tension is not to exceed 2000 N. The coefficient of friction is 3. The 1.2 m pulley, which is the driver, runs at 200 rpm. Due to belt slip on one of the pulleys, the velocity of the driven shaft is only 450 rpm. Calculate the torque on each of the two shafts, the power transmitted, and power lost in friction. What is the efficiency of the drive?

(b) Describe with a neat sketch the working of a single plate friction clutch.

5. Attempt any *one* part of the following: 10 x 1 = 10

(a) In an epicyclic gear of the 'sun and planet' shown in fig 2. The pitch circle diameter of the internally toothed ring is to be 224 mm and the module 4 mm. When the ring D is stationary, the spider A, which carries three planet wheels C of equal size, is to make one revolution in the same sense as the sunwheel B for every five revolution of the driving spindle carrying the sunwheel B. Determine suitable numbers of teeth for all the wheels.

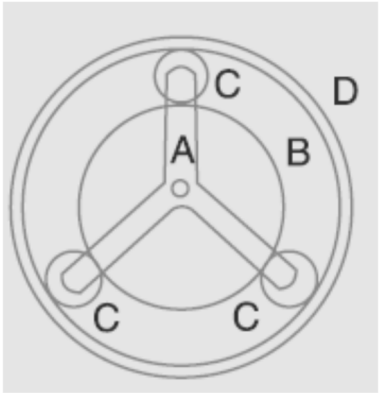

Fig 2

(b) Draw the displacement, velocity and acceleration diagrams for a follower when

it moves with simple harmonic motion. Derive the expression for velocity and acceleration during outstroke and return stroke of the follower.

6. Attempt any *one* part of the following: 10 x 1 = 10

(a) A shaft carries four masses A, B, C and D of magnitude 200 kg, 300 kg, 400 kg and 200 kg respectively and revolving at radii 80 mm, 70 mm, 60 mm and 80 mm in planes measured from A at 300 mm, 400 mm and 700 mm. The angles between the cranks measured anticlockwise are A to B 45°, B to C 70° and C to D 120°. The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100 mm, between X and Y is 400 mm and between Y and D is 200 mm. If the balancing masses revolve at a radius of 100 mm, find their magnitudes and angular positions.

(b) A Proell governor has equal arms of length 300 mm. The upper and lower ends of the arms are pivoted on the axis of the governor. The extension arms of the lower links are each 80 mm long and parallel to the axis when the radii of rotation of the balls are 150 mm and 200 mm. The mass of each ball is 10 kg and the mass of the central load is 100 kg. Determine the range of speed of the governor.

7. Attempt any *one* part of the following: 10 x 1 = 10

(a) Discuss how a single revolving mass is balanced by two masses revolving in different planes.

(b) The speed ratio of the reverted gear train, as shown in Fig.3 , is to be 12. The module pitch of gears A and B is 3.125 mm and of gears C and D is 2.5 mm. Calculate the suitable numbers of teeth for the gears. No gear is to have less than 24 teeth.

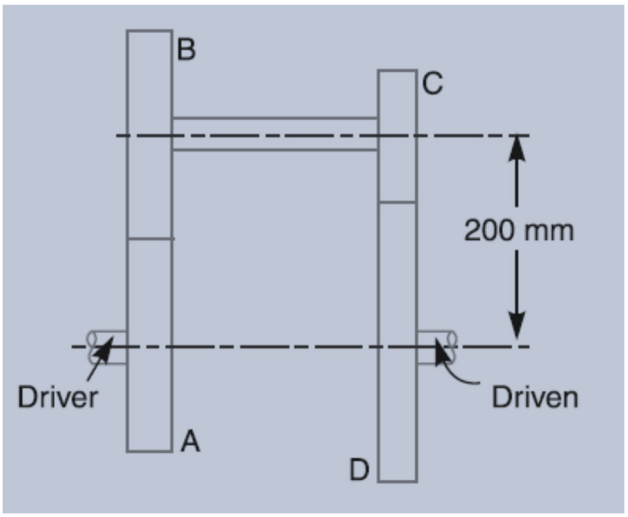

Fig.3