

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

Fifth Semester B.Tech Degree Regular and Supplementary Examination December 2020

**Course Code: ME307****Course Name: MACHINE DESIGN - I**

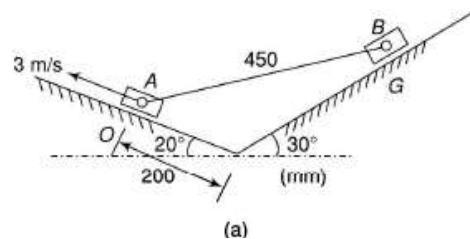
Max. Marks: 100

Duration: 3 Hours

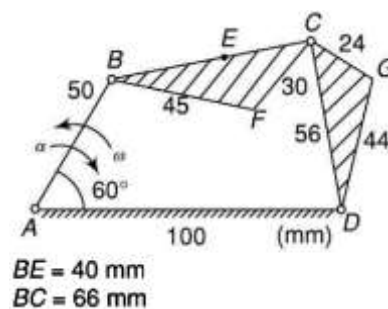
**PART A***Answer any three full questions, each carries 10marks.*

Marks

- 1 a) Define Mechanical advantage and Transmission angle. (4)  
 b) Describe various inversions of slider-crank mechanism with examples. (6)
- 2 a) Explain Grashoff's law? (4)  
 b) Define coupler curve? (2)  
 c) Explain higher pairs and lower pairs with examples? (4)
- 3 a) Differentiate static and dynamic force analysis? Also give examples (5)  
 b) For the position of the mechanism shown in the figure, find the velocity of the slider B for the given configuration if the velocity of the slider A is 3m/s. (5)



- 4 A configuration diagram of a four-link mechanism along with the lengths of the link in mm is given. The link AB has an instantaneous angular velocity of 10.5 rad/s and a retardation of 26 rad/s<sup>2</sup> in the counter clockwise direction. Find, (10)
- The angular accelerations of links BC and CD.
  - The linear accelerations of the points E, F and G.



**PART B**

*Answer any three full questions, each carries 10marks.*

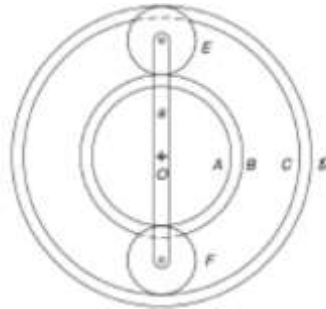
- 5 a) Explain Sensitiveness of a governor and Hunting (3)  
b) Explain Porter governor. (7)
- 6 a) Explain the gyroscopic effect on an aeroplane? (5)  
b) An aeroplane flying at 240 km/h turns towards the left and completes a quarter circle of 60m radius. The mass of the rotary engine and the propeller of the plane is 450 kg with a radius of gyration of 320mm. The engine speed is 2000 rpm clockwise when views from the rear. Determine the gyroscopic couple on the aircraft? (5)
- 7 a) Derive an expression for maximum fluctuation of energy for a flywheel? (5)  
b) A flywheel absorbs 24 KJ of energy on increasing its speed of 210 rpm to 214 rpm. Determine its kinetic energy at 250 rpm? (5)
- 8 a) Explain turning moment diagram for an IC Engine. (4)  
b) The turning moment diagram for a petrol engine is drawn to a vertical scale of 1 mm= 500 Nm and a horizontal scale of 1 mm = 3°. The turning moment diagram repeats itself after every half revolution of the crankshaft. The areas above and below the mean torque line are 260, -580, 80, -380, 870 and -250 mm<sup>2</sup>. The rotating parts have a mass of 55 kg and radius of gyration of 2.1 m. If the engine speed is 1600 rpm, determine the coefficient of fluctuation of speed. (6)

**PART C**

*Answer any four full questions, each carries 10marks.*

- 9 Draw the profile of a cam operating a knife-edge follower having a lift of 30 mm. (10)  
The cam raises the follower with SHM for 150° of the rotation followed by a period of dwell for 60°. The follower descends for the next 100° rotation of the cam with uniform velocity, again followed by a dwell period. The cam rotates at a uniform velocity of 120 rpm and has a least radius of 20 mm. What will be the maximum velocity and acceleration of the follower during the lift and the return?
- 10 a) Define the following terms for a cam (i) Base circle (ii) Trace point (iii) Pitch curve (iv) Pitch circle (v) Prime circle (5)  
b) Derive an expression for maximum velocity and acceleration if the follower motion is Simple Harmonic Motion (SHM)? (5)

- 11 a) Explain the various types of cam classification with examples? (7)  
 b) Explain polynomial cams? (3)
- 12 In the epicyclic gear train, the compound wheels A and B as well as internal wheels C and D rotate independently about the axis O. The wheels E and F rotate on the pins fixed to the arm A. All the wheels are of the same module. The number of teeth on the wheels are  $T_A=52$ ,  $T_B=56$ ,  $T_E=T_F=36$ . Determine the speed of C if (i). The wheel D fixed and arm 'a' rotates at 200rpm clock-wise (ii). The wheel D rotates at 200rpm counter-clockwise and the arm 'a' rotates at 20rpm counter clockwise? (10)



- 13 Derive the expression to calculate the path of contact and arc of contact for gear teeth with involute profile. (10)
- 14 a) Define circular pitch, diametral pitch and module. (3)  
 b) Explain the terms addendum and dedendum. (2)  
 c) Two spur gears have a velocity ratio of  $1/3$ . The driven gear has 72 teeth of 8mm module and rotates at 300rpm. Calculate the number of teeth and the speed of the driver. What will be the pitch line velocities? (5)

\*\*\*\*