

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIFTH SEMESTER B.TECH DEGREE EXAMINATION, APRIL 2018

Course Code: ME307

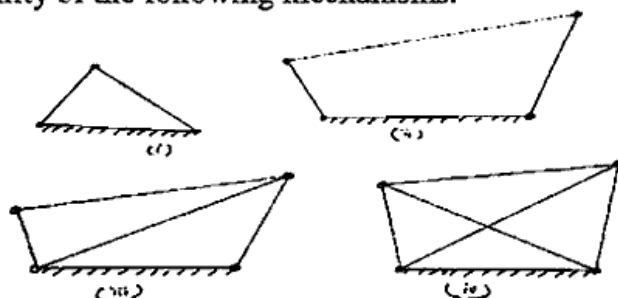
Course Name: MACHINE DESIGN – I (AU)

Max. Marks: 100

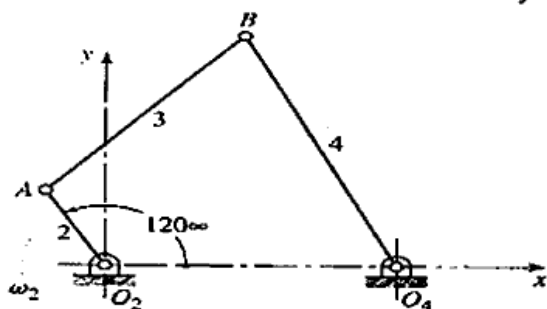
Duration: 3 Hours

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

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|---|---|-----|
| 1 | a) Define transmission angle in a planar mechanism and give its significance. | (3) |
| | b) What is the Kutzbach Criterion for mechanisms? | (3) |
| | c) Calculate the mobility of the following mechanisms. | (4) |



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| 2 | a) What do you mean by kinematic inversion? | (2) |
| | b) What are the different kinematic inversions of the slider crank chain? Explain each with the help of figure and state applications of the same. | (8) |
| 3 | For the mechanism shown in figure, $AO_2 = 100\text{mm}$, $BA = 250\text{ mm}$, $O_4O_2 = 250\text{mm}$ and $BO_4 = 300\text{mm}$. If link 2 is given a constant angular velocity of 45 rad/s in the counter clockwise direction, Find the angular velocities and angular accelerations of links 3 and 4. Also find the absolute velocity of point B. | (10) |



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| 4 | a) What do you mean by a linear system and the principle of superposition? | (3) |
| | b) In a slider crank mechanism with crank radius of 40 mm and connecting rod length of 100 mm , find the external torque to be applied on the crank for static equilibrium when the crank angle is 45° from top dead centre and the piston load is 1500 N . | (7) |

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

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| 5 | Explain the construction and working of the following | |
| | a) Watt governor | (5) |
| | b) Hartnell Governor | (5) |
| 6 | a) Derive an expression for the gyroscopic couple in a rotor with moment of inertia I , angular velocity of rotation ω and velocity of precession of the rotational axis ω_p . | (4) |
| | b) An aeroplane flying at 200 km/h turns towards the left and completes a quarter circle of 50m radius. The mass of the rotary engine and the propeller of the plane is 450 kg with a radius of gyration of 320 mm . The engine speed is 2000 rpm clockwise when viewed from the rear. Determine the gyroscopic couple on the | (6) |

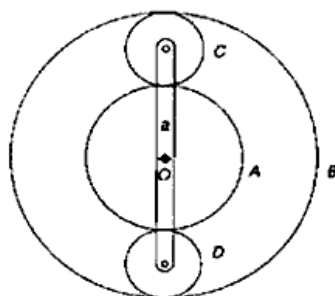
aircraft and state its effect.

- 7 Turning moment diagram for a petrol engine is drawn to the following scales: (10)
turning moment, 1 mm = 5 Nm, crank angle 1mm = 1°. The turning moment diagram repeats itself at every half revolution of the engine and the area of above and below the mean turning moment line taken in order are 295, 685, 40, 340, 960, 270 mm². The rotating parts are equivalent to a mass of 36 kg at a radius of gyration of 150mm. Determine the coefficient of fluctuation of speed when the engine runs at 1800 rpm.
- 8 a) Derive an expression for the energy stored in a flywheel. (7)
b) Explain and derive an expression for the coefficient of fluctuation of speed of a flywheel in terms of both angular and linear speeds. (3)

PART C

Answer any four full questions, each carries 10 marks

- 9 The cam follower mechanism is used to transmit motion by direct contact. How are followers classified according to their shape, movement and location of line of movement? Explain each with the help of simple figures. (10)
- 10 Draw the profile of the cam with knife edge follower. The cam lifts the follower for 120° with SHM followed by a dwell period of 40°. Then the follower lowers down during 150° of the cam rotation with uniform acceleration and deceleration followed by dwell period. Given that the minimum radius of the cam is 25 mm, lift is 30mm. If the cam rotates at a uniform speed of 150 rpm calculate the maximum velocity and acceleration of the follower during the descent period. (10)
- 11 A cam with a radial roller follower imparts the following motion to the follower (10)
To raise the follower through 30 mm with uniform acceleration and deceleration during the 120° rotation of the cam. Dwell for the next 30° of cam rotation and to lower the follower with simple harmonic motion during the next 100° rotation of the cam and dwell for rest of the cam rotation.
The cam has a minimum radius of 30 mm and rotates in the clockwise direction at uniform speed of 800 rpm. The roller diameter is 14mm.
- 12 a) What do you mean by pitch circle of a gear? (2)
b) Define module in a gear. Can two gear of different modules mesh? (2)
c) What is contact ratio in the context of gears? What is its significance? (2)
d) State and explain the law of gearing. (4)
- 13 a) What are the different types of gear trains? (2)
b) An epicyclic gear train as shown in figure has 100 teeth on A and 250 teeth on B. Determine the speed of arm 'a', if A rotates at 100 rpm clockwise and B at 50 rpm counter clockwise. (8)



- 14 a) Define addendum and addendum circle in a gear. (2)
b) Explain undercutting in a gear with the help of a diagram. (4)
c) The number of teeth in a spur gear is 30 and it rotates at 200 rpm. What will be its circular pitch and the pitch line velocity if it has a module of 2 mm. (4)
