

INDIAN MARITIME UNIVERSITY
(A Central University, Government of India)
End Semester Examination Dec 2019/Jan 2020
B.Tech (Marine Engineering)
Semester -III
UG11T3305- Mechanics of Machines I

Date: 19.12.2019
Time: 3 Hours

Max Marks: 70
Pass Marks: 35

Part – A (compulsory)

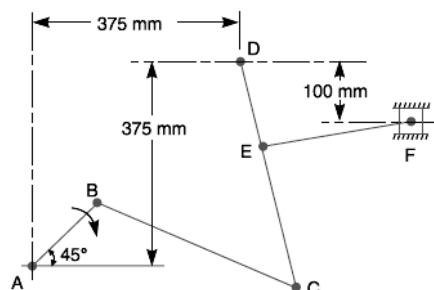
Answer the following (10x2=20 Marks)

1. Define Degrees of Freedom.
2. Define Instantaneous centre.
3. Define tangent cam?
4. Define undercutting in cam. How it occurs?
5. Define Pitch curve.
6. What is the advantage of a compound gear train over a simple gear train?
7. What is an angle of obliquity in gears?
8. What are the advantages and limitations of gear drive? Write any two.
9. How is angular momentum defined?
10. What is precessional angular motion?

Part – B

Answer any 5 out of 7 questions (5 x 10= 50 marks)

11. The turning moment diagram for a multicylinder engine has been drawn to a scale 1 mm = 600 N-m vertically and 1 mm = 3° horizontally. The intercepted areas between the output torque curve and the mean resistance line, taken in order from one end, are as follows: + 52, - 124, + 92, - 140, + 85, - 72 and + 107 mm², when the engine is running at a speed of 600 r.p.m. If the total fluctuation of speed is not to exceed $\pm 1.5\%$ of the mean, find the necessary mass of the flywheel of radius 0.5 m. (10 marks)
12. The mechanism, as shown below has the dimensions of various links as follows: AB = DE = 150 mm; BC = CD = 450 mm; EF = 375 mm. The crank AB makes an angle of 45° with the horizontal and rotates about A in the clockwise direction at a uniform speed of 120 r.p.m. The lever DC oscillates about the fixed point D, which is connected to AB by the coupler BC. The block F moves in the horizontal guides, being driven by the link EF. Determine:
 - a) velocity of the block F (3 marks)
 - b) angular velocity of DC (4 marks)
 - c) Rubbing speed at the pin C which is 50 mm in diameter. (3 marks)



- 13.** 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 motion, 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. (10 marks)
- 14.** A pair of 20° full depth involute spur gears having 30 and 50 teeth respectively of module 4 mm are in mesh. The smaller gear rotates at 1000 r.p.m. Determine:
- Sliding velocities at engagement and at disengagement of pair of a teeth. (7 marks)
 - Contact ratio. (3 mark)
- 15.** In an epicyclic gear train, the internal wheels A and B and compound wheels C and D rotate independently about axis O. The wheels E and F rotate on pins fixed to the arm G. E gears with A and C and F gears with B and D. All the wheels have the same module and the number of teeth are:
 $TC = 28$; $TD = 26$; $TE = TF = 18$.
- Sketch the arrangement; (4 marks)
 - Find the number of teeth on A and B ; (2 marks)
 - If the arm G makes 100 r.p.m. clockwise and A is fixed, find the speed of B ; (2 marks)
 - If the arm G makes 100 r.p.m. clockwise and wheel A makes 10 r.p.m. counter clockwise; find the speed of wheel B. (2 marks)
- 16.** The turbine rotor of a ship has a mass of 2000 kg and rotates at a speed of 3000 r.p.m. clockwise when looking from a stern. The radius of gyration of the rotor is 0.5 m. Determine the gyroscopic couple and its effects upon the ship when the ship is steering to the right in a curve of 100 m radius at a speed of 16.1 knots (1 knot = 1855 m/hr).
 Calculate also the torque and its effects when the ship is pitching in simple harmonic motion, the bow falling with its maximum velocity. The period of pitching is 50 seconds and the total angular displacement between the two extreme positions of pitching is 12° . Find the maximum acceleration during pitching motion. (10 marks)
- 17.** In a symmetrical tangent cam operating a roller follower, the least radius of the cam is 30 mm and roller radius is 17.5 mm. The angle of ascent is 75° and the total lift is 17.5 mm. The speed of the cam shaft is 600 r.p.m. Calculate:
- The principal dimensions of the cam. (5 marks)
 - The accelerations of the follower at the beginning of the lift, where straight flank merges into the circular nose and at the apex of the circular nose. (5 marks)
- Assume that there is no dwell between ascent and descent.
