

**Indian Maritime University**  
**(A Central University, Govt. of India)**  
**End Semester Examinations – June 2023**  
**Programme Name: B Tech (ME)**  
**Semester: III**  
**Subject Code: UG11T4308**  
**Subject Name: Mechanics of Machines**

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Date: 24.05.2023

Max Marks: 70

Duration: 03 Hrs

Pass Marks: 35

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General Instructions

- (i) All Sections (A, B & C) are to be attempted.
- (ii) Options, if any, are specified in respective section.

**Section A**

Ten MCQs/Fill in the Blanks of 01 Mark each – Choose the correct answer as applicable.

1. The number of degrees of freedom of a planar linkage with 8 links and 9 simple revolute joints is
  - (a) 1
  - (b) 2
  - (c) 3
  - (d) 4
  
2. The Coriolis component of acceleration is considered in which the following Mechanism
  - (a) Beam engine
  - (b) Slider crank mechanism
  - (c) Four bar mechanism
  - (d) Crank and Slotted lever Quick return motion mechanism
  
3. The number of inversions for a slider crank mechanism is
  - (a) 1
  - (b) 2
  - (c) 4
  - (d) 5

4. In a ball bearing, ball and bearing forms a

- A. Turning pair
- B. Screw Pair
- C. Rolling Pair
- D. Spherical Pair

5. For full depth of involutes spur gears, minimum number of teeth of pinion to avoid interference depend upon

- (a) Speed ratio
- (b) Pitch diameter
- (c) Circular Pitch
- (d) Pressure angle

6. In a gear train, when the axes of the shafts, over which the gears are mounted, move relative to a fixed axis, is called

- (a) Simple gear train
- (b) compound gear train
- (c) Reverted gear train.
- (d) Epicyclic gear train

7. For a given lift of the follower of a cam follower mechanism, a smaller base circle diameter is desired.

- (a) Because it will give a steeper cam and higher-pressure angle.
- (b) Because it will give a profile with lower pressure angle
- (c) Because it will avoid jumping
- (d) None of the above

8. For high-speed engines, the cam follower should move with

- (a) Uniform velocity
- (b) simple harmonic motion
- (c) Uniform acceleration and retardation
- (d) cycloidal motion

9. Often an unbalance of forces is produced in rotary or reciprocating machinery due to the

- (a) Centrifugal forces
- (b) Centripetal forces
- (c) Friction forces
- (d) Inertia forces

10. In order to have a complete balance of the several revolving masses in different planes

- (a) The resultant force must be zero
- (b) The resultant couple must be zero
- (c) Both the resultant force and couple must be zero
- (d) None of the above.

## Section B

Five Questions of 02 Marks each:

11. Show the plots reflecting the fluctuation of primary inertia forces and secondary inertia forces due to reciprocating parts of single cylinder two stroke engine in one crank rotation
12. What are three important types of kinematic chains with four lower pairs and explain inversion mechanism?
13. Explain briefly the concept of Interference in gears
14. Explain what is roller and flat face follower?
15. State the necessity of Balancing.

## Section C

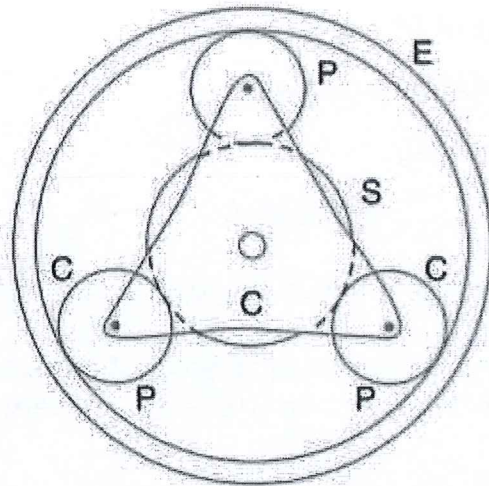
Seven Questions of 10 Marks each of which any 05 questions to be answered.

16. (a) What you understand by Equivalent dynamic system, what are the essential condition of placing the two masses, so that the system become dynamic equivalent. **(3)**
- (b) The crank pin circle radius of a horizontal engine is 300 mm. The mass of the reciprocating part is 250 kg. When the crank has travelled  $60^\circ$  from inner dead centre, the difference between the driving and the back pressure is  $0.35 \text{ N/mm}^2$ . The connecting rod length between centres is 1.2 m and the cylinder bore is 0.5 m. If the engine runs at 250 r.p.m. and if the effect of the piston rod diameter is neglected, calculate  
(i) pressure on slide bar,  
(ii) Thrust on the connecting rod,  
(iii) Tangential force on the crank pin, and  
(iv) Turning moment on the crank shaft. **(7)**
17. (a) Explain type of constrained motion and classify the kinematic pair according to the type of contact between the elements. **(4)**
- (b) What are the different Inversions of a Slider crank mechanism? Describe the working of the any one inversion (with a neat sketch) which can be used for shaping application. **(6)**
18. (a) With the help of diagram state and prove law of gearing. **(5)**
- (b) Two  $20^\circ$  involute spur gears have module of 10 mm. The addendum is 1 module. The larger gear has 40 teeth and the pinion 20 teeth. Does interference occur? If it occurs, how could eliminate the interference? **(5)**

19. An epicyclic gear train consists of a sun wheel S, a stationary internal gear E and three identical planet wheels P carried on a star-shaped planet carrier C. The size different toothed wheels are such that the planet carrier C rotates at  $1/5^{\text{th}}$  of the speed of the sun wheel S. The minimum number of teeth on any wheel is 16. The driving torque on the sun wheel is 100 N-m.

Determine: 1. Number of teeth on different wheels of the train and  
2. Torque necessary to keep the internal gear stationary.

**(10M)**



20. (a) Write a short note about tangent cam and their application.

**(2M)**

(b) In a symmetrical tangent Cam operating a roller follower, the list radius of the cam is 30 mm and roller radius is 17.5 mm. The angle of outstroke is  $75^\circ$  and the tool lift is 17.5 mm. The speed of the cam shaft is 600 r.p.m.

Calculate (Assume there is no dwell between angle of outstroke and angle of return)

1. The principal dimensions of the cam
2. The acceleration 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 and at the apex of the circular nose.

**(8M)**

21. (a) Write a short note on primary and secondary balancing

**(4)**

(b) Four masses  $m_1$ ,  $m_2$ ,  $m_3$  and  $m_4$  are 200 kg, 300 kg, 240 kg and 260 Kg respectively. The corresponding radii of rotation are 0.2 m, 0.15 m, 0.25 m and 0.3 m respectively and the angles between successive masses are  $45^\circ$ ,  $75^\circ$  and  $135^\circ$ . Find the position and magnitude of the balance mass required, if its radius of rotation is 0.2 m.

**(6)**

22. A shaft carries four masses A,B,C and of magnitude 200 kg ,300 kg ,400 kg and 200 kg respectively and revolving at radii 80mm ,70mm,60mm 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  $45^\circ$ , B to C  $70^\circ$ , and C to D  $120^\circ$ . 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. **(10M)**

Tolani

