Indian Maritime University

(A Central Uni2versity, Govt of India)

Supplementary Examinations – March/April 2025

Programme Name: B Tech (ME)

Semester: III

Subject Code: UG11T4308

Subject Name: Mechanics of Machines

Date: 29.03.2025	Max Marks: 70
Duration: 03 Hrs	Pass Marks: 35

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 **(1×10=10)**– Choose the correct answer as applicable.

1. In a 4 –bar linkage, if the lengths of shortest, longest and the other two links are denoted by s, l, p and q, then it would result in Grashof's linkage provided that

(a) $l + p < s + q$
(b) $l + s < p + q$
(c) $l + p = s + q$
(d) none of these

2. In a skew bevel gears, the axes are

(a) non-parallel and non-intersecting
(b) parallel and intersecting
(c) intersect, and the teeth are curved
(d) None

3. The product of the diametral pitch and circular pitch is equal to
(a) 1
(b) $1/\pi$
(c) 2π
(d) π

4. The partial balancing means

(a) balancing partially the revolving masses
(b) balancing partially the reciprocating masses
(c) best balancing of engines
(d) all of the above

5. 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

6. When the axes of first and last gear are co-axial, then gear train is known as
(a) simple gear train
(b) compound gear train
(c) epicyclic gear train
(d) reverted gear train

7. The total number of instantaneous centres for a mechanism consisting of n links are

(a) n/2

(b) n

(c) n–1/2

(d) n(n–1)/ 2

8. The two links OA and OB are connected by a pin joint at O. If the link OA turns with angular velocity ω_1 rad/s in the clockwise direction and the link OB turns with angular velocity ω_2 rad/s in the anti-clockwise direction, then the rubbing velocity at the pin joint O is

(a) $\omega_1 . \omega_2 . r$

(b) $(\omega_1 - \omega_2) r$

(c) $(\omega_1 + \omega_2) r$

(d) $(\omega_1 - \omega_2) 2 r$

9. In reciprocating engines, the primary unbalanced force
(a) cannot be balanced
(b) can be fully balanced
(c) can be partially balanced
(d) is maximum when the angle of crank with the line of stroke is 45

10. In a radial cam, the follower moves
(a) in a direction perpendicular to the cam axis
(b) in a direction parallel to the cam axis
(c) in any direction irrespective of the cam axis

(d) along the cam axis

Section B

Five Questions of 02 Marks each **(2×5=10)**

11. Explain the terms Lower pair and Higher pair.
12. Differentiate: static and dynamic balancing.
13. Why the involute gears are more commonly used in actual practice, compared to cycloidal gears.
14. Why a roller follower is preferred to that of a knife-edged 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) Sketch and explain any one inversions of a four bar chain mechanism. **(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° from inner dead centre, the difference between the driving and the back pressure is 0.35 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 (a) thrust on the connecting rod, and (b) turning moment on the crank shaft.

(7)

17. State and prove the law of gearing. Show that involute profile satisfies the conditions for correct gearing. **(10)**

18. Two involute gears of 20° pressure angle are in mesh. The number of teeth on pinion is 20 and the gear ratio is 2. If the pitch expressed in module is 5 mm and the pitch line speed is 1.2 m/s, assuming addendum as standard and equal to one module, find, (a) The angle turned through by pinion when one pair of teeth is in mesh, and (b) The maximum velocity of sliding. **(10)**

19. In an epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 r.p.m. in the anticlockwise direction about the centre of the gear A which is fixed,

determine the speed of gear B. If the gear A instead of being fixed, makes 300 r.p.m. in the clockwise direction, then find the speed of the gear B.

(10)

20. Design a cam for a knife edge follower with the given data: 1. Cam lift is 40 mm during 90° of cam rotation with simple harmonic motion, 2. Dwell for the next 30°, 3. During the next 60° of cam rotation, the follower returns to its original position with simple harmonic motion and, 4. Dwell during the remaining 180°. Draw the profile of the cam when the line of stroke of the follower passes through the axis of the cam shaft.

(10)

21.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°, 75° and 135°. Find the position and magnitude of the balance mass required, if its radius of rotation is 0.2 m. **(10)**

22. The three cranks of a three-cylinder locomotive are all on the same axle and are set at 120°. The pitch of the cylinders is 1 metre and the stroke of each piston is 0.6 m. The reciprocating masses are 300 kg for inside cylinder and 260 kg for each outside cylinder and the planes of rotation of the balance masses are 0.8 m from the inside crank. If 40% of the reciprocating parts are to be balanced, find the magnitude and the position of the balancing masses required at a radius of 0.6 m. **(10)**

Fwd: Clarification - UG11T4308 - 29.03.2025 - AN - reg. Inbox

Manoj Hirkane
to me

4:07 PM (6 minutes ago)

---------- Forwarded message ---------
From: **ESE IMU HQ** <imuese@imu.ac.in>
Date: Sat, Mar 29, 2025 at 4:04 PM
Subject: Clarification - UG11T4308 - 29.03.2025 - AN - reg.
To:

Sir/Madam,

With reference to the subject cited above it is informed that for Q No 20 the base radius is to be assumed as 40mm. This is for your kind information and necessary action please.