Graphic Era
HILL UNIVERSITY
Established by an Act of the State Legislature of Uttarakhand (Adhiniyam Sankhya 12 of 2011)
University under section 2(f) of UGC Act, 1956

End Term (Odd) Semester Examination November 2025

Roll no.....

Name of the Course and semester: **B.Tech- V SEM** (ME)
Name of the Paper: **Theory of Machines**
Paper Code: **TME 508**

Time: 3 hour Maximum Marks: 100

Note:

(i) All the questions are compulsory.
(ii) Answer any two sub questions from a, b and c in each main question.
(iii) Total marks for each question is 20 (twenty).
(iv) Each sub-question carries 10 marks.

Q1. (2X10=20 Marks)

a. What are the degrees of freedom in a mechanism and how are they determined? Explain with examples.CO1

b. Enumerate the inversions of a double-slider-crank chain with examples.CO1

c. A four-bar mechanism has the following dimensions: input crank AB = 150 mm, coupler BC = 550 mm, output link CD = 400 mm, and fixed link AD = 600 mm. If the input crank AB rotates at 180 rpm (counter clockwise) and makes an angle of 45° with the fixed link AD, calculate the angular velocity of link CD. CO2

Q2. (2X10=20 Marks)

a. Explain the procedure to construct klein's construction to determine the velocity and acceleration of a slider-crank mechanism.CO2

b. Distinguish between simple, compound, and epicyclic gear trains with examples.CO3

c. An epicyclic gear train consists of a sun gear of 40 teeth, planet gear of 25 teeth, and a ring gear of 90 teeth. The arm rotates at 100 rpm counterclockwise. If the sun gear rotates at 220 rpm clockwise, find the angular velocity and direction of the ring gear.CO3

Q3. (2X10=20 Marks)

a. Explain the classification of followers in cam mechanisms.CO4

b. Derive an expression for the velocity and acceleration of a piston in dynamic analysis of slider crank mechanism.CO4

c. A flywheel stores 25 kJ of energy when its speed decreases from 120 rpm to 117 rpm. Determine its kinetic energy when rotating at 160 rpm.CO4

Q4. (2X10=20 Marks)

a. What is the effect of centrifugal tension on tight side and slack side of a belt drive? Derive the condition for maximum power transmission by a belt drive considering the effect of centrifugal tension. CO5

b. Explain the method of finding the counter masses in two planes to balance the dynamic unbalance of rotating masses. CO5

c. The following data relate to a single cylinder reciprocating engine: CO5

Mass of reciprocating parts = 40 kg
Mass of revolving parts = 30 kg at crank radius
Speed = 150 rpm
Stroke = 350 mm

If 60% of the reciprocating parts and all the revolving parts are to be balanced,
Determine,

(i) Balance mass required at a radius of 320 mm
(ii) Unbalanced force when the crank has turned 45 degree from top dead centre.

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Q5. (2X10=20 Marks)

a. Describe the working and characteristics of Hartnell governor. CO6

b. What do you mean by gyroscopic couple? Derive a relation for its magnitude. CO6

c. A Porter governor has arms of length 200 mm pivoted on the axis of rotation. Each ball has a mass of 4 kg and the mass of the central load on the sleeve is 10 kg. The radius of rotation of the ball is 120 mm when the governor begins to lift and 160 mm at maximum speed. Find the minimum speed, maximum speed, and speed range of the governor. CO6