DEPARTMENT OF MECHANICAL ENGINEERING

UNIVERSITY INSTITUTE OF ENGINEERINGAND TECHNOLOGY, CSJM UNIVERSITY, KANPUR

DYNAMICS OF MACHINE AND VIBRATIONS (MEE-S301)

Semester: 2022-23 (Odd Semester) **Year: 3rd Year (2K19)**

Mid-2 Semester Examination

Time: 1.5 h **Maximum marks: 30**

All questions are compulsory

Section A

9 marks (9 questions of 1 mark each)

1. Define generalised coordinates in dynamical system.
2. What do you understand by orthogonality properties of mode shape with mass matrix and stiffness matrix?
3. Write the displacement equation of follower for S.H.M.
4. What do you understand by decoupling of coupled differential equation of motion?
5. What do you understand by gyroscopic couple and also write the equation for gyroscopic couple?
6. What do you understand by static balancing?
7. What do you understand by dynamic balancing?
8. What do you understand by balancing of reciprocating masses?
9. Define degree of freedom and number of degree of freedom for continuous system.

Section B

9 marks (3 questions of 3 marks each)

1. Balancing of masses in single plane problem:

$m_1 = 3kg$	$r_1 = 30\ mm$	$\theta_1 = 30^0$
$m_2 = 4kg$	$r_2 = 20\ mm$	$\theta_2 = 120^0$
$m_3 = 2kg$	$r_3 = 25\ mm$	$\theta_3 = 270^0$

Find the amount of the countermass at a radial distance of 35 mm for the static balance.

2. A flywheel having a mass of 20 kg and a radius of gyration of 300 mm is given a spin of 500 rpm about its axis which is horizontal. The flywheel is suspended at a point 250 mm from the plane of rotation of the flywheel. Find the rate of precession of the wheel.

3. Define the following terms related in radial Cam

(a) Pitch curve

(b) Trace point

(c) Base circle

Section C

12 marks (2 questions of 6 marks each, Each question can have parts)

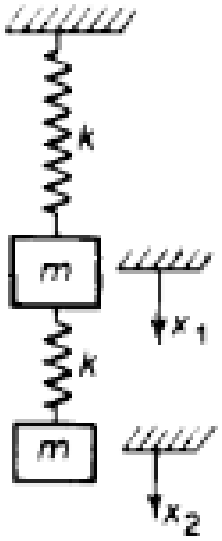
1. Write the equations of motion for the system shown in figure

(a) Derive the DEOM and write it in matrix form.

(b) Determine its natural frequencies and mode shapes.

(c) Find modal matrix, Decouple equation.

(d) Verify orthogonality properties of mass matrix and stiffness matrix.



2. Four masses A, B, C and D are completely balanced. Masses C and D make angle of 90^0 and 210^0 respectively with B in the same sense. The Planes containing B and C are 300 mm apart. Masses A, B, C and D can be assumed to be concentrated at radii of 360, 480, 240 and 300 mm respectively. The masses B,C and D are 15 kg, 25 kg, and 20 kg respectively. Determine

(i) The mass A and its angular position

(ii) The positions of planes A and D.