

## MCL731 Analytical Dynamics

Mid-Semester Examination (May 13, 2023, Wed, LH 308, 10:30-12:30 hrs)

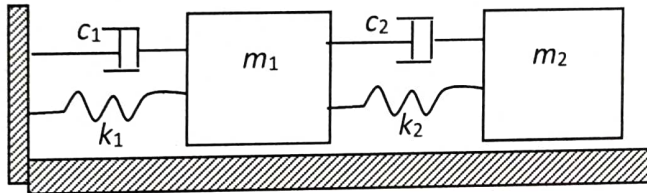
- Don't keep mobile with you
  - Don't share calculator, pencil, compass, etc.
  - Don't ask anything about question paper (Do whatever you feel best!)
- Show your I-card when signing for your attendance

prof. S.K. Saha

Total Marks: 30

Duration: 2 hours

1. For the system shown in the figure find the following: [5+4+1=10]
- Write the Lagrange's equations of motion.
  - Write Hamilton's equations of motion in 1<sup>st</sup> order form.
  - Verify that the Hamilton's equations are basically same as Lagrange's equations.



2. Using ZXZ Euler angles find out two relationships for the angular velocity of a rigid body in the fixed and moving coordinate frames in terms of the time-rate of change of the Euler angles. Indicate the rotations clearly using a sketch. [8]
3. Answer the following: [3×4 = 12]
- Using appropriate sketches, define (i) generalized coordinates; (ii) generalized forces; and (iii) holonomic and non-holonomic constraints.
  - What is virtual work principle? Illustrate with an example.
  - Express Lagrange's equations of motion in the presence of constraints and non-conservative forces.
  - Define ignorable coordinates with an example.

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