UNIVERSITY
OF SKÖVDE

School of Engineering Science

WRITTEN EXAMINATION

Course: Mekanik IV / Mechanics IV

Sub-course

Course code: MT355G

Credits for written examination: 3 hp

Date: 2024-11-22

Examination time: 08:15-12:30

Examination responsible: Karl Mauritsson

Teachers concerned: Karl Mauritsson, Mahdi Eynian, Daniel Svensson

Aid at the exam/appendices

• Inman D. J. (2014). Engineering Vibrations. (4th ed) Essex England: Pearson. ISBN 9780273768449 or printed pages from the e-book version

• Råde, L, Westergren, B. (1990). *Beta – Mathematics Handbook*. Lund: Studentlitteratur.
Or a similar handbook

• Sundström, B. (red.) (2010). *Handbook of Solid Mechanics*. Stockholm: Department of Solid Mechanics, KTH. ISBN 9789197286046.
Or the Swedish version

• Sundström, B. (1999). *Handbok och formelsamling i hållfasthetslära*. Tekniska högskolan Stockholm: Institution för hållfasthetslära.

• An approved calculator according to "Allmänna riktlinjer gällande utbildning på Institutionen for ingenjörsvetenskap":
- Casio Teknikräknare FX-82 all variants
- Texas Instruments Tl-30 all variants
- Texas Instruments Tl-82, Tl-83, Tl-84
- Casio FX-7400Gii, Fx-9750GII

• An English-Swedish-English ordbok or English-Spanish-English dictionary.

No added notes are allowed in the texts used during the examination.

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Instructions

- ☐ Take a new sheet of paper for each teacher.
- ☒ Take a new sheet of paper when starting a new question.
- ☒ Write only on one side of the paper.
- ☒ Write your name and personal ID No. on all pages you hand in.
- ☒ Use page numbering.
- ☒ Don´t use a red pen.
- ☒ Mark answered questions with a cross on the cover sheet.

Examination results should be made public within 18 working days

Good luck!

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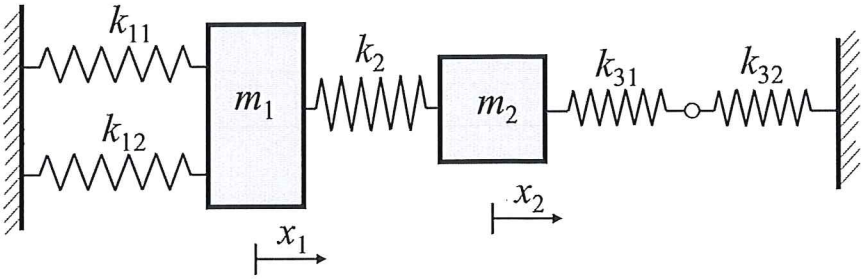
Question 1 (5 p)

The mass-spring system below is started at its static equilibrium position $x_1(0) = x_2(0) = 0$ with initial velocities $\dot{x}_1(0) = 1.0$ m/s and $\dot{x}_2(0) = 0$. The following dynamic parameters are given:

$k_{11} = 1$ kN/m, $k_{12} = 2$ kN/m, $k_2 = 3$ kN/m, $k_{31} = 4$ kN/m, $k_{32} = 6$ kN/m
$m_1 = 100$ kg, $m_2 = 64$ kg

Determine the force in the spring with stiffness k_2 as a function of time.



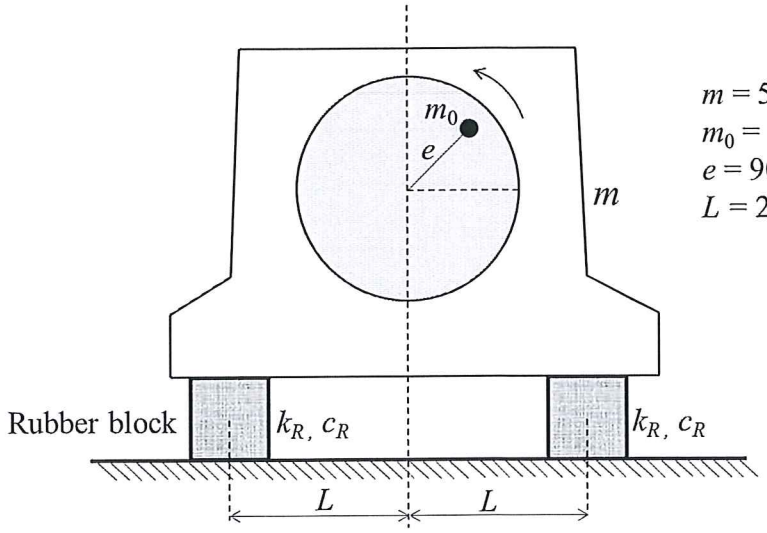
Question 2 (5 p)

An electric motor with a total mass of 50 kg has an eccentric mass of 6 kg and is set on two identical rubber blocks. The motor runs at 800 rpm and the mass eccentricity is 90 mm from the center.

Design the rubber blocks in the following way:

a) Chose the stiffness k_R of one rubber block such that the static compression of each rubber block is 3 mm (compression when the motor is not running).

b) Chose the damping coefficient c_R of one rubber block such that the amplitude of the vertical deflection of the system does not exceed 20 mm (when the motor is running).



$m = 50$ kg
$m_0 = 6$ kg
$e = 90$ mm
$L = 200$ mm

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Question 3 (5 p)

A sawtooth periodic force $F(t)$ is applied to a mass-spring system (with the dynamic parameters m, k and c). The force has a peak value of F_0 and a period of T.

Determine the steady state response $x(t)$.