Helwan University
Faculty of Engineering
Mechanical Design Dept.
Third Year Production Dept.

Mech. Vibration Course
Academic Year 2015/2016
Allowable time: 3 hrs.
Max. Mark: 100

Final Exam

Question 1: [30 marks]

A) Figure (1) shows the time response x(t) for the free vibration of a damping single degree of freedom mass-spring system. Derive a relation for the damping ratio ζ from the logarithmic decay of n successive amplitudes measurement and determine the system damping ratio ζ. ***(10 Marks)***

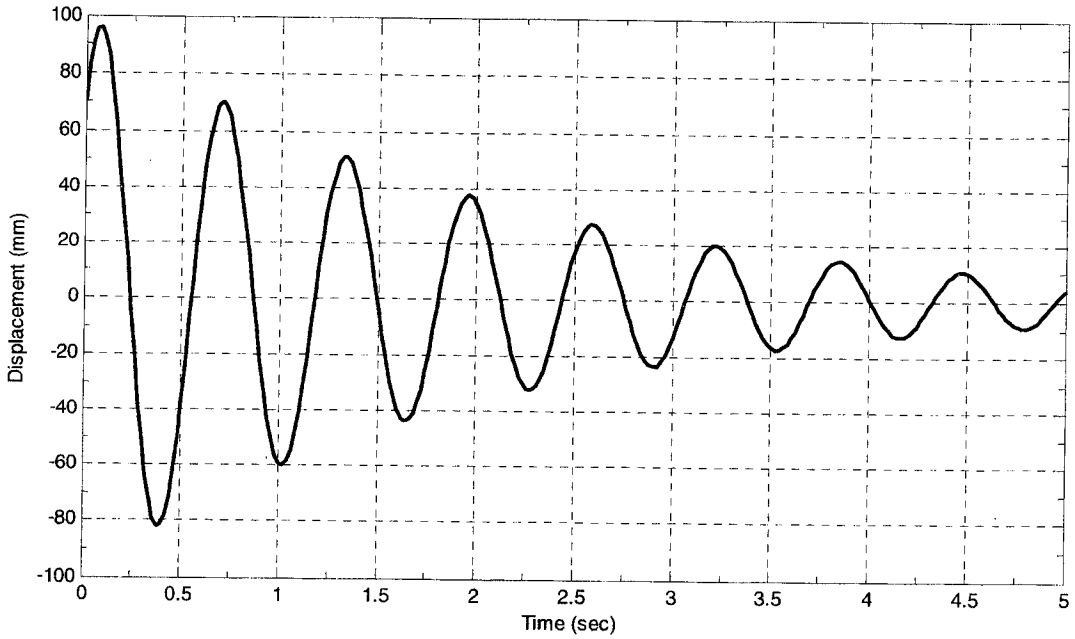

Fig.(1)

B) Derive the equation of motion and find the steady-state response of the system shown in Fig. (2) for rotational motion about the hinge O for the following data: k =5000 N/m, c =1000 N-s/m, m =10 kg, M_0 =100 N-m, $\omega = 1000\,rpm$, $\ell = 1\,m$. (Note: $I_c = \frac{1}{12}m\ell^2, I_o = I_c + md^2$) ***(20 Marks)***

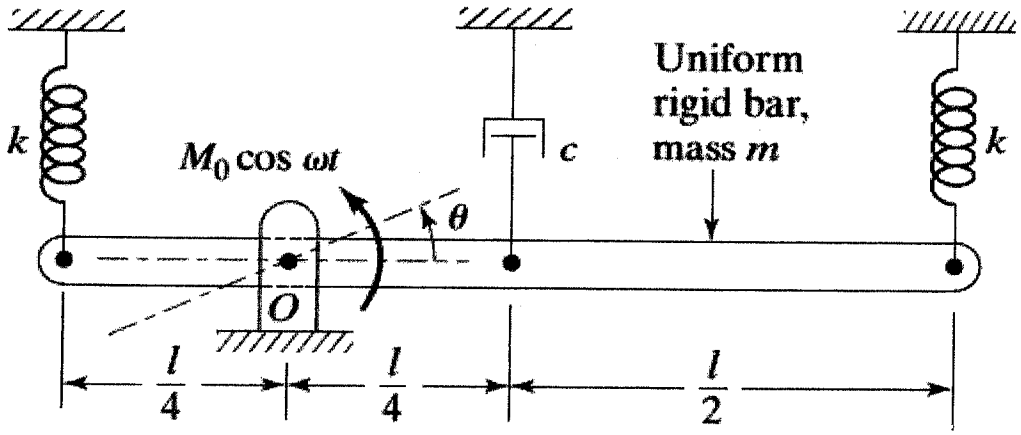

Fig.(2)

Please turn over

Question 2: [20 marks]

A two-mass system consists of a solid cylinder of mass m, connected by two elastic springs each one has a stiffness k. A mass $m/2$ is fixed at one end of a link of length ℓ and the other end of the link is hinged at the center of the solid cylinder as shown in Fig.(3). Derive the equations of motion of the system in terms of x(t) and θ(t). Find the natural frequencies, mode shapes, and time response x(t) and θ(t) for the free vibration of the system for the following data:

k =1000 N/m, m =10 kg, ℓ = 1m, R =0.2 m, a =0.15 m.

(Note: $I_c = \frac{1}{2}mR^2$ – Assume rolling motion)

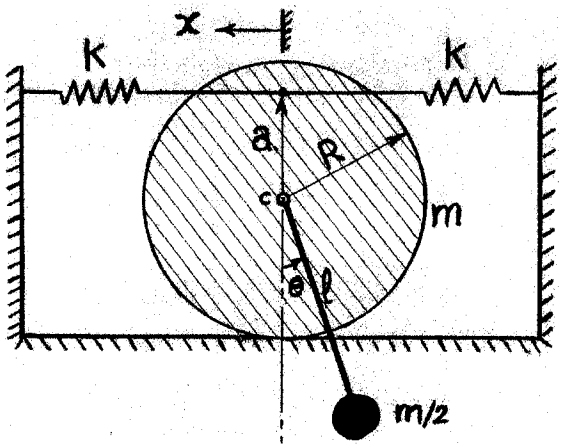

Fig. (3)

Question 3: [25 marks]

For the four degree of freedom system shown in Fig.(4), write the equations of motion for small oscillation.

(Consider the mass M_3 as point mass vibrates with θ positive in clockwise direction as shown in Fig.(4)).

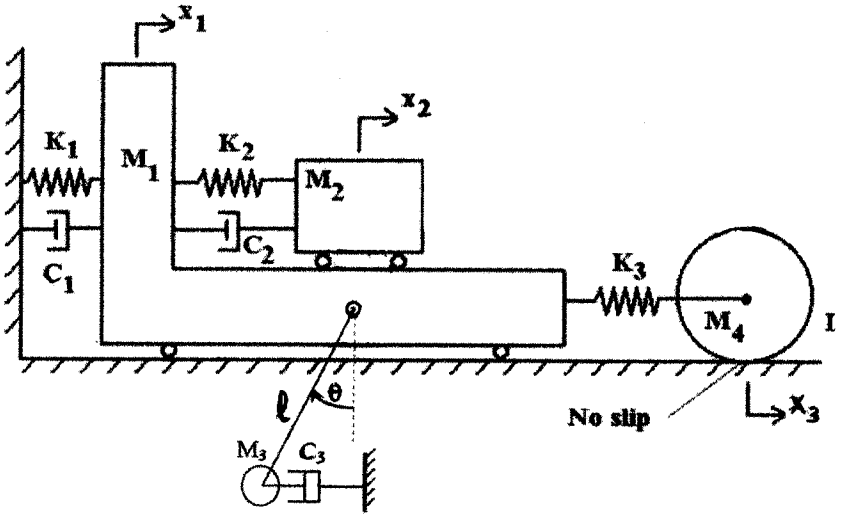

Fig.(4)

Question 4: [25 marks]

a) Derive the differential equation of motion for longitudinal vibration of bar. ***(10 Marks)***

b) A bar of length **L** is fixed at one end and connected at the other end by a mass **M** as shown in Fig.(5). Derive the longitudinal frequency equation of the system and show how can you solve to obtain the natural frequencies? ***(15 Marks)***

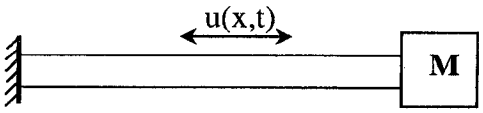

Fig.(5)

Good luck

D/ Ashraf El-Barbary *D/ Ahmed ElSawaf*

(The figures are taken from mechanical_vibrations_5th-edition_ Singiresu S. Rao)

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Helwan University Faculty of Eng., Helwan Mechanical Eng. Dept	Final Term Exam	Automatic control Exam Time: 3 hr 3 rd Production division

Answer the following questions:

Question No. 1 (20 Mark)

a) Given the following differential equation:

$\ddot{y} + 4\dot{y} + 3y = u$

Where u is the input and y is the output. Find mathematical expressions for the output when the input is unit step.

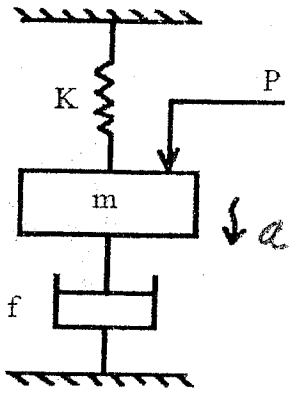
b) Derive expressions for time constant for the following dynamic systems:

- Mechanical type
- Electrical type

c) Derive mathematical expressions for properties of linear time invariant control system.

Question No. 2 (30 Mark)

a) Given the following dynamic system in which the input is applied force (P) while the output is the acceleration (a)



- Derive the transfer function
- Draw the block diagram

b) Consider a second order dynamic system whose parameters are $\zeta = 0.5$, $W_n = 5$ rad/sec. Determine the rise time, the peak time, max. overshoot and settling time when the system is subjected to a unit step input.

Question No. 3 (20 Mark)

a) A first order dynamic system is controlled by a (PD) controller. Find a mathematical expression for the response when the system is subjected to a unit step input.

b) Consider a dynamic system whose open loop transfer function is given by

$$G(s) = \frac{K}{S(S+3)(S+1)}$$

Find the value of K for marginal stability

Good luck

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Faculty of Engineering	Dept: Mechanical Engineering - Production Academic level : Third Jan. 2016 Courses code. & title: Powder Metallurgy Mec.5315 Instructor: Dr. A. Shafi, Dr. M. Ramadan, Dr. M. Abdallah Total mark: 70 mark Time allowed: 3 hrs	

Answer the following questions

Q1 a) Explain with simple drawing some different shapes of powder particles that can be seen by SEM, then compare between three methods used to determine the particles diameter.

b) State the different factors that difficult the powder flow rate, then draw the flow-meter. (Mark 10)

Q2 a) Illustrate a chart to show the steps of powder sampling.

b) Draw and give the function of the following tools:
Sampling thief - Sieves – Blenders (Mark 10)

Q3 a) Draw a curve to show the change of powder density with increasing the compaction pressure.

b) Sketch with complete details three possible methods for the powder fabrication by atomization. (Mark 10)

Q4 A 10 kg of Iron powders are used to fabricate 100 Rings (Washers). The bulk powder volume is 3600 cm^3. A 400 Mpa compaction pressure is applied to form each ring green compact with final height of 12 mm and density of 5.5 g/cm^3.

a) Calculate the apparent density of the powder and the die fill height.

b) Draw the approximately tooling (die & punches) used for this job. (Mark 20)

Q5 a) State five examples of powder metallurgy products.

b) Define the sintering process and differentiate between solid state and liquid state sintering.

c) Illustrate the effect of green density on the strength of sintered structures.

d) Mention the advantages and disadvantages of powder metallurgy.

e) With clear sketches, write short notes about:
- Isostatic pressing
- Powder rolling

(Mark 20)

انتهت الأسئلة مع خالص الأمنيات

Faculty of Engineering	Dept/division: Mechanical Engineering/ Production Academic level: 3rd year Course title/code: Engineering Measurement Systems (MEC 5312) Instructor: Prof. Dr. Mohamed Rady, Asst. Prof. Mohamed Abdallah Bhlol, Asst. Prof. Mohamed Abdalla Attia Final-term Exam, Jan 2016 Total marks: 120 marks Time allowed: 3 hrs	

الامتحان في ثلاثه ورقات

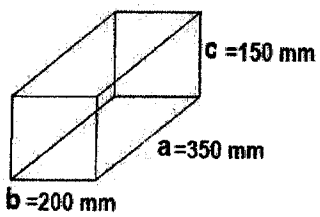
Answer the following questions

Question (1) [25 Marks]

a) The use of high-gain negative feedback is an important method of compensation for modifying inputs and non-linearity; explain the basic principles of this technique. **[5 Marks]**

b) The density (ρ) of a liquid is calculated by measuring its depth (c) in a calibrated rectangular tank and then emptying it into a mass measuring system. The length and width of the tank are (a) and (b). The density is given by: $\rho = m / (a \times b \times c)$

Where m is the measured mass of the liquid emptied out. If the uncertainty in the measurements of a, b, and c are 1%, 2% and 0.5%, respectively. The experiment is repeated ten times and the measured values of m at each time is given in Table below. Determine (i) the uncertainty in mass measurement, (ii) The mean value and uncertainty of the density (ρ). **[20 Marks]**



m (g)	1500.25	1500.40	1500.30	1500.20	1500.00	1500.15	1500.30	1500.25	1500.45	1500.15

Question (2) [25 Marks]

a) An instrument is calibrated in an environment at a temperature of 20°C and the following output readings Y in Volt are obtained for various input values X in mm.

X (mm)	5	10	15	20	25	30
Y (V)	13	26	39	52	65	78

i) Find the instrument non-linearity for Y(V) values of 15 mm and 30 mm as a percentage of f.s.d.

ii) When the instrument is subsequently used in an environment at a temperature of 50°C, the input/output characteristic changes to the following:

X (mm)	5	10	15	20	25	30
Y (V)	15	29	43	57	71	85

Assuming ideal straight line behavior of the instrument, derive the ideal straight line equations for cases (i) and (ii). Determine the effect of change of ambient temperature on the instrument sensitivity and drift due to the change in ambient temperature from 30°C to 50°C. **[20 Marks]**

b) Explain using a sketch the block diagram for a general static model of a measurement element. **[5 Marks]**

Question (3) [30 Marks]

a) Derive the linear differential equation that describes the dynamic behavior of a spherical temperature sensor immersed in a hot fluid. **[10 Marks]**

b) A first order temperature sensor is placed inside water. Initially $T(0-) = T_F\ (0-) = 25\,^\circ C$. If ($T_F$) is suddenly raised to $100\,^\circ C$ and the time until sensor temperature reaches $99.5\,^\circ C$ is 2 min. Calculate: **[20 Marks]**

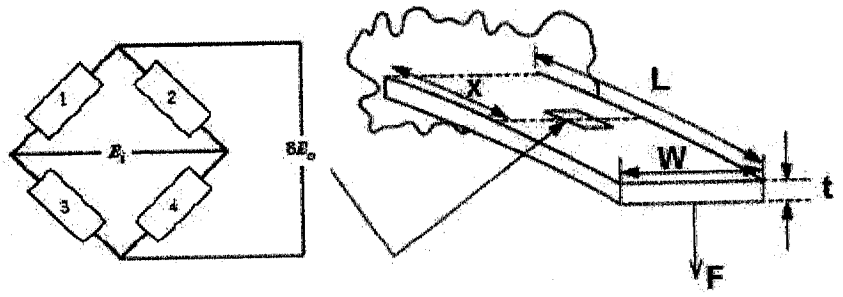
a) The time constant of the first order temperature sensor.
b) The dynamic errors in temperature measurement after 30, 60, and 90 seconds.
c) How we can reduce the dynamic error for this element?

Question (4) [25 Marks]

(a) Describe the principle of operation of non-contact temperature measurement instruments? **[5 Marks]**

(b) The magnitude of the strain in a cantilever is given by $\varepsilon = 6\,(L-X)F/\,(W\,t^2\,E)$ where L, W, and t are the length, width, and thickness of the beam respectively, X is the distance of the gauge from the beam's mounting and E is the modulus of elasticity. If a weight of F=980 N is applied to the end of the cantilever and four strain gauges are fixed at distance X=15 cm from the cantilever base, using the data given in the table below calculate: (i) the strain produced at X=15 cm (ii) the strained resistance of the gauge. (iii) If the strain gauges are mounted in the arms of a Wheatstone bridge as shown in Figure below. R1, and R2 mounted on top; R3 and R4 on bottom of the cantilever. The arms are of equal unstrained resistances of 120 Ohm, calculate the bridge constant and the output voltage of the bridge for an excitation voltage of 5 V? **[20 Marks]**

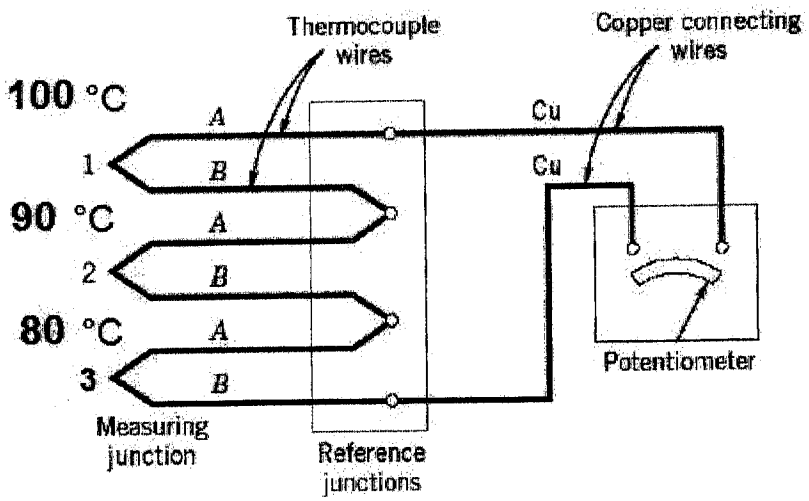
Length	Width	Thickness	Young's Modulus	Gauge Factor	Gauge unstrained resistance
L	W	t	E	G	R_o
30 cm	5 cm	4 mm	$70x10^9$ Pa	2	120 Ohm



Question (5) **[15 Marks]**

(a) Explain using sketches the law of intermediate material and intermediate temperature for thermocouple circuits? **[5 Marks]**

(b) In the following thermocouple circuit (type K) determine, the potentiometer reading in microvolt if the reference junctions are at uniform temperature of 30 °C. **[10 Marks]**



ITS-90 Table for type K thermocouple

°C	0	1	2	3	4	5	6	7	8	9	10
	Thermoelectric Voltage in mV										
0	0.000	0.039	0.079	0.119	0.158	0.198	0.238	0.277	0.317	0.357	0.397
10	0.397	0.437	0.477	0.517	0.557	0.597	0.637	0.677	0.718	0.758	0.798
20	0.798	0.838	0.879	0.919	0.960	1.000	1.041	1.081	1.122	1.163	1.203
30	1.203	1.244	1.285	1.326	1.366	1.407	1.448	1.489	1.530	1.571	1.612
40	1.612	1.653	1.694	1.735	1.776	1.817	1.858	1.899	1.941	1.982	2.023
50	2.023	2.064	2.106	2.147	2.188	2.230	2.271	2.312	2.354	2.395	2.436
60	2.436	2.478	2.519	2.561	2.602	2.644	2.685	2.727	2.768	2.810	2.851
70	2.851	2.893	2.934	2.976	3.017	3.059	3.100	3.142	3.184	3.225	3.267
80	3.267	3.308	3.350	3.391	3.433	3.474	3.516	3.557	3.599	3.640	3.682
90	3.682	3.723	3.765	3.806	3.848	3.889	3.931	3.972	4.013	4.055	4.096
100	4.096	4.138	4.179	4.220	4.262	4.303	4.344	4.385	4.427	4.468	4.509
110	4.509	4.550	4.591	4.633	4.674	4.715	4.756	4.797	4.838	4.879	4.920
120	4.920	4.961	5.002	5.043	5.084	5.124	5.165	5.206	5.247	5.288	5.328
130	5.328	5.369	5.410	5.450	5.491	5.532	5.572	5.613	5.653	5.694	5.735
140	5.735	5.775	5.815	5.856	5.896	5.937	5.977	6.017	6.058	6.098	6.138

Good Luck