Course Title: Theory of metal cutting
Course Code: MPD3116
Year: 3rd Year Production Engineering

Date: 15-01-2022
Allowed time: 3 hrs.
Final Exam
No. of pages: 2

Assume any missing data

Question One

1. Differentiate between orthogonal and oblique cutting.
2. Discuss the inverse methods that used to estimate the cutting heat source in turning.
3. What is the common used equipment to measure cutting forces and temperature field (on surface and on certain points)?
4. What the difference between drilling and boring operations?
5. What are the advantages of using the quartz dynamometer in measuring the forces in the cutting process?
6. It is required to machine a cylindrical workpiece of 250 mm long and 80 mm diameter made of magnesium. The final dimensions of the workpiece after being turned on a lathe machine are 180 mm long and 60 mm diameter. The rotational speed of the lathe spindle is 250 rpm, the feed rate of tool during the process is 150mm/min.
   Calculate 1- The time of cutting process. 2- The material removal rate. 3- The power consumed during the turning process. (Given the specific cutting energy of magnesium is 0.007 kW/cm^3/min).
7. A 20 mm diameter hole of length 50 mm on a stainless steel work piece is reamed with a 20.5 mm eight flute reamer. The feed for the reamer is 0.15 mm/ tooth. The speed of cutting is 50 m/min Calculate the weight of chips resulted from the cutting process on the work piece given the density of the stainless steel of work piece is 7750 kg/m^3.

Question Two

1. Compare using sketches between gun drilling and ejector drilling.
2. Compare between die threading and thread whirling
3. Explain mechanics of orthogonal cutting according to Merchant's force circle.

4. A rectangular block made of stainless steel is 500 mm long and 50 mm wide. The block is firstly clamped on milling machine to perform face milling to a 2mm depth of the surface. The surface milling is carried out by using a 200 mm diameter carbide face milling cutter with 10 cutting teeth. The process took place at feed per tooth 0.2 mm/rev and rotational speed for the spindle 200 rpm.

   Secondly the block was unloaded from the milling machine then loaded and clamped on a drilling machine to perform 25 holes each of depth 25mm by using a 12 mm diameter carbide drilling tool. The point angle of drilling tool is 120° and the cutting speed was 100m/min and feed was 0.3 mm/rev.

   Calculate the total power consumed for finishing the two cutting processes, given the specific cutting energy for stainless steel is 0.09 kW/cm3/min .

   If the cost of operating the drilling machine is 1800 LE/hr calculate the cost of performing the drilling process.

5. An orthogonal cutting operation is being carried out using a 5 mm thick tube under the following conditions: feed = 0.1 mm/rev, chip thickness = 0.2 mm, cutting speed = 120 m/min, and rake angle = 10°. The forces were measured such as cutting force = 500 N and thrust force = 200 N. Calculate the percentage of the total energy dissipated in the shear plane during cutting.

Question Three

1. Discuss the force components in orthogonal cutting based on Merchant's circle.
2. Discuss the main types of chips in machining operations.
3. Discuss the experimental methods used to study primary deformation zone.
4. Discuss the effect of rake angle on shear strain.
5. Discuss the main sources of heat generation during turning.
6. What are the main portions of the generated heat during turning/ (support your answer with equations).
7. In an orthogonal cutting operation, the rake angle is 8° and the coefficient of friction using a coated insert is 0.4. Determine the percentage change in chip thickness if an uncoated inset is used, which results in double friction compared to coated insert.

Tanta University

Department: Production and Mechanical Design
Total Marks: 60 Marks

Faculty of Engineering

Course Title: Machine Tool	Course Code: MPD3118	Year: 3rd
Date: Jan. 18 th 2022 (First term)	Allowed time: 3 hrs	No. of Pages: (2)

Remarks: (answer the following questions… assume any missing data… answers should be supported by sketches)

Problem number (1) **(True or False)** **(10 Marks)**

1. **Machine Tool Parts, Driving Element includes Bed, Column and Box. ( )**
2. **Machine Tool Parts, Driving Element includes Accessories and power transmitting. ( )**
3. **Form of frame of machine tool parts is Symmetric. ( )**
4. **Form of Driving Element of machine tool parts is Symmetric. ( )**
5. **Materials of driving element of machine tool make from cast iron. ( )**

Problem number (2) Match the items in column 'A' and column 'B' and choose correct answer. (10 Marks)

column 'A'	column 'B'
1. Machine Tool Define as	( ) Machine tool structure must satisfy the following requirement: (a) The initial geometrical accuracy of the structure should be maintained for the whole life of the machine tool. (b) All mating surfaces of the structure should be machined with a high degree of accuracy to provide the desired geometrical accuracy.
2. Classification of machine tools according to types of operation	( ) Welded structures of steel have much thinner wall thickness as compared to cast structure. Walls of different thickness can be welded more easily than casting it. Machining allowances for cast structures are generally greater than for weld steel structures. Machining allowance is necessary in casting to remove defects such as inclusions, scales, etc. Welded structure can be easily repaired as compared to cast structure.
3. Classification of machine tools according to Degree of specialization	( ) Planer, shaper, Lathe, Milling machine, Drilling, tapping and reaming machine, Grinders and polishers, Broach, saw, Gears and thread cutting machines.
4. functions and requirements of machine tool structure	( ) a power-driven machine Capable o. producing various shapes. By cutting tools. Suitable relative motions between the cutting tool and the workpiece.
5. Machine Tool Manufacturing Problems	( ) General purpose (universal) machine tools. small lot of production. Single purpose machine tools Crankpin's crankshafts Specialized machine tools. Large lot and mass production.

Problem number (3) **Choose the correct Answer (14 Marks)**

1. **A Machine Tool:**
   a) Is a group of links (elements) connected in sequence by joints.
   b) Bed, Column, Box
   c) Carriage and Foundation.
2. **Materials of frame of machine made of**
   a) Cast iron
   b) Alloy steel
   c) Diamond

3. **In continuous force of machine?**
a) Due to Main cutting force, PZ along the velocity vector, VC.
b) Due to Shaping, planning, slotting and gear shaping operation.
c) Due to Fluctuating forces due to intermittent cutting in milling, and hobbing.
4. **In impact-initiated force of machine?**
a) Due to Feed or axial force, PX along the feed direction
b) Due to Shaping, planning, slotting, and gear shaping operation.
c) Due to Transverse force (thrust), PY normal to PZ – PX plane in turning.
5. **Intermittent force of machine?**
a) Due to Fluctuating forces due to intermittent cutting in milling, hobbing etc.
b) Due to Torque and thrust force in drilling, counterboring, counter sinking etc.
c) Due to acceleration and deceleration at the end points of sliding.
6. **Gravitational forces of machine tools?**
a) Due to Dead weight of the major and heavy components of the Machine
b) Due to reciprocating tables, rams, jobs etc.
c) Due to high-speed rotation of eccentric masses.
7. **Process Capability of a machine tool Depends upon:**
a) Foundation –bolts –keeping enough space.
b) The rigidity which is defined as its capability to resist deformation produced due to the introduction of cutting forces generated during machining.
c) Carriage and Foundation.

Problem number (4) (13 Marks)

a) **Write short note about: Definition of machine tool joint "a concept of "region of joint"? (3 Marks)**

b) **How to reduce vibrations in the machine tools? (3 Marks)**

c) **The length of joint under tension load is L=210 mm,** $\frac{\delta_j}{\delta_s} = 3.8*10^{-3}, 1.6*10^{-4}$ **and** $m = 2.44*10^{2}\,mm^{-1}, 58.46*10^{2}\,mm^{-1}$ **for slab milling and fine grinding respectively. Then if F = 500 Kgf., diameter of solid = 20 mm. Calculate the joint area necessary to fulfil the given requirements of As(solid)/Aj(joint),** $\delta_j(joint)/\delta_s(solid)$ **for each value of m. Also the number of bolts required if compression** σ **=20 Kgf/mm². where E=2100 Kgf./mm², Pm=0.75 Kgf./mm² and As(solid)/Aj(joint) =2/3, Bolt diameter(M) mm, Areas of bolt mm², M6 , 20.1, M8, 36.6, M10, 58.6, M12, 84.3 respectively. (7 Marks)**

Problem number (5) (13 Marks)

a) **What are the general rules during erection of machine tools? (3 Marks)**

b) **Mention and explain the assumptions of the foundation design? (5 Marks)**

c) **A machine tool having a moving column with 300 Kg weights along the machine bed. The bed is 8.0 m long, 1.2 m width; flexural rigidity (EI)ı is 24x10⁶ Kgf.m². What is the suitable concrete depth to keep the deviation from alignment of the bed / foundation system not more than 6x10⁻⁵ m measured between the mid bed (a=0) and its end (a=l/2). Take the concrete width is equal to the bed width, and the concrete modulus of elasticity as 24x10⁸ Kgf/m². The deviation from alignment is given as, (5 Marks)**

$$\Delta = \frac{W_m l^3}{(EI)_3}\left[-\frac{1}{16}\left(\frac{a}{l}\right)^2 + \frac{1}{6}\left(\frac{a}{l}\right)^3 + \frac{5}{24}\left(\frac{a}{l}\right)^4 - \frac{1}{10}\left(\frac{a}{l}\right)^6\right]$$

Tanta University
Faculty of Engineering
Production Engineering & Design Dept.
3rd Year Prod. 2021/2022

Saturday, 22.01.2022
Time allowed : **3** hours
Final Grade : **100** Marks
# of pages: **3**

Theory of Metal Forming (**MPD3117**)

Final Exam

Solve all questions and make use of the information given at the end:

Question 1 : (25 marks)

a) Show in neat sketches the difference between the idealized stress-strain curves of metallic materials.

b) Plot the yield locas for Tresca vs von-Mises criterion in both 3-D and 2-D cases.

c) A tensile test of two different metal alloys "**A**" and "**B**" each having 10 mm diameter and 40 mm gauge length gives the following deformations and the corresponding load for both alloys:

Load ***P*** for alloy "**A**" (kN)	17.2	22.2	25.0	26.8
Load ***P*** for alloy "**B**" (kN)	15.2	22.0	26.3	30.6
Length ***L*** for both alloys (mm)	40.02	41.0	42.5	49.0

If the flow curve of both alloys obeys the power low, choose the appropriate alloy for a forming process with no pre-strain upto an effective strain of 20%.
(Hint: the choosing criterion here is only the minimum work required to accomplish the process)

Question 2 : (15 marks)

a) A slab with width "**b**", height "**h**" and thickness "**w**" is subjected to a plane strain compression. Use the slab analysis to determine the average pressure applied on the punch-surface interface. (Make the necessary assumptions)

b) A 100 mm wide strip is cold reduced in thickness from 1.605 to 1.1325 mm in one pass on a two-high mill having steel rolls operating at 150 rpm. The plane-strain average flow stress of the strip is 545 MPa and the roll diameter is 250 mm. The strip is subjected to a back tension of 100 MPa and a front tension of 180 MPa. The coefficient of friction at the roll–strip interface is 0.055 . Determine the following:

i. Rolling load.
ii. Rolling torque required.
iii. Power requirement of the cold-rolling mill.

Question 3 : (15 marks)

a) A square sheet is subjected to in-plane stretch forming such that the stress on one side (σ_1) is half the stress on the other side (σ_2).

i. Get the von Mises effective stress in terms of σ_1.
ii. If the loading is proportional, what will be the effective strain for $\sigma_1 = 400$ MPa?
iii. If the effective strain is 0.3 and the initial thickness is 1mm, get the final sheet thickness.

b) It is requested to produce cups of 65 mm in height from 2 mm thick steel sheet. The used steel has a flow curve with the characteristic $\sigma_f = 700\,\phi^{0.20}$ MPa

The diameter of the cups is 32 mm.

i. What is the used blank diameter?
ii. Is a redrawing step necessary? (Assume that a safe drawing ratio is 1.8)
iii. Calculate the drawing force during the first drawing at a punch travel, which equals 0.25 of the cup height and a 75% forming efficiency .
iv. Draw two possible methods to redraw the cup.

Question 4 : (25 marks)

a) Explain the term superplasticity and state under which conditions it can be achieved.

b) Calculate the bending moment necessary to bend a sheet of thickness ***h*** and width ***b*** made of an elastic-perfectly plastic material with a modulus of elasticity **E** and yield stress of **Y** . Get the final radius of curvature of the bend if the half of the section is being plastically deformed.

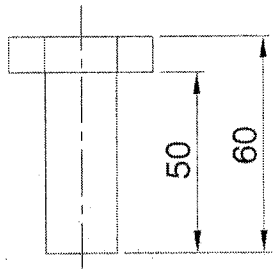
c) Derive the optimum die angle to draw a wire from $\mathbf{D_1}$ dimater to $\mathbf{D_2}$ diameter and a friction coefficient μ between the die and the wire material.

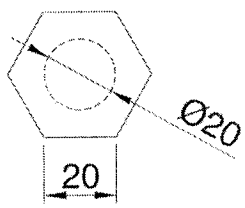
Question 5 : (20 marks)

a) Explain the phases in the die during impression die forging process.

b) The aim is to produce the head of the shown part out of material (42CrMo4) by forging. The coefficient of friction is 0.15 and the forging efficiency is 0.75 . Get:

i. Stock diameter
ii. Stock height
iii. Actual upsetting ratio
iv. Upset forging force knowing that the process is performed in one operation
v. Upset forging work





Useful information:

Incremental effective strain: $d\bar{\varphi} = \sqrt{\frac{2}{3}[d\varphi_1^2 + d\varphi_2^2 + d\varphi_3^2]}$

von Mises yield criterion $\bar{\sigma} = \sqrt{(1/2)[(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_3 - \sigma_1)^2}$

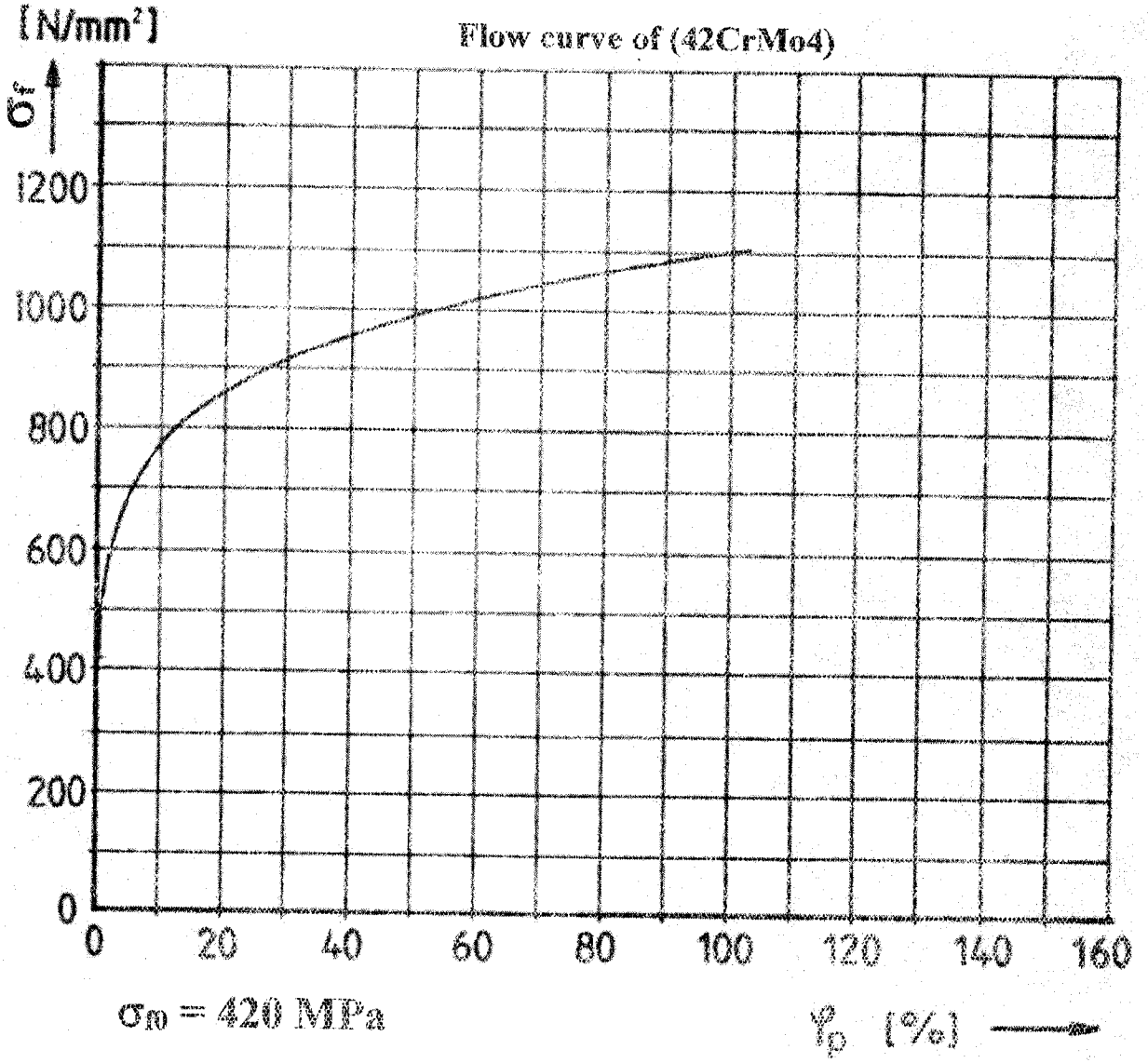
For wire drawing: $F_D = A_2\, \sigma_{f_m}\, ln\left(\frac{A_1}{A_2}\right)\left[1 + \frac{\mu}{\alpha} + \frac{2}{3}\alpha/ln\left(\frac{A_1}{A_2}\right)\right]$

For deep drawing: $F_D = \frac{\pi\, d_m\, S\, \sigma_{f_m}\, ln\left(\frac{D}{d_m}\right)}{\eta_F}$

For sheet rolling: $P_{av} = \frac{h}{\mu L}\cdot\left[e^{\frac{\mu L}{h}} - 1\right]\left[\sigma_{f_m} - \frac{(\sigma_{x1} + \sigma_{f1})}{2}\right]$

Upset forging force: $F = A_1 \sigma_{f1}\left[1 + \frac{1}{3}\cdot\mu\frac{d_1}{h_1}\right]$

Upset forging work: $W = \frac{V\cdot\sigma_{fm}\,\varphi_p}{\eta_F}$



TANTA UNIVERSITY

FACULTY OF ENGINEERING

DEPARTMENT OF: **Production Engineering & Mech. Design Dep.**

EXAMINATION (3 YEAR) STUDENTS OF Production ENGINEERING

COURSE TITLE: **Mechanical Design (2)**			COURSE CODE: PMD3219
DATE: 25- 1-2022	TERM: First term	TOTAL ASSESSMENT MARKS:	TIME ALLOWED: 3 HOURS

Notes:

It is allowing for student to use bearing table and only the signed papers 1/1

Systematic arrangement of calculations and clear neat drawings are essential.

Any data not given is to be assumed – Answer as many questions as you can. Answer as brief. as possible.

Question One (20%):

I- What types of bearings do you chose for a turbine running at 3600 RPM with a rotor weight 150 kN and shaft diameter 25 cm? Justify your answer. (5%)

II- It is required from you to select type of bearings for the following applications and justify your answer: -

1. Cement miller machine with a weight of 200 toms and it rotates at 1500 RPM?
2. Fan works inside refrigerator at temperature lower than -70 C° and its weight is 5Kg and it works at speed 1450 RPM?
3. Grinding machine works at speed of 6000RPM and with radial load of 100 kg and axial load of 120kg?
4. Fan works inside furnace its temperature less than 500 C°?
5. Concrete vibrator rotates at 6000RPM with eccentric weight of 1kg and distance 1cm?
6. The bearings in tailstock of lathe machine?
7. Bearings support the spindle of drilling machine at both sides?
8. Bearings support the rear wheel of the truck?
9. Hand car lifter which works with screw?
10. Bearings support the lath machine chuck?

Question one (20%):

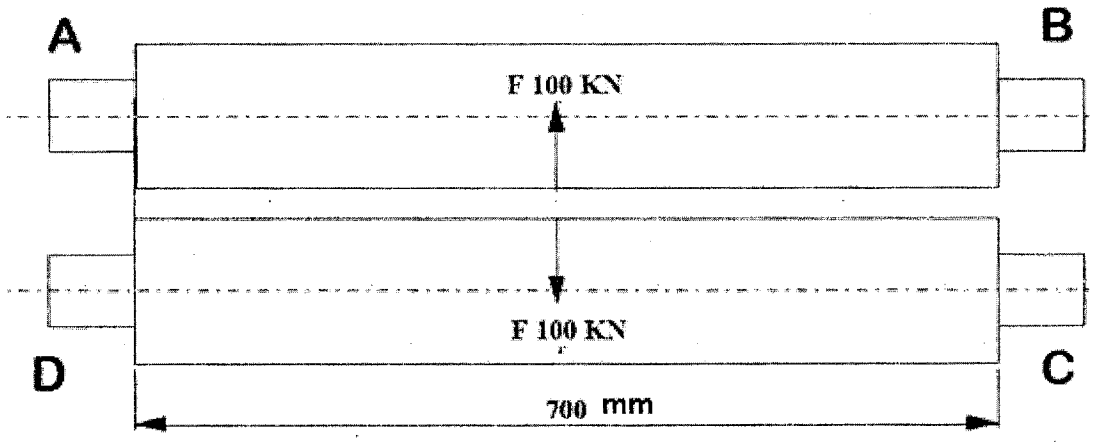
A journal bearing with an axial groove has the flowing specifications, 125.0 mm diameter, 125.0 length, and c/r=0.001. It carries a 45.0KN load at speed of 1450.0 RPM. SAE 30 oil is circulated with inlet temperature of 35C°. It is required to calculate the mean oil temp., and the flow rate.

You gut to replace the above bearing by another one with a central circumferential groove. What are your requirements so that the oil temperature in the second one does not exceeds the oil temperature in the first bearing? And what are the losses in both bearing?

PROBLEM # TWO (60 %)

I- Why are roller bearings used? What magnitude of thrust load can they withstand?

II- Two: - Sugar cane squeezer (عصارة قصب السكر)has four supports A, B, C, D as shown in the figure below. Each of them contains bearing assembly. It is required from you to select the bearing types and numbers to satisfy the requirements below in case of minimum deference between them should be achieved. If the machine works for 16 hours a day 330 day a year and the life of the machine should be around 10 years. The machine rotates by speed of 300 RPM and the weight of each roller is 10KN and the squeeze force F as shown in the figure. Draw the bearing assembly for support A and B (60%)



Tanta University	Production Engineering and Mechanical Design Department Total marks: 85 Marks	Faculty of Engineering
Course Title: Theory of Vibrations **Course Code:** MPD3153 **Year:** 3rd year Mech. Power. Eng.	**Final exam**	**Date:** 29 / 1 / 2022 **Allowed time:** 3 Hours **No. of pages:** 2 pages

Solve the following questions **(Total marks 85)**

Q1- Find the equation of motion and the natural frequency for the mechanical system shown in Fig. 1, motion in terms of x using the **energy method**. The disk A rolls without slipping and the pulley B rotates around the fixed center O.

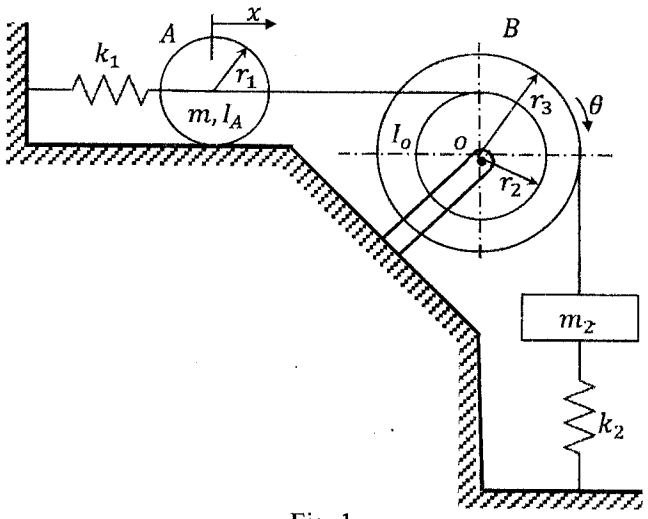


Fig. 1.

Q2- For the mechanical system shown in Fig. 2, the uniform bar has mass moment of inertia I and pinned at point O. Find the equation of motion in terms of θ using **Lagrange's formula**. Also, find the damping ratio and natural frequency.

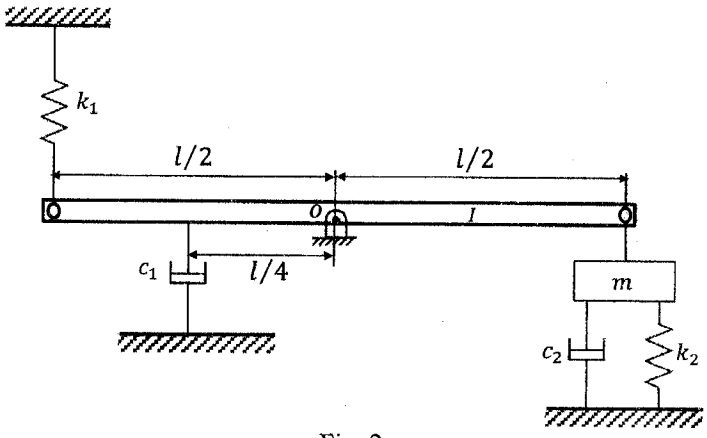


Fig. 2.

Q3- In a spring mass system, the mass is $10\ Kg$, the spring stiffness is $16\ KN/m$ and the damping constant is $1600\ N.s/m$. the mass is displaced by 0.01 m and released with a velocity $2\ m/s$ in the direction of return motion. Find

(a) Circular frequency.

(b) Damping ratio.
(c) Displacement after 0.01 s.

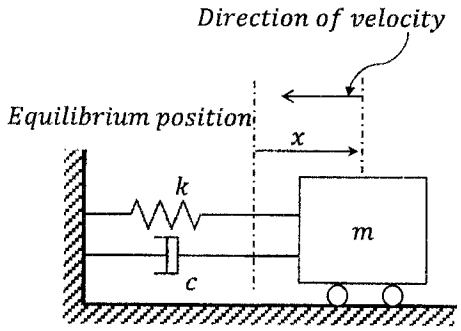


Fig. 3.

Q4- A vibrating system having 50 Kg mass and spring stiffness of 500 N/m is having dry friction damping with limiting frictional force equal to 6 N. If the mass is given initial displacement of 300 mm, find:
(a) Reduction of amplitude per cycle.
(b) Number of cycles before stopping.
(c) Time elapsed before stopping.
(d) Distance at which the mass stops from the mean position.

Q5- A machine of 100 Kg mass is supported on springs of total stiffness 700 KN/m and has an unbalanced rotating element, which results in a disturbing force of 300 N at a speed of 2500 rpm. Assuming a damping ratio of 0.25, determine:
(a) Amplitude of vibration.
(b) Transmissibility.
(c) Transmitted force.

Q6- Consider a viscously damped two-degree-of-freedom spring-mass system shown in Fig. 4. The motion of the system is completely described by the coordinates $x_1(t)$ and $x_2(t)$ which define the positions of the masses m_1 and m_2 at any time t from the respective equilibrium positions. The external forces $f_1(t)$ and $f_2(t)$ act on the masses m_1 and m_2, respectively. Find:
a) the equations of motions in matrix form;
b) the natural frequencies, the normal modes and mode shapes when $k_1 = 30\ N/m$, $k_2 = 5\ N/m$, $k_3 = 0\ N/m$, $m_1 = 10\ Kg$, $m_2 = 1\ Kg$, $c_1 = c_2 = c_3 = 0\ N.s/m$.

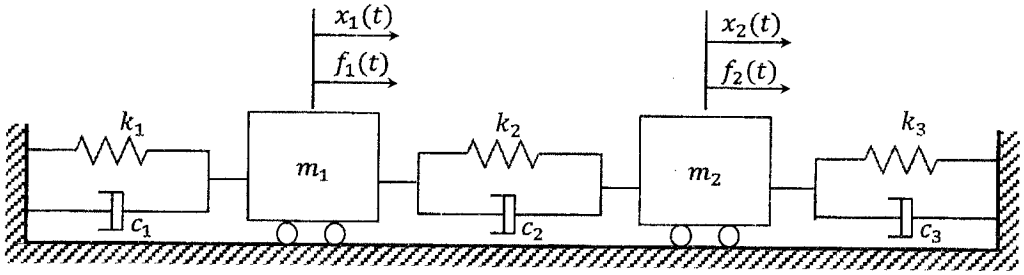


Fig. 4.

With best wishes
Dr. Abdelhameed Zayed

Tanta University	Mechanical Power Engineering Department Production Engineering and Mechanical Design Students	Faculty of Engineering

Course Title	**Elective Course (1)** Refrigeration and Air-Conditioning	**Academic Year 2021/2022** **First Semester Exam**	**Course Code**	**MEP3153**
Year/ Level	**Third Year Production**			
Date	**01-February-2022**	**No. of Pages (2)**	**Allowed time**	**3 hrs**
			Total Assessment Marks: 50	

Remarks: Request from the Exam Committee:
Kindly allow students to use their Refrigeration and Air-Conditioning Tables and Charts, however students are not allowed to write in or exchange these materials.

Notes for Students: Neat and clear answers will be appreciated.

Question Number (1) (13 Points)

a) A refrigeration system operates on the reversed Carnot cycle. The higher temperature of the refrigerant in the system is 40°C and the Lower is - 20°C. The Capacity is to be 10 tons. Neglect all losses **Determine:** i) COP; ii) Heat rejected from the system; iii) Power required. **(4 points)**

b) A boot-strap cooling system is used for an aeroplane to take 10 tons load. The temperature and pressure conditions of atmosphere are 15°C and 0.9 bar. The pressure of air is increased from 0.9 to 1.1 bar due to ramming action of the plane. The pressure of air leaving the main compressor and auxiliary compressor are 3.2 and 4.2 respectively. Isentropic efficiency of both compressors is 90% and isentropic efficiency of the cooling turbine is 85%. About 55% of the total heat of air leaving the main compressor is removed in the first heat exchanger and 30% of the total heat of air leaving the auxiliary compressor is removed in the second heat exchanger using rammed air. Assuming the ramming action is isentropic. Draw the system flow diagram and the corresponding T-s chart then, **determine** a) H.P. required to take the cabin load; b) COP of the system. If the required cabin pressure is 1.03 bar and the temperature of air leaving the cabin should not exceed 27°C. **(9 points)**

Question Number (2) (12 Points)

a) Draw the system flow diagram and (P-h) chart for cooling three stores in the following cases: (1) Separate expansion valves with one compressor. (2) Multiple expansion valves with three multiple compressors with refrigerant intercooling. **(6 point)**

b) A refrigerant 12 vapor - compression system includes a subcooling heat exchanger. The heat exchanger cools saturated liquid coming from the condenser from 30°C to 20°C with vapor which comes from the evaporator at - 10°C. The compression is isentropic in both cases listed below. a) Calculate the COP of the system without heat exchanger but with condensing temp. of 30°C and an evaporator temp. of -10°C. b) Calculate the COP with heat exchanger. **(6 points)**

Tanta University	Mechanical Power Engineering Department Production Engineering and Mechanical Design Students	Faculty of Engineering

Question Number (3) (13 Points)

a) A 0.3 Kg/sec of air at 293 K DBT and 20% RH is mixed with 0.1 Kg/sec of air at 313 K DBT and 283 K dew point temperature. The mixture is then preheated to 310 K DBT, then, passed through an air washer, and finally reheated to 300 K DBT and 293 K WBT. Find: (a) The relative humidity of the air-leaving the air washer. (b) The heat added by the heaters in kW. (c) The water consumed in the air washer in kg/sec. **(7 points)**

b) A simple summer air conditioning systems is to be used for a space with sensible load of 90 TR and latent load of 30 TR. The system assumes 50 % fresh air supply and has a filter section, cooling coil section and a fan. Draw the system flow diagram and sketch its psychrometric process and determine the volume flowrate of air required to the space and the cooling coil capacity if air leaves the coil with 90 % RH. Indoor air is at 24°C and 50% RH and outdoor air is assumed to be 40°C and 40% RH. **(6 points)**

Question Number (4) (14 Points)

A room 8m x 5m and 3m height (with the longer wall oriented facing north direction) in a gymnasium building is to be conditioned. The building site is 32° North latitude. West wall separates the room from conditioned space otherwise south wall separate the room from unconditioned space and they are constructed from (100-mm face brick + 100-mm common brick). Other walls (north and east) are side streets and are constructed from (100-mm face brick + 50-mm insulation + 100-mm concrete). The room has single window facing north with 2m x 1.5m and 6-mm single glass sheet with light colour, medium weave indoor shading. The average number of occupants in space is 15 persons works from 9:00 AM till 9:00 PM. Lighting is unvented and unsuspended fluorescent lamps; Number of lamps are 8 and each lamp has 40 watts. Inside design condition is 25°C dry-bulb temp. and 50% relative humidity. Outside design condition is 40°C dry-bulb temp. and 70% relative humidity. Ventilation requirement is estimated to be 2.5 L/s of outdoor air per person. Neglect all other loading and calculate the space total cooling load and the sensible heat factor (SHF). Base your calculations on **July**, 15:00 o'clock (3:00 PM).

End of questions.....

Best of Luck *Dr. Ahmed Mostafa Khaira*