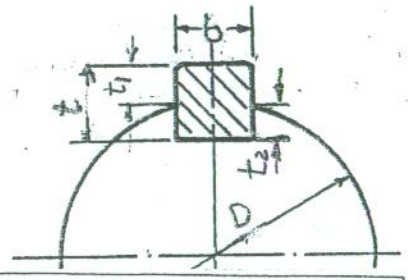


Table (4) Feather keys and Keyways
(all Dimensions in mm)

Shaft diameter D		Key dimensions		Keyway in shaft and Hub		Key length	
Over	Up to	b	$t = t_1 + t_2$	t_2	t_1	Minimum	Maximum
6	8	2	2	1.1	0.9	8	20
8	10	3	3	1.7	1.3	8	36
10	12	4	4	2.4	1.6	10	45
12	17	5	5	2.9	2.1	12	56
17	22	6	6	3.5	2.5	16	70
22	30	8	7	4.1	2.9	20	90
30	38	10	8	4.7	3.3	25	110
38	44	12	8	4.9	3.1	32	110
44	50	14	9	5.5	3.5	40	140
50	58	16	10	6.2	3.8	45	180
58	65	18	11	6.8	4.2	50	200
65	75	20	12	7.4	4.6	56	220
75	85	22	14	8.5	5.5	63	250
85	95	25	14	8.7	5.3	70	280
95	110	28	16	9.9	6.1	80	315
				+0.1	+0.2		

Tanta University
Faculty of Engineering
Dept. of Production Engineering
and Mechanical Design
Academic Year : 2011 - 2012
Date : 26 - 1 - 2012

third Year
Machine Design (2)
Code : MPD 3114
Time : 3 Hours
Total Marks: 75Marks

Tables and Charts are allowed

Answer all the following Questions :

Question No. 1 (30 Marks)

A transmission shaft supporting two pulleys A & B and mounted between two bearings C_1 & C_2 is shown in Fig.(1). The pulleys are kayed to the shaft . Design the shaft and the flat pulley(A) (Permissible tension for grade 10 Rubber belt is 26.8 K_g/ cm.)

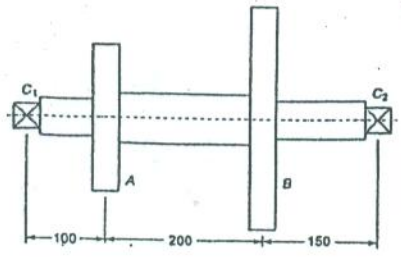
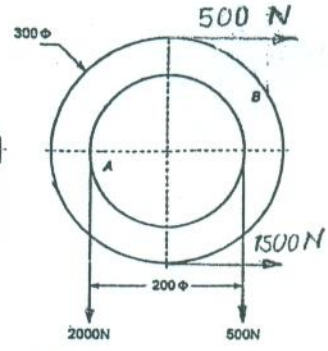


Fig.(1)



Dimms. in mms.

Question No. 2 (30 Marks)

a- Draw kinematic diagram for 6- speeds gear box with Minimum size .

b- Draw and compare between three methods of Rolling Bearing lubrication.

c- Compare between the Hydrostatic & Hydrodynamic lubrication.

Question No. 3 (15 Marks)

a- Prove that : $f = 2\pi^2 \frac{\mu N}{P} \frac{r}{c}$

b- A Lightly loaded 3x3 In^2 bearing has a load of 90 Ib. The Journal rotates at 400 rpm & is lubricated with SAE 40 oil ($\mu = 7.5\ 10^{-6}$ Lb.Sec./In^2 at a temprature stabilized at 130 ^oF) Find the frictional torque and the coefficint of friction when the clearance is 0.002 Ib.

Tanta University

Department: Production and Mechanical Design
Total Marks: 60 Marks

Faculty of Engineering

Course Title: Machining Machine	Course Code: MPD3118	Year: 3rd
Date: Jan 18th 2012 (First term)	Allowed time: 3 hrs	No. of Pages: (1)

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

Problem number (1) **(15 Marks)**

Write short notes on:

a) The requirements made to machine tool? (2 Marks)
b) The basic objective of machine tool? (2 Marks)
c) Different types of beds, ribs, slid and slide ways? (6 Marks)
d) Classification of machine tools according to types of operation and criteria? (2.5 Marks)
e) Error of machine tools? (2.5 Marks)

Problem number (2) **(15 Marks)**

a) Explain the different types of joints by neat sketches? (3 Marks)
b) Discuss the importance of joints in machine tools? (2 Marks)
c) The length of joint under tension load is L=250 mm, $\frac{\delta_j}{\delta_s} = 3.1*10^{-3}, 1.3*10^{-4}$ 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. (10 Marks)

Problem number (3) **(15 Marks)**

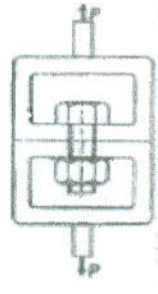
a) Write short notes on: vibrations of machine tools; damping in machine tools? (5 Marks)
b) For a certain machine tool having a dynamic stiffness of 400 N/mm. The logarithmic damping decrement (Δ) 0.15. From power spectrum the amplitude A/$\sqrt{2}$ μm at the band width ($\Delta\omega$) is 40 Hz. Calculate the dynamic load and natural frequency of this machine. (5 Marks)
c) Assume initial clamping load is 2.5 KN. Load P = 5 KN as shown in Fig. 1. Allowable tensile stress = 160 MPa., and Kp=2.5 Kb. Determine size of bolt. (5 Marks)

Problem number (4) **(15 Marks)**

a) What are the general rules should taken when erection of machine tools? (2 Marks)
b) Explain the order of machine tools test? (2 Marks)
c) Explain in detail, the Forces developing and acting in Machine tools? (3 Marks
d) Discuss the forces distribution act in drilling machine as shown in the Fig. 2? (8 Marks)

M thread Coarse series	M thread Fine series
M4×0.7	M6×0.75
M5×0.8	M8×1
M6×1	M10×1
M8×1.25	M10×1.25
M10×1.5	M12×1.25
M12×1.75, M14×2	M12×1.5
M16×2	M14×1.5

Fig. 1



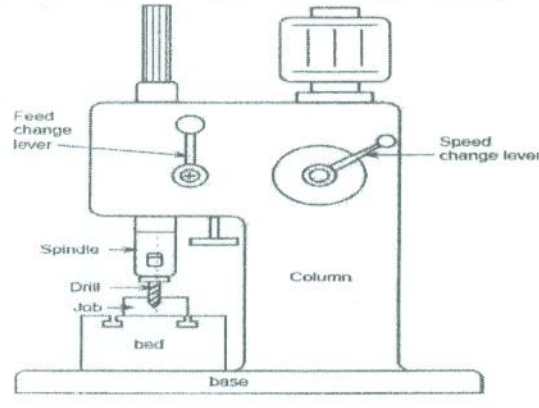


Fig. 2

All walls are constructed from 100-mm Face brick and 200-mm common brick. The room has single window facing east with 2 m × 2 m and 3-mm single glass having dark color open weave shading. The average number of occupants in space is 20 person's works from 8.00 Am till 4.00 Pm. Lighting is unvented and unsuspended fluorescent lamps, Number of lamps are 8 and each lamp has 60 watt. Inside design condition is 25°C and outdoor air is assumed to be 40 °C. Neglect all other loading and **calculate** the space total load and the sensible heat factor (SHF). Base your calculations on Aug., 2.00 Pm O'clock.

(10 Marks)

Problem number (4) **(12 Marks)**

a) An amount of 0.3 kg/sec of air at 15 °C dbt and 10 °C wbt is heated to 30 °C dbt, then partially adiabatic saturated to relative humidity of 90%. **Draw** a schematic diagram of the system and **plot** it on the psychometric chart and then **Calculate**:

i) The capacity of the heaters in kW.

ii) The quantity of water consumed for humidification in kg/sec.

iii) The humidifying efficiency of the air washer.

(6 Marks)

b) An ammonia refrigeration system with 30 T.R., evaporator at -13 °C. At 7 °C uses flash gas removal and intercooling, as shown in Fig.1. The condensing temperature is 47 °C. **Calculate** the power required for each compressor and for the whole system and the COP of the cycle.

(6 Marks)

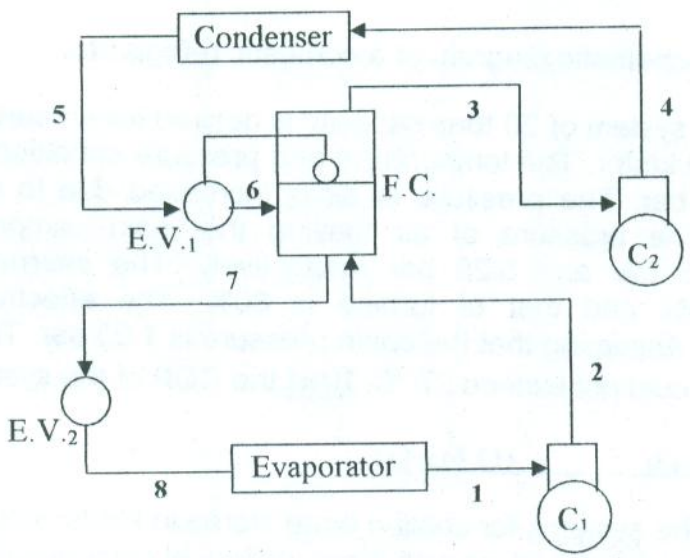


Fig. 1

Greeting sentence (Optional)

Course Examination Committee

Prof. Prof.

Dr. **Abd-elkader saad Bekhatro** Dr.

Course Coordinator: Prof. Elsaied khalil

Tanta University

Department: Pro. Des. Mech. Engineering
Total Marks: 50 Marks

Faculty of Engineering

Course Title: Refrigeration and Air conditioning	Course Code: EPM3101	Year: 3rd year
Date: 11/1/ 2012 (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…etc) مسموح للطالب بالدخول بخريطة وجداول التبريد والتكييف

Problem number (1) **(12 Marks)**

a) Is it possible for a heat engine to operate without rejecting any waste heat to a low-temperature reservoir? **Explain**. (2 Marks)

b) **Compare** between open air system and dense air system. (4 Marks)

c) A Carnot heat engine receives 650 kJ of heat from a source of unknown temperature and rejects 250 kJ of it to a sink at 24°C. **Determine** (a) the temperature of the source and (b) the thermal efficiency of the heat engine. (6 Marks)

Problem number (2) **(14 Marks)**

a) **Define** the following:
1) Refrigeration effect
2) Ton of Refrigeration
3) Volumetric efficiency of compressor. (3 Marks)

b) **Discus** and draw a schematic diagram of a domestic refrigerator. (3 Marks)

c) A boot-strap cooling system of 20 tons capacity is desired for an aeroplane cabin and the plane speed is 1100 km/hr. The temperature and pressure conditions of the atmosphere are 20 °C and 0.8 bar. The pressure of air is increased due to ramming action with efficiency 80 %. The pressure of air leaving the main compressor and auxiliary compressor are 3.5 bar and 5.25 bar respectively. The internal efficiency of both compressors is 85% and that of turbine is 80%. The effectiveness of two heat exchangers is 70%. Assuming that the cabin pressure is 1.03 bar. The temperature of air leaving the cabin should not exceed 27 °C, **find** the COP of the system. (8 Marks)

Problem number (3) **(12 Marks)**

a) **Compare** between the systems for cooling three stores in the flowing:
1. Separate expansion valves with three individual compressors.
2. Multiple expansion valves with three individual compressors.

(2 Marks)

b) A room 5m × 6m and 4m height (with the longer wall oriented facing east direction) in a Restaurant building is to be conditioned. The building site is 40° North latitude. North wall separate the room from conditioned space otherwise south wall separates the room from unconditioned space. Other walls (east and west) are side streets.

P.T.O.

to the ventilator to reduce the vibration. Derive the dynamic equations for small oscillations using Lagrange equations and determine the natural frequencies and normal modes of the system. **(Marks 20%)**

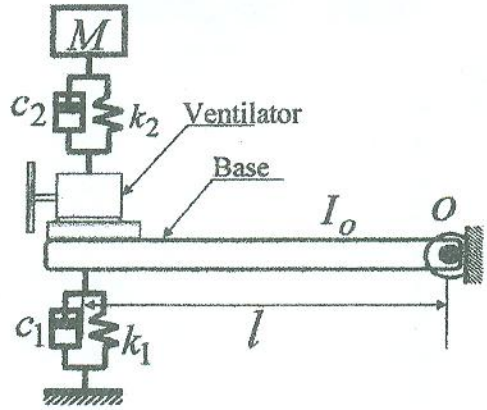


Fig. 1

5- A physical model of a winch is represented in Fig. 2, in which the stiffness of the torsional shafts are k_{t1} and k_{t2}. The two mass-less gears have a gear ratio of n. The inertia of the rotor of the motor is I_2 while the inertia of the drum is I_1. The rope is modeled as a mass-less spring of stiffness of k. A block of mass m is attached to the end of the rope. The damping properties of the system are modeled by a damper with a coefficient c. Derive the equations of motion using Lagrange's method. **(Marks 20%)**

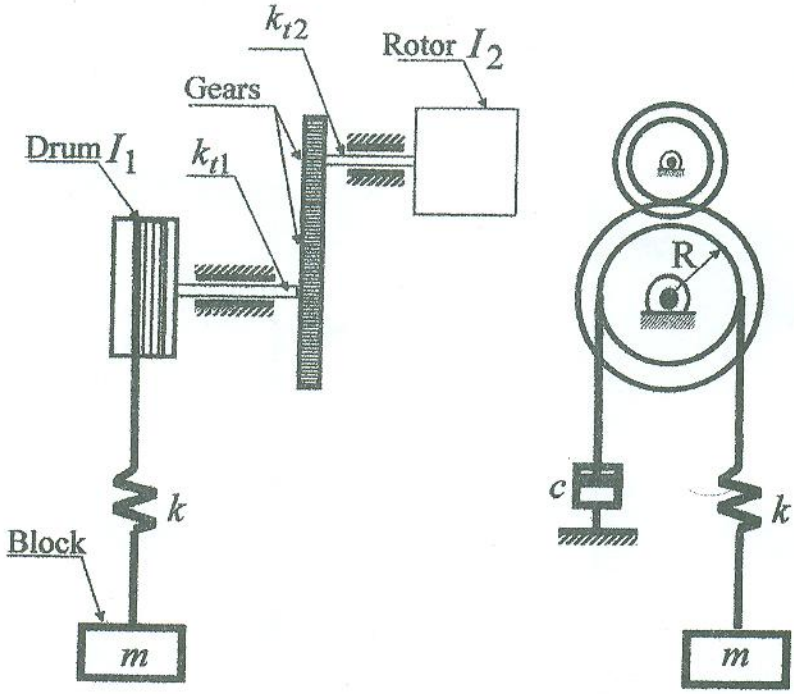


Fig. 2

FINAL TERM EXAM

1- A circular disc weighting 178 N is mounted midway on a 15 mm diameter steel shaft 915 mm long and its Young's modulus is 2×10^{11} N/m^2. The center of gravity of the disc is 3 mm from its geometric center. The unit rotates at 600 r.p.m and the damping factor is 0.05. Determine the critical speed of the shaft and the bending stress at the operating speed. Where the disc should be located in order to increase the critical speed by 20 %. (Note, the deflection of simply supported shaft subjected to a load p is $\delta_{st}=\frac{pa^2b^2}{3EIL}$). **(Marks 20%)**

2- A vibrometer having a spring stiffness of 4 KN/m and a viscous damping 50% of the critical is used to measure a vibration of 2000 cpm. If the error is not exceeding 2%, which one of the following masses (1.5, 2, 2.5, 3) kg is used in the instrument. If it is desired to use this instrument as an accelerometer by changing the spring, which one of the following stiffness (110, 114, 118, 122) KN/m can be used, comment on the result. **(Marks 20%)**

3- A washing machine is simplified by a rotating unbalance machine. A bundle of wet clothes forms an unbalance mass of 1 kg and the total mass of the washer including the clothes is 20 kg. The radius of the washing basket is 0.25 m. Assume that the spin cycle rotates at 300 r.p.m. The stiffness and the damping of the support of the machine are 1000 N/m and 0.01, respectively.

- **a-** Calculate the magnitude of the unbalance force causing the vibration.
- **b-** What percent of the above force is transmitted to the foundation?
- **c-** Calculate the amplitude of the machine and the force transmitted to the foundation.
- **d-** For the un-damped case, in order to reduce the force transmitted to the foundation, a dynamic vibration absorber is attached to the machine. Design the absorber to keep the resultant resonant frequencies at least ±20% of the operating speed and then calculate the amplitude of the absorber and the force transmitted to the foundation. Comment on the result.
- **e-** Suggest with explanation another way to reduce the force transmitted to the foundation without altering the speed of the spin cycle. **(Marks 20%)**

4- An assembly of a ventilator with its base, as shown in Fig. 1, is free to oscillate about O. It is kept in the horizontal position by means of a spring and a damper (k_1, c_1). Its moment of inertia about O is (I_o). The rotor of the ventilator has unbalance of (me) and rotates with a constant angular velocity of (γ). A damped dynamic vibration absorber of mass (M) with a stiffness and a damper of (k_2, c_2) is attached

Question 3 : (20 marks)

a) Draw the idealized stress-strain curves.

b) Cylindrical cups with a mean diameter of 150 mm and 250 mm height are deep drawn from sheets of alloy (X), whose thickness is 2 mm. The maximum drawing ratio for that condition is 1.9 . The maximum ratios for redrawings are 1.3, 1.24 and 1.2 respectively. You are requested to:

i- Find the number of redrawings required and their ratios.
ii- What is the blank diameter required to produce these cups?
iii- Calculate the ideal drawing force during the first drawing, when the depth of drawing is 0.4 its full value at this first drawing.

(The flow curve of the alloy (X) is given in the attached figure)

Question 4 : (20 marks)

a) What are the undesirable effects occurred upon the use of elevated temperature during hot working?

b) Calculate the temperature rise in a high-strength steel that is adiabatically deformed to a strain of 1.2 .

Take $\rho = 7.87\times10^3$ kg/m^3, $\sigma_a = 800$ MPa, $C = 0.46 \times 10^3$ J/kg °C.

c) Cupper rods 25 mm in diameter are formed by hot extrusion. The billet's diameter is 75 mm and have a length of 500 mm. The mean flow stress of the heated billets is 65 N/mm^2 . Caiculate the extrusion force and the power required to extrude the rods at a rate of 2 m/s.

Question 5 : (25 marks)

a) Derive an expression to calculate the amount of springback of a sheet being bent by a 3-roll mechanism.

b) Pipes made of steel sheet metal are produced by a 3 roll bend. The thickness of the pipes is 10 mm and the length is 2 m long. The pipes mean diameter is 1 m. The flow stress in plane strain is 210 MPa and E = 224 GPa and the metal is assumed to behave elastic-perfectly plastic. Calculate the amount of the lateral movement of the moveable roll, knowing that the distance between each roll and its succeesive one is 25 cm.

مع تمنياتي بالتوفيق و النجاح

Useful information:

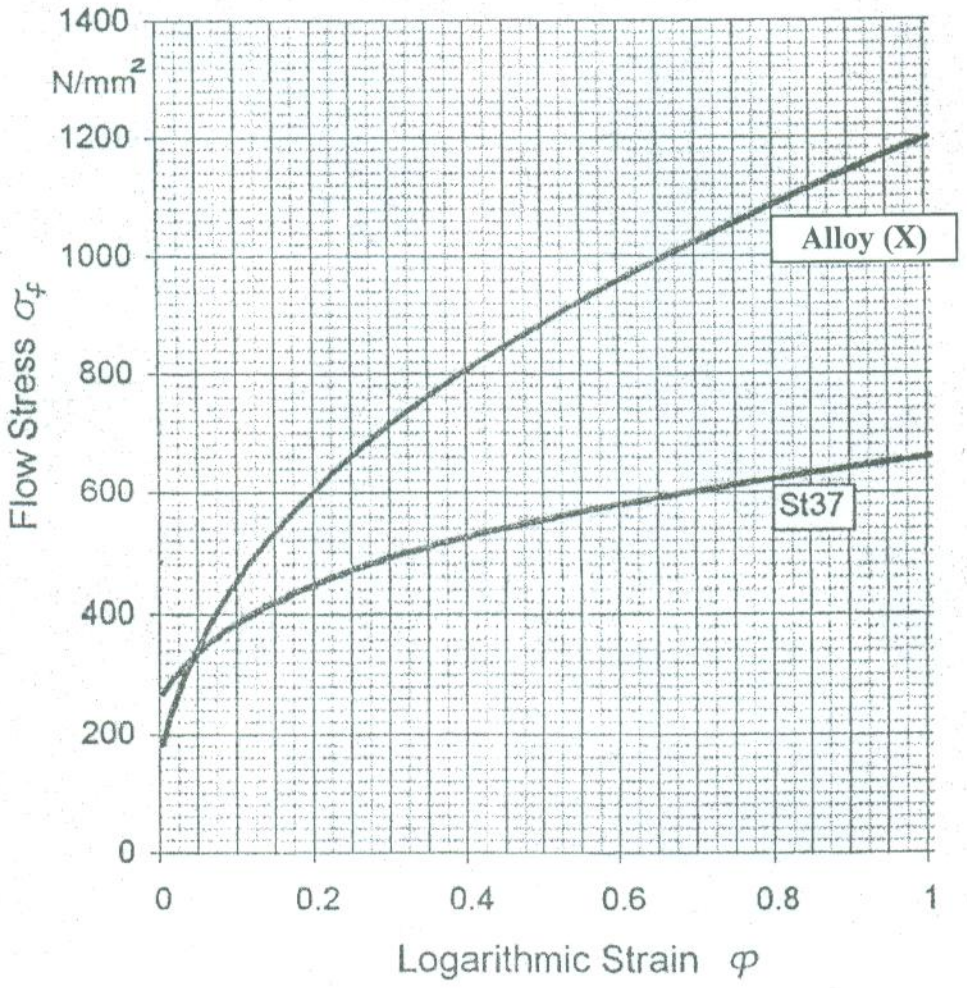
Flow rule: $$\frac{d\varphi_1}{(\sigma_1-\sigma_m)}=\frac{d\varphi_2}{(\sigma_2-\sigma_m)}=\frac{d\varphi_3}{(\sigma_3-\sigma_m)}=\frac{3}{2}\frac{d\bar{\varphi}}{\bar{\sigma}}$$

$$d\bar{\varphi}=\sqrt{\frac{2}{3}\left[d\varphi_1^2+d\varphi_2^2+d\varphi_3^2\right]}$$

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

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

For temperature rise during plastic deformation : $$\alpha\int_0^{\bar{\varphi}}\bar{\sigma}\,d\bar{\varphi}=\rho\,C\,\Delta T$$



Tanta University
Faculty of Engineering
Production Engineering & Design Dept.
3rd Year Prod. 2011/2012

الإمتحان فى ٣ صفحات

Theory of Metal Forming
Sunday, 22.01.2012
Time allowed : 3 hours
Final Grade : 100 Marks

Final Exam

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

Question 1 : (20 marks)

a) Explain with the aid of an example the importance of use of logarithmic strain in the metal forming processes.

b) A square element 8 × 8 mm in an undeformed sheet of 0.8 mm thickness becomes a rectangle, 7.5 × 9.4 mm after forming. Assume that the stress strain law is:

$$\bar{\sigma} = 600(0.008 + \bar{\varphi})^{0.22} (MPa)$$

If the stress normal to the sheet is zero and the material yields according to von-Mises criterion then determine:

i- The final thickness.
ii- The principal strains.
iii- The effective strain.
iv- The applied stress ratio (α).
v- The final stresses in the element.
vi- The total work done in this forming process.

Question 2 : (25 marks)

a) A tensile sample of a metal alloy of 20 mm diameter and 100 mm gage length gives the following readings:

Load ***P*** (ton)	3	6.5	8.5	11	12	12.5
Extension ***L*** (mm)	0.05	0.08	0.10	1.5	3.5	6

Use the above data to get the constants in the flow stress-strain relation ($\sigma = K\varphi^n$) of the alloy sample.

b) An annealed wire, 5 mm in diameter, from the steel St37 is drawn in two successive passes to a final diameter of 3.7 mm. The flow curve of the used St37 is given in the attached figure. The wire leaves the first pass with a diameter of 4.3 mm. The angle of the dies is 12°. The coefficient of friction is 0.1.

i. Calculate the total drawing force required to accomplish the drawing process in the second pass.
ii. Derive an expression for the optimum die angle in the second pass.
iii. What is the optimum die angle in the second pass and how much is the reduction in the drawing force?

Tanta University

Department: Production and Mechanical Design
Total Marks: 100 Marks

Faculty of Engineering

Course Title: Theory of Metal Cutting	Course Code: MPD3115	Year: 3rd
Date: Jan 15th 2012 (First term)	Allowed time: 3 hrs	No. of Pages: (1)

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

Problem number (1) **(20 Marks)**

What are the classifications of the cutting tools? (4 Marks)
Explain with neat sketch tool geometry? (4 Marks)
What are the types of rake angles and its importance? (4 Marks)
Explain the types of chip by using sketches? (4 Marks)
Explain chip thickness ratio and chip velocity? (4 Marks)

Problem number (2) **(30 Marks)**

Explain the Orthogonal & Oblique cutting by sketches? (5 Marks)
A tube 32 mm diameter is turned on a lathe. Cutting velocity of the tool relative to the work piece is 10 m/min. rake angle = 35°, depth of cut = 0.125 mm, length of the chip = 60 mm, horizontal cutting force of the tool on the work piece = 200 N. Cutting force required to hold the tool against the work piece = 80 N.
Calculate: i) Coefficient of friction(μ) , ii) Chip thickness ratio, iii) Shear plane angle iv) Velocity relative to the tool and v) Velocity of chip relative to the work piece. (25 Marks)
(5 Marks)

Problem number (3) **(25 Marks)**

Explain the factors influencing tool life? (5 Marks)
Discuss the properties of cutting tool materials? (5 Marks)
For C-40 steel with a H.S.S cutting tool at a feed of 0.2 mm/min. and a depth of cut is 2 mm is given by Taylor's equation. The following V and T observation have been noted V= 25 and 35 m/min, T= 90 and 20 min. Calculate i) n and C. ii) Hence recommended the cutting speed for a desire tool life of 60 min. (15 Marks)

Problem number (4) **(25 Marks)**

Explain the types of tool wear? (4 Marks)
What are the categories and properties of the Cutting fluids? (4 Marks)
State the functions of a cutting fluid? (4 Marks)
What are the characteristics of a good cutting fluid? (4 Marks)
Explain the ways of separation of cutting fluids and chips? (4 Marks)
Calculate the power consumed during cutting of a low carbon steel bar 40 mm diameter of cutting force is 150 kg at 200 rpm. (5 Marks)